# Effectiveness of environmental legal instruments for climate change in the city of Recife (Pernambuco, Brazil)

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# Effectiveness of environmental legal instruments for climate change in the city of Recife (Pernambuco, Brazil)

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## Abstract

Over the years, with the purpose of promoting sustainable development and a better quality of life, several international agreements and national policies have been formulated in favor of the environment and the fight against climate change. The climate change policy in the city of Recife has been implemented since 2014, using the provisions of laws and regulations. The aim of this study is to identify the effectiveness of the legal environmental instruments used for climate change in Recife. This analysis of public policy is based on climate thematic frameworks, such as international agreements, the Federal Constitution of Brazil, and Environmental Legislation. To achieve this, a bibliographic and documentary review was conducted. This study shows that the city's laws create initiatives that contribute to the fight against climate change, such as the reduction of greenhouse gas emissions and increased reforestation. However, this alone is not sufficient to cause a significant change.

**Keywords**: Climate Change; Legislation; Legal Instruments; Recife.

## 1. INTRODUCTION

Currently, Brazil is one of the most miscegenated countries in the world, thanks to the diverse ethnic groups that have contributed to the formation of this nation, such as indigenous peoples, major colonizers, and immigrants. The first significant fusion occurred with the contact between indigenous peoples and European settlers. Another major miscegenation occurred due to the overwhelming interest in establishing a sugarcane company, where a large number of Africans were deprived of their lands to live as slaves. In these early days, the colonial economic model was basically linked to non-mechanized agriculture (Ribeiro and Paixão, 2012).

Over the years, the agricultural export model began to slowly lose ground in the face of capitalist modernization aspirations and technological advancement. The harsh and costly slave labor eventually made room for the entry of other immigrants (Ribeiro and Paixão, 2012).

From capitalism, it is assumed that there cannot be economic growth without the appropriation of natural resources. Modern man, who already considered himself alienated from nature, began to see environmental preservation as something completely out of context, which becomes evident through the new relationship between man and nature, where there is a duality of development versus environment. However, in recent decades, the emergence of environmentalism

and its growing acceptance by contemporary society challenge the current development model proposed since the 1st Industrial Revolution (Naves and Bernardes, 2014).

Considering the current context of growing global concern about the adverse effects of climate change and the pressing need for effective actions to mitigate its impacts, it is essential to systematically evaluate the performance of existing environmental policies and regulations at the local level. Thus, the problem arises: what is the effectiveness of the environmental legal instruments in force in the city of Recife to mitigate the impacts of climate change and promote local climate resilience?

The city of Recife was chosen as the object of study because it is a metropolis with dual dynamics, possessing contrasts between the new and the old, between rivers and avenues, and between urban areas and the coastline. Additionally, Recife was the first Brazilian city to declare a climate emergency in 2019 (Silva; Sousa; Farias, 2023). Based on the mentioned aspects, this study aims to identify the effectiveness of the environmental legal instruments used in addressing climate change in the city of Recife. The specific objectives are: to analyze international agreements related to the subject; examine the principles of Brazilian environmental legislation, as well as its federal constitution; evaluate sectoral public policies; analyze data related to the city (such as CO2 emissions and green areas).

## 2. METHODOLOGY

### 2.1 Methodological Steps

The study was conducted through bibliographical and documentary research, where articles, decrees, laws, ordinances, resolutions, and legislation were analyzed. According to Gil (2002), the main difference between documentary and bibliographical research is that documentary research uses sources that have not received analytical treatment, whereas bibliographical investigation employs contributions from various researchers on a subject. The methodology was divided into steps to achieve each specific objective and the general objective.

In selecting documents for research, various criteria were considered to ensure the quality and relevance of the sources used. Primarily, priority was given to recognized primary and secondary sources in the field of environmental research and related legislation. These sources included scientific articles published in reputable journals, official documents from international organizations such as the United Nations and the World Bank, as well as national and international legislation and regulations relevant to the subject under study.

To achieve the first specific objective (analyzing international agreements related to the subject), primary and secondary sources were used, including official documents from the involved

international organizations such as the United Nations and the World Bank, as well as academic studies published in scientific journals. The process of selecting and analyzing materials took into account the relevance of information for understanding the historical panorama and the strategies adopted to address environmental issues on a global scale. Additionally, the main milestones and legal instruments were identified, such as the IPCC, the UNFCCC, and Agenda 21, highlighting their contributions to the formulation of policies and the implementation of measures for mitigating and adapting to climate change. From this critical analysis, the relationships between the various agreements and established objectives were delineated, emphasizing the interconnection between sustainable development, poverty reduction, environmental protection, and actions aimed at addressing the impacts of climate change, as advocated by the UN through the Millennium Development Goals and the Sustainable Development Goals.

To achieve the second specific objective (examining the principles of Brazilian environmental legislation, as well as its federal constitution), literature regarding the principles of Brazilian environmental legislation and articles of the federal constitution related to climate change were analyzed.

To achieve the third and final specific objective (evaluating sectoral public policies), Brazilian environmental legislation was analyzed, especially Law 6,938/81, known as the National Environmental Policy (PNMA), and its interactions with other related public policies, such as the National Policy on Climate Change (PNMC) and the National Policy on Environmental Education (PNEA), in addition to the Environmental Crimes Law (LCA). The investigation was conducted through a detailed bibliographical review of these legal documents, highlighting their main provisions and guiding principles.

Finally, data from the city were analyzed from various official documents, including the Sustainability and Climate Change Confrontation Policy of Recife, established in 2014 by Law No. 18.011/2014, and the Greenhouse Gas Emission Inventories and Water Footprint of Recife, prepared by the City of Recife in subsequent years. Additionally, sectors that contributed most to $CO_2$ emissions were examined, as well as factors influencing these emissions, such as population growth, local economic activities, and waste management. Concurrently, the evolution of urban afforestation in Recife was investigated using data from the Afforestation Plan, the Afforestation Manual, and the Planning and Planting Handbook. Finally, urban planning policies, such as the 2008 and 2020 Master Plans, were analyzed to understand the impact of measures adopted on the expansion and conservation of green areas in the city.

## 3. RESULTS AND DISCUSSION

### 3.1 International Agreements

Over the years, with the purpose of promoting sustainable development and a better quality of life, several international agreements have been formulated in favor of the environment, concerning various issues ranging from marine pollution to climate change. These agreements can be seen as a boost to countries' environmental policy processes, increasing state intervention and promoting a proactive model of addressing problems and outcomes (Barros-Platiau & Varella, 2009).

In 1988, the Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations (UN) and the World Meteorological Organization (WMO), becoming one of the main scientific sources on climate change. In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted, the main international instrument in the area. This convention aims to stabilize concentrations of greenhouse gases so that there is no dangerous anthropogenic interference with the Earth's climate (UN, 1992).

At the United Nations Conference on Environment and Development in 1992, Agenda 21 was developed, aiming to understand the biological, chemical, physical, geological, hydrological, social, and economic phenomena that affect and are affected by the Earth's atmosphere at local, regional, and global levels. It also aims to increase international cooperation and better understand the consequences of climate change, as well as mitigation measures for these changes (UN, 1992).

The World Bank, as a development agency, did not ignore the impacts of economic growth on nature. Thus, it revised policies to consider environmental issues for project financing. One of the main operational policies (OP) is 4.01, which requires environmental assessment of projects proposed for Bank financing. This OP is highly relevant in terms of climate change since projects must be environmentally sound and sustainable to receive financing, thus helping to mitigate pollution generated by unsustainable projects (World Bank, 1999).

Since Human Development is the safest basis for adapting to climate change, in 2000 the UN analyzed the world's major problems and established the 8 Millennium Development Goals (MDGs). The main objectives related to climate change are "eradicating poverty and hunger" and "ensuring environmental sustainability," as ending hunger and poverty makes environmental education more accessible, and ensuring sustainability increases protected areas and reduces levels of air pollution (UN, 2006).

The UN also created the Sustainable Development Goals (SDGs) with the purpose of fulfilling the agreements made in the 2030 Agenda. Goal 13 prioritizes the development of urgent measures to combat climate change and its impacts. Its targets involve improving education, increasing awareness of climate change, promoting mechanisms for climate-related planning and impact reduction, as well as alerting to climate changes (UN, 2015).

### 3.2 Principles of Environmental Legislation

In order to legally legitimize States to create policies aimed at environmental protection, certain principles have been established. The Principle of Non-Retrogression in Environmental Protection consists of seeking the maximum effectiveness of the Constitution, ensuring that new laws are not less protective than the old ones. According to Fujiki and De Almeida (2020), this principle is not merely a formal clause but a legitimation that ensures environmental protection by preventing rollback. This non-retrogression is essential to prevent the removal of achievements and advancements and can be applied to any offense against environmental progressions. In the field of climate change, it is unacceptable for there to be regressions in Brazil's international commitments, such as reducing deforestation and avoiding the emission of greenhouse gases (GHGs).

The Principle of Sustainable Development ensures the rationalization of the use of environmental resources, as well as the selection of less polluting sources, allowing for renewal without compromising the quality of life of future generations (Marinho & França, 2008). Combating climate change and promoting sustainable development are mutually reinforcing actions; one cannot be achieved without the other.

The Principle of an Ecologically Balanced Environment constitutes an essential requirement for all individuals within society to enjoy a minimum standard of living, which is in itself a fundamental right (Do Nascimento, 2021). With an ecologically balanced environment, climate change would also be balanced.

The Principle of Precaution against Environmental Damage and Degradation asserts the need for a new global stance in the face of risks and doubts associated with scientific uncertainties and technological deficiencies in the context of human development accompanying environmental exploitation. The mere probability of degradation of natural resources, or even a significant reduction for future generations, is sufficient reason to apply this principle (Schroeder, 2010).

A good example of its application is the warming of the atmosphere predicted by scientists due to the increase in daily carbon dioxide emissions by countries. However, there is no exact scientific basis for the harmful effects of this global warming on the climate, sea levels, and agriculture, only doubts and concerns about the risks and consequences of unwanted climate change. Obviously, the absence of certainty about environmental damage does not prevent preventive action before it becomes irreversible.

The Principle of Prevention of Environmental Damage and Degradation aims primarily to prevent and guide the occurrence of an adverse event that causes undesirable and consecutive impacts on the environment, with corrective action being preventive (Cielo, 2012). Considering that climate change requires preventive actions on the part of the international community, the bias of the

prevention principle is analyzed as a driving force in democratic discussions about the risks that may arise from this phenomenon, as well as the engagement of stakeholders on when and how to prevent it.

The Polluter-Pays Principle or Accountability not only imposes on the polluter the obligation to bear the costs of further environmental degradation but also has a preventive nature, meaning the polluter must take measures to avoid further damage. Therefore, the polluter pays according to the principle, covering all costs of environmental protection, which can help decrease pollutant emissions (Mercês, 2015).

The Principle of Restoration assigns to the offender the duty and responsibility to restore the degraded area to its previous condition or compensate for the effects caused by the damage at their own expense and subject to judicial oversight, bringing greater efficiency to environmental recovery and a more consistent response (Costa; Pinheiro; Ferreira, 2020). By making the polluter pay for the impact caused, there is a tendency for such actions to decrease, as the amounts paid can be high.

The Principle of Cooperation is of fundamental importance as it incorporates the need for integrated action between the population and the government. The United Nations stipulates that all countries must strive in a spirit of cooperation and equality to solve international problems related to the protection and improvement of the environment. Internally, the principle of cooperation imposes on the State and the community the obligation to protect and preserve an ecologically balanced environment for present and future generations (Galbiatti, 2015). Since climate change affects the entire planet, it is imperative that countries cooperate so that together they can unite in favor of measures that reduce pollutant emissions, as well as other causes of change.

### 3.1 Federal Constitution of Brazil

In the Federal Constitution (Brasil, 1988), Article 23 deals with shared competence among municipalities, the Federal District, states, and the Union, as can be observed in clause VI, where the protection of the environment and the fight against pollution are determined. Considering that one form of pollution is atmospheric pollution and its pollutants include more gases than just greenhouse gases, it is one of the causes of climate change, making this article essential for controlling alterations. A similar provision is also found in Article 24, clause VI, which deals with environmental protection legislation and pollution control.

The legislation imposes in Article 84 the competence of the President of the Republic to conclude acts, conventions, and international treaties, as mentioned in section 2.1 (Brasil, 1988). Therefore, it is pertinent that the President understands the relevance of the consequences caused by climate change, as well as its causes, so that they can sign and comply with agreements for a stable global climate.

Article 170 advocates for the dignified existence of all according to certain principles, one of which is the defense of the environment and differentiated treatment according to environmental impact (Brasil, 1988). In contrast to this idealized vision of dignified existence and environmental defense, are the climate changes that have intensified in the last century, more intensely after the Industrial Revolution.

Article 225 guarantees the right to an ecologically balanced environment, with clause V addressing the control of substances, techniques, and methods that endanger the environment, quality of life, and life itself, and paragraph 3 addressing the penalties applied to offenders who harm the environment (Brasil, 1988). The integrity and stability of the climate both form the essential core of the fundamental right to the environment and the minimum ecological existence. The recognition of a new and reinforced climatic dimension inherent in the established ecological constitutional system gives rise to the characterization of specific obligations to protect and promote, including organizational, institutional, and procedural aspects, such as combating, controlling, and mitigating the causes and consequences of climate change.

**3.2 Sectoral Public Policies**

Law 6.938/81, known as the National Environmental Policy (PNMA), was created in 1981 and based on Articles 23 and 235 of the Federal Constitution. With it, the National Environmental System (SISNAMA) and the Environmental Defense Registry (Brasil, 1981) were established. This law is considered a legal milestone for all environmental public policies to be developed. Before this, states and municipalities had autonomy to determine their environmental guidelines independently, but from this moment on, there was a harmonization of these policies.

Article 2 states that the objective of PNMA is to improve, preserve, and recover environmental quality, with one of its principles being the control and zoning of activities with potential or effective pollution, such as atmospheric pollution caused by industries and those causing climate change (Brasil, 1981). Pollution and the polluter are characterized in Article 3 of the same law. While Article 4 of PNMA aims to impose on the polluter and predator the obligation to recover, as well as compensate for the damages caused (Brasil, 1981). This imposition is important because by paying for the criminal act, it is less likely that the person will commit it again, which would not happen if they went unpunished.

Articles 8(I) and (II) assign to the National Council for the Environment (CONAMA) the establishment of norms and criteria for licensing activities considered effectively or potentially polluting, supervised by IBAMA. It also establishes norms and standards for pollution control produced by aircraft, automobiles, and vessels, contributing to lower emissions of GHGs (Brasil, 1981). Some PNMA instruments that help reduce emissions of gases causing climate change can be

found in Articles 9 (IV) and (XII). One of these instruments is the licensing and review of activities considered polluting, and the other is the Federal Technical Registry of potentially polluting activities or those using environmental resources. Article 10 establishes the need for prior environmental licensing for the construction, installation, expansion, and operation of enterprises that use environmental resources or are polluting and/or capable of causing environmental degradation (Brasil, 1981).

With the aim of penalizing polluters, Article 14 of PNMA imposes measures such as fines, aggravated in cases of recidivism, loss or restriction of tax incentives, loss or suspension of financing, and suspension of their activity. In addition to these penalties, they are also required to indemnify or repair the damages caused (Brasil, 1981).

Considering that climate change affects all forms of life, with excessive rains, increased average temperatures, scarcity of drinking water, and long periods of drought, Article 15 of PNMA can be applied. This article is directed at the polluter who affects the safety of human, animal, or plant life, aggravating an existing danger. The penalty is imprisonment from one to three years and a fine, which can be increased if the damage is irreversible, if the pollution arises from industrial activity, or if the crime is committed during the night, Sunday, or a holiday (Brasil, 1981).

In 2009, the National Policy on Climate Change (PNMC) was created, which formalized Brazil's commitment to the United Nations Framework Convention on Climate Change to reduce GHG emissions. Article 2 of the said policy characterizes some aspects related to climate change, such as emissions, sources, mitigation, among others. Article 4 aims at reducing GHG emissions, as well as strengthening anthropogenic removals through GHG sinks. The promotion and development of technologies that mitigate climate change through emission reductions are also addressed in Article 5. Article 6 shows some instruments used by PNMC, with one of them, in clause VI, being the stimulation of GHG emission reduction and removal through fiscal and tax measures, such as differentiated rates, incentives, compensations, and exemptions (Brasil, 2009).

But merely reducing, mitigating, and penalizing is not enough if the population does not understand why such actions are wrong. For this, there is the National Policy on Environmental Education (PNEA), created in 1999 and aiming to stimulate actions and practices that sensitize society to environmental issues and the defense of the environment (Brasil, 1999).

The Environmental Crimes Law (LCA) determines the penalization of conducts harmful to the environment. Section II deals with crimes against flora considered permanently preserved, and Article 53 determines an increase in sentence from one-sixth to one-third if there are certain consequences, one of them being the modification of the climate regime (Brasil, 1998).

Section III of the LCA discusses pollution and other environmental crimes. Article 54(2), clause II of the said law determines imprisonment from one to four years and a fine in cases where the crime causes atmospheric pollution and leads to the temporary or permanent evacuation of the local population, or causes harm to the health of the inhabitants. Article 60 of the LCA determines detention from one to six months or a fine for anyone who constructs, reforms, or installs works, services, or establishments that are potentially polluting without a license or authorization from environmental agencies (Brasil, 1998).

**3.2 City Analyses**

In 2014, the Sustainability and Climate Change Confrontation Policy of Recife was instituted through Law No. 18,011/2014. This policy established actions related to global warming and sustainability at the local level, with one of its main objectives being the reduction of greenhouse gas emissions and the greening of the city. It also mandated the development of inventories on the emission of polluting gases, with the aim of creating specific plans to address the issue (Recife City Hall, 2014).

Upon consulting the first and third Greenhouse Gas Emission Inventories and the Greenhouse Gas Emissions Inventory (2012 – 2015) and Water Footprint (2015) of Recife, the following data were obtained from the city of Recife (Table 1):

**Table 1.** $CO_2$ Emissions 2012 – 2017 in Recife

| Year | Population | Emissions (tCO2e) | Emissions per capita (tCO2e/cap.) |
|---|---|---|---|
| 2012 | 1.555.039 | 3.120.426 | 2,00 |
| 2013 | 1.599.513 | 3.124.691 | 1,95 |
| 2014 | 1.608.488 | 3.195.038 | 1,99 |
| 2015 | 1.617.183 | 2.916.963 | 1,80 |
| 2016 | 1.625.583 | 3.452.849 | 2,12 |
| 2017 | 1.637.834 | 3.043.608 | 1,86 |

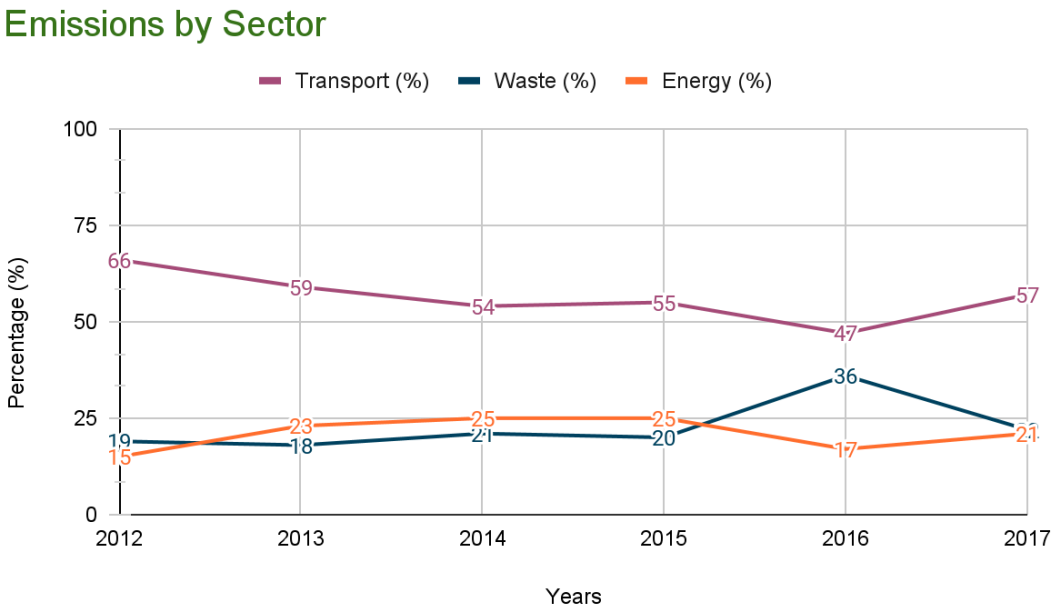
Source: Adapted from Prefeitura do Recife (2015, 2017a, 2017b)

Through Table 1, it can be observed that after the institution of the Sustainability and Climate Change Confrontation Policy of Recife in 2014, the amount of $CO_2$ emitted decreased by 8.7% in 2015 but rose again by approximately 18% the following year. These data highlight the challenge, which can occur for various reasons, in maintaining sustainability actions. These fluctuations can be attributed to a range of factors influencing greenhouse gas emission behavior. Among these factors, variations in population growth, changes in local economic activities, implementation of mitigation

and adaptation measures, technological advancements, and environmental policies adopted by the local government stand out.

Based on the data collected in the Inventories created by the Recife City Hall (Graph 1), it can be observed that over the period from 2012 to 2017, the transportation sector emitted the most $CO_2$, followed by energy and waste sectors, which had similar contributions. These data support Borges' study (2014), which asserts that the transportation sector has the highest projected growth in greenhouse gas emissions and currently accounts for 13% of total emissions, holding significant potential for reduction.

**Graph 1.** tCO2e emissions by sector

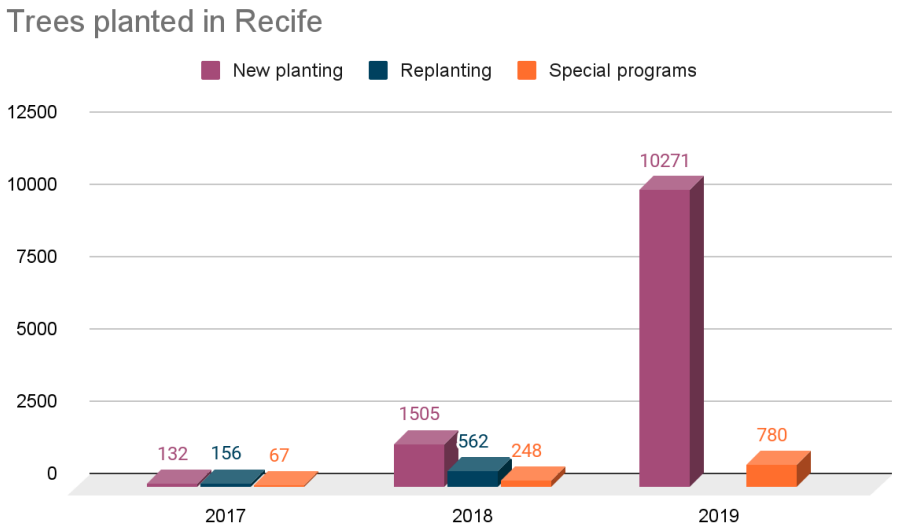



Source: Based on data from Prefeitura do Recife (2015, 2017a, 2017b)

In addition to identifying the transportation, energy, and waste sectors as the main $CO_2$ emitters during the analyzed period, it is important to note that urban expansion and population growth also contributed to the increase in these emissions. The demographic growth observed in the city of Recife during the period in question resulted in a significant increase in the vehicle fleet and energy consumption, factors that directly influenced greenhouse gas emissions. Furthermore, inadequate solid waste management, both in production and final disposal, played a significant role in $CO_2$ emissions. These pieces of information underscore the need for the implementation of effective and integrated measures to reduce greenhouse gas emissions, including promoting the use of sustainable public transportation, encouraging clean energy sources, and improving waste management, aiming to mitigate the impacts of climate change in the city of Recife.The Recife Afforestation Plan was published in 2010, and the Afforestation Manual was published in 2013. During this period, there was significant coordination among the involved agencies to put the plan

into action, and in 2017, the Planning and Planting Handbook was developed, which began to be implemented at the end of the same year in partnership with the Secretariat of Environment and Sustainability (SMAS). During the period from 2017 to 2019, there was a steadily increasing number of trees planted, as can be seen in Graph 2. There is a noticeable increase of approximately 3000% in two years.

**Graph 2.** Trees planted in Recife (2017 – 2019)

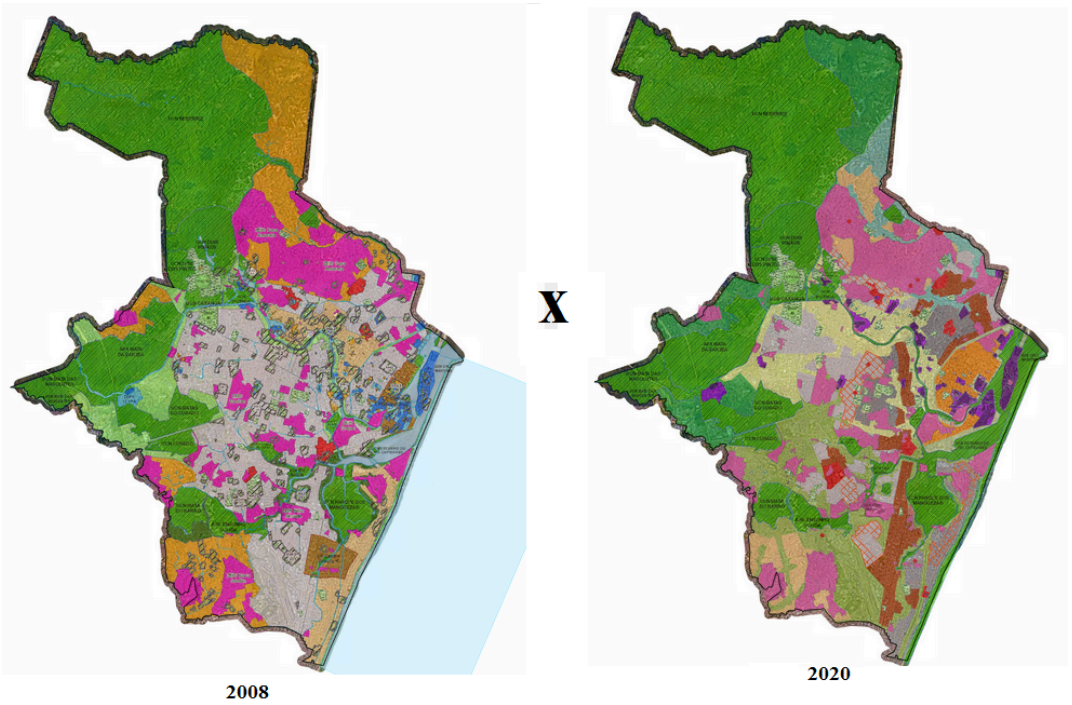



Source: Based on Carvalho (2021)

This progress is the result of continuous efforts to promote urban afforestation, which not only contributes to improving environmental quality but also plays a significant role in mitigating the effects of climate change, reducing air pollution, and promoting the well-being of the population. These results demonstrate the benefits of an effective afforestation policy and the importance of its continuation to achieve more ambitious goals regarding the expansion and conservation of urban greenery in Recife.

Figure 2 shows the comparison between the 2008 Master Plan and the 2020 Master Plan, where a significant increase in green areas can be observed. This was made possible thanks to the policies created during this period that promoted greater afforestation as a means of addressing climate change.

**Figure 1.** 2008 Master Plan vs. 2020 Master Plan




Source: ESIG (2022)

The policies adopted in this context aimed not only at the quantitative increase of green areas but also at promoting environmental quality and the well-being of the population. The inclusion of specific guidelines for the expansion and preservation of green areas in the 2020 Master Plan reflects the municipality's commitment to promoting a healthier, more resilient, and sustainable urban environment, recognizing the fundamental role of green areas in mitigating the impacts of climate change and improving citizens' quality of life. This positive evolution demonstrates the effectiveness of urban planning policies aimed at promoting green areas and underscores the ongoing need for their development and implementation to achieve a more sustainable city adapted to climate change.

The analysis of the data presented on the Recife Sustainability and Climate Change Confrontation Policy, as well as greenhouse gas emission inventories and tree planting, reveals the complexity and challenges faced in pursuing sustainable development in the city. The implementation of policies and actions aimed at reducing emissions of polluting gases and increasing urban afforestation are relevant measures to mitigate the impacts of climate change. However, the data also highlight the difficulties encountered in maintaining these actions over time. The increase in $CO_2$ emissions after a temporary decrease points to the need for continuous commitment and more effective measures to address the climate challenge. This underscores the importance of constantly monitoring and evaluating implemented policies to identify their limitations and adapt them to promote sustainable and lasting results.

In light of this data, reflection is made on the importance of consistent environmental policies and the need for ongoing commitment to address the challenges of climate change. Individual actions may bring temporary positive results, but to achieve significant and lasting changes, an integrated approach involving different sectors of society, such as governments, businesses, and citizens, is necessary. Additionally, it is crucial to invest in environmental education and awareness among the population so that everyone can understand the importance of individual and collective actions in building a more sustainable future. Only through joint efforts and effective environmental policies can the impacts of climate change be mitigated and environmental preservation ensured for future generations.

## 4. CONCLUSIONS

Recife is one of the cities most threatened by the consequences of climate change. Its geography, population density, and inequality are just a few of the factors contributing to this position. This vulnerability has been recognized by its leaders, who have been creating laws for over a decade to mitigate this situation.

This study has allowed us to find initiatives in the city's legislation that contribute to addressing climate change, such as reducing greenhouse gas emissions and increasing afforestation. However, the data obtained regarding greenhouse gas emissions showed that efforts have not yet yielded significant results, as there is no decreasing stability in the amount emitted, but rather oscillations.

The transportation sector is the biggest contributor to the city's air pollution. Based on this, a possible solution would be to improve the quality and quantity of public transportation since just one bus can transport 40 seated people, which would otherwise require between 10 and 40 cars. This measure, besides considerably reducing greenhouse gas emissions, would also improve the population's finances, considering that fuel prices always undergo increases. Afforestation is also a highly effective measure, as trees can act as carbon sinks.

More detailed studies are needed on the existing sources of pollution in the city to provide more specific tools for their mitigation or resolution.

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## DATA AVAILABILITY STATEMENT

All data supporting the findings of this study are contained within the manuscript itself. The research is based on publicly available documents, official reports, and legislation properly cited throughout the text. No additional datasets were generated or analyzed for this study.

## AUTHOR CONTRIBUTION

The author was solely responsible for the conception of the study, literature review, data collection and analysis, interpretation of results, and writing of the manuscript.

## CONFLICT OF INTEREST STATEMENT

The author declares that there are no financial, personal, or institutional conflicts of interest related to the publication of this work.

## DISCLOSURE

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