

SYNERGIES BETWEEN MITIGATION AND ADAPTATION IN BRAZILIAN CITIES: A CASE STUDY



BY

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Abstract

Considering the increasing effects of climate change, the world faces a growing need for mitigation and adaptation efforts. While the debate on climate change is mostly contained within political and academic institutions in the Global North, its impacts are likely to be more severely felt within the Global South. Also, due to a lesser institutional and financial capacity, addressing adaptation and mitigation is deemed more challenging for developing countries. For these reasons, promoting synergies between these two approaches is offered as a way forward. By overcoming their usual divide and creating strategies that promote win-win situations, a more efficient use of scarce resources can be found, while effectively addressing climate change and its effects. The effects of climate change in Brazil are indisputable, while its leadership position among developing nations and the global impact of its natural environment make climate adaptation in Brazil a matter of global impact. Considering the intrinsic importance of cities for the climate agenda, this study focuses on 3 major Brazilian cities: Curitiba, Sao Paulo and Salvador. This study aims to gain insight into how those cities are currently performing in developing synergies and avoiding tradeoffs between adaptation and mitigation, unraveling which factors play a role therein, which conditions constitute an enabling policy environment that compensate the lack of financial and institutional capacity. Ultimately, this study aims to answer: How can synergies between mitigation and adaptation be enhanced in local contexts in Brazil? To answer this question, 19 semi-structured interviews were conducted, accounting for a diversity of perspectives on the subject. The research has shown that higher levels of collaborative capacity create enabling conditions for synergies and city networks account for the advance of the climate agenda in the absence of national support.

Keywords: cities, climate change, synergies, mitigation, adaptation, Brazil

1. INTRODUCTION

Synergies between mitigation and adaptation in Brazilian cities: a case study: a case study

1. Introduction

1.1 Background

In the face of increasing climate change effects, which are widely acknowledged as unavoidable (Wright & Boorse, 2014), and the growing need to cope with those consequences worldwide, the issue of urban climate adaptation has gained central importance in contemporary planning (Geneletti & Zardo, 2016). This setting creates a broad and rich area for research with substantial scientific and societal relevance. The climate crisis, as defined by Ripple et al. (2019), brings unprecedented uncertainties and challenges, especially to the developing world where those effects are expected to have a higher impact (Scoville-Simonds, Jamali & Hufty, 2020). Cities nowadays face a crescent need for adaptation, in a world filled with uncertainty (Bambrick et al., 2011).

The last few decades were marked by the emergence of climate change as one of the most pressing issues facing humankind, with ample scientific evidence of human contribution to it (Zwiers, Zhang, & Feng, 2011). In the face of the urgent need to act, the Paris Agreement sets a remarkable milestone in fighting climate change, by bringing countries together to engage in advancing and strengthening responses to it, charting a new path for global climate actions (UNFCCC, n.d.). It sets the goal of limiting the global temperature rise to 2 degrees for this century. Through the Paris Agreement, parties set out their intended Nationally Determined Contributions (NDCs), “that reflect national climate policies and actions of 189 countries” (Northrop, Biru, Lima, Bouye, & Song, 2016, p. 1). This instrument provides a foundation for countries to act on climate change, requiring them to regularly report on emissions and implementation of efforts (Mbeva & Pauw, 2016).

As noted by Northrop et al. (2016), the sustainable and climate agendas display a high degree of convergence. In that sense, the Sustainable Development Goals (SDGs) adopted as part of the 2030 Agenda for Sustainable Development, aim at integrating economic, social and environmental ambitions (Allen, Metternicht & Wiedmann, 2016). The SDG 13, referring to ‘take urgent action to combat climate change’, specifically touches upon the climate agenda. As presented by Allen et al. (2016), SDGs are likely to present “major implications for national development planning efforts” (p. 199), as targets and priorities are to be defined

within nations and the balance between realistic and ambitious targets along with the selection of adequate paths falls upon their governments.

1.2 Problem Statement

Climate change responses are usually split into mitigation and adaptation options. A fundamental distinction between mitigation and adaptation is their target, while the former intends to limit global warming in itself, the latter addresses its already occurring impacts (Locatelli, Evans, Wardell, Andrade & Vignola, 2011). The Intergovernmental Panel on Climate Change (IPCC) (2018) defines mitigation as “a human intervention to reduce emissions or enhance the sinks of greenhouse gases” (p. 554), while adaptation is described as “the process of adjustment to actual or expected climate and its effects” (p. 542). As put by Dang, Michaelowa & Tuan (2003), mitigation refers to prevention and adaptation to protection. Mitigative options include the use of “biofuels, renewable energy, energy efficiency, low-carbon agriculture, carbon market, changes in consumption patterns and waste reduction” (Barbi & da Costa Ferreira, 2017, p. 239). Adaptive responses are diverse in nature, being linked to distinct sectors. At the subnational level, land use, environment, infrastructure and health management are considered key sectors (Barbi & da Costa Ferreira, 2017). As mentioned by Ayers & Huq (2009), both concepts are also intrinsically related, since advancing mitigating efforts may decrease the need for future adaptive measures, for example.

While mitigation and adaptation are increasingly acknowledged as highly correlated and as serving the same fundamental purpose of addressing climate change (Ayers & Huq, 2009; Berry et al., 2015; Landauer, Juhola & Söderholm, 2015), they are normally practiced separately, historically taken as two distinct strategies and applied on distinct scales in terms of time, geography and socioeconomic factors (Ayers & Huq, 2009; Berry et al, 2015). In terms of geographical scale, while mitigation is mostly attributed to international accords and national efforts to diminish green gas emissions (Grafakos, Trigg, Landauer, Chelleri & Dhakal, 2019), adaptation is predominantly linked to the local efforts to address the consequences of climate change. Likewise, mitigation efforts are usually related to long-term solutions, linked to significance on a global scale, while adaptation refers to shorter-term efforts mostly bringing local benefits (Moser, 2012; Berry et al., 2015). Also, “incentives for, and the willingness of, countries to implement mitigation and adaptation actions are asymmetrical” (Dang, Michaelowa & Tuan, 2003, p. 86). In that sense, mitigation is a strategy

usually linked to developed countries, while the developing world often faces an urgent need to adapt (Swart & Raes , 2007; Locatelli et al., 2011).

As noted by Betts (2007), this traditional divided approach may lead “to inadequate or incomplete advice for climate policy” (p. 602), in which “policymakers and negotiators treating the two as policy alternatives or even in opposition” (Ayers & Huq, 2009, p. 755), usually to the detriment of adaptation, which only relatively recently gained importance within the climate change debate (Ayers & Huq, 2009). Consequences of this dichotomous approach include negative interactions between adaptive and mitigative efforts and missed opportunities in terms of exploiting synergies between them (Parker-Flynn, 2014).

Creating synergies between mitigation and adaptation is intrinsically linked to the ability of distinct sectors, levels and individuals to act in a collaborative manner. For Schneider et al. (2003), policy making requires coordinated and collaborative action for political actors, especially in terms of environment, “where the physical boundaries (...) typically cross local political and administrative boundaries” (p. 143). For Ingold & Fischer (2014), intersectoral collaboration is essential for effectively tackling climate change, as they mention, its “multi-level and cross-sectoral context requires collaborative management when designing mitigation solutions over time and space”(p. 88). This is particularly important when considering synergies between adaptation and mitigation, since these two approaches are normally conducted “ at different scales and are addressed by different groups” (Duguma, Minang & van Noordwijk, 2014, p. 421). For Gazley, collaboration is defined as “the process of facilitating and operating in multi organizational arrangements to solve problems that require joint effort” (p. 664) and collaborative capacity dealt with characteristics that support collaborative activities. Thus, an evident link between synergistic approaches to mitigation and adaptation and collaborative capacity emerges. This link however, lacks empirical evidence that could support this intuitive connection.

1.3 Brazil as a case study

One of the main emerging economies in the Global South, Brazil has an important leadership position in climate change efforts within the developing world (Lucon, Romeiro & Pacca, 2013). The protection of its ecosystems has an enormous impact around the globe, for its biodiversity and a central role in maintaining global oxygen levels (Chakraborty, Dey & Gupta, 2019; Lahsen, de Azevedo Couto & Lorenzoni, 2020). Also, its green emissions are high, having a significant global impact (Barbi & da Costa Ferreira, 2017). At the same time, the country has a high vulnerability to climate change impacts, especially for its food and

energy production, allied to its widely spread social vulnerability (Darela Filho, Lapola, Torres & Lemos, 2016).

In 2015, 85.7 % of Brazil's population was already living in urban areas, which is predicted to reach 91% by 2050 (United Nations, 2018). Most Brazilian cities already face environmental problems associated with disorderly development patterns and geographic transformations. The effects of climate change are increasingly felt, with rising temperatures, increased occurrence of extreme rainfall and water shortage issues in big cities (Gateau-Rey et al., 2018; Soares-Filho & Rajão, 2018). According to Lahsen et al. (2020), in the previous decade, extreme weather events, such as floods due to heavy rainfall and associated landslides, affected 90 million people in Brazil, leaving 7.5 million homeless. Rampant urban growth and its consequent ecosystem suppression, is one of the main factors to reduce cities's resilience, increasing their vulnerability in the face of future climate-related events. A common feature among Brazilian cities is the prevalence of precarious housing in flood-prone regions and in areas with high declivity. Besides the potential material losses associated with these risks, it represents a threat to the physical integrity of people (PBMC, 2016).

Irregular hydrological cycles show a tendency to further accentuate existing risks, such as water supply shortages, inundations and landslides. Changing rainfalls patterns can alter the water supply for a rising demand. (PBMC, 2016) This was evident in São Paulo's 2014 hydrological crisis, an unprecedented situation since 2016, largely linked to deforestation of the Amazon rainforest, an important source of moisture also for Brazil's southern regions (Marengo et al., 2015). Also, in the case of Brazil, these alterations have even a broader impact, considering that hydropower is its main energy source. In itself, energy shortage may bring its own consequences, directly affecting cities's functioning and economy. Examples include paralyzing trains and metros, closed commercial buildings, public lighting shortage and associated public safety concerns, to mention some. Also, varying temperatures and increased heavy rainfall may accelerate the deterioration of structures, raising risks for traffic interruptions and accidents. (PBMC, 2016). Another remarkable national urban issue is waste disposal. Ill-conditioned urban waste may obstruct water galleries, which, in turn, may contribute to the frequency and severity of flooding events. Even though investments have been made in the past few decades in order to tackle some of these issues and increase the country's adaptive capacity, "effective long term adaptation planning has lagged" (Darela et al., 2016, p. 141). Moreover, as climate change affects progress, increased efforts are needed in order to cope with them (Marengo, Torres & Alves, 2017).

While mitigation has long been considered, Brazil's adaptation policy has lagged by comparison (Di Giulio et al., 2018). even though Brazil's National Policy on Climate Change was approved by the National Congress in 2009, establishing the country's regulatory framework for climate change action, its targets are mostly focused on mitigation, particularly in reducing deforestation rates (Motta et al., 2011). Besides that, this national policy does not regulate urban emissions, as mentioned by Castello (2011), contributing to cities' inefficiency in tackling climate change, "pressed by their daily needs, they show little concern towards climate change and do not include the regulation of major sources of emissions among their priorities" (p. 498). For Lahsen et al. (2020), Brazil shows a lack of preparedness to face weather-related calamities and previous accomplishments provide limited capacity to enhance climate change policy and "Brazilian policy and discursive context imposed formidable obstacles to policy development on climate change" (p. 225). National and local climate change adaptation have limited assistance, both monetarily and institutionally. These financial and institutional constraints are combined to a disconnect between climate policy and local land management decision-making (Lahsen et al., 2020).

Locality and scale are important elements in the context of climate change in Brazil, as both emissions and impacts are dispersed geographically and across sectors. Given the country's continental dimension, displaying a wide-range of climate-related issues, and the acknowledgment that both adaptation and mitigation efforts at subnational levels are indispensable (Barbi & da Costa Ferreira, 2017), Brazil makes an interesting case study for unraveling the state of affairs at the local climate policy in the Global South, understanding how synergies between adaptation and mitigation can be further explored.

1.4 Research aims and questions

In order to better understand the local policy context regarding synergies between adaptation and mitigation, this study focuses on 3 major Brazilian cities, namely Curitiba, Sao Paulo and Salvador. These cities were chosen considering their ambition for climate change action, as indicated by their membership to the C40 group, while also representing different regions in the country and thus, different climatic conditions. It aims to unravel the context of climate change mitigation and adaptation in these cities, shedding light on the current state of affairs and bringing insights on how synergies can be enhanced, which factors play a role therein and which conditions constitute an enabling policy environment. By doing so, it intends to contribute to the literature by better understanding how the commitments stated by the Paris agreement and UN's sustainable development goals can be reached in the context of the

Global south, where there are usually financial and institutional constraints. Ultimately, this study aims to answer the following main research question:

How can synergies between mitigation and adaptation be enhanced in local contexts in Brazil?

Sub questions:

1. To what extent are synergies and tradeoffs between adaptation and mitigation being implemented in Brazilian cities?
2. What are the main drivers and barriers for synergies in Brazilian cities?

1.5 Scientific and societal relevance

1.5.1 Scientific relevance

In terms of its scientific relevance, the present research contributes to the literature by exploring synergies between adaptation and mitigation for urban contexts in major Brazilian cities, a relatively underexplored area of study. Also, by focusing on some of the country's most climate-ambitious cities, an overall indication of how synergies are being explored at the local level in the country as a whole can be inferred.

More importantly, it may provide valuable input to the current theoretical discussion on synergies between adaptation and mitigation. The literature on synergies often focuses on overcoming the dichotomy between adaptation and mitigation and identifying sectors which carry potential for advancing them (Swart & Raes, 2007; Lucena et al., 2018; Berry et al., 2015). In that sense, it largely neglects the potential that building collaborative capacity may bring. Similarly, the theoretical discussions on collaborative capacity cover a broad range of issues, from post conflict development (Fred-Mensah, 2004) to epidemiology research (Andruchow, Soskolne, Racioppi, Bertollini, 2005). While the value of collaboration to climate change action is clear (Brown, Nkem, Sonwa, & Bele, 2010; Leck & Roberts, 2015), the discussion still overlooks the specific case of synergies between adaptation and mitigation. Therefore, this research aims to contribute to literature by linking these two concepts.

The connection between these two concepts is intuitive. Understanding synergies as having a joint action for mitigation and adaptation necessarily relates with the ability of different sectors, levels or intuitions to work together for achieving a common goal. Thus, collaborative

capacity could potentially be an enabler of synergies. The present research suggests a causal relationship between collaborative capacity and synergistic approaches for mitigation and adaptation. There is no empirical evidence at the moment whether or not a higher collaborative capacity can positively influence the occurrence of synergies between mitigation and adaptation. This research aims to fulfill this gap in the present understanding. This research can serve as a first attempt to provide empirical evidence to the relation between collaborative capacity and synergies between mitigation and adaptation, which in turn may contribute to a better understanding of these synergies and its drivers.

1.5.2 Societal relevance

As to the societal relevance, there is enough scientific consensus on the increasing impacts of climate change. As those are expected to be felt unevenly, to the detriment of those in most needy geographical locations, academic contributions to the field can positively affect this scenario. This research may assist climate policy elaboration and implementation in local contexts with limited institutional and financial resources, it will help climate policy in the Global South to be more efficient by making use of synergies between adaptation and mitigation, and streamlining collaboration. More specifically, it will identify drivers and barriers to these synergies, culminating in an overview of best practices. By doing so, it supports the development of an enhanced adaptation planning and more robust climate strategies, the achievement of the UN agenda for sustainable development goals and the implementation of the Paris Agreement commitments. At the same time, it follows the advice of Biermann & Möller (2019) by taking a more holistic approach and placing the discourse on climate adaptation within the Global South, emphasizing its own voices and context. By doing so, it creates more practically useful insights and avoids solutions that oversee the context of these settings. Finally, the findings from the present research may aid the development of climate action in other settings with similar characteristics.

2. LITERATURE REVIEW

2. Literature review

In this section, climate change adaptation literature is critically reviewed, discussing its fundamental aspects, reviewing distinct nuances of its debates and both identifying and clarifying some key perspectives. First, some main aspects of the climate debate for both mitigation and adaptation are presented (2.1), followed by the challenges for climate action in the Global South (2.2). Then, the gap between awareness and action is presented (2.3), to which synergies between mitigation and adaptation may appear as an alternative, especially in developing countries (2.4). The role of cities in climate action is discussed (2.5), relevant frameworks are reviewed and the concept of collaborative capacity is presented with a discussion on its main dimensions (2.6). Finally, the operationalization of the concepts is introduced (section 2.7).

2.1 The climate debate

Füssel (2007) takes a general approach, describing the basic concepts and different adaptation contexts. He then reviews different approaches to both impacts and climate adaptation assessment. By summarizing the current ideas on climate adaptive planning, he provides valuable lessons and a good starting point to grasp the main elements of the field and its overall dynamics. Roggero, Kähler, & Hagen (2019) have a similar approach while focusing on climate mitigation. The authors give a comprehensive overview of the main issues and concepts in that regard, while emphasizing that climate mitigation and adaptation are similar in terms of their cross boundary character and spillover effects.

In terms of scale, Araos et. al (2016) examine the current state of climate adaptation in big cities, arguing that most research has focused on the national level, regardless of the administrative importance of the municipal institutions. In contrast, the debate on climate mitigation focused on the global level, being shaped by intergovernmental agreements and subsequently being translated into national policies, as noted by Hasegawa et al. (2018).

Baker et. al (2012) evaluate climate adaptation planning in Australia at a local government level. The authors discuss the challenges to implementing adaptation plans in terms of capacity, arguing that local governments, also those of prosperous countries, are not prepared for the complexity of the problems that come with climate change. For Kane and Boule (2018), mitigative action in less developed countries is hindered by “poorly resourced, fragmented, under-capacitated governance structures, often in conflicted settings” (p. 1177).

Thus, while there are important contrasts between the debates, challenges for implementing both mitigation and adaptation may also differ among distinct geographical locations.

2.2 Climate change and the Global South

Thomalla et. al (2006) discuss the social vulnerability in the face of climate hazards making a parallel between risk reduction and climate action, showing another dimension of the climate change field and proposing experiments in terms of meta-analysis of vulnerable areas. Both adaptation and mitigation to climate change in the context of the developing world is likely to bring its own challenges, since the impacts of climate will be unevenly distributed, more severely impacting the Global South than the developed world (Scoville-Simonds, Jamali & Hufty, 2020), while action is hindered by a lack of governance capacity and limited resources (Kane & Boulle, 2018). Araos et al. (2016) assess patterns of adaptation, classifying cities according to their level of adjustment to climate change risks. Their findings support the assumption that wealthy cities in the Global North are more likely to be extensively adapted to such risks, however, positive examples in the Global South can also be found, which means that economic factors are insufficient to determine adaptation efforts. Likewise, reporting is also discussed as an obstacle to a de facto classification, since it is not clear whether or not the wealthier areas are better at adapting or simply have a superior reporting capacity.

The debate on climate change is, to a large extent, still constrained within political and academic institutions in the Global North, often neglecting the voices of the Global South (Biermann & Möller, 2019). Defending a more inclusive approach, these authors argue for a stronger engagement of developing countries in the production of technologies for climate change adaptation and mitigation, referred to as 'climate engineering'. Overlooking the developing countries in these processes runs the risk of overemphasizing particular approaches, interests and voices, strengthening inequalities. This becomes especially relevant considering the distributive effects of climate-related decision making, as noted by Scoville-Simonds, Jamali & Hufty (2020), that may benefit some in the detriment of others. The work of Carmin, Anguelovski & Roberts (2012) fit this suggestion, by taking urban climate adaptation from the perspective of the Global South. The authors explain climate adaptation initiatives as being influenced by endogenous factors and the operation of local actors facing opportunities. Exploring the perspective of the Global South for climate

mitigation, Creutzig (2019) indicates that a major challenge is to reconcile development and low carbon energy sources.

The climate debate runs the risk of not only overemphasizing ideas and solutions from the Global North, but also overlooking the particularities of climate change in the Global South, where it will have more dramatic impacts. This scenario raises questions in terms of how adaptation and mitigation should take place in developing countries and how the potential for climate action can be increased, considering their specificities in terms of governance capacity, policy arrangements and economic aspects, to name a few.

The engagement of developing countries is increasingly acknowledged as key for effective climate change action (Dang, Michaelowa & Tuan, 2003). As argued by Halsnæs & Verhagen (2007), in the Global South, climate policy competes with the development agenda, often being “overshadowed by a number of immediate development priorities” (p. 666) despite their intrinsic connection, as “climate issues are deeply rooted in core economic development issues” (p. 682). Besides that, addressing the mitigation-adaptation dichotomy is particularly important for the Global South, as the limited institutional and financial resources may restrain the possibilities of effectively tackling adaptation and mitigation as two separate actions. In practice, developing nations show a tendency to focus on adaptive measures only, given their lesser capacity and high vulnerability. Reconciling adaptation, mitigation and development is highlighted as an important strategy, especially under these conditions (Ayers & Huq, 2009; Dang, Michaelowa & Tuan, 2003). Therefore finding synergies between adaptation and mitigation in the Global South is a highly relevant approach to tackling the climate crisis.

2.3 The gap between awareness and action

One of the key issues for climate adaptation is the lack of concrete action despite the prevalence of climate related issues. The gap between awareness and effective response is often made explicit by the literature (Baker et al., 2012; Eisenhauer, 2016; Carmin et al., 2012). Goosen et. al (2013) debates why information on climate change does not translate into effective policy action and how to make effective adaptive strategies. The authors focus on the Netherlands and discuss tools to assist the planning process. They also stress the importance of “translating climate data to policy relevant indicators and by offering support in the design of adaptation strategies” (p. 1045). Eisenack et. al (2014) reinforce the necessity of action in face of the inevitability of climate change issues, mentioning and adaptation deficit growth. The authors conceptualize barriers to adaptation and make some suggestions

regarding the research agenda. Those proposals include explaining how barriers to climate adaptation emerge, so moving from simply counting those barriers to exploring how to strategically deal with them. In that regard, they mention the need to consider the interdependency between them to understand their dynamics and more effectively address those obstacles. Another suggestion is a comparative research to understand the predominant conditions that result in similar obstacles. Understanding the patterns of those barriers could provide some important insights on what elements hinder adaptation in practice. Multiple attempts to theorize this gap between awareness and action have been conveyed, bringing district explanations on what factors play a role therein and how to tackle this issue (Eisenhower, 2016).

2.4 Synergies as a way forward

Considering this gap between awareness and action, a growing body of literature suggests that in order to effectively tackle climate change, especially in contexts of limited resources, climate policy should aim at the interplay between adaptation and mitigation, promoting synergetic responses while avoiding tradeoffs between them (Duguma et al., 2014; Dang, Michaelowa & Tuan, 2003; Kim & Grafakos, 2019). For the IPCC (2014), “developing tools to address these linkages is critical to the success of climate policy in the context of sustainable development” (p. 112). In fact, overcoming the traditional divide between adaptation and mitigation may create opportunities to strengthen global responses to climate change as “an integrated approach could offer benefits over two independent, parallel strategies” (Swart & Raes, 2007, p. 290), making “climate policies more responsive, comprehensive and efficient” (Dang, Michaelowa & Tuan, 2003, p. 87). Similarly, as stated by Duguma et al. (2014), “handling the two within the same institution contributes significantly to the resource-use efficiency” (p. 140). Besides, “development programs will be less effective when they overlook potential synergies and tradeoffs between development and climate change” (Ngum et al., 2019, p. 666). Despite this, Dang, Michaelowa & Tuan (2003) suggest that integrative approaches to climate policy are often overlooked in developing countries. For them, an explanation would be the “perception that commonalities are small” (p. 82) besides differences in areas of authority and uneven distribution of investments and benefits.

2.5 The key role of cities

Cities are widely acknowledged as units of utmost importance when it comes to climate change. They are considered to contribute the most to climate change while suffering its

consequences more severely as well (Raparathi, 2018; Carter, Handley, Butlin & Gill, 2018). To many, cities are considered the problem and the solution to climate change, in other words, potential hotspots of climate change. For Barbi and da Costa Ferreira (2017), even though the climate policy literature essentially focuses on the higher levels of governance, neglecting the multilevel aspect of climate change, the local and regional levels are “important forums and enablers of global climate governance” (p. 238). For the authors, the different levels of government are interconnected and given the complexity of climate change issues, these cannot be addressed by nation wide policies alone.

Barbi & da Costa Ferreira (2017) also highlight the role of transnational networks for climate change as opening “the possibility of an urban approach to climate governance” (p. 239). Stressing the emergence of the C40 network in 2005, the authors note that these networks expanded and gained political significance through the 2000s, providing “subnational governments with inspiration, information, experience, concrete projects, access to finance, examples of good practices and informal structures of recognition and rewards” (p. 239). For them, taking part on such networks may enhance possibilities to improve climate policy action within the urban sphere.

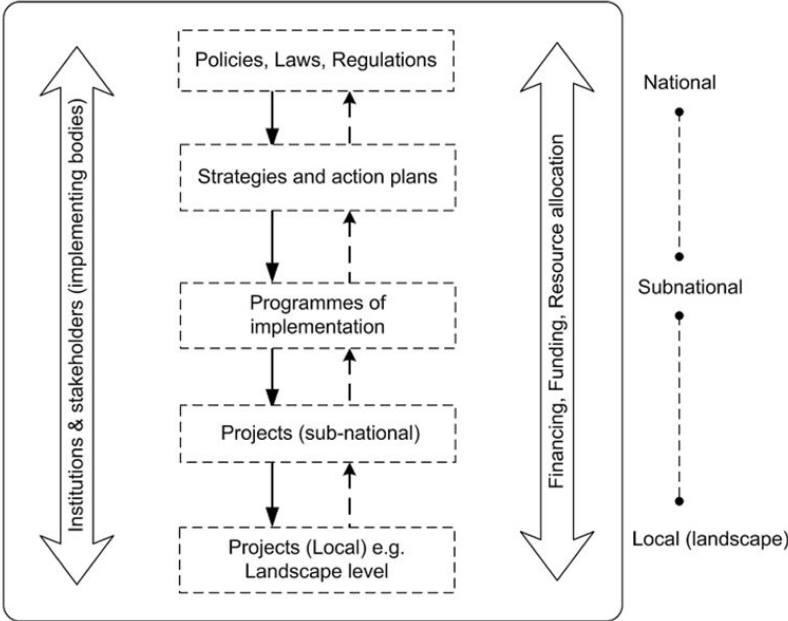
Various studies of synergies between climate strategies in the Global South show a tendency towards rural contexts, in particular the agricultural and the forestry sectors, argued to contain a high potential for synergistic approaches for adaptation and mitigation. Still, urban environments also carry a strong potential for synergetic approaches to climate change within sectors such as land-use and water (Swart & Raes, 2007; Lucena et al., 2018; Berry et al., 2015).

2.6 Synergies and collaborative capacity

Duguma et al. (2014) systematically analyze the enabling conditions for synergies between mitigation and adaptation at the national level, they identify these conditions as “policies and strategies, programs and projects, institutional arrangements and financial mechanisms” (p. 138). The authors relate those to the different levels of government, namely national, subnational and local (figure 1). As clarified by them, the usefulness of their approach lies in the identification of “areas of emphasis to promote holistic and efficient climate policies” (p. 138). Although focusing their analysis on the national level, the authors do not simply assume a top-down approach, but acknowledge the influence of the lower levels, via projects

and implementation. Whilst not automatically transferable, these enabling conditions also provide some guidance on unraveling what plays a role at the local level.

Figure 1: the enabling condition for synergies at the national level



Source: (Duguma et al., 2014)

In terms of its contribution, the framework introduced by Duguma et al. (2014) falls on the diagnostic side and their enabling conditions are closer to the channels in which synergies can be found rather than the underlying causes of these synergies. Their practical value is to provide guidance on the assessment of different cases in terms of the existence or absence of synergetic approaches. In order to further unravel the drivers of synergies, a potential contribution comes from the concept of collaborative capacity.

This derives from an understanding of synergies as conceptually linked to collaboration. It is important to clarify what the concept of collaboration entails. Its importance stems from the increasingly blurred borderlines among organizational, sectoral and administrative segments. In these conditions, dialogue, coalition forming and stakeholder engagement are key to achieve resilience (UNDP, 2013). Initiating synergies involves, by definition, establishing collaborative actions. This is made explicit by the United Nations Environment Programme’s (UNEP) definition of synergies as a “result of joint activities that goes beyond the sum of individual activities, making efforts more effective and efficient“ (p. 9). Also, as noted by Moreno & Romero (2018), both terms have been used interchangeably. These authors discuss the concept of capacity development, within which synergies are explained “to enhance cooperation and collaboration and foster partnerships for action” (p. 8). Not

specifically on synergies in terms of a climate context, Leck & Roberts (2015) support collaboration in enabling effective climate action at local level which for them “requires meaningful collaboration and information and knowledge sharing across institutional silos” (p. 63).

Focusing on the value brought by collaboration, the UNDP (2013) mentions that it “allows the construction of working groups, coalitions and networks” (p. 5), “creates hubs of dynamic doers that get things done” (p. 5) and “facilitates the challenging process of anticipating, appreciating and acting to bring about development change” (p. 5). In that sense, the UNDP (2013) discusses capacity development, which they characterize as “the process of creating, using, retaining and enhancing capacities according to capacity, assets and needs” (p. 7). For the UNDP (2013), collaborative capacity is especially relevant in dealing with complex issues, such as climate change and their particular structure will vary depending on the context, but still following a set of main elements. As to these elements, the UNDP (2013) presents leadership, institutional arrangements and knowledge as the main drivers for developing collaborative capacity. In this conception, leadership refers to “the ability to influence, inspire and motivate people, organizations and societies to achieve - and go beyond - their goals” (p. 10). Institutional arrangements are “the policies, procedures and processes that countries, companies and organizations have in place” (p. 10) and knowledge refers to “what people and organizations know. It underpins their assumptions, perspectives and actions and informs their approach to development” (p. 10).

2.6.1 Leadership

For the UNDP (2013), if collaboration is not valued by influential leaders, either with formal or informal positions of leadership, institutional arrangements and knowledge alone are unable to account for successful outcomes. Collaborative leadership creates an “enabling environment by engaging with others, projecting enthusiasm and offering incentives” (UNDP, 2013, n.p.). It is not necessarily attached to formal roles and can be found at both individual and institutional level. It is translated by acceptance to new ideas, rapport and the ability to negotiate, coordinate and network (UNDP, 2013). From the UNDP’s (2010) indicators of leadership: “clearly formulated visions”, “communication standards”, “management skills” and “outreach mechanisms” can be distinguished.

2.6.2 Institutional arrangements

Successful collaboration normally deals with how it is perceived by members, as it is more likely to succeed when there is a wide recognition of its importance for achieving goals. This perception is influenced by how institutional arrangements are designed. Institutional arrangements account for both hard rules, such as regulation, and soft rules, such as guidelines or incentives. These arrangements can also either ease collaboration or create barriers to it. An enabling institutional environment includes clear plans and strategies, a compelling motivation to collaborate, clear direction and timespan for acting. A common issue arising in that sense is the lack of perceived urgency, which hinders active climate change action in various nations (UNDP, 2013), including Brazil (Bonatti et al., 2016). As to the indicators of effective institutional arrangements, the UNDP (2010) offers: “streamlined processes”, clearly defined “roles and responsibilities”, “merit-based appraisal” and “coordination mechanisms”.

2.6.3 Knowledge

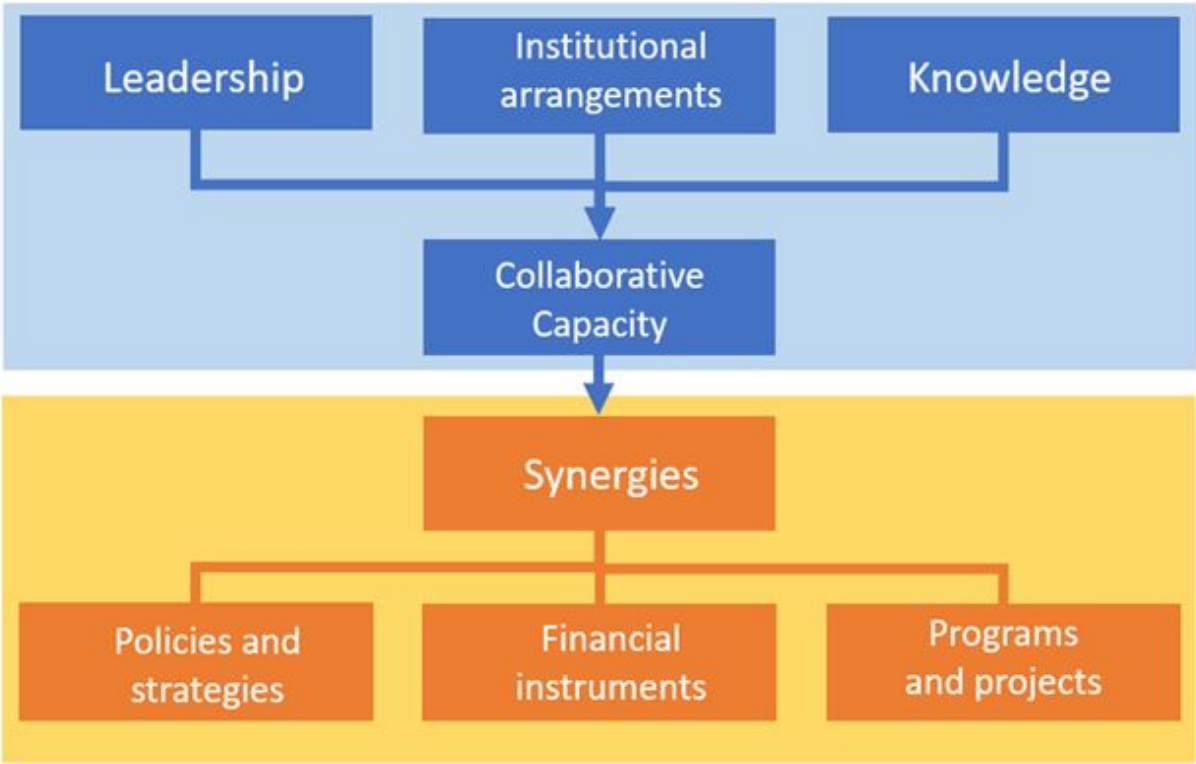
Knowledge refers to what individuals know, which is the basis for their capacities. Accordingly, collaborative capacity also relates to individual capabilities. It also deals with how knowledge is built and shared within organizations and communicated to those outside of them. In collaborative capacity development, knowledge has a double contribution, promoting collaboration by disclosing interdependencies and connections and, at the same time, sharing beliefs, viewpoints, priorities and plans. As to its core characteristics, knowledge is ever changing, non-absolute and it flows in multiple ways (UNDP, 2013). As indicators of knowledge, the UNDP (2010) sets: Mechanisms linking “research supply and demand” and “knowledge sharing tools and mechanisms”.

The greatest contribution of this framework in understanding which factors may play a role in synergetic approaches for climate action resides in its practical guidance. For each driver, a thorough description of indicators is provided, which can serve as a point of departure to investigate the possible elements that might also play a role in the exploitation of synergies between adaptation and mitigation.

2.7 Conceptual framework

This research considers the framework of analysis proposed by Duguma et al. (2014) and that presented by the UNDP (2013) as non-contradictory, but rather complementary. While the former presents the different instruments, the latter uncovers potential drivers for creating synergies between adaptation and mitigation. Based on that and serving as a starting point for conducting research, the following analytical framework is proposed:

Figure 2: Conceptual framework



(based on UNDP, 2013; Duguma et al., 2014)

In this theoretical framework, the concept of synergies, especially those found in 'policies and strategies', 'financial instruments' and 'programs and projects', is accounted for the effect, while collaborative capacity, which consists of 'leadership', 'knowledge' and 'institutional arrangements', stands for the cause. Therefore, the present research investigates a potential causal relationship between these two concepts, aiming at the validation of the hypothesis that a stronger collaborative capacity positively influences the occurrence of synergies between adaptation and mitigation. The research will do so by quantitatively assessing the synergies for the 3 case studies and further investigating the extent to which the indicators for the independent variable are also found, which would support the above hypothesis.

3. METHODOLOGY

3. Methodology

3.1 Research strategy

3.1.1 Research philosophy, approach and paradigms

Utilizing the different layers of research proposed by Sander et al. (2011), the research philosophy - that is the normative assumptions of what reality is and how it can be known - in this thesis follows an interpretivist perspective, by acknowledging reality as subjective and necessarily entailing multiple perspectives. The research approach is deductive, trying to explain a particular issue by making use of existing theories, investigating to what extent the proposed theories are actually able to account for the empirical phenomenon. Considering Guba & Lincoln's (1994) research paradigms classification, this research has a critical theory nature, for its understanding of reality as shaped by a series of social and cultural concepts. According to Given (2008), critical theory is a foundational perspective for the analysis of political and social action, then particularly suitable in this case.

3.1.2 Case studies

The selection of case studies for this research is due to the method's appropriateness to explain complex phenomena, as noted by Harrison et al. (2017). Case studies provide a sound methodological pathway to investigate, in this case, the specific issue of climate change in the context of Brazil. For Yin (2014), the defining feature of case studies, when compared to experiments, is their focus on the existing reality. They are described by Harrison et al. (2017), as "a pragmatic, flexible research approach, capable of providing comprehensive in-depth understanding of a diverse range of issues across a number of disciplines" (n.p.). The authors also highlight its versatility in terms of not belonging to a specific research paradigm.

Among the fundamental characteristics of multiple case studies, Creswell & Poth (2016) mention that the selection should consider well-defined parameters and consider cases that would allow for comparison. Also, the authors defend that data collection should follow a careful replication reasoning, applying the same procedures to all cases.

In this research, the selection of the case studies follows Flyvbjerg's (2006) strategies for critical cases as "to achieve information that permits logical deductions of the type" (p. 230).

It is a selection based on information, as opposed to a random selection. This type of case selection enables inferences about the state of climate adaptation capacity in the country, by studying the cities that are more likely to have a robust adaptation program based on their showcased ambition. If the research concludes that those cities are not well-prepared for dealing with climate-related issues, then it can be inferred that other cities within the country may tend to not be prepared as well. Thus, the selection of cities will be based on identifying those displaying higher levels of climate change ambition, being more likely to present sound climate adaptation strategies. The analysis will take the C40 Cities Climate Leadership Group, self-promoted “as a network that enables cities to learn from each other in their efforts to confront climate change” (Heikkinen, Ylä-Anttila & Juhola, 2019, p. 90). Among this group, 4 major Brazilian cities are present, namely Sao Paulo, Rio de Janeiro, Salvador and Curitiba. Given that both Sao Paulo and Rio de Janeiro are located in the same region, the southeast of Brazil, a choice between those two cities is done in order to reduce the number of cases, while maintaining the diversity of the sample. A choice for Sao Paulo is made considering that it is the biggest city in the country and a pioneer on climate change policy (Di Giulio et al., 2018). The case studies then focus on those cities, from which the national state of affairs in terms of climate change adaptation can be deduced.

3.1.3 Use of semi-structured interviews

Considering the methodological choices for this research, different strategies could be used to explain the phenomena and a choice is made considering the present research aims and questions. A survey could be used to collect data, with the advantage of enabling a relatively large sample to be studied in a short period of time, besides allowing the use of statistics. However, taking into account the complexity of the phenomenon, this strategy may fail to provide enough detail to effectively explain it. Participant observation in different government agencies could also be considered a potential strategy, as it allows the examination of their daily functioning. Observing meetings between government representatives could give some insight on how (and if) collaboration takes place in their day-to-day business. However, this method, though enabling a very detailed analysis, may constraint the scope of the study, focusing on a few institutions. Moreover, the added level of detail may not necessarily help in understanding the link between collaborative capacity and synergies, while its more limited scope may also hinder comparisons between different settings. In this case, comparative study between a few cases might be more suitable to this research. In this case, semi structured interviews are more suitable, since they allow the collection of detailed information, while still allowing the examination of multiple cases and thus, enabling

comparisons between them. This choice is made on the basis of the nature of the research question and sub questions.

In terms of the selection of cases, studies of adaptation policies will be conducted among the 3 selected Brazilian cities, making use of an extensive literature review, desk research and semi-structured interviews with relevant stakeholders and experts. Semi-structured interviews have the advantage of allowing more flexible communication while still providing enough guidance on the point of inquiry, It leaves room for the interviewee to express ideas and might lead to interesting insights (Bryman, 2012).

3.2 Operationalization

In terms of the operationalization of the conceptual framework, it is important to clarify how synergies between mitigation and adaptation will be assessed. In that regard, the enabling conditions for synergies (Duguma et al., 2014) provide the diagnostic level of the analysis, combined with the indicators of collaborative capacity advanced by the UNDP (2010; 2013), which account for the investigation of the underlying factors playing a role on synergetic approaches. The framework is operationalized as follows:

Table 1 - Operationalization of the conceptual framework

Concept	Dimension	Indicators	Questions
Enabling conditions for synergies (Duguma et al., 2014)	Policies and strategies	Joint climate policy and strategies	Are there climate policy and strategies to jointly tackle adaptation and mitigation? Are there specific goals set for each?
	Funds	Common funds	Is there a fund for both mitigation and adaptation?
	Programs and projects	Joint programs and projects	Is there a joint program to address both mitigation and adaptation?
Collaborative capacity (UNDP, 2009 2013)	Leadership	Clearly formulated vision	What are the city's main goals for mitigation and adaptation? Is there a clearly formulated vision?
		Communication	Are climate-proof strategies from one

		standards	department clearly communicated to others inside and outside the government? Is collaboration encouraged between departments?
		Management skills	Are the different departments able to negotiate, network and coordinate? Are they opened to new ideas?
		Outreach mechanisms	Are there mechanisms to engage the community in dialogue and reach out for those outside of the government? How are the private parties involved?
	Institutional arrangements	Streamlined processes	Are the processes for adaptation and mitigation efforts streamlined?
		Clearly defined roles and responsibilities	In a collaboration process are the roles well-defined? Are there overlapping responsibilities?
		Merit-based appraisal mechanisms	Are expectations in terms of collaborative work made clear? Are there any rewards associated with collaboration? Does absence of effective collaboration bring any sanctions or penalties?
		Coordination mechanisms	Are there coordinated mechanisms to tackle mitigation and adaptation jointly? How is the intersectoral collaboration coordinated? Is there an overseeing body? Who takes the lead?
	Knowledge	Research supply and demand linkage mechanisms	Is there enough technical-political capacity/knowledge to deal with climate action? Is there enough data

			to inform decisions? How is the need for technical capacity dealt with?
		Knowledge sharing tools and mechanisms	Is knowledge shared across departments, sectors, levels and institutions?

(based on UNDP, 2013; Duguma et al., 2014)

3.3 Data Collection

Following the approach adopted by Landauer, Juhola & Söderholm (2015) to analyze cross-interaction between mitigation and adaptation in Scandinavian cities, the empirical data is collected from a series of in-depth semi-structured interviews with relevant stakeholders on the climate change domain. The extent to which synergies are considered within these cities and the underlying factors of the state of affairs are revealed by the interviews with stakeholders. Ultimately, interactions between mitigation and adaptation strategies are investigated on the policy level, identifying cases that help explaining the occurrence of synergies and conflicts.

3.4 Selection of respondents

In terms of the data collection, an important topic is the selection of respondents. For that, the approach of Gutiérrez, Engle, De Nys, Molejón & Martins (2014) is followed while analyzing the Brazilian policy context. For these authors, the selection of key informants is based on the following criteria:

1. proven expertise in mitigation and adaptation
2. diversity of perspectives

From this perspective, the stakeholder consultation will include dialogue with relevant cross-section informants in the public and private sectors. For that, potential respondents from 3 different groups were contacted: local government, climate activists and academics. First, the governmental institutions are considered, selecting the relevant sectors in which expertise is likely to be found, specifically looking at those within which mitigative and adaptive actions have a high potential for synergies. In terms of local and urban contexts, the sectors of land use and planning, water management and environment are particularly

relevant for synergetic approaches (Swart & Raes, 2007; Lucena et al., 2018; Berry et al., 2015). Importantly, the 'local government' group is not constrained to civil servants, but also includes consultants who closely deal with the climate agenda within the public sector. After all, these respondents will similarly bring an institutional perspective on the issues. As to the diversity of perspectives, this will be accounted for by conducting interviews with local NGOs and academics, including those outside of the government and having an enriched set of viewpoints on the issue. Potential stakeholders within those areas of interest will be contacted and the snowballing technique (André, Simonsson, Swartling & Linnér, 2012) is employed in order to find further respondents. A few issues are associated with snowballing as a sampling method, as mentioned by Biernacki & Waldorf (1981), such as the accessibility to the target population, often difficult to access or even locate. For that, respondents were searched for on platforms such as LinkedIn, where a selection can be made in terms of their position. Another major issue is the sampling bias, referring to respondents suggesting others with similar attributes, meaning that, in practice, the sample could be biased (Baltar & Brunet, 2012). Besides interviewing different groups in different cities, this was minimized by having multiple starting points for interviews, allowing a wider selection of respondents.

A total of 19 interviews were conducted with different groups in different cities (see appendix II). The interviews were conducted by video call in most cases (16). To increase the flexibility of the research in terms of the available time frame, some interviews were conducted via email (3). This was the case when respondents did not have availability for video call interviews. The data was collected, transcribed and later analyzed by using the program ATLAS.ti. The research aimed at evaluating the collaborative capacity in the 3 cities by making use of UNDP's (2010; 2013) indicators. The responses from the actors inside of the public institutions (either civil servants or consultants participating in the elaboration of climate action plans) and those outside (either climate activists or academics) were complementary points of view to enable a clear understanding of the studied issue.

3.5 Validity and reliability

In terms of reliability, that is "the accuracy and consistency with which the variables are measured" (van Thiel, 2014, p. 48), it is important that the research outcomes are not incidental, but rather create "a systematic and representative picture" (p. 48). Even though the present research follows an interpretive approach, a higher level of reliability was achieved by following some measures. In the case of this research reliability was ensured by following Guba & Lincoln (1994) on their advice for thick description, carefully describing the

research decisions for case selection and data gathering. In that sense, case selection is made explicit and the procedure for analyzing the semi-structured interviews followed the interview guide (appendix I). The interview transcript as well as the Atlas.ti files, with codes and memos, are made available as well.

For Harisson et al. (2017), “validity of research results are verified through the scrutiny of others and, as such, adherence to mechanisms that ensure rigor in data collection and analysis is vital” (n.p.). For many, a distinction is made between external and internal validity. The former refers to the cogency of the research, whether or not the research follows a proper operationalization and whether or not the presumed causal relationship indeed occurs (van Thiel, 2014). In terms of internal validity, it will be addressed by a reliance on the theoretical streams for analyzing the real-life case. This departure from existing theories is complemented by the feedback of specialists. As to external validity, due to the character of the research design it is clearly not as achievable as, for example, those normally conducted in natural sciences. The very nature of social scientific studies, intrinsically contextual and impermanent, hinders the empirical generalization of results. However, that does not mean they would have no contribution in understanding overall trends or help unravel similar phenomena elsewhere. In this case, this research could be valuable for cities in the Global South working to integrate mitigation and adaptation efforts. Also for Bryman (2008) transparency is key for achieving higher levels of external reliability in qualitative research. So, a thorough description of the context and specificities of the area of study but also the selection of cases and respondents (sections 3.1.2 and 3.4) account for that.

4. CITIES

4. Cities

In this section the 3 studied cities are presented with the relevant background information in terms of general characteristics, climate risks and urbanization processes. This research selected Curitiba, Sao Paulo and Salvador as case studies. All these cities are members of the C40 leadership group and representing different geographical locations among the country's capitals (figure 3).

Figure 3: Location of the studied cities



Source: Google Maps, 2020, modified by the author)

4.1 Curitiba

Figure 4 - The city of Curitiba



Source: https://www.c40.org/case_studies/curitiba-honey-garden

Curitiba (figure 4) is the capital of the state of Paraná and the 8th most populated city in the country, with over 1.7 million inhabitants, covering 434 km² (IBGE, 2017). The city is located in a subtropical region with an average temperature of 18° C and 1500 mm of annual rainfall. Curitiba is located in a relatively flat area, containing multiple water streams. The main climate risks are extreme rainfall, river flooding and severe wind (Curitiba, n.d.; C40, 2020). Curitiba is a famous example of planning and sustainability, having followed a different trajectory of development when compared to Brazil's major cities in the second half of the 20th century. Suffering from an accelerated growth pace at the time, Curitiba's had its most acclaimed Master Plan elaborated in 1965, which oriented its development in an orderly manner, based on 3 basic functions: land use, public transportation and road systems (IPPUC, n.d.), coordinating its urban configuration and public policies, which made Curitiba known as the ecological city (Arashiro, 2016). From the middle 70's and through the 80s, objectives were translated into equipping the city, implementing various projects in public transportation, restoration and preservation of historic sites and implementation of leisure areas, including the urban parks. From these projects the city reinforced its image as an urbanistic model (de Oliveira, 1968). The integration of these different functions or agendas denote a high level of coordination within the public sphere at the time.

4.2 Sao Paulo

Figure 5 - The city of Sao Paulo



Source: <https://mei-arch.eu/en/agenda/re-use-symposium-in-sao-paulo/>

With almost 12 million inhabitants and covering 1509 km² (C40, 2020c), Sao Paulo (figure 5) is South America's largest urban agglomeration, with its metropolitan area encompassing 39 municipalities and housing over 20 million citizens, holding more than 10% of the national population (Paiva, 2009; Di Giulio et al., 2018). The city is located in South-east Brazil, Sao Paulo has an average temperature of 18.7 °C and 1412mm of annual rainfall. Its main climate risks include floods, heat waves, vector-borne diseases and drought, with the latter being the most severe (C40, 2020c) While Sao Paulo is Brazil's frontrunner in economic development, it also faces increasing urban issues, including housing shortage, aggravating social deprivation and irregular settlement in risky areas (Andrade et al. 2012), concentrating both resources and issues. For Di Giulio et al. (2018) "this complexity also challenges straightforward assessments of success and failure, with cities often showing both in different policy areas, including adaptation" (p. 237). Sao Paulo's highly impermeabilized surface and limited space for water flows, makes it prone to floods, especially considering the increased extreme rainfall events it already faces (Millington, 2018), the city has one of the lowest vegetation indices per inhabitant, 14,02 against 64,5 in Curitiba (da Silva, Benites, Monterio & Duarte, 2019). Poor communities, often living in the near water courses and floodplains, are disproportionately affected by such events (Millington, 2018). From climate projects, a further aggravation of these issues and increased risks are expected, with rising temperatures and rainfall intensity for the region where Sao Paulo is located (Ambrizzi,

2012), “which threaten to exceed its capacity to absorb losses and recover from impacts” (Di Giulio et al., 2018, p. 238).

4.3 Salvador

Figure 6 - the city of Salvador



Source: <https://static.independent.co.uk/s3fs-public/thumbnails/image/2017/11/08/11/salvador-city-scape.jpg?w968h681>

The capital of the state of Bahia, Salvador is the third most populated city in Brazil, with over 2.6 million inhabitants, covering an area of 693 km² (IBGE, 2017). Salvador is a coastal city (figure 6) and its climate regime is distinguished by high levels of annual rainfall, around 2000mm/year (Sathler, Paiva, & Brant., 2016). The average temperature is 25.3 °C and, in terms of climate risks, the city is exposed to rain storms, heat waves and coastal flooding (C40, 2020b). The city has a varied topography, being divided by Lower Town (Cidade Baixa), a coastal plain along the shore and Upper Town (Cidade Alta), characterized by a rugged relief with cliffs and valleys. An intense and disordered urbanization process has led to a wide range of urban issues, such as gentrification, pollution of urban rivers and inadequate land use practices, with the occupation of hills and slopes, with a high risk of landslides (Santos, 2008).

5. RESULTS

5. Results

The discussion is divided by the proposed dimensions and indicators, accounting for enabling conditions for synergies and the indicators for collaborative capacity. First, the results for the enabling conditions for synergies are presented, accounting for specific examples of synergies between mitigation and adaptation in each dimension (sections 5.1.1 - 5.1.3). Then the results for each dimension and indicator of collaborative capacity are discussed (sections 5.2 - 5.4). Finally, an overview of the cities' examples under the enabling conditions of synergies and their current collaborative capacity for climate action is shown (section 5.5).

5.1 Enabling conditions of synergies

In terms of the enabling conditions of synergies, respondents were asked about examples of synergies between mitigation and adaptation in terms of policies and strategies, funds and programs and projects. The subsections below present the examples found in the 3 cases.

5.1.1 Policies and strategies

In terms of policies and strategies to jointly tackle climate mitigation and adaptation in the studied cities, respondents indicate that climate action plans are currently under development. This development of climate action plan is due the cities's membership to the C40 group, which assists the local government in developing the local government by providing not only a framework for the plans but also technical assistance and professional training for municipal staff (R1; R10; R13; R14).

Besides that, for Curitiba, a significant example of policy integrating mitigation and adaptation was the Urban Agriculture Law, that allows public places to be used to make community gardens (R2; R3). These community gardens are mitigative considering the avoided emissions from transportation, since food is being produced locally and adaptive for both improving food security and by maintaining permeable areas within the city (R1). Besides that, respondents mentioned the city's floodable parks, implemented in the 1970s as part of the city's strategy for urban water drainage. As mentioned by activist respondent R3, these parks were mostly a massive work of microdrainage.

For the city of Sao Paulo, respondents were also able to mention further examples. One was the Sao Paulo Climate Change Policy, a municipal law approved in 2009, for climate change

action, including climate mitigation and adaptation, as mentioned by activist respondents R9 and R10. For academic respondent R11, implementation, however, has not occurred. For activist respondent R9, even though this was a positive example in terms of legislation, it does not have practical applicability, not indicating an execution plan. Another example of joint policy for both mitigation and adaptation in Sao Paulo was the environmental quota, as mentioned by government respondent R8. As she explains, this is an instrument of the city's Master Plan, with the objective of stimulating the implementation of green infrastructures in buildings, having benefits for both mitigation and adaptation.

For Salvador, respondents did not point to further examples of policies and strategies for climate action, other than the city's climate action plan, currently under development.

In terms of policies and strategies that jointly tackle climate change, all 3 cities are experiencing positive developments at the moment in accordance to the requirements established by their C40 membership. The city of Sao Paulo has a longer history in that sense, having a municipal climate plan since 2009 and stimulating synergies by a specific instrument within its Master Plan. Still, implementation has lagged, as defended by respondents. For Curitiba, positive examples were found in terms of the Urban Agriculture Law and the floodable parks. For Salvador, specific policies or strategies for climate action were still not developed.

5.1.2 Funds

In terms of funds to jointly serve adaptive and mitigative endeavors locally, respondents point out that those are highly absent in all 3 cities. However, international opportunities and funds that are not specifically aimed at climate action were indicated by the respondents.

In Curitiba, respondents indicated the absence of specific funds for climate action. For government respondent R1 from Curitiba, there is an intention to create a specific fund for climate adaptation and mitigation, but for her, this is hindered by the fact that every new fund will withdraw resources from existing ones. However, as mentioned by activist respondent R3, the city has access to international finances for climate related projects, related to its participation on city networks, such as the C40.

For São Paulo, specific funds for climate mitigation and adaptation are also not available according to respondents. However, as mentioned by R9 environmental and development

funds are available and may be used for mitigative and adaptive purposes. As exemplified by her, cyclopaths were implemented with resources from the Special Fund for the Environment and Sustainable Development (FEMA), a municipal fund for environmental actions.

For Salvador, again, the absence of a specific fund for climate action was mentioned by respondents. For academic respondent R18 this is a central hindrance, even though the city has partnerships with the C40 and the Inter-American Development Bank (IDB). For government respondent R14, being part of international networks is central for financing climate action in the city, giving access to international financing opportunities. For her, this brings awareness about what opportunities are there and to promote the city internationally.

While specific funds for tackling adaptation and mitigation were not present in any of the cities, all of them seem to benefit from international opportunities as a consequence to their participation in city networks. In Sao Paulo, other municipal funds may also be used with climate mitigation and adaptation endeavors.

5.1.3 Programs and projects

In terms of joint projects and programs for climate mitigation and adaptation, some examples of synergies between mitigation and adaptation were found in all 3 cases.

For Curitiba, the example of the city's community garden can also be considered a joint program for both climate mitigation and adaptation. The Urban Agriculture Law (see section 5.1.1) unfolds in a specific program, the Community Urban Gardens Program, which was able to expand the number of community gardens in the city, as explained by activist respondent R3.

In the case of Sao Paulo, a positive example in that sense were the city's linear parks (R9, R11, R12), as mentioned by respondents increasing soil permeability while also enhancing carbon sinks. As mentioned by academic respondent R11 the city has implemented multiple linear parks, as specified by the city's master plan, but their significance is limited considering the scale of the city.

For Salvador, 2 examples were mentioned by respondents. First, the sanitation and recovery project in the Mane Dende river basin, which includes reforestation, cycling infrastructure and the use of green infrastructures (R13; R14). Besides that, as mentioned by activist respondent R16, the city has a program for distributing native plant seedlings to the

population, the Salvador Capital of the Atlantic Forest program. For activist respondent R17, this is more a symbolic effort than necessarily an impactful action.

For all 3 cities, distinct examples of synergies in terms of programs and projects were identified. In Curitiba a specific program for implementing community gardens in the city appears as an unfolding of a related municipal law. Similarly, in Sao Paulo, specific provisions in the city's master plan account for its multiple projects of linear parks. In Salvador, a program for distributing plant seedling and a project that encompasses both adaptive and mitigative benefits were encountered.

5.2 Leadership

In terms of leadership, the 3 case study cities currently showcase relatively high levels of climate ambition, as indicated by their membership of networks, such as the C40 leadership group, engaging in the climate change debate internationally and committing to the development of climate plans in accordance with the 2020 deadline. Still, the studied cities substantially differ as to how, when and to what extent their climate-related leadership took place. Following the UNDP's (2010; 2013) conceptualization of leadership, the case studies were assessed in terms of their formulated vision, communication standards, management skills and outreach mechanisms, as shown below.

5.2.1 Clearly formulated vision

The first indicator of leadership is the existence of clear formulated visions. This research aimed at unraveling whether or not these cities have set specific goals in terms of mitigation and adaptation. Even though the rise of the climate change discussion is relatively recent for all studied cases and all 3 cities are still developing their climate action plans, the interviewees' responses indicate that these cities already have clear goals in terms of mitigation and adaptation. To a large extent, setting these specific goals are directly linked with their membership in the C40 leadership group. According to GR1, the C40 methodology includes training and evidence-based documents to establish the city's climate action plans, such as emission inventories and climate risk assessments, based on which the cities are able to establish their own priorities. So while it provides a basis and guidance, the cities still lead the process of choosing their own priorities:

“the local leadership, the maturity, the local knowledge, the role of the municipalities is very important in the way you will bring these issues into your reality (instead of)

simply transferring these ideas in a generic format to place as dissociated from your reality” (R1).

In Curitiba, the urbanization process was shaped by a clear vision. For decades, the city was able to develop itself in a distinct way within the Brazilian context. In the 1960s, while Brazil's major cities were experiencing rapid urbanization, Curitiba established definite goals in terms of urban development, based on preserving its natural environment and heritage and improving quality of life (Rabinovitch, 1992). Nowadays, the city has a target to achieve carbon neutrality by 2050, while the climate action plan will further develop this goal and establish both mitigative and adaptive targets (R1; R3).

The climate agenda in Sao Paulo has been considered since 2003, when the city entered the Cities for Climate Protection campaign, followed by its first emission inventory. In terms of climate change goals, Sao Paulo was a pioneer city within the national context, being the first one to institute a Municipal Climate Law in 2009, establishing particular goals, such as reducing 30% of its emissions by 2012. This has inspired other Brazilian cities and states, including the state of Sao Paulo, to create their own (Di Giulio et al., 2018). Government respondent R7 highlights the city's capacity to incite replication, exemplifying that small towns started to close streets for cars on Sundays after Sao Paulo started doing that with one of its main streets, Avenida Paulista. Despite having clear goals, implementation is still problematic and the objectives set in 2009 were not reached (Di Giulio et al., 2018). While the new climate action plan will bring renewed objectives for both mitigation and adaptation, as mentioned by activist respondent R9, Brazilian cities often have robust regulations, as in the case of Sao Paulo, which are not implemented in practice.

Aiming to turn the city into a global reference in terms of resilience and climate change, the current political leaders of Salvador have defined that the city must be carbon neutral by 2049, the year in which the city completes 500 years (R13). This general and symbolic commitment is to be further specified in the city's climate action plan. According to government respondent R15 this global goal is to be further specified by the plan. This respondent also mentions waste and transport as the most polluting sectors in the city. Also, for academic respondent R18, the city is also able to map its risky area, which demonstrates that formal leaders already possess elements to further establish specific goals in terms of mitigation and adaptation. The interviews indicate that not only the establishment of definite targets, but the rise of climate change awareness is a recent phenomenon in the city and this change was largely attributed to the formal leadership roles, in particular to ACM Neto, Salvador's mayor since 2013. For government respondent R15, not even 'environment' was

discussed by the city's leaders, for him, "before the current administration there was no such agenda".

With Curitiba being praised as a successful example in the past, while Sao Paulo presents itself as a potential catalyst nationally and Salvador emerging as a new leader recently, the 3 cities seem to be on the right track to establish clear visions from tackling climate change, challenges to implementation may still be faced in the near future.

5.2.2 Communication standards

In terms of communication standards, the research investigated to what extent communication between distinct departments within the public institutions and also with external actors happens effectively. The development of a climate action plan under the C40 framework established formal collaborative working groups in all 3 cities. This facilitates communication among different departments for climate action and encourages engagement with other actors. However, findings still show a marked difference between cities, especially in terms of external communication standards.

Respondents indicate that communication standards are a noticeable problem in Curitiba, even within the institutional sphere. As exemplified by activist respondent R3:

"We had a meeting with the international relations representative of the mayor's office and he was very far from really knowing what was happening within the environment secretariat in relation to the climate agenda".

For him, in regards to its external communication standards, the problem escalates, being the main issue of the city's political management. He mentions that the inventory of emissions, finished in 2016, was only published in 2019, after the municipality yielded to the pressures of civil society members. Also for activist respondent R3, the Municipal Secretariat of the Environment is publicly known as the city's worst secretariat in terms of communication, widely acknowledged for its poor helpdesk services and the population faces difficulties with contacting them. Even though the city has a multidisciplinary working group, as typically observed in C40 member cities, including a diverse range of municipal departments for developing its climate action plan, communication within the public sector is regarded as insufficient even from the perspective of civil servants. Curitiba's government respondent R1 admits that climate-related actions within the local government are often dissociated, sometimes following distinct political trajectories, since the city still lacks a

governance model able to organize and integrate those actions. For her, the development of the city's climate action plan will fill this gap.

In Sao Paulo, communication standards were also regarded as insufficient by the respondents. For activist respondent R10, this is far from mainstream in the city, due to the city's governance model, which was not designed to enable dialogue between departments, instead separating issues into disassociated categories. For her, communication is neither a daily practice nor encouraged. For academic respondent R11, even though the city's technical staff are open to cooperation and dialogue, acknowledging the value of this integration, this is usually not valued by political leaders, which in turn burdens coordinated work.

“the technicians are informed of these issues, they know what is happening, they know the need for dialogue, to propose joint actions, but often the secretaries and their advisers are not interested in that” (R11).

Being Brazil's largest city, the size and complexity of the administrative body in Sao Paulo also brings barriers to communication. The city employs over 100,000 civil servants, while Salvador has around a quarter of that (IBGE, 2017). In the latter, hierarchy is also less noticeable, according to government respondent R14, who currently works within Salvador's local government, but has worked for Sao Paulo's municipality in the past. As she puts:

“Salvador being smaller, it ends up being a little less bureaucratic in that sense and it is easier for you to communicate, I pick up the phone, call another office (...) communication is a little more fluid in that sense.”

Among the studied cities, communication is relatively more prominent in Salvador. According to government respondent R8, who accompanied the recent development of the climate action plans in the 3 studied cities, especially Sao Paulo and Salvador, is also positive about the communication standards in the former. As to the differences between the cities, she mentions:

“the actors in Salvador are much more engaged, so they are much more involved, I think this awareness will come much faster, it is already coming and it will come much more in an integrated way even in their action”.

For government respondent R13, the municipality performs a major effort for communication and integration within the climate debate. As exemplified by government respondent R14, the municipality has been working on raising the citizen's awareness on what resilience is. For

her, these communication efforts resulted in higher levels of acceptance for proposed solutions, even within the government, as some technical staff used to show much more resistance to new ideas. Accordingly, academic respondent R19 noticed indications of greater integration within the elaboration of the emissions inventory and the city's risk assessment, for him, somewhat deviating from the historical lack of communication between departments. As an example, he mentions an increased articulation between Codesal, the municipal civil defense, with the Sedur and the Semob, the city's infrastructure and mobility departments respectively.

In sum, Curitiba seems to have a technocratic approach to climate action, where the lack of transparency is a major issue. In Sao Paulo, scale and complexity increase the challenge of effective communication. For Salvador, communication was regarded as one of the city's main strengths in terms of its collaborative capacity, especially when compared to the other studied cities.

5.3.3 Management skills

In terms of management skills, respondents were asked about the public bodies' ability to negotiate, network and coordinate action, whether or not they value new ideas and are prone to facilitate collaborative work.

Even though communication standards were regarded as suboptimal in Curitiba, respondents have been positive about the capability of the departments in terms of networking and negotiating. The city managers are able to articulate different departments when it comes to access funds and elaborating reports as noted by activist respondent R3, the existence of working groups indicates that the secretariats are collaborating in some way, but in a rather restricted way, failing to involve the community, for example. For R1, the municipality is indeed capable of conducting coordinated work, even though many actions are done in a segmented way. For her, one of the main intentions of the climate plan is to build a governance model to further enhance this coordination.

For Sao Paulo, again, the scale plays a role in managing collaborative work. For government respondent R8, public departments in the city are usually highly technical and focused on the business-as-usual, being resistant to new ideas:

“(departments) are less open to new things and problematize more, they are more afraid, it is a very big city, it has many implications and a lot has happened, I think this

influences a little at the time, so they are a little more resistant when it comes to bringing new things”

Still, she mentions a positive example, a municipal plan focused on summer rainfall (Plano Chuvas de Verão), involving articulated work between different sectors, including transport and social assistance. The plan has been able to survive political changes and represents a positive potential in that sense.

In Salvador, for activist respondent R16, coordinate and collaborative works is something the city is now developing. According to academic respondent R19, recently there were indications of higher levels of integration, for him, this articulation has to do with the profile of the current local managers:

“Salvador today has better municipal management than before, with young people at the front, people in tune with what is happening, my view is that municipal management is much more articulated today than before”.

Government respondent R13 mentions the elaboration of the city’s strategic planning and the environmental sanitation and urbanization program for the Mané Dendê river basin as examples of successful initiatives of coordinated work between multiple departments.

In all three cases, it becomes evident that, even though management skills may benefit from the elaboration of the cities’ climate action plans, it is not limited to that. Examples of effective collaboration between departments beyond the climate action plans development indicate that, at least to a minimum level, management skills were already present in three cities. Still, especially in Sao Paulo, this is far from mainstream and for Curitiba the lack of transparency appears again as a major barrier. For Salvador, the positive recent changes are observed but still not consolidated.

5.2.4 Outreach mechanisms

In terms of outreach mechanisms, the research focused on the capability of the local government to engage those outside of the formal institutions, specially the extent to which they were able to involve the local community.

In Curitiba, a deficient connection between the public institutions and the local community is clear. Deliberative and consultative spaces assigned to enhance that connection do not work in practice, according to activist respondent R3. For him, the city managers have a very

limited idea on what participation entails and climate related decisions are being made unilaterally. As an example, he mentions the city's cycle plan, elaborated without the participation of the city's main cyclists association:

"I think they did the online consultation in a very short period of time and without any disclosure, the cyclists association didn't even know it happened and the plan was built without the main cyclists association that works with advocacy, which is pushing for public policies for urban mobility (...) so, to me, it shows a position of denying participation".

Activist respondent R4 also sees little initiative from the city in terms of trying to involve citizens, she exemplifies with an online consultation on the municipality's website on the topic of climate change, with a reduced space for actually writing an argument, "you can't argue in the face of so many problems and so many things that happen within the city in 200 characters", as she explains. Government respondent R1 mentions the same online consultation, but rather as a positive example tool to engage the community. For her, it is part of the local government's engagement plan, focusing on profiling the population in terms of their perception of climate change. Government respondent R1 also mentions that for the development of the climate action plan, relatively higher levels of participation have been achieved, as a requirement of the C40. In a more general sense, government respondents admit that citizen's participation is problematic in the city. For government respondent R2, participation is not as accessible and permanent for the community as it should and for R1, those elements are still being built. It becomes clear that for the municipality of Curitiba the standards for involving citizens are still relatively low and outreach mechanisms are usually translated into online consultations, overseeing the potential of debate and dialogue.

For government respondent R8, especially in Curitiba, but also in Sao Paulo, the interaction between local government and civil society is problematic. According to her, Sao Paulo has committees with representatives of the civil society, "but it is still a very small representation in relation to what exists". For activist respondent R10, in general, the climate debate is still far from the general population, being constrained within a niche, since citizens are very unlikely to attend meetings or public hearings since they usually happen "in a closed room, in a government building, during working hours", however, she noted some efforts to involve the community through social media. For government respondent R8, the exchanges between the local government and the civil society in Sao Paulo can be further enhanced and that the public body is concerned about enhancing public consultation and validation. As mentioned by activist respondent R9, Sao Paulo's climate action plan is being developed in a

regionalized way and public hearings to present the plan to the neighborhoods are being scheduled, which represents efforts from the municipal government to reach the community. Still, doing so to present solutions represents a rationale of using citizens simply to validate governmental solutions (R18). As to the involvement of private parties, there were moments of involvement with mobility and building syndicates (R8), but as mentioned by government respondent R7 and activist respondent R9, the private sector is still not fully aware of the climate agenda's significance.

Recently, Salvador has taken important steps towards a more participative approach on climate change governance, among the 3 studied cities it has shown the highest level of community engagement. For government respondent R8, Salvador is the city who is most committed to involve its citizens:

“they are really pushing for greater participation and validation at all stages of the plan, in other cities it is only partly done or at the end final, a validation, but Salvador wants it, it is bringing (participation) to everything”

For activist respondent R16, there is a genuine effort from the local government in that sense, creating thematic events to engage the population in the discussion, broadcasting debates online or distributing native plant seedlings to citizens, for example. Still, he points out that these efforts often fail to effectively reach the population, “I have this impression that the invitation frequently stops in the bubble and doesn't really reach the community”. For government respondent R13, the local government is concerned with expanding citizens participation, listening to and involving the community. As to the involvement of private parties, she mentions the inclusion of associations and representatives of different sectors in the debate. For government respondent R15 there are several stages in levels of participation, besides the meetings and presentations organized by the public sector, documents are made “available for the citizens to evaluate, criticize, include, change”. As exemplified by government respondent R14, when the municipality conducted Ecosystem-based Adaptation (EbA) studies, they went to the communities, presented their proposed solutions to be evaluated by them, and incorporated some of the citizen's ideas in their studies. For activist respondent R17, citizens are usually included as to validate the political decisions. Also for academic respondent R18, participation is used as a way to legitimize “what the institutionality wants to implement, while the opposite path should be taken”. As he puts:

“we only appear as thinking agents about the reality of Salvador after the process is almost done. So, we appear as those who are going to adjust a document that has been produced, for example, by a company that is not even based in Salvador. So we cannot consider this a relationship of effective communication”

For academic respondent R18, even though participation indeed occurs in Salvador, it is still “unable to overcome the limits of institutionality or political intentionalities”.

While in Sao Paulo and Curitiba, the involvement of the community in the climate debate has been relatively less stimulated, substantial efforts have been perceived in Salvador. Still, it is clear that engaging the community in the climate debate is still a work in progress and this engagement is mostly used to validate decisions.

5.3 Institutional arrangements

In terms of institutional arrangements the case studies were assessed in terms of to what extent their institutional design favours collaborative work. It accounts, for example, for soft and hard rules, which may facilitate or hinder cooperation. The specific indicators comprise “streamlined processes”, clearly defined “roles and responsibilities”, “merit-based appraisal” and “coordination mechanisms.

5.3.1 Streamlined processes

This indicator is focused on investigating the extent to which mitigative and adaptive endeavors are well-aligned in the studied municipal contexts. Results indicate that climate action in the context of these cities is a recent phenomenon, little has been in fact implemented, either in terms of mitigation or adaptation. Also, the theoretical development of mitigation and adaptation as dichotomous reverberated in how these cities tackle climate change.

For Curitiba, responses from civil society members again indicate that transparency might be a major issue. For activist respondent R3, the fact that the city now has a group, within the public sphere, to discuss climate change indicates that there might be an alignment to some extent, however, as he mentions, from his perspective, it is not possible to precisely indicate whether or not this is the case since communication is lacking. For society respondent 2, as a citizen, the climate agenda is not much talked about and she does not see effective actions in that sense. As to the local government, government respondent R1 indicates that even

though mitigation and adaptation are tackled as two distinct enterprises, which she attributes to the way the scientific literature evolved, co-benefits are highly prioritized in the development of the city's climate action plan. However, as mentioned by government respondent R2, the climate debate is still not fully incorporated in the country as a whole.

In Sao Paulo, integration between mitigation and adaptation was also highly overlooked. In this case, the city has favoured the former, with a clear mitigation bias in its master plan. For government respondent R7 The local government is already able to understand mitigation, focusing its attention on energetic efficiency and transport. For academic respondent R11, despite this inclination, little has been done in practice even in terms of mitigation. For activist respondent R9, besides the troublesome implementation of plans, the city's sectorial and segregated rationale hinders strategic thinking in terms of climate change, which include integration between the mitigative and adaptive agendas.

Unlike Sao Paulo, Salvador is mostly focused on adaptation (R8). For academic respondent R18, adaptation occurs regardless of public interventions, mentioning the steps at the doors of the houses as a way to prevent water from entering during flooding, a common feature in the low regions of the city. For activist respondent R16, there are positive initiatives, but that need to be better aligned. Similarly, for activist respondent R17, those good examples are punctual. The government respondents that incorporating climate change in the city is still at an early stage. For government respondent R13, "there was a lot of difficulty to understand what adaptation and mitigation is in the resilience strategy and now that we are exactly doing an exercise". For activist respondent R17 and academic respondent R19, again, mitigation and adaptation are integrated in the development of the city's climate action plan.

For the 3 cities the dichotomy between mitigation and adaptation is still to be overcome, however, their membership to the C40 group represents an unprecedented opportunity to integrate mitigation and adaptation in tackling climate change. The climate plans will bring both aspects and their intersections, or synergies, are being considered and prioritized. Still, these cities still lack maturity in terms of implementation.

5.3.2 Clearly defined roles and responsibilities

This indicator deals with the different roles in processes of collaboration, as to reveal the extent to which those are defined and avoid ambiguity. It accounts for the consistency and maturity of collaborative processes for tackling climate change within the public institutions. For this element, some respondents of the civil society refrained from responding, justifying

that only those inside of the public institutions were able to precisely indicate whether or not there is a clarity of roles and responsibilities.

For Curitiba civil society respondents could not precisely evaluate the processes within the public institutions take place, again, due to the lack of transparency. For government respondent R2, actions for tackling climate change are still not well-planned in the city, including the distribution of roles and assignments. assignments and roles. For R1, as the municipality's climate action is being prepared, so is the definition of roles and responsibilities.

Also for Sao Paulo, collaborative processes are not well coordinated (R11). Government respondent R8 notes that, for the climate agenda, the legislation does not always define roles and responsibilities, often mentioning what should be elaborated, but failing to indicate whose responsibility that is. Also, for her, this is worsened by government changes, with which departments or their duties may shift, creating confusion. For activist respondent R10, unclear roles and responsibilities are related to a lack of maturity in cooperative work, for her, networks of local governments, such as ICLEI¹, play an important role, promoting cooperation.

For Salvador, the roles in collaborative processes for tackling climate change were regarded as clear. Different actors are closely engaged and, even though this is a recent phenomenon in the city, the structure of the city's climate governance is relatively developed.

For government respondent R13, it is also clear what is expected from the different actors in terms of collaboration, especially since the city is now at the end of a political cycle. This means that there was enough time to adjust to the changes that normally occur between governmental mandates. Both government respondents R14 and R15 confirm that clarity in terms of roles and expectations has significantly improved when compared to the recent past.

For the definition of roles and responsibilities, Salvador has outperformed the 2 other case studies, having a clearer organizational structure. However, political changes can negatively affect these recent improvements. For Curitiba and Sao Paulo, collaborative work is still not the norm. Still, for all 3 cases, the development of the climate action plan might help building or further defining a governance structure for climate change action.

¹ ICLEI – Local Governments for Sustainability is a global network of local governments for sustainability. (Frantzeskaki et al., 2019)

5.3.3 Merit-based appraisal mechanism

For this indicator, the aim was to investigate if and how these cities made use of specific mechanisms to directly encourage collaboration, either by rewarding or sanctioning instruments. Most respondents could not point out any examples in that sense. However some important insights are discussed below.

For activist respondent R3, some coordination between public departments in Curitiba is encouraged through access to funds, technical advice, support from organizations and city branding. For him, these work as incentives to collaboration to some extent. As mentioned by R1, the collaborative working group is established by a decree, which is, to some extent, a formal incentive for collaborative work.

For government respondents in Sao Paulo, the understanding of collaborative work as beneficial is still lacking. As mentioned by government respondent R8, “the transaction costs of a new relationship are always high”. In that sense, absence of incentives are linked to a lack of political priority for the climate agenda. Even though financial instruments, especially from international sources exist, these opportunities are still not fully perceived by the local government (R7).

For Salvador, government respondents pointed out two ways in which collaboration is encouraged within the local government. Besides creating a working group by decree to develop the city’s climate action plan (R13), the names of those who collaborated with the development of the inventory of emissions, for example, were included in the final document, which is public. For government respondent R14 this was a way to acknowledge their contribution.

For the studied cases, merit-based appraisal mechanisms are still not fully exploited. From the collected data, the most visible instrument was the establishment of working groups by decree, mentioned by respondents in Curitiba and Salvador. However, mechanisms of reward and sanction were not referred to for any of the cases.

5.3.3 Coordination mechanisms

Similar to having a clear distribution of roles and responsibilities, this indicator focuses on how intersectoral collaboration is coordinated and whether or not there is an overseeing body.

For Curitiba, the coordination of the climate action plan is shared between the city's urban planning department, IPPUC, and the Municipal Secretariat of the Environment. For government respondent R1 coordination mechanisms will be enhanced with building a new governance model under the city's climate action plan. For civil society respondents, it was not clear how the coordination inside the city's public institutions occur.

In Sao Paulo, there is clarity on which department takes the lead in the municipal climate agenda, most often it is the Secretariat of Green and Environment. For activist respondent R9, this represents that the government fails to understand climate change as "an economic, social, administrative agenda". For her, this role should be given to a more articulated department, as she mentions, "this fractional thinking we have here is very detrimental to the climate agenda". For government respondent R8, the need for better integration is evident and this role should be attributed to the Municipal Government Secretariat, since the Secretariat of Green and Environment has difficulties in entering other departments, due to political conflicts. For academic respondent R11, the latter is politically weakened, which harms the advance of the agenda.

Also for Salvador, the department which takes the lead in such processes is clear-cut, in this case, the Municipal Secretariat of Sustainability, Innovation and Resilience (SECIS), as mentioned by all respondents. For government respondent R13, the Civil Office has also an important role in the climate agenda, functioning as an orchestrator for implementing the city's actions, identifying resources, connecting departments and overseeing other secretariats. Activist respondent R17 makes a critique in terms of coordination in terms of vertical reach. For him, the city's climate action plan is not integrated with other instances of public power, such as state and federal governments, which is also valid for the other cities.

For the 3 cities, coordination of collaborative work under the climate agenda has clarity on which department takes the lead. However, the allocation of the agenda under the environmental department in Sao Paulo does not only represent a limited view on climate change, but also hinders the engagement of other departments. From this point of view, Curitiba seems to acknowledge climate change as related not only to the environment, but also planning. In Salvador, a specific department coordinates the climate agenda and collaborative work is also facilitated by the Civil Office.

5.4 Knowledge

Put simply, knowledge deals with the knowing of individuals, being the basis of their capacities. In terms of climate change, knowledge sharing is highly important, considering that the debate is rather recent, especially in the Global South. The UNDP (2010, 2013) offers as indicators of knowledge linking mechanisms for research supply and demand, brain gain and retention strategies and knowledge sharing tools and mechanisms.

5.4.1 Research supply and demand linkage mechanisms

In terms of research supply and demand linkage mechanisms. respondents were asked about the technical and political capacity of the local public institutions to tackle climate change and how potential gaps in those capacities were dealt with. Similar conditions were found in the 3 studied, highlighting the role of city networks.

For activist respondent R3, Curitiba has the capacity to advance the climate agenda, especially considering the city's positive historical experiences in terms of environment and planning. For him, the limitations are more political than technical, with the public departments having "a very narrow view on management". Currently, for activist respondent R4, where technical capacity might be lacking, networks like the C40 leadership group are able to fill this gap. For R1, the C40 has a major contribution for advancing the climate agenda in the city by providing a framework, a script that guides the development of climate policy in the city (R1).

Also, for activist respondent R10, climate expertise is still lacking in Brazil as a whole. In that sense, international cooperation has been employed to overcome this shortage in cities like Sao Paulo, providing training technical support to the municipal staff. As mentioned by activist respondent R9, networks such as the C40 are "extremely important, because this expands the technical staff". For government respondent R8, such networks do not only contribute with knowledge but also to advance the climate agenda in these contexts. For her, it is noticeable that cities participating in such networks are way ahead of those which are not.

Similarly, for Salvador, the role of external sources of knowledge was highly valued. Besides the membership to the C40 leadership group and the Global Resilient Cities Network from the Rockefeller Foundation (R14), the city makes use of specialized consulting firms. As exemplified by government respondent R14, a consultancy company, GIZ (German

Corporation for International Cooperation) was hired to conduct some analyses, including a study of the interplay between climate change and tourism in the city. This closer engagement of academics in the climate debate reflects a positive element in the case of Salvador the closer engagement of academics in the climate debate. As mentioned by government respondent R8, when comparing Salvador and Sao Paulo, in the former “the academy is much more connected with the city, the public authorities, and especially in this area, because they created the panel, so there is a greater mobilization and they are participating a lot”.

For the 3 cities the evaluation in terms of the knowledge supply and demand link is noticeably similar. The demand for expertise in climate change is fulfilled by external sources to a large extent and their membership in the C40 leadership group was a major factor in advancing the climate agenda in these cities recently. Comparatively, Salvador’s public body is cultivating a closer relationship with academia, from which the climate agenda in the city may also benefit.

5.4.2 Knowledge sharing tools and mechanisms

As to knowledge sharing, the research focused on investigating to what extent information was shared across the different departments, sectors, levels and institutions of the public power and what instruments were employed to facilitate these flows.

In Curitiba, civil society respondents were unsure about the flowing of knowledge within the local government. In Curitiba a strong sharing of information with international organizations, like the C40, is present (R3). Respondents indicate that the membership to this network has also a positive influence on the internal knowledge flow. For R1, in the specific case of the elaboration of the city’s climate action plan, knowledge is shared among departments, since it is a joint task between them. As to the tools utilized, she mentions that meetings are recorded and made available for those that are part of the group of participants but could not attend.

For Sao Paulo, as already discussed in section 5.1.2, communication between departments is problematic, which is also valid for the sharing of knowledge among them. Also, the involvement of the academic community in the elaboration of the city’s new climate action plan, when compared to Salvador, is slighter. Again, the membership in the C40 group has a fundamental role as knowledge sharing linkage, bringing knowledge and training (R8).

For Salvador, besides the knowledge sharing via city networks, respondents indicate that information is also shared across public departments and academia. For government respondent R13, information is shared across the local public body via databases, such as the cartographic mapping of Salvador, a digital system for cartographic information which is publicly available online. For government respondent R14, the city still lacks an internal communication channel to enhance knowledge sharing, as she explains, since departments occupy different buildings, civil servants are only aware of the projects of their own department or the ones they are directly involved in. For academic respondent R19, the city's climate action plan will discuss the issue of knowledge sharing, for him closer linkages with cities such as Recife and Fortaleza, which share more similarities with Salvador than Sao Paulo, for example, would also benefit the city's advancement in the climate agenda. A sound tool for knowledge sharing mentioned by respondents (R14, R19) is the Salvador Climate Panel, a research-oriented network, inspired by the IPCC, aiming at increasing the accessibility of data in Salvador. The panel includes 10 thematic chambers, coordinated by academics, who will participate in the development of studies on the proposed theme (Salvador, 2019).

In terms of knowledge sharing tools, all 3 cities are benefiting from their membership in city networks, especially the C40. For the development of its climate action plan, Curitiba is also sharing knowledge across departments to some extent. In Sao Paulo departmentalization is also a challenge for sharing information in terms of climate change, but there is an involvement of the academy to a certain degree. For Salvador, knowledge sharing mechanisms are more developed, especially in terms of linking the local government and academia.

5.5 Diagnosis

Based on each of the indicators for both the enabling conditions for synergies and collaborative capacity, tables 2 summarizes the diagnosis for all 3 cases. For collaborative capacity, Curitiba is especially problematic in terms of communication standards and outreach mechanisms. Sao Paulo exhibits a modest collaborative capacity, with insufficient communication standards, outreach mechanisms and clarity of roles and responsibilities. Salvador outperforms the other 2 cities, showcasing better levels for almost all indicators. For some indicators, all 3 cities had similar status. This was the case of merit-based appraisal mechanisms, not clearly utilized in any of the cities, and clearly formulated views,

coordination mechanisms and streamlined processes, highly influenced by the cities' participation in the C40 group.

Table 2: assessment of enabling conditions of synergies and collaborative capacity

Indicator	Curitiba	Sao Paulo	Salvador
Policies and strategies	Climate action plan under development, besides the Urban Agriculture Law	Climate action plan under development. Besides the Sao Paulo Climate Change Policy and the Environmental quota	Climate action plan under development
Funds	No local climate specific funds, but the city has access to international funds	No local climate specific funds. But environmental and development funds used for climate action	No local climate specific funds, but the city has access to international funds
Programs and projects	Community Urban Gardens Program	Linear parks	Mane Dende river basin project and Salvador Capital of the Atlantic Forest program
Clearly formulated vision	clearly formulated visions being developed in the climate action plan	clearly formulated visions being developed in the climate action plan	clearly formulated visions being developed in the climate action plan
Communication standards	poor communication standards due to lack of transparency	communication hindered by scale and complexity	good communication standards
Management skills	departments are able to articulate action	scale hinders coordinate action, but positive examples also exist	coordinated work is a recent development, with increasing levels of integration
Outreach mechanisms	public body closed to public participation	Citizens participation is still limited, the debate is constrained within a niche	community engagement is relatively high
Streamlined processes	mitigation and adaptation tackled in a disconnected manner, to be improved by the new climate action plan	emphasis on mitigation only, to be improved by the new climate action plan	emphasis on adaptation only, to be improved by the new climate action plan

Clearly defined roles and responsibilities	Collaborative work is still not the norm, roles are unclear	Collaborative work is still not the norm, roles are unclear	Collaborative work is evolving, roles are already clear
Merit-based appraisal mechanism	no sound rewarding or sanction mechanisms for inducing collaboration	no sound rewarding or sanction mechanisms for inducing collaboration	no sound rewarding or sanction mechanisms for inducing collaboration
Coordination mechanisms	clarity on how intersectoral collaboration is coordinated and who takes the lead	clarity on how intersectoral collaboration is coordinated and who takes the lead	clarity on how intersectoral collaboration is coordinated and who takes the lead
Research supply and demand linkage mechanisms	C40 membership establishes sound research supply and demand links	C40 membership establishes sound research supply and demand links	C40 membership establishes sound research supply and demand links. Local academia closely involved with the development of the climate action plan
Knowledge sharing tools and mechanisms	knowledge sharing via city networks	knowledge sharing via city networks	knowledge sharing via city networks. Information is also shared across public departments and academia

6. DISCUSSION

6. Discussion

In this section, explanations are provided by relating the results with relevant literature. The discussion will present how the diagnosis relates to the synergies and tradeoffs between mitigation and adaptation identified in each of the cities, clarifying similarities and differences between them, while also providing general abstractions thereof (sections 6.1-6.3). This is followed by discussions on a higher level, discussing the national level and the role of transnational city networks (sections 6.4 and 6.5).

6.1 Curitiba

Often portrayed as an exemplary city in terms of urban planning and sustainability in the national context, Curitiba's development was distinct among Brazilian cities, integrating environment and planning as major city objectives (Neto, 2012). According to R1, the city has deployed elements of mitigation and adaptation in its past, obviously without specifically referring to those terms, but to common concepts at the time, for example 'ecology'. In the 60s and 70s objectives included reducing traffic congestion, preserving green areas and even avoiding economical losses from floods (R3).

According to R1, while Brazilian major cities were suffering an accelerated and disorderly urbanization process, Curitiba was taking a different path, preserving green areas, in particular its bottom valleys, which in turn, contributed to contributing to a lesser intensity of flood events, when compared to other major capitals in Brazil.

While Curitiba's avant-garde urban planning and public policies from decades ago substantially benefited the city, shaping its identity and creating the myth of Brazil's model city, its environment-orientation and urban management have lagged during the last two decades (Macedo, 2004; Arashiro, 2016). This was supported by respondents, as mentioned by activist respondent R4 : "it was an ecological city, it no longer is, because it stopped in time, it stagnated, it is not advancing anymore, we have the same public transport from 50 years ago". For government respondent R2, while environment-oriented projects have decreased, the city branding continued to this day. Activist respondent R3 also emphasizes city branding as a major preoccupation of the local management. Martiello (2001) supports that marketing was an important strategy deployed by the municipality of Curitiba through the years, also to create a positive image towards its population. For Macedo (2004):

“despite the institutionalization this myth (...) growth and development of Curitiba have negatively impacted the quality of life of many of its citizens, leading the majority to question the contention that this is one of the most livable cities in the world” (p. 540).

In terms of its current collaborative capacity, among the 3 studied cities, the measurement for Curitiba was relatively low, especially in terms of its communication with those outside of the local government. Communication standards and outreach mechanisms were the lowest indicators, suggesting that, while the city may be able to perform relatively well and maintain its imagery of sustainability frontrunner, it has a technocratic stance, closed to the outside. This lack of transparency in Curitiba’s public policy processes was already identified by da Silva & Rauli (2009). Still, the city performs well in establishing goals, linked to a strong and consolidated identity, and coordination, exemplified by the shared handling of the city’s new climate action plan by the planning and environment departments.

As to the examples of synergies, respondents in Curitiba mentioned the city’s floodable parks and community gardens. As green infrastructures both initiatives have clear mitigative and adaptive benefits (Udvardy & Winkelman, 2014). In terms of adaptation, the parks have a major role on flood prevention, increasing soil permeability and the community gardens, besides being a permeable ground, also deals with food security. For mitigation, these parks may increase carbon sinks and, in the case of the community gardens, local food production avoids emission from transportation (C40, 2016).

In the case of Curitiba, floodable parks were part of the city’s strategy for urban water drainage in the 1970s, also considering environmental and social added benefits. A clear indication of their main purpose is the presence of large ponds in the middle of these parks, neither incidental nor primarily serving aesthetic purposes, and corresponding to over a third of their total area (de Oliveira, 1996) (figures 7 and 8).

Figure 7: St. Lawrence Park in Curitiba



Source: <https://www.curitiba.pr.gov.br/conteudo/parque-sao-lorenco/317>

Figure 8: Barigui Park, Curitiba



Source: <https://guides.hurb.com/parque-barigui-curitiba-pr/>

As put by activist respondent R3, Curitiba's parks were basically a major work of microdrainage. Even though it was primarily an adaptation effort, it also aimed at serving secondary purposes, as mentioned by de Oliveira (1996), such as recovery and preserving areas in the city and improving air quality in the cases of Barigui and Saint Lawrence parks, both from 1972 (de Oliveira, 1996). The city's rationale at the time clearly favoured an

integrated approach to its agendas, in accordance to its Master Plan, reconciling ecology, land use, mobility and, in this case, flood risk management. As mentioned by R1:

“if you look at our rationale for planning, the soil, the road transport system and an inverted tripod for economic, social and environmental development, what we mean by that is that these things are interconnected. And that we care about the benefits that one thing generates in another”.

As to what the main reason why the city has historically implemented actions that integrated somewhat distinct agendas, government respondent R1 says: “the main factor was the change in the look of the administrator, first of the manager, the local leadership to address the issue of urban planning as a priority”. For Arashiro (2016) the political leadership of Jamie Lerner, internationally recognized, and its close links with the planning department IPPUC favoured the implementation of projects in accordance to the Master Plan guidelines. This indicates strong leadership from appointed leaders and a clear link between knowledge and practice, suggesting that collaborative capacity at the time was relatively high. Another important factor for Curitiba’s awarded urban management, environment and public transport was a continuity in municipal administration (Curitiba, n.d.). As mentioned by R1:

“in terms of urban planning, at least we managed to have it until then, we were lucky, very lucky I think, to have a certain administrative continuity in the political process of the city, at times when planning was perhaps not so consolidated, and that could have a distortion if a management change occurred”.

The community gardens in Curitiba (figure 9) were another example of synergy between adaptation and mitigation found in Curitiba. It is “a community project that rehabilitates degraded land, (...) including schools, backyards, and balconies, to produce food (C40, 2016, n.p.). In this case, it was clearly a bottom-up initiative, arising from the civil society and incorporated by the local regulation, as mentioned by government respondent R2. For activist respondent R3, community gardens in Curitiba have also started in the 1970s, when citizens living in peripheral areas of Curitiba started to grow vegetables under power transmission lines. For government respondent R2 and activist respondent R4, the role of civil society members was crucial. She highlights the role of restaurant owners who made the link between and local public managers and individual community garden projects, stimulated by their desire to bring local and organic products to their restaurants. Then, a city councilor, Goura, drafted a legislative proposal, approved in 2018, to regulate and encourage community gardens in the city (R2). This fragmented and shared leadership is in accordance

with Meijerink et al. (2015) in their analysis of leadership practices for regional climate adaptation in European contexts. According to their study, both government and non-government actors may take leadership roles, since leaders are defined through action rather than formal roles. In this case, a connective role was played by restaurant owners while a political-administrative role from the city counselor is also evident.

Figure 9 - Community Garden in Curitiba



Source: <https://blog.bemglo.com/horta-urbana-de-curitiba/>

It becomes clear that, even though the local government itself was regarded as closed to participation and lacking outreach mechanisms to involve the community, this example shows that this relationship can also happen the other way around. For this specific project, besides being fragmented and not solely attached to formal leadership positions, leadership emerged from civil society, suggesting that collaborative capacity may also benefit from bottom-up movements and that outreach mechanisms alone do not entirely cover the relationship between government and community. In sum, the community may also take the lead and induce collaboration.

Curitiba seems to live by its image built decades ago. Its past is defined by a strong leadership and appreciation for an integrated approach to planning, environment and mobility, suggesting high levels of collaborative capacity. The successful example of the floodable parks is in accordance to that. Nowadays, Curitiba's frontrunner character has faded and its collaborative capacity assessment indicates a lack of communication and outreach mechanisms. Still, the example of the community gardens denotes that in some cases, the initiative of civil society members is able to fill this gap.

6.2 Sao Paulo

Sao Paulo's climate action is marked by heterogeneity, the city may be seen as "an example of the complexity of urban systems in that they may simultaneously combine experiments and innovations with tremendous deficits" (Di Giulio et al., 2018, p.238). The city is a source for innovation and lead transformative processes (IPCC, 2014, Leite, 2010, Seto et al., 2010) and was a pioneer by, in 2009, conceiving the first municipal law on climate in the national context, influencing cities and states to create their own (Di Giulio et al., 2018). This pioneerism and capacity to induce changes in other cities was also mentioned by respondents. The diagnosis of Sao Paulo's collaborative capacity identified a segregated thinking in the public institutions as a major barrier. Urban issues are mostly tackled separately by different departments, which does not only oversee the potential for synergistic approaches but also leaves room for trade offs, as indicated by results. Complexity and scale may also play a role therein, hindering communication and clarity of roles in collaborative work.

In São Paulo, the level of interaction between scientists and decision-makers is low, especially regarding climate science and action. Martins and Ferreira (2011), in their work on climate change action in two big Brazilian cities, including São Paulo, suggest that poor understanding in terms of the extent of climate change and its impacts and a mismatch between policy makers and the scientific community as obstacles and constraints to developing city-level climate policy.

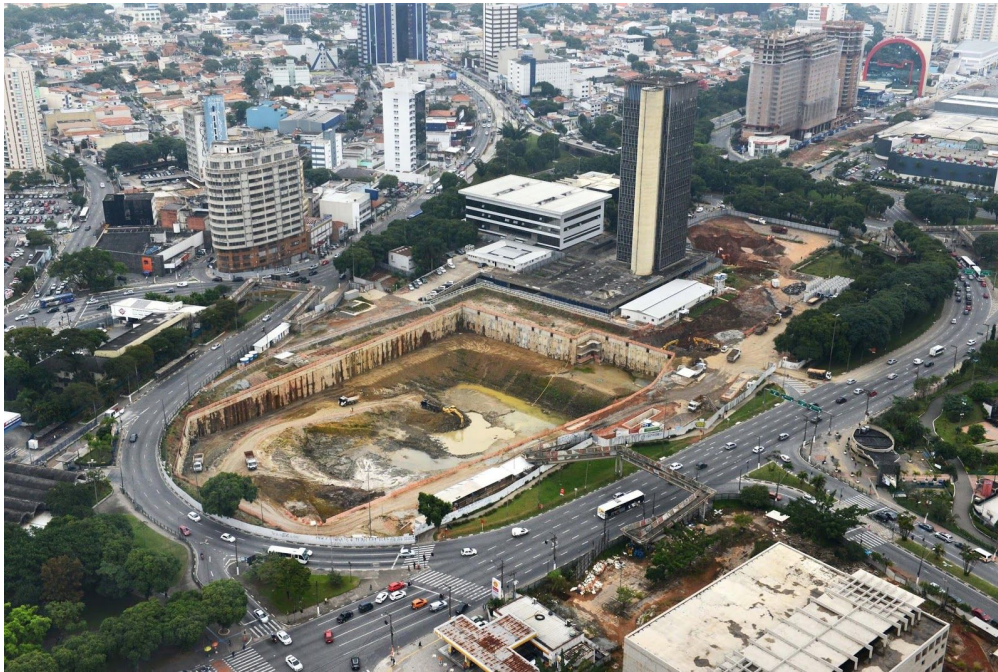
When asked about examples of integrated implementation of mitigative and adaptive works in Sao Paulo, respondents mentioned city parks and an instrument of Sao Paulo's Master Plan for stimulating green infrastructures, the environmental quota. The former refers to a set of occupation rules related to water drainage, climate and biodiversity, aimed at improving water absorption and reducing heat island effects in the city (Sao Paulo, n.d.). This quota, implemented in 2016, applies to new buildings or renewals where alterations surpass 20% in

area, exempting lots smaller than 500 m² (da Silva et al., 2019). According to government respondent R8., the city's new climate action plan is currently discussing ways in which this instrument can be strengthened in terms of increasing coverage.

Another example mentioned were the linear parks, with a focus preventing both urban floods and irregular occupation near water streams. According to academic respondent R11, these parks were already determined by the city's Master Plan of 2009. As noted by Silva-Sánchez & Jacobi (2016) overarching character and the complexity of problems to be considered in these projects require joint action for a successful implementation, in other words, the execution of riverside parks demands collaborative work, as he puts "inter-sectorial action is a necessary condition for these projects" (p. 68), still "planning and conducting joined-up and institutionally complex policies – as is the case of the city of Sao Paulo – is not something trivial" (p. 68). As noted by academic respondent R11, even though the linear parks were important actions for both mitigation and adaptation, representing a resumption of reforestation in the city, their significance within the scale of the metropolis is limited. Accordingly, for Millington (2018) "the majority of linear parks in the city are small-scale interventions" (p. 855).

While these parks represent positive examples of synergies and demonstrate that collaborative work may occur in the local level to some extent, it is not always the case. Collaboration is still not the rule when it comes to climate change implementation in Sao Paulo, largely due to the city's complexity, scale and "bureaucratic constraints" (Silva-Sánchez & Jacobi, 2016, p. 71). Responses indicate that Sao Paulo may represent a heterogeneous setting for collaborative work. While positive examples of collaborative work and synergies were found, a segregated-thinking is still dominant in the city, tackling mitigation and adaptation separately and even creating conditions for trade offs between them. An example of the disconnectedness between approaches for tackling urban issues is the city's flood risk management. A regular solution adopted for flooding in Sao Paulo is to build large water reservoirs, named *piscinoes* ("large pools") (figure 10), as noted by activist respondent R9, a very questionable solution: "you destroy the landscape, the neighborhood, you create an urbanistic Frankenstein to not make the right debate".

Figure 10 - Piscinao in Sao Paulo



Source: <https://www.ofitexto.com.br/comunitexto/afinal-relacao-custo-beneficio-dos-piscinoes-e-positiva/>

Activist respondent R9 also mentions a noticeable example of tradeoff in Sao Paulo, the construction of cyclopaths on top of median strips (figure 11), usually one of the few remaining areas for water absorption in a highly impermeable environment. Whereas the development of a cycling network creates benefits from the mitigative point of view, the suppression of unpaved areas may hinder water penetration in the soil, contributing to flood events, a severe risk in case of Sao Paulo. This shows another clear example of segregated thinking, in which mobility is considered dissociatively from environment and urban water drainage.

Figure 11 - Cyclepath in the Henrique Schumann avenue, Sao Paulo



Source: <https://glo.bo/2FwOM4C>

Another major barrier found in Sao Paulo is the symbolic value of individual motorized transportation and its political implications. As noted by activist respondent R9, whereas the referred street (Henrique Schumann avenue) has 6 lanes for cars, usually permeable areas and bike paths compete for what is left in terms of space. For her, the local government in Sao Paulo would need a lot of courage to counter the middle class which highly values car ownership. Accordingly, to academic respondent R11, municipal managers who dared to take measures that would interfere with the circulation of individual motor vehicles, would suffer electoral retaliation.

In the megacity of Sao Paulo scale and complexity represent obstacles to collaboration at the local level, at the same time, the city concentrates resources and a potential to take the lead on climate change debate nationally. The diagnosis of its collaborative capacity suggests a modest level. The examples of synergies support this middle-range classification, in which positive and negative examples coexist, revealing an heterogeneous status. While the city has a certain level of collaborative capacity, especially in terms of intentionalities and vision, which explains the linear parks and the requirements for green infrastructures in buildings, lower scores in communication standards and the definition of roles, explain the existence of tradeoffs.

6.3 Salvador

Even though the climate debate is relatively new in Salvador, the local power has been showing positive signs of political commitment to climate action. Overall, respondents not only those from Salvador, but also some from Curitiba and Sao Paulo acknowledged Salvador's current administration advances in that sense. An episode mentioned by multiple respondents was the 2019 Latin America and Caribbean Climate Week, an initiative of the United Nations (UN), hosted by Salvador. While the national environment minister, Ricardo Salles, publicly cancelled the event, Salvador's mayor, ACM Netto criticized the decision and declared that the event would still take place regardless of the national support, which eventually ceded the pressure (R3, R14, R16). To some extent, this example supports the results for Salvador, that suggest a strong leadership. Besides that, for government respondent R13, the current mayor's political handling values teamwork and transversality of actions, and for activist respondent R16, he showed a greater proximity with environmental issues than his predecessors.

Among the studied cities, Salvador has performed the best in terms of collaborative capacity. Responses indicate higher levels of community engagement and participation when compared to Curitiba and Sao Paulo. Communication and coordination between departments in the public sphere were also deemed higher. The same is valid for knowledge sharing, the Salvador Panel on Climate Change, connects academics, decision makers and civil society and, while promoting inter and cross-sectorality for policy and decision-making (Salvador, 2019). In general, respondents indicate that collaboration has been cultivated in the city in recent years, so both the climate agenda and collaborative capacity have parallelly evolving locally. In that sense, political leadership seems to be a major factor, by introducing the debate on climate change, in contrast to previous political mandates, which did not prioritize or discussed environmental issues, let alone climate change action (R16). The city also benefits from a lesser complexity and smaller scale when compared to Sao Paulo, contributing to the engagement of different actors, inside and outside of the formal institutions.

In terms of synergies, respondents were able to mention a sanitation and recovery project in the Mane Dende basin, still in progress. The objectives of the project involve "improve sanitary and environmental conditions, reduce flood vulnerability risks, and enhance urban conditions" (IDB, 2017). This large-scale project "will include macro and micro drainage works, slopes stabilization, water and sanitary sewer systems, urbanization, roads and urban

equipment, and help to resettle families to less vulnerable locations” (IDB, 2017). From the point of view of mitigation, the project includes the reforestation of river banks, investments on cycling infrastructure and the inclusion of solar panels and green infrastructures for the new buildings. For adaptation, besides the resettlement of families living in vulnerable conditions, green infrastructures and recovery of the river have sound benefits (R14). This example shows that the city took an holistic approach to the urban issues in this area, considering climate risks, environment, housing, sanitation and mobility in an integrative manner. Besides that, the involvement with the community is also occurring according to (R14) “the projects were discussed with society for them to approve, for them to want, also to ensure that they feel part of it, they feel ownership, so that the project is well done, succeeds” (R14). This example supports the premise that a higher collaborative capacity may enable the integration between agendas, creating opportunities for synergies between adaptation and mitigation. Other positive examples include the planting of trees, with the distribution of native seedlings to the population. However, as noted by activist respondent R17, rather than a mitigative or adaptive endeavor, it is mostly a symbolic effort. For activist respondent R16, it helps to engage the community and raise awareness about deforestation.

An interesting observation was the emergence of a tradeoff, represented by the construction of the BRT, first presented to the population in 2013 (Salvador, 2017). While it represents an important effort in terms of mobility, investing in public transportation, the project has also had negative impacts for the environment, both from mitigative and adaptive points of view. According to activist respondent R16 during its execution phase, the project caused an expressive deforestation, provoking reactions from environmentalists. Moreover, according to academic respondent R19, this project suppressed urban rivers instead of implementing NBSs. This example suggests that capacity building is still a work in progress in Salvador and until recently, urban issues were also tackled in a partial, incomprehensive manner. This is also in accordance to respondents, especially those from the local government, who admit that the climate change debate and collaborative work are recent developments in Salvador.

Whereas at the present moment Salvador shows a relatively high collaborative capacity, the positive changes are particularly recent. Thus, it may not necessarily be mature and fully incorporated to the local governance, as observed in Curitiba, which benefited from long-term political continuity for multiple years in the second half of the 20th century. In that sense even though the current situation seems favourable, the next political cycle may be decisive for the continuity not only of Salvador’s collaborative capacity levels, but of the local climate agenda

itself. In sum, continued leadership in integrating climate change mitigation and adaptation and in valuing collaboration seems vital to produce positive examples of synergies over time.

6.4 National overview

The national level poses barriers that are common to all these cities, including a shortage of investments from the national level and the downsizing of the public sector. Also, political discontinuity emerges as a major threat to effectively integrate climate action in cities.

As mentioned by Estevam (2010), administrative and public policy discontinuity are persistent themes in Brazilian political life (p. 1). For the author this issue is even more explicit at the local level, where a shift in political authorities raises doubts about whether or not there will be continuity in the policies previously developed. Inconsistent political priorities may hinder the development of effective climate change policies (Simshauser & Tiernan, 2019). In the studied cases, Curitiba have benefited from a certain level of continuity in that sense during decades, enabling substantial achievements, including its floodable parks. Whereas for Salvador, while collaborative capacity may be rising, positive changes are recent and may be at risk, considering that the current administration is at the end of its political mandate. Whether or not this emergence of Salvador as a climate leader will prosper, consolidating the city's current ambitions, is highly dependent on the next political configurations. Thus, continued leadership appears to be vital in that sense, allowing climate action to gain dimension and scale.

Another barrier for climate action in Brazil relates to the fact that mainstreaming, or the integration of the climate change agenda into existing policy areas, as advocated by Di Giulio et al. (2018) is usually not the norm. For activist respondent R10, this integration is still not occurring in Brazil and issues such as water shortage and flooding, for example, are usually taken as water management issues only, unconnected to climate change narratives. The crossboundary character of climate change is often neglected, as climate change is seen as part of the environmental agenda, as explained by activist respondent R10. For her, climate is "not treated as a matter of public security, an issue of infrastructure or survival", which hinders its prioritization among other agendas. Moreover, in the face of a shortage of investments for the environmental agenda at the national level, climate change deviates further from the political horizon in Brazil.

Besides, the current national panorama may impose considerable barriers for climate action development. Once a prominent environmental leader at the international level, Brazil is

radically shifting away from its agenda built in the last few decades (Scantimburgo, 2018). For Pereira et al. (2019) environmental issues are highly neglected under Bolsonaro's presidency, who pledged a series of actions adverse to conservation during his campaigns, including facilitated "access to the environmental license" (p. 10). Also during the campaigns, he mentions his intention to withdraw Brazil from the Paris Agreement (Scantimburgo, 2018). The lack of environmental funds at the national level and the dismantlement of the public sector in recent years were repeatedly mentioned by respondents as barriers to the advance of the climate agenda nationally. As put by activist respondent R17, this dismantlement annihilate the public capacity to provide answers to collective problems. For Cardoso (2019), this downsizing of governmental structures goes beyond the discourse on reducing public spendings, representing a desire to systematically reorient public policies and expenditures based on a liberal-conservative worldview in ideological terms and reductionist in terms of the weight and role of the State, the economy and society in contemporary times (p.166). These intentions have a particularly high impact on climate change action at the national level. In 2019, the national government decreed a readjustment, taking more than 46 million dollars from the Ministry of the Environment and the National Policy on Climate Change was one of the most affected areas, losing 95% of its budget (Pereira et al., 2019). Thus, in terms of national support for climate action, Brazilian cities are experiencing a critical shortage, which raises the significance of the support of other sources, such as city networks.

6.5 The role of city networks

In the face of these investment shortages and complete disregard to climate change action at the national level, city networks have a vital role for the endurance of the climate agenda in local contexts. These networks, such as the C40, have given cities like Curitiba, Sao Paulo and Salvador, encourage cities to take the lead, becoming the protagonists in climate action within the Brazilian context. As mentioned by academic respondent R19, while in climate governance at the global level, usually only national leaders have a say, city networks can empower cities in terms of pressuring the national government as well. For him, this bottom-up movement is specially important in Brazil's current context, considering its climate skeptical national government. Also for activist respondent R10, these networks may work as a safety net to prevent retrogression, enabling local actors to communicate and coordinate actions.

The analysis of the 3 cases indicate that the C40 has a positive impact on their collaborative capacity. In that sense, the C40 membership has incitated intersectoral communication in all

studied cities, creating a focal point for discussion and collaboration. At the same time, it provides guidance and knowledge sharing instruments for the development of the cities' climate action plans (C40, 2020). In terms of collaborative capacity, all the 3 elements analyzed, namely leadership, institutional arrangements and knowledge were enhanced by the C40 membership.

Considering the indicators for leadership present in the conceptual framework (section 3.2), responses indicate that the C40 membership group is supporting the studied cities in developing their climate action plans in an intersectoral manner, thus encouraging better communication standards and coordination to occur. At the same time, with these plans, cities intend to establish clear goals and formulate their vision for climate action. Also, outreach mechanisms may also be encouraged by the C40, as argued by Curitiba's government respondent R1: "engagement is another factor that the C40 demands a lot from us, the engagement plan, both in the elaboration and later for implementation". In the C40 planning framework this is clearly stated: "long-term commitment to the plan will be demonstrated through a transparent process of monitoring, progress reporting and assessment of impacts." (p. 8). Thus, it may induce cities to develop sound outreach mechanisms.

In terms of knowledge, the C40 represents an important source of information for the member cities, providing knowledge and training to the municipal staff. Besides that, this network of cities enables information to flow on a global scale, as mentioned by Lee (2019), member cities learn from each other and "socialization opportunities can occur through field trips to best practice sites during conferences and meetings" (p. 108). Thus, it creates new opportunities for knowledge flows.

As to institutional arrangements, the membership in the C40 may also induce the development of a new governance model in member cities. The C40 framework establishes that the climate plans must include a stakeholder engagement plan, "detailing the stakeholders, their roles in the plan and the engagement activities undertaken" (C40, 2020, p. 12), thus inducing a clearer definition of roles and responsibilities in the local climate change action. At the same time, it may encourage the streamlining of actions in terms of mitigation and adaptation by endorsing their integration in a unified plan. According to the C40 framework, cities should consider "adaptation & mitigation in an integrated way, identifying interdependencies to maximise efficiencies and minimise investment risk" (p. 7). Thus, it becomes clear that besides having a positive effect on the collaborative capacities of the studied cities, the C40 membership group also addresses directly the issue of synergies

between mitigation and adaptation, stating that “the plan will identify synergies between mitigation and adaptation interventions so that interactions between actions can be actively leveraged” (p. 7). In sum, the C40’s approach is then beneficial to these cities in terms of improving collaborative capacity and creating an enabling environment for synergies.

Even though these transnational city networks may account for higher levels of collaborative capacity and encourage synergies between mitigation and adaptation in local contexts, a striking limitation clearly emerged from the research. While the membership to the C40 created a strong connection between cities in a global sense, the local contexts and surroundings of the studied city are being neglected in the formulation of their climate action plans. As mentioned by activist respondent R17, major cities like Salvador export problems and induce transformations in its surroundings due to its own demands. Being mostly a city of resources consumption, Salvador could establish targets for food entry into the city, incentivizing good agroecological practices, as he exemplifies. As pointed by academic respondent R19, the city does not exist in a vacuum, water management issues will not be solved without involving Salvador’s surroundings, as around 80% of the water utilized in Salvador comes from other municipalities. For Sao Paulo, this disregard to the surrounding areas in policy making was also mentioned. For activist respondent R9, in practice, the absence of a master Plan for Sao Paulo’s metropolitan region means that the city expands itself in a disorderly manner, increasing, for example, the need for transport infrastructure, which in turn has clear negative consequences to mitigation. The same is valid for Curitiba, “has always been planned as if it were an “island”, which contributed to endemic problems in the other municipalities of the metropolitan region” (Macedo, 2004, p. 548), which paid the price for the elements that made Curitiba so popular (Arashiro, 2016, p. 48).

Thus, while transnational city networks, like the C40, may induce beneficial changes in these cities, advancing the agendas of mitigation and adaptation and finding synergies between them, their scope is often too narrow. Salvador may not call itself resilient if it does not address water supply issues on a larger scale. Sao Paulo might not effectively tackle mitigation if the city continues to expand disorderly with an increasing dependence on the individual car. Curitiba may not advance if it keeps neglecting the negative impacts it creates in its metropolitan region. Of course, this is not to detract the significance of these city networks for climate change action, especially in the context of Brazil, where they play a vital role for advancing this agenda. Still, the inclusion of metropolitan regions would account for a more holistic view on adaptation and mitigation at the local scope, acknowledging that cities do not exist in a vacuum.

7. CONCLUSION AND RECOMMENDATIONS

7. Conclusion and recommendations

7.1 Answering the research questions

By analyzing Curitiba, Sao Paulo and Salvador in terms of their collaborative capacity for climate action and the implemented synergies between mitigation and adaptation, some conclusions are made, answering the research question and subquestions.

Answering the first subquestion, *to what extent are synergies and tradeoffs between adaptation and mitigation being implemented in Brazilian cities?*, this research demonstrates that even for some of the frontrunners in the climate change debate in Brazil, synergies between mitigation and adaptation are still underexplored. To date, efforts for mitigation and adaptation in the studied cities are modest at best, let alone the integration of these two agendas. At the same time, examples from the studied cases demonstrate that climate-related issues are usually not even framed as such and are often tackled in a sectoral and disassociated manner, resulting in tradeoffs between mitigative and adaptive efforts. However, it is also clear that, for these cities, synergistic approaches to mitigation and adaptation are important elements of their climate action plans, to be concluded by the end of 2020. Thus, these new plans may open possibilities for synergies between mitigation and adaptation to be further explored in the future. Still, considering Curitiba, Sao Paulo and Salvador as some of the most ambitious Brazilian cities in terms of climate change action, it can be inferred that for Brazilian cities as a whole, synergies and tradeoffs between mitigation and adaptation are still far from being exploited or even identified.

Considering the second subquestion, *what are the main drivers and barriers for synergies in Brazilian cities?*, a few drivers and barriers were identified. In terms of barriers, segregated thinking, political discontinuity and the current national context emerged as major barriers for synergistic approaches to mitigation and adaptation.

Results indicate that a segregated thinking towards climate-related issues in Brazilian cities is the norm, hindering collaborative approaches and coordinated action. As a result, synergies between mitigation and adaptation are underexplored. At the same time, this approach creates conditions for tradeoffs between them. Another major barrier for Brazilian cities is political discontinuity which may suppress positive changes by shifting political priorities, sometimes in an opposite direction. This is particularly concerning in cities where the climate debate and collaborative capacity are still not consolidated. Finally, the current

national panorama imposes obstacles to the advance of the climate agenda in these cities, as the national government cuts investments and dismantles the capacity of public institutions.

As to the drivers, the results support the hypothesis that higher collaborative capacity may positively influence the occurrence of synergies. Positive examples in all 3 cities have a clear linkage with the dimensions of collaborative capacity, namely leadership, knowledge and institutional arrangements. Leadership had a central role in the synergies identified, including the shared leadership that contributed to the establishment of Curitiba's community gardens. Salvador's project for the Mane Dende basin demonstrates how higher levels of collaborative capacity also in terms of knowledge and institutional arrangements can contribute to a more holistic approach. Also, for the studied cities, their membership to the C40 leadership group has played a crucial role, by boosting their collaborative capacity and, at the same time, advancing the climate agenda in the absence of national support.

Answering the main research question, *how can synergies between adaptation and mitigation be enhanced in Brazilian cities?*, besides a robust collaborative capacity for public institutions, including sound outreach mechanisms to involve external actors, mainstreaming climate change action and networks of cities may also play a role. In terms of collaborative capacity, the alignment of the agendas of mitigation and adaptation will benefit from high levels of leadership in that sense, favourable institutional arrangements and knowledge linkages, as supported by the results. In the face of possible political discontinuity, city networks may also enable positive changes in unfavourable conditions imposed by higher government levels. Ideally, these networks should take a more comprehensive approach and extend their scope, by including metropolitan areas and indeed accounting for the negative effects cities like Curitiba, Sao Paulo and Salvador may create in their surroundings. Finally, mainstreaming climate change into the everyday business of these cities may favour implementation of mitigation and adaptive actions, integrating them in multiple agendas, unveiling considerable potential for synergies.

In conclusion, this research supports the hypothesis that a higher collaborative capacity for local governments may contribute to synergies between mitigation and adaptation. By concentrating in some of the frontrunners in the climate debate, the research brings some light on the nation's overall stance in this topic.

7.2 Reflection

The proposed theoretical framework has a sound potential for further research and the qualitative nature of the research has enabled the gathering of detailed information, from which other relevant matters have emerged.

The choice for semi-structured interviews with different groups of respondents in different cities has limited the number of cases that could be explored. In fact, the responses from academics and climate activists were found to be noticeably similar. Considering this research design, it would be sufficient to divide respondents between those inside and outside of the institutions, as these indeed showed complementary, rather than alike points of view. This reduction in respondents per case would allow a wider range of cases to be analyzed.

Also, the choice of cities within the C40 leadership group had important implications. On the one hand, it was possible to confirm the positive impact of such networks on their collaborative capacity and, by focusing on some of the leading cities in climate debate within the country, it gave insight on how high the standards for climate action among Brazilian cities are. On the other hand, including cities which are not part of such networks would provide valuable insight on the difference between the cities which are ahead and those which, supposedly, are lagging behind. In other words, comparing these cities could evaluate this difference. Still, the fact that for the evaluated cities, some of the nations' frontrunners, examples of synergies are scarce, may suggest that the relationship being collaborative capacity and synergies may be not as straightforward as supposed. In that sense, other factors may play a role, such as a continued collaborative capacity, as the implementation of synergies may need a longer period to occur.

In terms of theoretical value, this research contributes to the theory of collaborative capacity by providing empirical evidence that support the relation between collaborative capacity and synergies between mitigation and adaptation, contributing to a better understanding of these synergies and its drivers. Also, findings indicate political continuity as an important precondition for sustained collaborative capacity, an element not accounted for in the UNDP's (2010; 2013) conceptualization, who seem to assume collaborative capacity as more stable than this research suggests. In that sense, not only leadership, but *sustained* leadership would be important. Adding an indicator of continuity to the UNDP's (2010; 2013) work would strengthen their framework for collaborative capacity.

7.3 Recommendations for praxis

First, in terms of local policies in Brazilian cities, some particular suggestions are relevant considering the results of this research. Besides the city's climate action plans, which already look at mitigation and adaptation in an integrative manner, for sectoral policies this may also be of value. The suggestion is that policies for environment, planning, water and mobility take a holistic approach, incentivizing synergies between mitigative and adaptive action, while avoiding tradeoffs. Also, these policies should provide specific instruments that could strengthen the municipal collaborative capacity by, for example, establishing groups of work for intersectoral collaboration and assigning clear roles to distinct departments or actors.

In terms of research, the limitations discussed previously offer opportunities to further inquiry. Considering that all studied cities are currently developing their climate action plans, it may be insightful to reevaluate these cases at a later stage to show to what extent plans were implemented. Furthermore, conducting the same research at a later stage would allow a comparative analysis across time, and the assessment of the long-term impact of the C40 membership for these cities. This would be particularly interesting in the case of Salvador, which has shown noticeable progress in recent years. Whether this momentum is able to survive political changes is still uncertain.

Considering the selection of case studies, the Brazilian context has further possibilities for applying the suggested framework. Multiple respondents (R1, R3, R7, R10, R19) have mentioned Recife as the most preeminent city in climate governance within Brazil, attributing this to a strong leadership from its local decision makers. Government respondent R7 from Sao Paulo exemplifies the use of cordel literature² and climate education in public schools as particular outreach mechanisms employed by the municipality of Recife. In this case, further research could be applied to this specific case. It could be valuable not only to apply the framework of collaborative capacity compared to other cities, but also to explore it as an exceptional case.

Finally, another recommendation for future research would be an exploratory study focused on civil society. Considering the centrality of the local community for successful implementation of climate mitigation and adaptation plans, exploring local contexts from their perspective could provide valuable input in that sense. As mentioned by academic respondent R18, instead of simply involving the community, local governments should

² cordel literature is traditional folk poetry from northeastern Brazil (Almeida, Massarani & Moreira, 2016).

actively engage with the population, upscaling solutions that already happen in practice. By understanding the population's perceptions on climate change and the solutions already put in place by them, this would enable a process of co-creation of context specific answers to climate change. By researching, listing and analyzing those solutions and their potential, it helps to unravel how local governments can support such measures, while avoiding standardized solutions.

8. REFERENCES

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