

**HISTORICAL ANALYSIS OF CLIMATE JUSTICE IN RECIFE, PERNAMBUCO:
TRAJECTORY AND SOCIO-ENVIRONMENTAL VULNERABILITY**

***ANÁLISE HISTÓRICA DA JUSTIÇA CLIMÁTICA EM RECIFE, PERNAMBUCO:
TRAJETÓRIA E VULNERABILIDADE SOCIOAMBIENTAL***

***ANÁLISIS HISTÓRICO DE LA JUSTICIA CLIMÁTICA EN RECIFE, PERNAMBUCO:
TRAYECTORIA Y VULNERABILIDAD SOCIOAMBIENTAL***



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ABSTRACT: The objective of this article is to identify the history of the construction of climate vulnerability in the city of Recife, Pernambuco. Recife faces significant challenges due to its geographical location, disorderly urbanization, and socio-environmental vulnerability, factors that amplify the impacts of extreme events such as flooding and sea level rise. The city is a pioneer in Brazil in adopting climate policies, including the Local Climate Action Plan (PLAC-Recife), which seeks to mitigate and adapt to climate change. However, critics point to the lack of participation of the most vulnerable communities in decision-making. Recife is not the sixteenth most vulnerable city to climate change in the world. This study analyzes the history of municipal climate management and the need for more effective and inclusive public policies. Climate justice must take social inequalities into account and involve affected populations in the formulation of solutions, ensuring equitable and sustainable adaptation for the future of the city.

KEYWORDS: Climate justice. Climate adaptation. Public policies. Climate vulnerability. Recife.

RESUMO: Este artigo tem por objetivo identificar o histórico da construção da vulnerabilidade climática presente na cidade de Recife, Pernambuco. O Recife enfrenta desafios significativos devido à sua localização geográfica, urbanização desordenada e vulnerabilidade socioambiental, fatores que amplificam os impactos de eventos extremos, como enchentes e a elevação do nível do mar. A cidade é pioneira no Brasil ao adotar políticas climáticas, incluindo o Plano Local de Ação Climática (PLAC-Recife), que busca mitigar e adaptar-se à mudança do clima. No entanto, críticas apontam a falta de participação das comunidades mais vulneráveis nas decisões. Recife não é a 16ª cidade mais vulnerável às mudanças climáticas do mundo. Este estudo discute o histórico da gestão climática municipal e a necessidade de políticas públicas mais eficazes e inclusivas. A justiça climática deve considerar as desigualdades sociais e envolver as populações afetadas na formulação de soluções, garantindo uma adaptação equitativa e sustentável para o futuro da cidade.

PALAVRAS-CHAVE: Justiça climática. Adaptação climática. Políticas públicas. Vulnerabilidade climática. Recife.

RESUMEN: El objetivo de este artículo es identificar la historia de la construcción de la vulnerabilidad climática presente en la ciudad de Recife, Pernambuco. Recife se enfrenta a retos significativos debido a su ubicación geográfica, urbanización desordenada y vulnerabilidad socioambiental, factores que amplifican los impactos de eventos extremos, como inundaciones y el aumento del nivel del mar. La ciudad es pionera en Brasil en la adopción de políticas climáticas, incluido el Plan Local de Acción Climática (PLAC-Recife), que busca mitigar y adaptarse al cambio climático. Sin embargo, las críticas señalan la falta de participación de las comunidades más vulnerables en las decisiones. Recife no es la decimosexta ciudad más vulnerable al cambio climático del mundo. Este estudio analiza la historia de la gestión climática municipal y la necesidad de políticas públicas más eficaces e inclusivas. La justicia climática debe tener en cuenta las desigualdades sociales e involucrar a las poblaciones afectadas en la formulación de soluciones, garantizando una adaptación equitativa y sostenible para el futuro de la ciudad.

PALABRAS CLAVE: Justicia climática. Adaptación climática. Políticas públicas. Vulnerabilidad climática. Recife.

Introduction

Climate change does not affect all populations equally; its consequences are unevenly distributed across world regions, countries, and social groups within countries (Kashwan, 2021). Climate injustice, in turn, may be understood through the lens of the unequal distribution of the impacts of extreme climate events, as well as disparities in capacities for prevention and response. It can be conceived as a process of social injustice—whether preexisting or not—that is exacerbated and made more explicit by the progression of the global climate crisis (Carvalho, 2025).

The climate justice movement originated in the Global North as a critique of the carbon economy, understood as a symptom of broader inequalities produced and exploited by global capital (Schlosberg; Collins, 2014). According to these authors, this struggle derives from the global environmental justice movement. In the Global South—and more specifically within the context of this research—this transition is not as clearly delineated and remains under construction, drawing theoretical contributions from political ecology and ecological economics (Torres *et al.*, 2020). The concept is grounded in principles of social justice, responsibility, democratic participation, and ecological sustainability. In Brazil, climate justice is still an emerging field of debate, though it has gained increasing prominence in recent years (OXFAM Brasil, 2025).

Historically, countries in Latin America, as well as other territories in the Global South, have experienced high levels of urban social vulnerability. According to Torres *et al.* (2020), in these regions, calls for action to address the impacts of climate change are closely tied to rising socio-environmental vulnerability. In this sense, adaptation, poverty, rights, and justice must be integrated into planning, public policy, and social mobilization to ensure that adaptation does not become merely a rhetorical framework or a mechanism that perpetuates territorial inequalities.

In Brazil, the climate crisis has often been excluded from decision-making processes, despite significant social concern regarding the issue (Torres; Leonel; Araújo, 2020). This context is reflected in the scarcity of specific climate adaptation plans in cities and in the continued growth of socially and environmentally vulnerable communities. Local adaptation policies are essential to reducing socio-environmental vulnerability across the country, as climate change impacts vary by locality (Barbi; Rei, 2021). However, as analyzed by Coutinho *et al.* (2021), Brazilian municipal adaptation plans and strategies must advance toward the definition of clear parameters to guide decision-making across different adaptive scales.

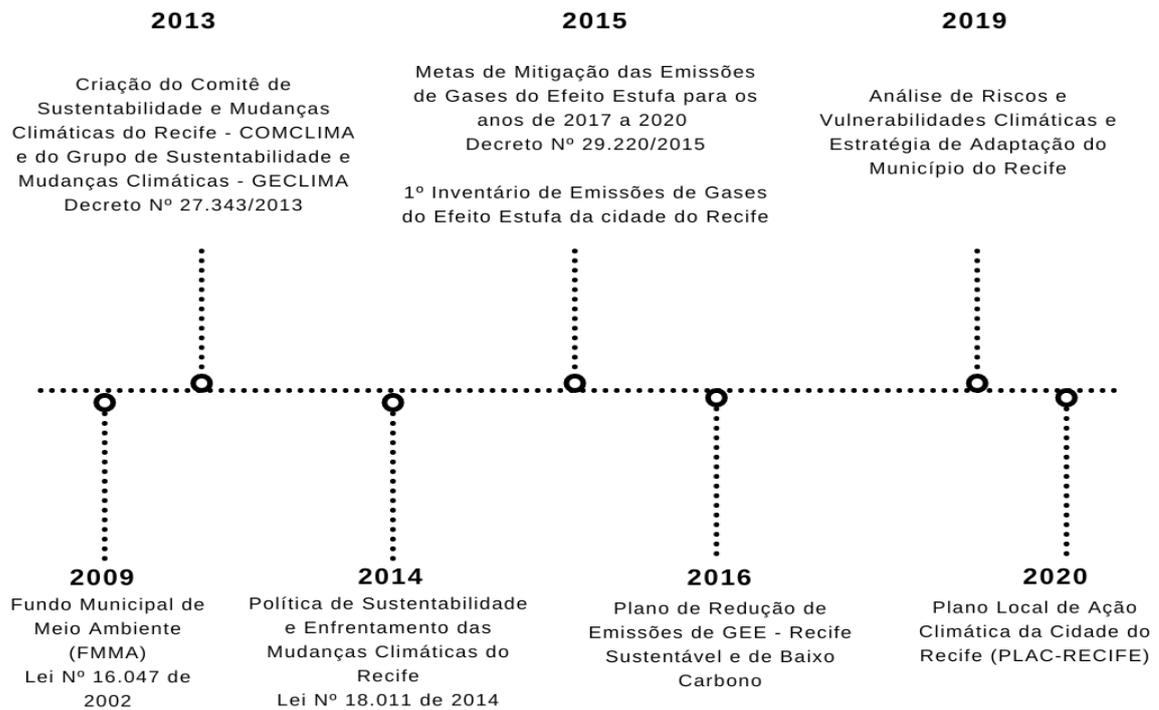
In the northeastern region of Brazil, Teixeira *et al.* (2021), in their analysis of climate-related policies in regional capitals, found that only the cities of Salvador and Teresina had incorporated climate concerns into their municipal master plans. Cities such as Fortaleza and Recife have integrated climate change into their governmental agendas, with Recife assuming a leading role in the climate emergency debate in the Northeast and implementing a policy framework considered successful in terms of climate prevention and adaptation (Oliveira *et al.*, 2021).

The city of Recife, capital of the state of Pernambuco, Brazil, was selected as the case study for this research. Its climate vulnerability is associated with its geographic conditions and a historically exclusionary and inadequate urban planning process that marginalized low-income populations. Differences in income and wealth, race, gender, ethnicity, age, and sexual identities within countries also significantly contribute to the persistence of climate injustices (Kashwan, 2021).

In a comparative study of other cities along Brazil's northeastern coast, Morais (2020) identified Recife as the city most sensitive to climate events and disaster occurrence. According to the Brazilian Network on Global Climate Change Research (Rede Clima) (2022), sea level along the city's coastline has been rising at a rate of 0.54 cm per year since 1940. This trend is considered one of the primary threats associated with the climate crisis in Recife. The Climate Risk and Vulnerability Analysis warns that constructions in coastal and estuarine areas are at high risk (Recife, 2020). The sandy stretches of urban beaches have already been significantly reduced in recent decades. Studies such as Sabiá *et al.* (2011) and Oliveira *et al.* (2014) highlight urban expansion through land reclamation in flooded areas, rivers, and streams, as well as the removal of riparian vegetation—such as mangroves—as key factors accelerating this process.

Due to its high degree of vulnerability, Recife has developed a history of public policies directly addressing the climate crisis within its territory (Figure 1). The most recent initiative, the Recife Climate Action Plan (PLAC-Recife), launched in 2020, adopts climate justice as one of its foundational principles. However, critiques of the document include the absence of a clear definition of vulnerable groups and the lack of explicit reference to the inclusion of social actors from climate-vulnerable communities.

Figure 1 – Timeline of Public Policies on Climate in Recife



Source: Prepared by the author. Adapted from Recife (2024).

Against this backdrop, this article aims to identify the historical construction of climate vulnerability in the city of Recife, Pernambuco, by examining socioeconomic and environmental factors, as well as the evolution of local public policies related to the climate agenda. Through this approach, the study seeks to understand how urbanization, unregulated population growth, and climate change have shaped the city's exposure to climate vulnerability. This vulnerability has resulted in a longstanding pattern of problems, including flooding and sea-level rise. The research therefore intends to provide inputs for the formulation of more effective public policies aimed at mitigating these impacts and strengthening climate adaptation.

Recife and Climate

The city of Recife, capital of the state of Pernambuco, is composed of 67.43% hills; 23.26% plains; 9.31% water bodies; and 5.58% Special Environmental Preservation Zones (ZEPA) (Recife, 2024). The average elevation is four meters above sea level, and the climate is classified as Humid Equatorial, characterized by high temperatures throughout most of the

year, high humidity, the absence of a clearly defined dry season, and average temperatures ranging between 25 and 30°C (Conti, 2019). Located in a central position within northeastern Brazil, the city has a 100% occupation rate, a population density of 6,803.60 inhabitants per square kilometer, and a total population of 1,488,920 inhabitants (Brazilian Institute of Geography and Statistics [IBGE], 2013), distributed across an area of 217.01 km².

Recife is situated on an alluvial plain, or floodplain, a geomorphological unit formed by sedimentary deposits created by water action near watercourses and subject to flooding during high-water periods (Borges; Ferreira, 2019). The city's hydrography comprises the basins of the Capibaribe, Beberibe, and Tejipió rivers (Figure 2) and includes more than 100 water bodies, such as channels, streams, lakes, lagoons, and tidal arms (Recife, 2024).

Figure 2 – Hydrography of Recife, Pernambuco, Brazil



Source: Data from Recife (2024).

Note: Scale: 1000 m.

These geographic and geological conditions further exacerbate flooding problems and climate instability in the region (Arruda Filho; Jacobi; Torres, 2023). In addition to flood-prone geography, low-income housing areas are frequently established in zones of extremely high risk—such as hilltops and low-lying areas near rivers and streams—due to the absence of viable housing alternatives (Arruda Filho, 2024). Beyond its topography, Recife also faces deficiencies in urban planning, particularly with regard to housing for low-income populations. According to the 2022 Census of the Brazilian Institute of Geography and Statistics (Brazil, 2024), 1,016,388 people in the Greater Recife metropolitan area live in favelas and urban communities, representing 26.9% of the metropolitan population. Hillsides, flood-prone zones, areas near water bodies, and locations with unsuitable soils—such as mangrove areas—are commonly used for housing construction by those lacking alternative options. Recife ranks fifth

among Brazilian cities with the largest populations living in risk areas, with more than 200,000 residents inhabiting hillsides and slopes (Brazil, 2018).

The Recife Climate Action Plan (PLAC-Recife, 2020) identifies the city's primary critical risks as flooding, heat waves, meteorological drought, landslides, communicable diseases, and sea-level rise. Historically, Recife has experienced—and continues to experience—such climate-related events, with direct consequences for its population (Arruda Filho; Jacobi; Torres, 2023). The Brazilian Panel on Climate Change (2016) highlights two severe impacts resulting from the increase in intense rainfall: flooding and slope failures (landslides), both associated with inadequate infrastructure and, above all, with the population's social and economic conditions.

Recife exhibits socio-environmental vulnerabilities similar to those of other Brazilian metropolises, a scenario rooted in an exclusionary development model and insufficient investment in urban infrastructure. Highly susceptible to the effects of climate change, this adverse context may worsen, as the city faces sea-level rise, increased precipitation, and rising temperatures, with the potential for more frequent flooding, heat waves, landslides, and coastal erosion (Melo *et al.*, 2021).

Historically, Recife has suffered from floods and hillside landslides, particularly between April and July, the period of highest rainfall (Wanderley *et al.*, 2018). In June 1965, rainfall totaling 176.4 mm resulted in two deaths and more than 300,000 displaced persons. In August 1970, 335.8 mm of rainfall were recorded, according to INMET, causing 84 deaths and leaving more than 40,000 people homeless. This event is considered one of the most severe rainfall-related tragedies in the city's history. The most affected areas were located along the banks of the Beberibe River in the northern zone, a densely populated region inhabited predominantly by low-income communities that face significant challenges due to the absence of urban planning incorporating effective drainage systems, adequate housing, and green areas for flood mitigation (Anjos *et al.*, 2024). In May 1986, 235 mm of rainfall disrupted transportation and infrastructure. In August 2000, 22 people died and more than 60,000 were displaced following 185.9 mm of rainfall (Anjos *et al.*, 2024). Between 1991 and 2012, 13 flood or flash flood events were officially recorded in Recife (Nóbrega *et al.*, 2023). In May 2016, four consecutive days of rainfall totaling 102.1 mm caused fallen trees, flooding, and landslides (Santos *et al.*, 2019).

In May 2022, Pernambuco experienced what was considered the most severe climate-related tragedy of the past 50 years. Between May 25 and 30, Recife recorded 551 mm of rainfall—140 mm above the expected monthly average (Marengo *et al.*, 2023). The

concentration of rainfall resulted in more than 120 deaths in the metropolitan region. According to the Pernambuco Water and Climate Agency (APAC), total precipitation for the month reached 686.4 mm, representing 209% above the historical average (Pernambuco, 2022). A study by World Weather Attribution (2022), using climate models and regional weather simulations, indicated a 20% increase in rainfall patterns in the Northeast region—particularly in Pernambuco—attributed to global temperature rise. The most affected were women, especially Black women living in precarious hillside communities (International Council for Local Environmental Initiatives [ICLEI], 2023). In the Jardim Monte Verde neighborhood alone, 25 people died in a single landslide, including 11 members of the same family (Figure 3).

Figure 3 – Landslide in the Jardim Monte Verde neighborhood, Recife, May 2022



Source: Alves (2021).

Beyond the imbalance in precipitation patterns, Recife has begun to experience the impacts of sea-level rise along its coastline. Costa *et al.* (2010) identify Recife as one of the Brazilian cities most vulnerable to sea-level rise due to its physical characteristics and persistent problems related to flooding and coastal erosion.

According to the Brazilian Network on Global Climate Change Research (2022), sea level has risen at an average rate of 0.54 cm per year since the 1940s. Between 1946 and 1988, the rate increased to 5.6 mm per year (Harari *et al.*, 2004), corresponding to a rise of 0.24 meters over 42 years. Coastal erosion and post-beach occupation have reduced the shoreline by more

than 20 meters at Boa Viagem Beach—the most economically valued coastal area of the city (Brazilian Panel on Climate Change [PBMC], 2016). The Climate Risk and Vulnerability Analysis, a public policy instrument developed to assess potential future climate-related impacts in Recife, warns that constructions in coastal and estuarine zones present high risk in the coming years (Recife, 2020; Arruda Filho; Jacobi; Torres, 2023).

Sea-level rise in Recife poses significant risks to socio-climatically vulnerable communities, as many are directly exposed to the ocean and to the mouth of the Capibaribe River basin that runs through the city. These populations predominantly rely on informal housing structures such as stilt houses and derive their livelihoods directly from the sea and estuarine areas, commonly referred to as tidal zones. Flooding and river water salinization have already become recurrent problems affecting the poorest populations in these areas (Arruda Filho; Torres; Jacobi, 2024).

Urban occupation of the coastline further aggravates the problem, progressively reducing the beach's sandy strip (Figures 4 and 5). From the late 1970s to the early 1980s, significant anthropogenic modifications occurred at Boa Viagem Beach. The construction of a seafront avenue—including roadways, sidewalks, retaining walls, kiosks, restrooms, and leisure infrastructure—contributed to soil impermeabilization and dune stabilization, potentially shifting the fragile sedimentary balance toward increased beach erosion (Sabiá *et al.*, 2011). Oliveira *et al.* (2014) warn of future land-use limitations at Boa Viagem Beach, noting that socioeconomic pressures in Pernambuco have led to large-scale construction projects that intensify erosion and create sediment deficits, increasing the risk of shoreline reduction.

Figure 4 – Aerial photograph of Recife’s coastline in 1930



Source: Fundação Joaquim Nabuco (2022).

Figure 5 – Aerial photograph of Boa Viagem’s coastline in 2021



Source: G1 Pernambuco (2022).

According to Santos *et al.* (2024), between 2000 and 2018 the Recife Metropolitan Region recorded 2,419 natural deaths related to heat waves. The region ranked among those with the highest normalized heat-related mortality rates—alongside Rio de Janeiro, Porto Alegre, Belém, and Cuiabá—among 14 metropolitan regions analyzed. An intersectional analysis crossing gender, race, and socioeconomic data identified Black women over 65 years of age with low educational attainment as the most affected population group. According to Climate Central (2024), Recife experienced a temperature increase of 0.9°C between December

2023 and February 2024, ranking fourth among Brazilian municipalities with the highest recorded warming during that period.

The Historical Trajectory of the Climate Agenda and Public Policies in Recife

Climate-related issues were first incorporated into the master plans of the city of Recife in 1991, during the administration of then-mayor Gilberto Marques Paulo, of the Liberal Front Party (PFL). At that time, environmental preservation was framed in largely utilitarian terms, primarily as a means of mitigating the city’s high temperatures (Table 1).

Subsequently, in 2008, at the beginning of the second term of then-mayor João Paulo, who at the time was affiliated with the Workers’ Party (PT), climate concerns were again mentioned under the same rationale within the chapter on the Urban Environment, even though the principle of Sustainability was introduced for the first time as a Fundamental Principle of Urban Policy (Recife, 2008). Notably, these constitute the only references to climate issues in both master plan documents.

Table 1 – Historical incorporation of the climate agenda into Recife’s Master Plans

Legislation	Summary	References to Climate Change
Lei N° 15.547/1991	Establishes general guidelines on urban policy, institutes the Master Plan for the Development of the City of Recife, creates the city’s planning and information system, and provides other measures.	Art. 65 The guidelines for environmental policy in the city of Recife shall be defined by the Municipal Environmental Council, to be established by law pursuant to Art. 130 of the Organic Law: (...) III – native vegetation, especially remnants of the Atlantic Forest, and urban tree cover—both native and non-native—located in public areas and private backyards, which constitute an essential element in the composition of Recife’s landscape and in the moderation of its climate.
Lei N° 17.511 /2008	Promotes the revision of the Master Plan for the municipality of Recife.	Art. 124 Protected Units are areas containing forest, mangrove, watercourses, or bodies of water, as well as those of environmental or landscape interest necessary to preserve conditions that contribute to climate moderation, and are designated for recreational, sports, social, or leisure activities.

<p>Lei 18.770/2020</p>	<p>Nº Establishes the Master Plan for the municipality of Recife, revoking Municipal Law No. 17,511, of December 29, 2008.</p>	<p>Art. 4 The objectives related to fulfilling the principle of the social function of the city include: (...) V – reducing social, economic, and environmental impacts in risk areas and increasing the metropolis’s resilience to severe climate events resulting from climate change. Art. 20 The spatial structuring of Recife aims to: (...) XVI – expand public green spaces in response to the growing demand for areas dedicated to leisure, sports, health, relaxation, and well-being, as well as to promote resilience to climate impacts. Art. 31 The guidelines defined for the Natural and Cultural Environment Macro zoning Area (MANC) include: (...) III – developing the territory in a sustainable manner and strengthening the Municipality’s resilience capacity to address climate change. Art. 46 The guidelines defined for the Sustainable Development Zone (ZDS) include: (...) VIII – conserving permeable areas through the adoption of green infrastructure solutions for climate adaptation. Art. 47 The Sustainable Development Zones (ZDS) are delineated according to the main and secondary water bodies forming their respective subdivided watersheds: (...) III – Sustainable Development Zone Teji pió (ZDS Teji pió) – characterized by the concentration of medium and low population and building densities, whose land-use regulation shall consider: (a) the guidelines of the Recife Stormwater Drainage and Management Plan; (b) the need to apply climate adaptation and disaster risk management concepts; and (c) the presence of fishing communities within its territory. Art. 158 The sectoral guidelines of urban policy integrate and guide the Municipality’s urban, social, economic, and environmental development policies, directly or indirectly influencing territorial planning. They shall be implemented in an integrated manner by the Executive Branch to achieve the strategic objectives established in this Law and are organized as follows: (...) II – environmental policy, sustainability, climate change mitigation and adaptation, and civil protection and defense. CHAPTER III – ENVIRONMENTAL POLICY, SUSTAINABILITY, CLIMATE CHANGE RESPONSE, AND CIVIL DEFENSE Art. 167 The urban environmental sanitation policy shall observe the following guidelines: (...) LI – restore green vegetative infrastructure to enhance the city’s resilience to the impacts of climate change; (...) LXVI – mitigate the harmful effects of gas emissions through the capture and neutralization of methane resulting from biogas emissions at sanitary landfills, using appropriate technological alternatives, in accordance with the municipal climate change mitigation policy.</p>
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Source: Author’s elaboration, adapted from Recife (2024).

In 2020, at the beginning of the second term of then-mayor Geraldo Júlio of the Brazilian Socialist Party (PSB), the climate change agenda gained prominence, with particular emphasis on adaptation and resilience as cross-cutting principles. Territorial planning was positioned as a key instrument for addressing the extreme climate events affecting the city. Climate change is mentioned 33 times in the document, most notably in Chapter III – Environmental Policy, Sustainability, Climate Change Response, and Civil Defense, within the Sectoral Guidelines of Urban Policy. This chapter addresses the incorporation of socio-environmental sustainability into urban development through the continuous integration of public policies and the adoption of productive practices aligned with the protection and restoration of environmental resources and assets in the construction of the city (Recife, 2020). It establishes objectives and guidelines for both mitigation and adaptation climate policies.

This framework was maintained under the administration of the current mayor, João Campos—also a member of the PSB. Updates concerning the redefinition of Special Zones of Social Interest (ZEIS) and the city’s urban zoning were introduced through Complementary Law No. 02 of April 23, 2021.

Recife’s Master Plan stands as an exception regarding its articulation with the city’s climate policies (Arruda Filho; Jacobi, 2024), as it explicitly establishes sustainable territorial development and the strengthening of municipal resilience to climate change as guiding principles. This approach is operationalized through the creation of the Natural and Cultural Environment Macro zoning Area (MANC) and Sustainable Development Zones (ZDS), aimed at conserving permeable areas through the adoption of green infrastructure solutions for climate adaptation. According to Melo *et al.* (2021), Recife’s Master Plan demonstrates alignment with the climate agenda from both mitigation and adaptation perspectives. However, the available studies, the political process of social participation, and the depth of public debate proved insufficient to adequately inform decision-making in accordance with the city’s needs. This limitation may reduce the practical effectiveness of the proposal and hinder the effective implementation of adaptation measures. The Master Plan is connected to PLAC-Recife, which includes a specific axis dedicated to climate resilience actions.

According to Oliveira *et al.* (2021), policies addressing climate issues in Recife reveal a trajectory of progressive development that has positioned the city as a leading actor in confronting the climate emergency. The incorporation of climate-related concerns into public policy began in 2009 with the establishment of the Municipal Environmental Fund, through the amendment of Law No. 16,047 of 2002—the first legal instrument to formally integrate climate issues into its text. Subsequently, in 2013, the Recife Sustainability and Climate Change

Committee (CONCLIMA) and the Recife Sustainability and Climate Change Group (GECLIMA) were created pursuant to Decree No. 27,343 of 2013, alongside the preparation of the city’s First Greenhouse Gas Emissions Inventory. In 2019, Recife became the first city in Brazil to declare a climate emergency (Table 2).

Table 2 – Evolution of public policies related to climate issues in the city of Recife

Legislation	Description
Municipal Law 7,427/1961	Municipal Code of Conduct and Works.
Municipal Law 16,176/1996	Municipal Law on land use and occupation, zoning, and parameters.
Municipal Law 16,243/1996	Establishes the Environmental Policy of the City of Recife.
Municipal Law 16,292/1997	Regulates building and facility activities in the municipality of Recife.
Municipal Law 17,511/2008	Approves the Master Plan for the City of Recife.
Municipal Law 17,534/2009	Creates the Municipal Environment Council.
Municipal Decree 24,540/2009	Regulates environmental licensing in the municipality and defines parameters for public hearings.
Municipal Law 17,666/2010	Arborization Law.
Municipal Decree 27,045/2013	Recognizes the Metropolitan Solid Waste Management Plan as the Management Plan for the city of Recife.
Decree 27,343/2013	Establishes the Recife Sustainability and Climate Change Committee (COMCLIMA) and the GECLIMA Group.
Municipal Law 17,978/2014	Amends the environmental code and establishes new objectives for revitalization and/or green area implementation projects.
Municipal Law 18,011/2014	Establishes the Recife Sustainability and Climate Change Policy.
Municipal Law 18,014/2014	Establishes the Municipal System of Protected Units - SMPU (Green Area Protection Property - IPAV).
Municipal Decree 28,685/2015	Regulates Law No. 18,111/2014.
Decree 29,220/2015	Establishes voluntary targets for reducing greenhouse gas emissions for the years 2017 and 2020.
Municipal Law 18,111/2015	Defines limits and compensation mechanisms for environmental sustainability sectors - SSA 2.
Municipal Law 18,112/2015	Provides for the improvement of the environmental quality of buildings through the mandatory use of green roofs.
Municipal Law 18,147/2015	Establishes the Municipal Education Plan.

Municipal Law 18,207/2015	Establishes the Incentive Plan for popular housing projects of social interest.
Municipal Law 18,208/2015	Provides for the Municipal Basic Sanitation Policy and establishes the Municipal Basic Sanitation System.
Municipal Decree 29,753/2016	Regulates environmental sustainability certification as provided for in Municipal Law 18.011/2014.
Municipal Decree 31,073/2017	Approves the Municipal Basic Sanitation Plan and Municipal Basic Sanitation Fund.
Municipal Decree 33,080/2019	Declares recognition of the global climate emergency and establishes a commitment to carbon neutrality by 2050.
Decree 32,932/2019	It establishes energy efficiency and rational water use measures in new municipal public buildings.
Law 18,770/2020	It establishes the Master Plan for the municipality of Recife, revoking Municipal Law No. 17,511 of December 29, 2008.
Decree 34,640/2021	It establishes the Ecorecife program and makes other provisions.

Source: Author's elaboration, adapted from Recife (2024).

In 2020, the Local Climate Action Plan (PLAC) for the city of Recife was launched. This executive and instrumental document, pragmatic and dynamic in nature, sets out the city's level of ambition in planning mitigation and adaptation actions within the context of climate change (Recife, 2024). PLAC-Recife has emerged as a pioneering initiative in adopting climate justice and its social implications as one of its guiding principles. Following its launch, other adaptation plans—such as those of Salvador and Fortaleza—addressed the issue with greater emphasis and prominence (ICLEI, 2021). Action plans in cities such as São Paulo and Rio de Janeiro refer to climate justice only superficially, with little or no substantive engagement or relevance to the development of future actions. Within the field of public policy, climate justice has gained particular traction in cities in northeastern Brazil, a region historically marked by socio-environmental vulnerability (Arruda Filho; Jacobi; Torres, 2023).

The Urban Requalification and Resilience Program in Areas of Socio-Environmental Vulnerability (ProMorar Recife), launched in 2023, aims to provide communities with access to essential civic infrastructure, including streets and sidewalks, social facilities, green areas, sanitation services, and urban drainage, among other improvements designed to ensure greater dignity, comfort, and quality of life for the population as a whole (Recife, 2024). The program was introduced in response to the 2022 heavy rainfall events and seeks to reduce the city's socio-environmental vulnerability. In 2024, the Contingency Plan was launched by Recife's Secretariat of Infrastructure and Civil Defense. This document outlines the principal resources, procedures, and response actions to ensure that, in emergency situations, each actor within the Municipal Protection and Civil Defense System clearly understands its role and responsibilities

in civil defense operations (Recife, 2024). The document establishes guidelines for organizing responses to extreme climate events and focuses on the agencies that comprise the Municipal Protection and Civil Defense System (SIMPEDC).

Recife's Climate Vulnerability

Contrary to what is widely cited in academic studies (Silva Júnior *et al.*, 2020; Melo *et al.*, 2021; Meneses, 2022; Marengo *et al.*, 2023), public policy documents (Recife, 2019; Recife, 2020), the media (Dantas, 2020; Alves; Markman, 2021; Nóbrega, 2021; Sobreira, 2024), and institutional websites (ICLEI, 2019; Recife, 2022; UNICEF, 2023), Recife is not the 16th most vulnerable city in the world to climate events. This claim does not appear in any official document of the Intergovernmental Panel on Climate Change (IPCC), the source to which the information is commonly attributed. Across all IPCC reports, Recife is mentioned only twice and is not included in any ranking, as the Panel does not produce rankings in its official publications.

In *Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses* (1996), Recife is cited in reference to the impacts of sea-level rise on urban coastal areas:

Some of the more detailed recent studies of response strategies to sea-level rise have been undertaken for urban coastal areas. In all cases, the problems associated with sea-level rise are considered serious. Many examples can be found in Frassetto (1991) and Nicholls and Leatherman (1995a), including Venice, Hamburg, London, Osaka, St. Petersburg, Shanghai, Hong Kong, Lagos, Alexandria, Recife, and Tianjin. However, Devine (1992) argued that the slum areas found in many coastal cities may be particularly vulnerable to climate change and that adaptation options are uncertain (IPCC, 1996, [n. p.], our translation).

In *Climate Change 2007: Impacts, Adaptation and Vulnerability* (2007), the city is referenced as among those most vulnerable to extreme events due to its low elevation along the coast:

Low-lying coasts in several countries in Latin America (e.g., parts of Argentina, Belize, Colombia, Costa Rica, Ecuador, Guyana, Mexico, Panama, El Salvador, Uruguay, and Venezuela) and major cities (e.g., Buenos Aires, Rio de Janeiro, and Recife) are among the most vulnerable to climate variability and extreme hydrometeorological events, such as heavy rainfall and storms, and subtropical and tropical cyclones (i.e., hurricanes) and their associated storm surges (IPCC, 2007, [n. p.], our translation).

This statement has been widely cited and repeated in discussions of climate change in Recife. It was first referenced in the 2016 report *Impact, Vulnerability and Adaptation of Brazilian Coastal Cities to Climate Change: Special Report of the Brazilian Panel on Climate Change*, which in turn cited the 2013 report *Impacts, Vulnerabilities and Adaptation to Climate Change: Contribution of Working Group 2 of the Brazilian Panel on Climate Change to the First National Assessment Report on Climate Change*. However, neither this document nor any other publication of the Brazilian Panel on Climate Change (PBMC) presents a ranking of the most climate-vulnerable Brazilian or global cities.

According to the report *Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes: Exposure Estimates*, developed by the Organisation for Economic Co-operation and Development (OECD) in 2007, Recife ranked 81st among coastal cities worldwide in terms of exposure to climate change and 86th in the ranking of exposed assets for the same year. Projections for 2070 indicated that the city would occupy the 83rd and 95th positions, respectively, in these categories (Nicholls *et al.*, 2008). Wang, Du, and Wu (2020), in ranking global cities based on economic performance and climate change mitigation using data envelopment analysis, identified Rio de Janeiro and Salvador as the most vulnerable Brazilian cities. Recife was not included in that list.

It is important to clarify, however, that although the claim that Recife is the 16th most climate-vulnerable city in the world has proven to be inaccurate, the city does, in fact, face a high level of vulnerability to extreme climate events. The Municipal Climate Vulnerability Index (IVCM), developed by Instituto Votorantim, assesses the most pressing climate risks likely to affect a large number of Brazilian municipalities in the coming years. Its indicators include flooding; flash floods, urban inundation, and runoff; landslides; water scarcity (drought); wildfires; the reduction or disruption of agricultural and livestock sectors; and the increase in climate-related health problems (Instituto Votorantim, 2024). The index assigns a score ranging from 0 to 100 to each Brazilian municipality. Recife received a score of 48.52, while the municipality of Placas, in the state of Pará, ranked first with a score of 73.78. According to the Institute for Applied Economic Research (IPEA) (2024), the Recife Metropolitan Region recorded the highest Social Vulnerability Index (IVS) in Brazil in 2021.

One of the main current strategies advanced by the municipal administration and civil society organizations to reduce the city's climate vulnerability is the creation of floodable parks—areas designed to absorb excess rainwater during extreme precipitation events. These spaces form part of the urban drainage system and aim to enhance the natural retention capacity

of trees, shrubs, and soil, allowing stormwater to flow toward locations where it will not cause destruction. This initiative is being implemented under the ProMorar project, which includes adaptation measures for extreme climate events, such as macro-drainage works and the construction of floodable parks designed to flood on rainy days and function as recreational areas during dry periods. The first pilot park was inaugurated in November 2024 in the IPSEP neighborhood, along the banks of the Tejipió River—a region severely affected by flooding in recent years (Arruda Filho; Jacobi, 2024). The project required the expropriation of 95 homes, and some residents considered the compensation amounts to be below market value. Experts from Research and Innovation for Cities (INCITI) identified shortcomings in the project's implementation, noting that the materials selected for construction were inadequate. Moreover, many residents of neighborhoods slated to receive new parks have expressed concern and dissatisfaction regarding the initiative (Correia, 2024).

Final Considerations

Climate justice fundamentally represents the intersection between social justice and the climate emergency. These are inseparable dimensions within a broader framework marked by extensive socio-environmental—and particularly socio-climatic—vulnerability. Such vulnerability is imposed either through pre-established structural patterns or through the legacies of climate colonialism. The incorporation of this concept into the scope of public adaptation policies remains limited, especially in terms of effectively addressing the climate injustices that affect vulnerable populations at the local level. The procedural dimension—namely, the sphere of public policymaking—demonstrates concretely that resource allocation and environmental governance surrounding climate issues are directly shaped by these dynamics.

Cities in the Global South, such as Recife, face additional constraints in advancing climate adaptation processes, characterized by reduced access to financing and disproportionate impacts on historically marginalized groups. This context underscores the relevance of integrating climate justice into the debate. In Recife, climate vulnerability is further exacerbated by an exclusionary economic development model, insufficient investment in urban infrastructure, and high population density.

The evolution of municipal climate governance in Recife clearly demonstrates that pioneering action on climate issues does not necessarily entail prioritizing adaptation—much less ensuring the meaningful participation of populations most affected by recurrent climate-

related disasters. Despite notable progress in reducing greenhouse gas emissions and achieving international climate action targets, Recife exhibits shortcomings in strengthening adaptation within its policy agenda and in mitigating risks in low-income areas highly exposed to climate hazards. These territories have a documented history of fatalities and material losses resulting from intense rainfall, reflecting the most severe consequences of inadequate adaptation in the city.

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