Recommendations of Actions for Resilience and Sustainability

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Prefeitura de Teresina

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for Resilience and Sustainability
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Este relatório foi escrito com a colaboração de uma extensa equipe
inter / transdisciplinar e, como tal, alguns dos termos foram traduzidos
diretamente do português ou do inglês.

Executive Summary

Executive Summary

In 2019, the Municipality of Teresina, the Government of Brazil and the United Nations Program for Human Settlements signed a Cooperation Agreement for the implementation of the Teresina Urban Resilience Program. Through this agreement, for 2 years, the parties worked together implementing the City Resilience Profiling Tool to build technical capacity for urban resilience in the municipality and produce a strategic action plan for the city, called Recommendations on Actions for Resilience and Sustainability.

The aim of this report is (1) to better inform the Local Government, in this case the Municipality of Teresina, of the current state of the city with regards to resilience and ongoing related trends, based on conclusions derived from the CRPT implementation process described in this document; and (2) present a set of activities and actions, organised under three lines of action which, based on the project's theory of change, guides municipal public policies in response to the priority issues previously identified.

The Urban Context

Teresina: one of the fastest-warming intermediary cities in the world is using its resources wisely for building resilience and sustainability.

Figure: Location of the city of Teresina. Source: CRGP (2022).

Country	Brazil
State	Piauí
Location	Northeast region
Climate	Tropical group (A) with Savanna climate (Aw); the arid period from, September-December and the rainy season from January to April
Area	1392 km²
Population	864.845 (2019)
Language	Portuguese
Local GDP/cap.ta	USD 3.889,09 (2017)

Teresina's Challenges and Opportunities

Enduring Challenges

The Peripheral nature of the region

Poverty and inequality

Weak intergovernmental coordination

Emerging Challenges

Climate Change Effects

Safety and Crime

Opportunities

Growing coverage and provision of basic infrastructure and social services

Municipal revenue growth

Partnerships from local, to regional and international levels for increased technical and financial capacity

Figure: Teresina's Challenges and Opportunities. Source: CRGP (2022).

Resilience Building Priority Matters

Teresina's priorities for strengthening resilience are delineated to address key matters where multiple risks converge in light of enduring and emerging urban challenges.

In a series of workshops for building local knowledge and expertise held by UN-Habitat's City Resilience Global Programme, the Teresina Resilience Commission defined with other urban actors the priorities of the city for resilience building.

Priority Matter 1
Water Cycle Management

The water cycle, also known as the hydrological cycle, is the phenomenon of water circulation between the biosphere, atmosphere, lithosphere, and hydrosphere. In cities, this natural water cycle is affected and modified by urbanisation, industrialization, and population growth, and is made more complex by the need to properly manage water supply, drainage, and sewage collection.

Water cycle management is concerned with the management of both natural and urban water cycle in Teresina. This priority matter addresses different types of shocks and chronic stresses in the urban system for building climate resilience.

Drivers of Water Cycle Mismanagement	• Disruption of Hydrological Dynamics • Mismanagement of Urban Metabolism The lack of sustainable methods for managing urban metabolism, particularly solid waste, wastewater, and stormwater systems, undermine further the urban water cycle management with serious implications for the city" ecological balance, increasing the potential of more risks to emerge.
	Key Data Due to rapid urbanisation phenomena and lack of affordable housing, 7.8% of the urban footprint is located in hazardous and risk prone areas.
Associated	• Fluvial, Pluvial and Flash Floods • Landslide • Waterborne Diseases • Infrastructure Failure Processes of urbanisation, shaped by poverty and inequality, have altered the natural water flows leading to an increase in the frequency of multiple shocks with severe socio-economic impacts.
	Key Data Percentage of homes with inadequate structure is around 20%, and percentage of critical infrastructure with inadequate structures is almost 10%.

Priority Matter 2
Ecosystem Balance

The ecosystem imbalance refers to disturbances in the balance of a natural ecosystem due to natural or anthropogenic causes. In the urban context, some of the main causes of this process are the accelerated territorial expansion over the natural environment, the contamination of water bodies, the pollution of the atmosphere, soil erosion, and deforestation, among others.

In Teresina, the ecosystem imbalance is largely related to vegetation losses severed by rapid and unsustainable urbanisation patterns, leading to increasing heat island in context of high vulnerability to global warming; and water contamination driven mainly by untreated sewage discharge, and leading to biodiversity loss and plant infestation.

Drivers of Ecosystem Balance	• Vegetation Loss • Environmental Pollution • Wildfires The effects of this issue are becoming quite evident in Teresina through various events, mainly biodiversity loss, and insects, animals, and plants infestation, which in turn caused both marked public health problems and considerable socio-economic impacts.
	Key Data From 2001 to 2019, the urban perimeter lost approximately 40% of the tree cover. Between October 2019 and October 2020, 385 fires were identified in Teresina by satellite imagery.
Associated Risks	• Urban Heat Islands • Insects, animals, and plant infestation On the local level, Teresina is currently in the bidding process for the development of its Climate Action Plan, which will incorporate the construction of trend scenarios, mitigation strategies, and adaptation to the impacts of climate change.
	Key Data While the proportion of public open space per 100.000 inhabitants (57 ha/100,000hab) and urban green area per capita (13,43 ha/1,000hab) are considered positive indicators, there is a current trend in vegetation loss and the percentage of open areas within the urban footprint (46%) should be increased.

Priority Matter 3
Economic Performance

Teresina historically suffered the consequences of the peripheral nature of its location which has been most of time far away or at the fringes of major national economic hubs and their sphere of influence. It therefore never has never had any major strategic industries and relevant infrastructure.

Lack of well-connected national and interregional networks of transportation and supply chain, and an ongoing national economic crisis, have undermined the city's economic development and growth.

It is noteworthy that the COVID-19 pandemic intensified some drivers, especially the informal economy, and risks associated with low economic performance in Teresina, with a retraction in economic activities and, consequently, in municipal revenues and an increase in unemployment rates.

Drivers of Economic Performance	• Limited business attractivity • Informal economy • Weak economic diversity The city and the region are under-served by well-connected national and interregional networks of transportation and supply chains, which in turn have undermined the city's economic development and growth. The Brazilian financial crisis of 2015 exacerbated economic performance further in Teresina, with effects mostly evident in commercial and industrial activities.
	Key Data Market connectivity in Teresina is quite low, with the rate of commercial banks per 100,000 inhabitants being 6.13. The rate of informal employment in the city is 44,7%, with 50,1% Males and Females 49,9%. The manufacturing share of local city products is merely 5.7%
Associated Risks	• Social unrest • Unemployment • Local revenue losses Historically the city has suffered the consequences of its peripheral location, which has been mostly far away or at the fringes of major national economic hubs and their spheres of influence. Therefore, it has never had any major national strategic industries and relevant infrastructure.
	Key Data The total unemployment rate in Teresina is 13,7%, which is higher than the national estimate, but lower than regional figures. 22.5% of total local government revenue in Teresina is own-sourced.

Recommended Actions for Resilience and Sustainability

Developing a resilient and sustainable city requires implementing actions that address the most pressing matters.

The development of Recommended Actions for Resilience and Sustainability is the fruit of collective reflection among various stakeholders including local, regional, national and international actors; as well as different sectors of the government, civil society and private entities. This reflection was built on a thorough understanding of the cause and effects of risks and their drivers, the contextual factors constraining decision making and action in Teresina, and the matters that needed prioritisation and comprehensive actions. The multi-stakeholder collaboration enabled the development of a Theory of Change, focused on seeking points of intervention to maximise the impacts of the recommended actions and activities in Teresina for the 3 priority matters: Water Cycle Mismanagement, Ecosystem Imbalance, and Economic Underperformance.

The Recommended Actions for Resilience and Sustainability present a roadmap for the city to act on its priority issues by proposing activities that can bypass contextual challenges, seize the city's opportunities and leverage sustainable development outcomes and enhance urban resilience thinking inside the local government. It brings forward the city's vision for a more resilient future, with its desired goals to address each priority issue, the path from prioritisation to effective policy making, and the Lines of Actions to deliver on these goals.
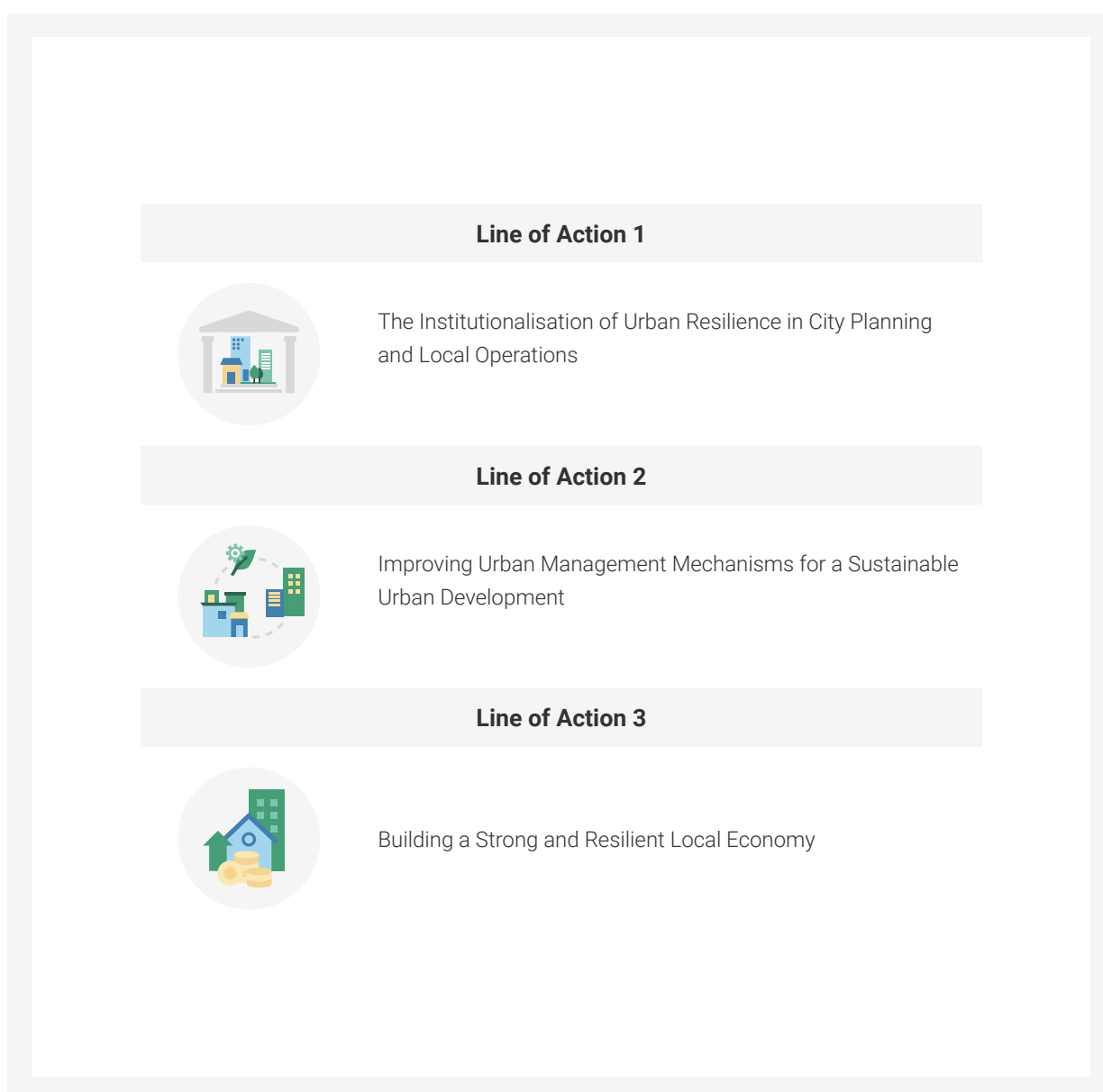

Line of Action 1

The Institutionalisation of Urban Resilience in City Planning and Local Operations

Line of Action 2

Improving Urban Management Mechanisms for a Sustainable Urban Development

Line of Action 3

Building a Strong and Resilient Local Economy

Figure: Recommended Actions for Resilience and Sustainability. Source: CRGP (2022).

Line of Action 1
The Institutionalisation of Urban Resilience in City Planning and Local Operations

Despite the active role of the local government in Teresina in leading the processes of resilience diagnosis and building consensus around a set of actions, there remains a risk of actions not being implemented (due to staff turnover, election cycles, etc.) as planned over the long run, unless resilience thinking is well embedded in the day-to-day work of the municipality and integrated into municipal departments policies, decision making and way of working.

Throughout the project implementation, a need to create a framework of a shared understanding of urban resilience was commonly agreed by all the stakeholders involved, including municipal departments. The aim was to implement the actions in an effective and efficient way, and sustain the municipality and local actors' commitment to the goals and objectives of this project - strengthening the city's resilience - beyond the project's lifetime.

As a main line of action, institutionalising resilience thinking and planning across the local government is comprised of a series of organisational, capacity building and awareness-raising activities, such as the formalisation of the role of the Resilience Committee and allocating the necessary resources for its tasks, promoting debates on economic development, mobility and environmental topics, and engaging the youth in the promotion of resilience thinking, among others.

Inputs for Line of Action 1

↓ The Institutionalisation of Urban Resilience in City Planning and Local Operations			
↓ Recommended Action: Mainstream resilience thinking and considerations across local policies, decisions making, projects and activities			
Activity Type	**Activities**	**Why**	**SDGs**
Strategic Activities	**1.1** Set up a comprehensive strategy for international municipal action.	Municipal international action can be a mechanism to increase urban resilience through spaces of learning and opportunities, creating robustness for local capacities. In order to take full advantage of international cooperation and to institutionalise it in the city's development framework, it is necessary to define a strategic plan, which will establish an expected perspective of impact and sustainability.	16 PEACE AND JUSTICE STRONG INSTITUTIONS / 17 PARTNERSHIPS FOR THE GOALS
Organisational Adjustments	**1.2** Institutionalise the role of the resilience commission to foster cross-departmental and cross-sectoral efforts around resilience building and RAR-S implementation.	Institutionalising urban resilience demands a holistic approach, considering all urban systems and its interdependencies. In order to institutionalise resilience thinking inside the local Government it is important to consolidate the Resilience Commission as a permanent Council for Urban Resilience.	11 SUSTAINABLE CITIES AND COMMUNITIES / 13 CLIMATE ACTION / 15 LIFE ON LAND / 17 PARTNERSHIPS FOR THE GOALS

Capacity Building Activities	**1.3** Continuous training and capacity development programmes for private entities and stakeholders to enhance their technical skills, operations and resource management towards more sustainable outcomes.	There is a need to increase the degree of sensitivity, knowledge on the subject and capacity of the companies and their workers who interact with urban development. Also, the administration collaborates and contracts with private companies the execution of various programmes and actions constantly. These companies and their workers must have the best training available to improve the results of the services they offer and whose client is often the administration. Given that the result of these actions and the economic benefits are not immediately perceived, it is necessary for the administration to promote and lead continuous training programmes that increase the degree of general training in environmental matters in the private sector.	11, 12, 13, 15, 17
Awareness Raising Activities	**1.4** Strengthen the role of youth in innovation and advocacy for resilience and climate change adaptation.	Integrating resilience thinking should be a cross-sectoral and at the same time inclusive process, incorporating the voice of youth to promote innovation and a new vision on public administration efforts towards a sustainable future.	4, 8, 13
	1.5 Promote high-level debates for discussing economic development, mobility and environmental nexus.	In order to achieve proper societal adherence for specific urban policies, it is necessary to integrate different stakeholders, such as the civil society and the private sector, in discussing the role of mobility, land use and environmental policies in building urban resilience.	11, 13, 16, 17
	1.6 Public Awareness Raising for Urban Resilience.	A resilient system ensures the preservation of life, the limitation of injury, and the enhancement of its inhabitants' "prosperity"; promoting inclusiveness and fostering not only comprehensive but also meaningful participation of all, particularly those in vulnerable situations. This approach can ensure a sense of ownership and support implementation of plans and actions.	11, 13, 16

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Line of Action 2
Improving Urban Management Mechanisms for a Sustainable Urban Development

Water cycle mismanagement and ecosystem imbalance - identified as priority matters - are driven by the rapid urbanisation process, the precarious basic infrastructure systems, and unsustainable development practices. In order to address and mitigate these issues, the local stakeholders and actors sought a holistic line of action centred around enhancing the sustainable urban development of Teresina.

Accordingly, three main actions were recommended which aim to promote a compact and sustainable urban form, sustainable green and blue infrastructure, and coherent urban planning and implementation. Each recommended action consists of a series of awareness-raising, capacity building, organisational enhancement, and strategic activities. Activities range from participation in international groups and programmes, the execution of training and continuous improvement programmes for the city officers and practitioners, the creation of a fund for the capture and management of land value gains, the execution of Transit Oriented Development programmes, to the creation of a single agency to coordinate the different aspects related to the water cycle management, to name but a few.

Inputs for Line of Action 2

↓ Improving Urban Management Mechanisms for a Sustainable Urban Development			
↓ Recommended Action: Shifting Towards a Compact and Sustainable Urban Form			
Activity Type	**Activities**	**Why**	**SDGs**
Strategic Activities	**1.1** Establishment of Transit Oriented Development Programme.	Reduce the risks of disasters and enhance the city's resilience, by limiting land consumption which result in altering natural terrains, and destruction of natural water systems, which in turn raise the risks of flash and fluvial floods in the city. Contribute to building more sustainable urban form, by maximising the urban density, and residential, commercial, and leisure spaces near public transport corridors, consequently, reducing the use of private cars, and strengthen economic viability through the concentration of commercial land, and activities, and services Also, the greater attractiveness of these areas results in an increase in the value of the land that can be captured by the city to improve the quality of urban spaces. Saving significant public spending on providing new infrastructure for low density developments.	
Organisational Adjustments	**1.2** Creation of the Fund For The Capture and Management of Land Value Gains.	This fund can be used to finance several activities that can facilitate strengthening sustainable urban development, namely: training programmes for municipal staff; awareness-raising campaigns on sustainability and resilience.	

Capacity Building Activities	**1.3** Training and continuous improvement program for City Officers and Practitioners.	A major bottleneck in the implementation of sustainable urban planning policies, plans and initiatives lies in the technical qualification and implementation chain from planning to execution. The municipality needs continuous staff training for optimal, up to date and innovative ways of implementation of legal frameworks from start to end.	11 SUSTAINABLE CITIES AND COMMUNITIES 15 LIFE ON LAND 16 PEACE AND JUSTICE STRONG INSTITUTIONS 17 PARTNERSHIPS FOR THE GOALS
Awareness Raising Activities	**1.4** Establish partnerships with professional associations and academia for promoting the city's master plan and innovative practises for its implementation.	To ensure effective and efficient implementation through gaining the public support and enabling adjustments whereby public concerns are heard and addressed properly and timely.	11 SUSTAINABLE CITIES AND COMMUNITIES 17 PARTNERSHIPS FOR THE GOALS

↓ Recommended Action: Improving urban metabolism through green and blue infrastructure

Strategic Activities	**2.1** Refining Teresina's Urban Revegetation Strategy.	The city must improve its revegetation strategy through proper tree planting on the streets and greening of building surfaces, through techniques such as green walls and green roofs, which will improve environmental quality and population's life quality as well as contribute to the function of the urban metabolism.	11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION 15 LIFE ON LAND
	2.2 Development of a permeabilization and soil de-sealing strategy.	The implementation of green infrastructure strategies and the de-sealing and permeabilisation improves the city's drainage system, reducing the occurrence of floods and landslides, as well as the pollution of water streams due to stormwater runoff.	11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION

Organisational Adjustments	**2.3** Improvement and expansion of Teresina's recycling system to reduce water and soil contamination.	Beyond environmental protection and public health benefits, an efficient municipal waste collection and recycling system can help in energy and natural resources saving, reducing waste disposal volume, decreasing air and soil pollution, mitigating greenhouse gas emissions, and boosting the circular economy.	
	2.4 Creation of a Municipal Unit for the Management of the Water Cycle in the City.	The water cycle mismanagement has been identified as a priority matter in the city, driven by a multitude of factors explained in detail in chapter 3. Addressing these multi-faceted issues requires bringing many actors and levels of the government together, and reducing multiple and overlapping work streams which in many cases lead to inaction or counteracting. This new unit inside the municipality, specifically within the department of planning (SEMPLAN) can take on the responsibility of overseeing the plans, projects and actions of the various bodies involved in water cycle in Teresina; facilitating information and knowledge sharing among all actors, ensuring consistency and coherence of plans and actions, and avoiding mal-functioning.	
Awareness Raising Activities	**2.5** Establish a guided visits and tours programme to key infrastructures, sites of interest, and pilot initiatives for sustainable and resilient developments.	In a city under the constant threat of flash-floods, it is essential to increase awareness and knowledge about nature-based solutions, such as green and blue infrastructure, as well as infrastructure and the functioning of the city in general, both for the general public, for administration technicians and from private companies. One of the most powerful and effective actions that can be carried out is the presentation and dissemination of existing projects, initiatives and experiences based on nature-based solutions that can serve as a model and inspiration for new initiatives. The visits and guided tours are in this sense a very powerful way to achieve this objective.	

↓ Recommended Action: Enhanced Intra-governmental Coordination for Coherent Urban Planning and Implementation			
Organisational Adjustments	**3.1** Increase inter and intra-departmental coordination throughout the policy cycle.	To reduce inconsistency between policy and projects planning goals and implementation outcomes, thus avoiding inefficiency and ensuring best delivery of goals and objectives.	11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION 15 LIFE ON LAND 17 PARTNERSHIPS FOR THE GOALS
Capacitação	**3.2** Development of Urban Planning and Implementation Guidebook, Checklist and Technical Manuals.	Teresina has an extensive administrative municipal organisation; thus, it is necessary to standardise a set of common criteria aligned with the general objectives of the city among the different administrative bodies. These guidelines will be officialised through documents such as guidebooks, checklists and technical manuals, which will allow the proper implementation of municipal policies and plans.	11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION 15 LIFE ON LAND 17 PARTNERSHIPS FOR THE GOALS

Line of Action 3
Building a Strong and Resilient Local Economy

Unemployment, low productivity, weak market connectivity and lack of economic diversity were all identified as factors driving the economic underperformance in Teresina. In order to address this priority issue, which has been exacerbated by the COVID-19 pandemic, a third line of action was agreed upon to focus on building a strong and resilient local economy.

This line of action is broken down into four recommended actions that, respectively, aim to finance economic development, enhance urban mobility management, promote city-rebranding for enhanced investment attraction and innovation, and enhance access to markets and opportunities. Each recommended action comprises a series of awareness-raising, capacity building, organisational adjustments, and strategic activities, such as staff capacity building for increased municipal revenue, the creation of a Local Mobility Agency for Operations, enabling City-to-City cooperation, the creation of a Local Economic Development Agency (LEDA) for territorial marketing, the creation of a committee to gather different stakeholders to work around science, technology, innovation and education, promoting innovation in the city, and the integration of the informal sector.

Inputs for Line of Action 3

↓ Building a Strong and Resilient Local Economy			
↓ Recommended Action: Enhanced Efficiency of Municipal Management and the Financial Sustainability of the Local Government			
Activity Type	Activities	Why	SDGs
Strategic Activities	1.1 Update and enhance municipal mechanisms of monitoring and evaluation of services effectiveness and efficiency.	The Urban Resilience Diagnostic showed deficiencies in monitoring data from municipal public services. This lack of data also coincides with relevant points raised by the Resilience Commission, such as difficulties in implementing urban projects and incompatibilities of technical capacity and demand for public services. This monitoring is critical to generate baseline and respond to problems of lack of technical capacity for adequate municipal services.	16 PEACE AND JUSTICE STRONG INSTITUTIONS 17 PARTNERSHIPS FOR THE GOALS
Capacity Building	1.2 Enhance municipal staff's skills for more improved and more efficient municipal tax collection.	The Resilience Commission consultation process clarified that the municipality already has projects for tax management modernisation, as well as secured resources. However, the administrative capacity to implement these resources and follow up on the programmes is still lacking. Modernising tax management responds to the need to increase own revenue sources to finance sustainable development and mitigate fiscal crises.	17 PARTNERSHIPS FOR THE GOALS

↓ Recommended Action: Enhanced urban mobility management for higher productivity and social-spatial inclusion

| Ajustes Organizacionais | **2.1** Create a Local Mobility Agency for Operations and Integrate Mobility Planning into the Macro-Area of Planning and Environment. | STRANS' current management model does not meet the need for agility in the coordination and supervision of municipal transport, be it traffic or public transport. It is thus recommended to update the model following the successful example of other cities, with a Local Transportation Agency, and integrating the mobility planning units with the other urban planning sectors under the Secretariat of Planning. | 11 SUSTAINABLE CITIES AND COMMUNITIES   16 PEACE AND JUSTICE STRONG INSTITUTIONS   17 PARTNERSHIPS FOR THE GOALS |
| | **2.2** Creation of an intersectoral committee for coordinated management of urban mobility and logistics. | The challenges of local and regional interconnectivity are key drivers of low local economic performance. It is necessary to create a local agenda that resumes the discussions of a Logistics Plan for the RIDE Grande Teresina, and that advances in projects that improve regional mobility. | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE   11 SUSTAINABLE CITIES AND COMMUNITIES |

↓ Recommended Action: City Rebranding for Enhanced Investment Attraction and Innovation

| Strategic Activities | **3.1** Prepare for the Future of Work. | To cope with ongoing global trends of digitalisation and the consequent shifts in work, industries and business, and prepare for the future of work while ensuring just and inclusive opportunities for all, and reducing inequality in access to work, opportunities and resources. | 8 DECENT WORK AND ECONOMIC GROWTH   9 INDUSTRY, INNOVATION AND INFRASTRUCTURE |
| Organisational Adjustments | **3.2** Set up a Local Economic Development Agency for Territorial Marketing (LEDA). | The municipality has struggled to implement its strategic economic development actions due to limitations in its organisational structure. The economic development department lacks the necessary resources and competencies to enable projects and coordinate the various actors required to leverage economic development strategies. Thus, the creation of a LEDA (Local Economic Development Agency) is proposed to overcome administrative limitations, facilitate knowledge exchange, conduct studies and coordinate multiple actors for context-specific economic development strategies. | 8 DECENT WORK AND ECONOMIC GROWTH   9 INDUSTRY, INNOVATION AND INFRASTRUCTURE   17 PARTNERSHIPS FOR THE GOALS |

| Capacity Building | **3.3** Set up City-to-City local economic development cooperation for knowledge transfer. | Cooperation with cities that have been dealing with similar issues and already established their LEDA-like agencies can prove very useful in finding new and innovative ways in addressing issues related to local economic development, and knowledge and skills exchange. Such corporations also allow cities to learn from each others' experiences - what works and does not work for a LEDA agency, whereby cities can avoid experimenting with new policies and projects that have proved unsuccessful in similar contexts, thus saving significant resources. | 8 DECENT WORK AND ECONOMIC GROWTH 17 PARTNERSHIPS FOR THE GOALS |

↓ **Recommended Action: Enhancing Access to Markets & Employment Opportunities for the Informal Sector**

| Strategic Activities | **4.1** Commission a comprehensive study, in collaboration with academia and non-profit organisations, to understand and characterise the informal sector. | The Brazilian informality rate is around 40%, while the state rate was almost 60% for the second half of 2021 being the 4th highest in the country. Thus, in the Brazilian context, no sustainable economic development is possible without a special focus on this sector. To develop better projects and with the appropriate target audience, it is necessary to conduct specific research that understands the particularities of this sector. | 8 DECENT WORK AND ECONOMIC GROWTH 17 PARTNERSHIPS FOR THE GOALS |
| Capacity Building | **4.2** Position the Popular Bank (Banco Popular) as the anchor for providing support to SMEs and informal sector integration. | The Popular Bank has been identified as a key institution, the gateway to strengthening vulnerable economic sectors. It had and continues to have an essential role during the economic crisis caused by the pandemic of COVID-19, proving to be a powerful policy for strengthening economic resilience. Its strengthening offers an area of opportunity to integrate this group into training programmes, improved access to credit, professionalisation, formalisation and facilitating access to rights and benefits. However, it has limited credit provision, which needs to be reassessed especially after the post-covid financial crisis period. Also, the diagnosis showed that their operating capacity is limited, requiring greater technical capacity to increase the supply of micro-credit, associated also with better management mechanisms. A resilient city must be inclusive, and thus accommodate vulnerable sectors with appropriately tailored programmes. | 8 DECENT WORK AND ECONOMIC GROWTH 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE |

| Awareness Raising | **4.3** Run awareness-raising campaigns, in collaboration with the civil society, on access to credits, grants and skills. | Although the municipality offers specific services aimed at the micro and small entrepreneurs, as well as support for formalisation and assistance to informal workers, their awareness and access to the service is still limited. The service does not have an adequate targeting and outreach strategy, which is necessary for efficient service delivery. It is also convenient to unify several services offered separately, to facilitate public's adherence. | **8** DECENT WORK AND ECONOMIC GROWTH   **9** INDUSTRY, INNOVATION AND INFRASTRUCTURE |

Glossary

Glossary

Access	Ability of the rights-holders to use or benefit of a certain service or product.
	Note: Restrictions can be caused by distance to the source (e.g., water supply network does not reach a certain neighbourhood) and unaffordability (e.g., service is too costly for a certain household or group of people), amongst others.
Alternative sources	Sources that differ from the main city source(s).
	Note: Particularly applicable for electricity (e.g. generators) and water (e.g. bottled water) supply.
Basic Social services	Set of services delivered in education, health, and social areas, as a means to fulfil basic needs.
Biodiversity	Variability among living organisms from all sources including, land, marine and other aquatic ecosystems, and the ecological complexes of which the organisms are part.
	Note 1: This includes diversity within species, between species, and of ecosystems. Biodiversity is thus not only the sum of all ecosystems, species, and genetic material, but rather represents the variability within and among them.
	Note 2: Bio-diversity can also be referred to as biological diversity.
	[Source: Chan, L., et al. User Manual on the Singapore Index on Cities' Biodiversity (also the City Biodiversity Index), 2014]
Built-up areas	Developed area based on built-up pixels.
	Note 1: Can be urban, suburban or rural.
	Note 2: Built-up area is considered urban if the built-up pixels have urban values greater than 50%, suburban if between 10-50%, and rural if less than 10%.
	[Source: Atlas of Urban Expansion. The City as a Unit of Analysis and the Universe of Cities. 2016].
Captured open land	All open space clusters of less than 200 hectares that are fully surrounded by urban and suburban built-up land pixels and the fringe open space around them.
Challenges	Long-term contextual changes and pressures originated outside the urban system that also undermine the city's capacity for sustainability and resilience.
Civil society	Wide range of individuals, groups of people, networks, movements, associations, and organisations that manifest and advocate for the interests of their members and others.
	Note 1: They can be based on philanthropic, cultural, religious, environmental, or political values and convictions.
	Note 2: This definition excludes for-profit companies and businesses, academia, and all government-dependent entities.

Civil Society Organisations (CSOs)	Formal associations in which society voluntarily organises around shared interests. **Note 1:** They include political, cultural, environmental, and faith-based organisations, as well as non-profit and non-governmental organisations. **Note 2:** *CSOs* are institutionalised organisations, bearing some form of legal status that represent particular groups of society and are involved in service delivery.
Climate change adaptation	Increased ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production. [Source: UNEP]
Climate change mitigation	Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impact of climate change. [Source: UNFCCC]
Connectivity	How a landscape is configured and how it allows species to move through its different elements. **Note:** A high degree of *connectivity* is generally linked to low fragmentation.
Contingency planning	Management process that analyses disaster risk and establishes arrangements in advance to enable timely, effective, and appropriate responses. [Source: UNISDR, 2017]
Coverage	Capacity of the duty-bearer to provide a service or product. **Note:** It may be influenced by its financial capacity, by geospatial setting and the normative and institutional frameworks.
Critical facilities	Physical structures, networks, and other assets which provide services that are essential to the social and economic functioning of a community or society. [Source: UNISDR, 2017]
Decentralised authority	Local authorities, distinct from the state's administrative authorities, who have a degree of self-government, elaborated in the framework of the law, with their own powers, resources, and capacities to meet responsibilities and with legitimacy underpinned by representative, elected local democratic structures that determine how power is exercised and that make local authorities accountable to citizens in their jurisdiction. [Source: UCLG, GOLD I, 2008]

Disaster risk	Possibility of loss and injury.

Note: *Disaster risk* includes potential loss of life, disruption to lives and livelihoods (including injury, illness, danger, loss of sense of security or displacement), damage to or loss of property, and disruption of community activities which could occur to a system, a society, or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability, and/or capacity.

[Source: ISO/DIS 22327:2017 and UNISDR, 2017] |
| **Disaster risk assessment** | Qualitative or quantitative approach to determine the nature and extent of disaster risk by identifying and analysing potential hazards, and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods, and the environment on which they depend.

[Source: UNISDR, 2017 with modification] |
| **Disaster risk management** | Coordinated activities to direct and control an organisation with regard to disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk, and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses.

Note: Activities should encompass:
Mitigation - the lessening or minimising of the adverse impacts of a hazardous event; and, Preparedness - the knowledge and capacities developed by governments, response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent, or current disasters.

[Source: UNISDR, 2017 with modification] |
| **Disaster risk reduction** | Aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and, therefore, to the achievement of sustainable development.

[Source: UNISDR, 2017] |
| **Drinking water** | All water either in its original state or after treatment, intended for drinking, cooking, food preparation, or other domestic purposes, regardless of its origin.

Note 1: Safe *drinking water* is water with microbial, chemical and physical characteristics that meet WHO guidelines or national standards on *drinking water* quality.
Note 2: Sources of *drinking water* include household connections, public standpipes, boreholes, protected and unprotected dug wells, protected and unprotected springs, rainwater collection and surface sources, such as river, dam, lake, pond, stream, canal, and irrigation channels.
Note 3: Access to *drinking water* means that the drinking water source is less than one kilometre away from its place of use and that it is possible to reliably obtain at least twenty litres per member of a household per day.

[Source: ISO 5667-5:2006 (en), 2.2 with added notes to entry] |

Duty-bearers	Individuals or institutions who have a particular obligation or responsibility to respect, promote, and realise human rights and to abstain from human rights violations. **Note 1:** The term is most commonly used to refer to State actors, but non-State actors can also be considered *duty-bearers*. **Note 2:** Depending on the context, individuals (e.g. parents), local organisations, private companies, aid donors, and international institutions can also be *duty-bearers*. [Source: UNICEF - Gender Equality, UN Coherence & You]
Ecological footprint	A quantitative measure looking at how much of the available biologically productive land and water an individual, a population, or an activity requires to produce the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices. It is measured in standard units called global hectares.
Economic diversity	Extent to which economic activity of a given defined geography is distributed among a number of categories such as industries, sectors, skill levels, and employment levels.
Ecosystem	Dynamic complex of plant, animal, and microorganism communities and the non-living environment (e.g. soil, air, sunlight) interacting as a functioning unit of nature. **Note:** Everything that lives in an *ecosystem* is dependent on the other species and elements that are also part of that ecological community. [Source: ISO 14055-1:2017(en), 3.1.1 with addition of Note]
Ecosystem services	Benefit people obtain from ecosystems. **Note:** These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, waste generation, and water quality and cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling. [Source: ISO 14055-1:2017(en), 3.1.2 with addition of Note]
Urban Governance	It is the software that enables the urban hardware to function, the enabling environment requiring the adequate legal frameworks, efficient political, managerial and administrative processes, as well as strong and capable local institutions able to respond to the citizens needs. [Source: UN-Habitat's New Urban Agenda]
Green infrastructure	Strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of *ecosystem services*. **Note 1:** It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. **Note 2:** *Green Infrastructure* is a tool for providing ecological, economic, and social benefits through natural solutions. It helps avoid relying on 'grey infrastructure' that is expensive to build when nature can provide cheaper, more durable alternatives. [Source: 2016 European Commission. Environment]

Greenhouse gas emission(s) (GHG)	Total mass of a *GHG* released to the atmosphere over a specified period of time. **Note 1:** Greenhouse gases (*GHGs*) are long-lived gases in the atmosphere that absorb infra-red radiation which would otherwise escape to space absorbing the radiation contributes to rising surface temperatures. **Note 2:** There are six major *GHGs*: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulphur hexafluoride (SF6). **Note 3:** *GHGs* remain in the atmosphere for long periods of time, ranging from months to millennia.
Grievance redress mechanisms	System by which queries or clarifications about a certain matter are responded to, problems that arise out of implementation are resolved, and complaints and grievances are addressed.
Gross Domestic Product (GDP)	Measure of all final goods and services produced in the city within a certain period of time.
Human rights	Rights inherent to all human beings, whatever our nationality, place of residence, sex, national or ethnic origin, colour, religion, language, or any other status. **Note 1:** People are all equally entitled to *human rights* without discrimination. **Note 2:** *Human rights* are: interrelated, universal, and inalienable, interdependent and indivisible, equal and non-discriminatory, and both rights and obligations.
Improved drinking water sources	Sources that, by the nature of their design and construction, have the potential to deliver safe water. **Note 1:** It includes piped water, boreholes or tube-wells, protected dug wells, protected springs, rainwater, and packaged or delivered water. **Note 2:** In order to meet the criteria for a safely managed drinking water service, people must use an improved source meeting three criteria: it should be accessible on premises, water should be available when needed, and the water supplied should be free from contamination. [Source: WHO-JMP-UNICEF, 2017]
Inadequate structure	Walls, ceilings, and floors built with materials, such as asbestos or zinc, or using techniques linked to the absence of appropriate know-how and maintenance, or loss of traditional knowledge based on experience.
Indicator	An indicator refers to a unit of measurement of the *urban system* and consists of a collection of Supporting Indicators and Related Questions. Each Component is composed of a small number of Indicators.
Inequality	State of not being equal, especially in status, rights, and opportunities. **Note:** *Inequality* can be measured economically (or monetarily), regarding living conditions, or based on rights and associated obligations (e.g. when people are not equal before the law, or when people have unequal political power). [Source: UNDP, 2015]

Inflation	Sustained increase in general price levels for all goods and services in an economy over time. **Note:** *Inflation* describes an erosion of the purchasing power of a unit of currency. It is usually expressed as an annual percentage rate of change on an index number.
Informal business	Unincorporated small or unregistered enterprises or productive units. **Note 1:** A productive unit is a formal or informal organisation that provides goods and/or services to the market. **Note 2:** An *informal business* is neither taxed nor formally monitored by any form of government.
Informal sector	Private unincorporated enterprises that are unregistered or small in terms of the number of employed persons (e.g. less than five employees). **Note 1:** An enterprise is unincorporated if it is not constituted as a separate legal entity, independently of its owner(s), and does not maintain a complete set of accounts. **Note 2:** Units engaged in the production of goods or services exclusively for own final use by the household are excluded from the *informal sector*, as are enterprises engaged in agriculture, hunting, forestry, and fishing.
Investment	Allocation of resources to achieve defined objectives and other benefits. **Note:** *Investment* takes two main forms: direct spending on buildings, machinery and similar assets, and indirect spending on financial securities, such as bonds and shares. [Source: The Economist, 2017; ISO/IEC 38500:2015(en), 2.13]
Land consumption	Expansion of built-up area which can be directly measured; absolute extent of land that is subject to exploitation by agriculture, forestry, or other economic activities; and over-intensive exploitation of land that is used for agriculture and forestry. [Source: EEA. 1997]
Land tenure	Relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land, determining how land is used, possessed, sold, or in other ways disposed.
Local public debt	Gross debt of the local public organisation under the following liabilities: 1) currency and deposits; 2) debt securities (bonds); 3) loans; 4) insurance pensions and standardised guarantees; and 5) other accounts payable (commercial debt, arrears).
Municipal solid waste (MSW)	Waste stream consisting of end-of-life-materials consisting mainly of waste generated by households, but may also include similar wastes generated by commerce and trade, small businesses, office buildings, and institutions (schools, hospitals, government buildings), and collected by or on behalf of municipal authorities. **Note:** The term 'municipal' is used in different ways from municipality to municipality and from country to country, reflecting different waste management practices. [Source: Eurostat, 2017 as modified by ISO 16559:2014(en), 4.134]

Natural protected area (NPA)	Clearly defined geographical space, recognised, dedicated, and managed through legal means or other types of efficient means to achieve the long-term conservation of nature with associated *ecosystem services* and cultural values. [Source: ISO 18065:2015(en), 3.6]
Open access	Specific rights are not assigned to anyone and no one can be excluded.
Open area	All the vacant areas - public or private - within the urban footprint. **Note:** Urbanised *open areas* are all fringe open space and captured open space pixels associated with the urban extent.
Open data	Publicly available data (preferably online) disseminated in a user-friendly way (metadata and machine readable format) which is reusable and license free for distribution and publication. **Note:** It must also be universally accessible.
Own-source revenue	All governmental revenues that are raised directly by the municipality **Note:** Common own-source revenues include property/land taxes, fees, and charges for services and permits, locally imposed sales, use or income taxes, investment or rental income generated from city assets, among others.
Para-transit	Transport services that are available to be shared, without prior arrangement, by the general public. **Note 1:** Para-transit, however, is not considered as a part of the traditional public transport regulatory system. **Note 2:** Para-transit, in general, has the following characteristics: Services are usually unscheduled and often, though not always, are on demand-responsive routes; and, The vehicles operated are typically small, including motorcycles and mini-buses. **Note 3:** Para-transit services are usually provided by informal operators with the following characteristics: They are non-corporate, usually operating as single-person enterprises; and, They are often outside the tax system or benefit from favourable treatment of the non-corporate sector. [Source: Roy, E. L., Rosemary, G. M, Transportation Engineering and Planning, Paratransit Systems, 2009]
Participation	Informed process of engagement with stakeholders, where key groups actively participate in defining the process and content of policy making. [Source: UNISDR, 2017 and ISO 22300:2018 (en), 3.187]
Poverty	State or condition of having little or no money/goods/means of support.
Preparedness	Activities, programmes, and systems developed and implemented prior to an incident that can be used to support and enhance prevention, protection from, mitigation of, response to, and recovery from disruptions, emergencies, or disasters. [Source: ISO 22300:2018 (en), 3.172]

Private modes of transport	Transportation means that are not available for the general public, as they are not shared by strangers without prior arrangement.
Private sector	For-profit enterprises, companies or businesses, regardless of size, ownership, and structure. **Note:** It covers all economic sectors and economic activities, ranging from local farmer organisations, cooperatives and small and medium enterprises to large international corporations. It includes private financial institutions, industry and trade associations, and consortia and coalitions that represent private sector interests (e.g., cross-industry multi-issue groups, cross industry issue-specific initiatives, industry-focused initiatives).
Pro-poor land administration	Inclusive system that extends land rights to all and recognizes all rights existing in a continuum. **Note:** It implies that a new, streamlined, affordable form of land recordings must be developed to record these different types of rights and link them to existing deeds and title systems.
Product share	Proportion of the overall market (defined in terms of either units or revenue) accounted for by a specific product.
Public modes of transport	Shared passenger transport services that are available to the general public and are shared by strangers without prior arrangement. **Note:** It ideally has well designed 'stops' and demarcated 'routes' that are both officially and/or formally recognised. [Source: UN-HABITAT, Unpublished manuscript, 2016]
Public open space	Areas within the urban footprint that are accessible for public use. **Note 1:** These are delimited by local planning. **Note 2:** *Public open spaces* encompass open air, outdoor areas in the city that are accessible by the public for recreational use, e.g. public parks, squares, recreational green areas, public playgrounds and widened pedestrian areas. It does not include streets, unless the city specifically indicates them as recreational space, nor areas devoted to public facilities that are not open to the general public.
Recovery	Restoration and improvement, where appropriate, of livelihoods and health, as well as economic, physical, social, cultural, and environmental assets, systems, and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and *build back better*, to avoid or reduce future disaster risk. [UNISDR, 2017 and ISO 22300:2018 (en), 3.187]
Related Question	Related Questions are structured similarly to Supporting Indicators, but the data collected are of secondary importance and generally not subject to a benchmarking process.

Resilience	Ability to absorb and adapt in a changing environment. **Note:** In the context of urban resilience the ability to absorb and adapt to a changing environment is determined by the collective capacity to anticipate, prepare, and respond to threats and opportunities by each individual component of an urban system. [Source: ISO 22300:2018 (en)]
Rights-holders	Individuals or social groups that have particular entitlements in relation to specific duty-bearers. **Note:** All human beings are *rights-holders* under the Universal Declaration of Human Rights. A human rights-based approach does not only recognize that the entitlements of *rights-holders* need to be respected, protected, and fulfilled, but it also considers *rights-holders* as active agents in the realisation of human rights and development, both directly and through organisations representing their interests. [Source: UNICEF, Gender Equality, UN Coherence & You]
Risk mitigation	Lessening or minimizing of the adverse impacts of a hazardous event. [Source: UNISDR, 2017]
Shocks	Uncertain, abrupt, or long-onset events that have potential to impact upon the purpose or objective of an urban system.
Social accountability	Approach to governance that involves citizens and civil society organisations in public decision making.
Social protection	Preventing, managing, and overcoming situations that adversely affect people's well-being. **Note:** It consists of policies and programmes designed to reduce poverty and vulnerability by promoting efficient labour markets, diminishing people's exposure to risks, and enhancing their capacity to manage economic and social risks, such as unemployment, exclusion, sickness, disability, and old age. [Source: UNISDR]
Social protection floor (SPF)	Nationally defined sets of basic social security guarantees that should ensure, as a minimum that, over a life cycle, all in need have access to essential health care and to basic income security which together secure effective access to goods and services defined as necessary at the national level.
Stakeholder	Person or organisation that can affect, be affected by, or perceive itself to be affected by a decision or activity. **Note:** Stakeholders may include government entities, private sector, civil society, academia, and other major institutions from the local to the international level operating in the city. [Source: ISO 9000:2015, 3.2.3 and ISO 22300:2018 (en), 3.124]
Stresses	Chronic and ongoing dynamic pressures originated within an urban system with potential for cumulative impacts on the ability and capacity of the system to achieve its objectives.

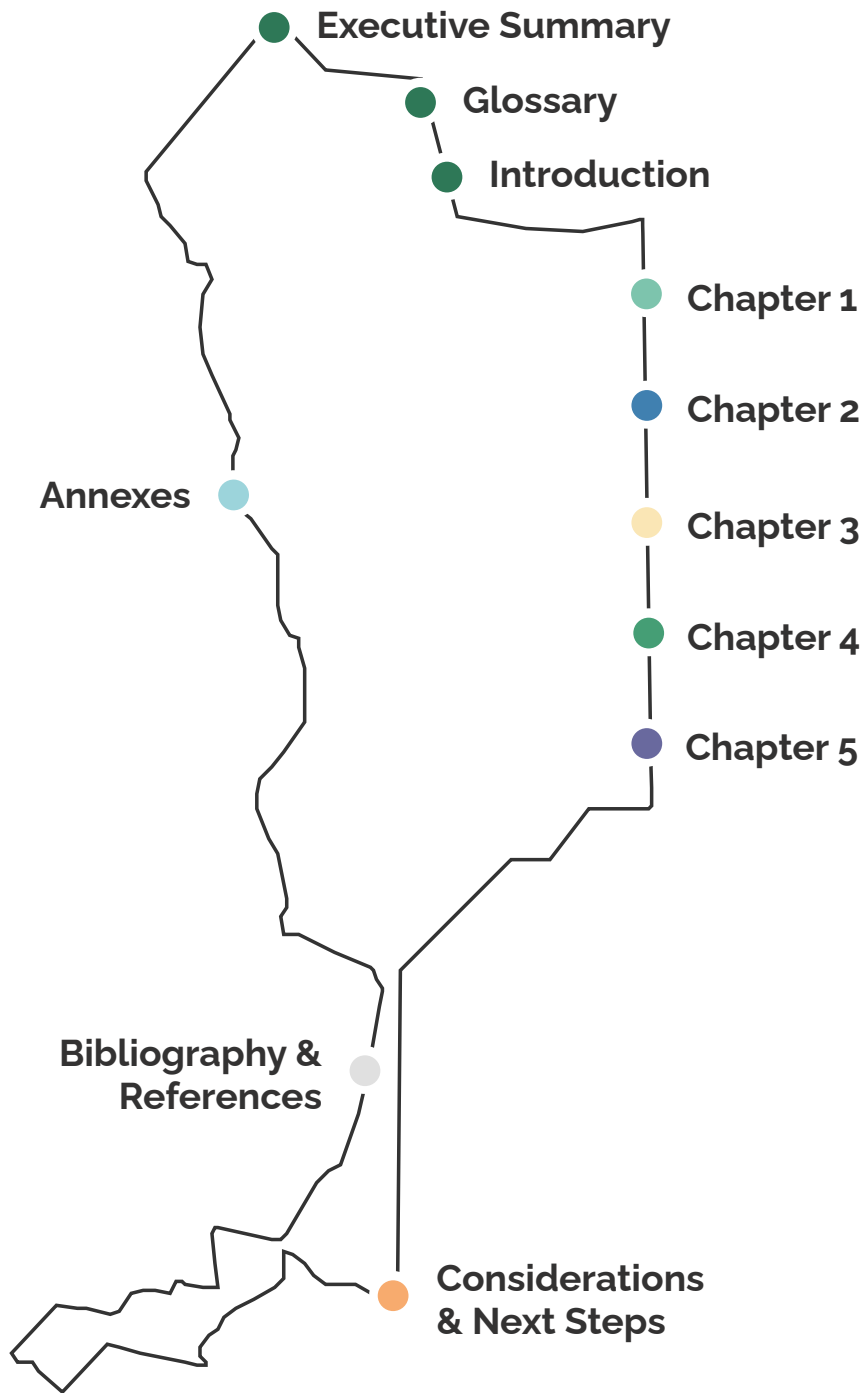|	
Stressor	Factors, processes, activities or interactions that individually or conjointly lead to the generation of a stress in the urban system.
Supply chains	Two-way relationships of organisations and/or people with processes, logistics, information, technology, and resources engaging in activities and creating value from the sourcing of materials through the delivery of products or services. **Note 1:** The supply chain may include vendors, subcontractors, manufacturing facilities, logistics providers, internal distribution centres, distributors, wholesalers, and other entities that lead to the end user. [Source: ISO 22300:2018 (en) 3.251]
Supporting Indicator	A Supporting Indicator is the principal data collection unit for the City Resilience Profiling Tool (CRPT), consisting of a question or group of questions requiring a quantitative and/ or qualitative response. The majority of data generated by Supporting Indicators are bench-markable or quantitatively measurable.
Sustainable modes of transport	Transport that has zero or minimum effect on the environment due to the use of sustainable or regenerated energy.
Trade balance	Measure of how a given entity's (city, region, country, etc.) total imports by value compare to its total exports by value. **Note 1:** An excess of imports over exports is referred to as a trade deficit while an excess of exports over imports is described as a trade surplus.
Urban	Any town, city, or other human settlement.
Urban agglomeration	The physical structure and composition of an urban area or continuity of large urban clusters where the built-up zone or population density of an extended city or town area or central place and any suburbs are linked by continuous, connected urban development.
Urban footprint	Built-up area, the fringe open land, and the captured open land.
Urban green space	Urban space covered by vegetation of any kind. **Note 1:** This includes: 1. smaller green space features (such as street trees and roadside vegetation); 2. green spaces not available for public access or recreational use (such as green roofs and facades, or green space on private grounds); and 3. larger green spaces that provide various social and recreational functions (such as parks, playgrounds, or greenways). [Source: 2017. Urban Green Space interventions and health. World Health Organisation. Regional Office for Europe]
Urban open area	All the vacant areas − public or private − within the urban boundaries. **Note 1:** Urban open areas are all fringe open space and captured open space associated within the scope and parameters of the urban system. **Note 2:** State, national parks, or open areas in the countryside outside the parameters of the urban area are not considered, here, as urban open areas.

Urban resilience

bility of any urban system, with its inhabitants, in a changing environment, to anticipate, prepare, respond to, and absorb shocks, positively adapt and transform in the face of stresses and challenges, while facilitating inclusive and sustainable development.

Note 1: A more resilient urban system is characterised by its ability to continue through disruption in the short-to-medium term, combined with a capacity to reduce pressures and adapt to changes, risks and opportunities. Urban resilience therefore is dependent upon not just the ability of an urban system to deal with shocks, but also with chronic stresses and challenges.

Note 2: Urban resilience is dependent upon the individual and collective resilience of the separate components of a complex urban system. Although a city, town, or community within an urban area may individually demonstrate enhanced resilience within their respective boundaries, urban resilience encompasses the broader geographic scope of urban agglomeration. Resilience of an urban system is measured by the capacity of resilience for each individual system component and dependent upon the resilience of the weakest performer among the urban agglomeration within the system scope.

Note 3: In order to assess, plan and act accordingly in the face of shocks, stresses, and challenges, an urban system's capability for resilience should be measured and analysed through qualitative and quantitative data.

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List of Acronyms and Abbreviations

A4R	Actions for Resilience
AGESPISA	Águas e Esgotos do Piauí
ANEEL	Agência Nacional de Energia Elétrica
BNDES	Banco Nacional de Desenvolvimento Econômico e Social (National Bank for Economic and Social Development)
BNH	Brazil's National Housing Bank
BRT	Bus Rapid Transit
CAF	Corporação Andina de Fomento
CAIXA	Caixa Econômica Federal
CDL	Câmara de Dirigentes Lojistas de Teresina
CODEVASF	Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba
CONAMA	Conselho Nacional do Meio Ambiente
CRGP	City Resilience Global Programme
CRPT	City Resilience Profiling Tool
CTA	Consórcio Teresina Ambiental
DRR	Damage and Risk Reduction
EEE	Estações Elevatórias de Esgoto (Sewage Lift Stations)
ETA	Estações de Tratamento de Água (Water Supply Treatment Plants)
ETE	Estações de Tratamento de Esgoto (Sewage Treatment Stations)
FIEP	Federação das Indústrias do Estado do Piauí
FTL	Ferrovia Transnordestina Logística
GDP	Gross Domestic Product
GEF	Global Environment Facilities
HDI	Human Development Index
IBGE	Instituto Brasileiro de Geografia e Estatística
ICLEI	Local Governments for Sustainability
ICMS	Imposto sobre Circulação de Mercadorias e Serviços (Tax on Circulation of Goods and Services)
IDEB	Índice de Desenvolvimento da Educação Básica
INMET	Instituto Nacional de Meteorologia (National Institute of Meteorology)
INPE	Instituto Nacional de Pesquisas Especiais

INSS	Instituto Nacional do Seguro Social
IPCA	Índice Nacional de Preços ao Consumidor Amplo (Broad National Consumer Price Index)
IPCC	Intergovernmental Panel on Climate Change
SEBRAE	Serviço Brasileiro de Apoio às Micro e Pequenas Empresas
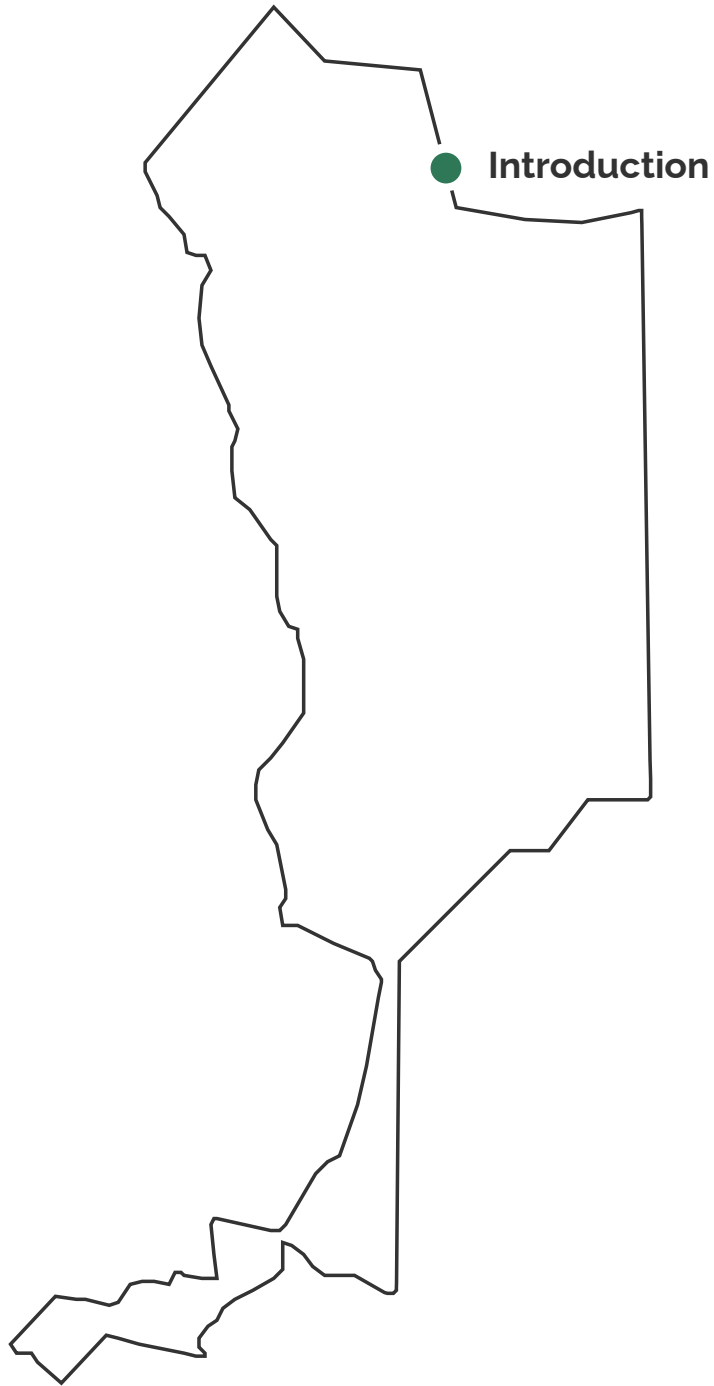
Introduction

Introduction

In 2019, the Municipality of Teresina, the Government of Brazil and the United Nations Human Settlements Programme signed a Cooperation Agreement for the implementation of the Teresina Urban Resilience Programme. Through this agreement, for 2 years, the parties worked together to build the technical capacity for urban resilience in the municipality and produced a strategic roadmap of action for the city, called Action Recommendations for Resilience and Sustainability.

With the support of the Global Resilient Cities Programme (CRGP), the municipality implemented the City Resilience Profile Tool (CRPT). The CRPT provides a universal framework that uses verifiable and context-driven city data to establish a resilience profile and create an analysis and diagnosis of its most pressing challenges. This profile and diagnosis provide a basis for the creation of evidence-based and implementable resilience actions that are designed to be incorporated into the city's current urban development strategies and management processes. This process aims to support Teresina and its partners in making informed decisions and, in turn, supporting long-term sustainable and resilient urban development.

The aim of this report is (1) to better inform the Local Government, in this case the Municipality of Teresina, of the current state of the city with regards to resilience and ongoing related trends, based on conclusions derived from the CRPT implementation process described in this document; and (2) present a set of activities and actions, organised under three lines of action which, based on the project's theory of change, guides municipal public policies in response to the priority issues previously identified.

The introduction of this report briefly presents the CRPT methodology, which serves as the basis for the analytical findings presented in the following chapters. Although the report seeks to summarise the multifaceted implementation process, the analytical and diagnostic efforts, towards the development of concrete recommendations for actions to build resilience in Teresina, it does not seek to provide details of the methodological basis from which the CRPT was developed, nor of the analytical process in its entirety, given its extensiveness. Please refer to the CRPT Implementation Manual for a detailed description of the CRPT implementation process.

CRGP: City Resilience Global Programme

CRGP is UN-Habitat's flagship programme for Urban Resilience in partnerships with local governments

UN-Habitat's flagship tool for urban resilience, the City Resilience Profiling Tool (CRPT), provides a cross-cutting, action-oriented approach to resilience and sustainable urban development. Its methodology is based on UN-Habitat's definition of urban resilience, shown below, which encompasses a theoretical approach followed by a more practical description of what resilience-building efforts entail and target.

UN-Habitat defines urban resilience as, "The measurable ability of any urban system, with its inhabitants, to maintain continuity through all shocks and stresses, while positively adapting and transforming toward sustainability. A resilient city evaluates, plans and acts to prepare and respond to threats - natural or man-made, sudden and slow onset, expected and unexpected - in order to protect and improve the lives of people, to ensure development, foster an investment environment and drive positive change".[1]

This definition and understanding of resilience outline the overall objective for each city implementing the CRPT. A shared understanding of resilience is crucial in catalysing stakeholder engagement and garnering buy-in from partners.

In addition to the definition of urban resilience, the following Urban Resilience Principles, which are integrated into the structure, design, and implementation of the CRPT, guide cities in urban resilience development.

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[1] UN-Habitat CRGP, (2018).

CRGP: Urban Resilience Principles

Principle 1
Dynamic nature of urban resilience

Resilience is not a condition, but a state that cannot be sustained unless the system evolves, transforms and adapts to current and future circumstances and changes. Therefore, building resilience requires the implementation of context-specific and flexible plans and actions that can be adjusted to the dynamic nature of risk and resilience.

Principle 2
Systemic approach to cities

Recognising that cities are comprised of systems interconnected through complex networks and that changes in one part have the potential to propagate through the whole network, building resilience requires a broad and holistic approach that takes into account these interdependencies when the urban system is exposed to disturbances.
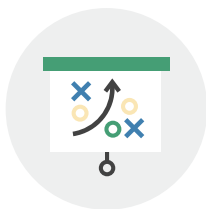
Principle 3
Promote participation in planning and governance

A resilient system ensures the preservation of life, limitation of injury, and enhancement of the 'prosperity' of its inhabitants by promoting inclusiveness and fostering comprehensive and meaningful participation of all, particularly those in vulnerable situations, in planning and various governance processes. Such an approach can ensure a sense of ownership, thus achieving successful implementation of plans and actions.

Principle 4
Multi-stakeholder engagement

A resilient system should ensure the continuity of governance, economy, commerce, and other functions and flows upon which its inhabitants rely. This necessitates promoting open communication and facilitating integrative collaborations between a broad array of stakeholders ranging from public entities, private sector, civil society, and academia to all city's inhabitants.

Principle 5
Strive towards development goals

Resilience building should drive towards, safeguard, and sustain development goals. Approaches to resilience should ensure that efforts to reduce risk and alleviate certain vulnerabilities do not generate or increase others. It must guarantee that human rights are fulfilled, respected, and protected under any circumstances.

CRPT: Methodology and alignment with the international Agenda 2030

The CRGP approach of working with cities to enhance resilience is characterised by four overlapping steps: (1) data collection; (2) analysis; (3) diagnosis; and (4) recommended actions for resilience. The methodological framework, discussed briefly below, and illustrated in Figure 1, explains how the data collected lead to actions, and how these key implementation processes are pursued and relate to one another.

The first three phases of implementation are facilitated through the application of the City Resilience Profiling Tool (CRPT). The Tool's flexibility and modularity enable it to be tailored to specific policy-driven, thematic, or vulnerability-derived demands, assisting cities both in tackling persistent systemic challenges and better informing strategies to address previously identified policy priorities. In Teresina, the tool modularity allowed for a baseline assessment, and an analysis and diagnosis around particular areas of concern for resilience in Teresina - hereinafter referred to as 'priority matters' - identified through several stakeholders' consultation and dialogue workshops.

At the data collection phase, the programme adopted different techniques that combined workshops, to derive local knowledge and expertise, with desk research and in-depth indicators-based approach - known as Urban context and Performance - to assess the urban system and corroborate the findings derived from workshops.

The initial phase of data collection in Teresina fed the Urban Context which explores the development narrative through the city's historical background and its spatial, social, economic, and cultural context. Urban Context covers the administrative structures, characteristics, and strategies, highlighting those related to resilience, and focuses attention on resilience-related challenges and opportunities, as well as the most plausible and serious risks of shocks and stresses the city faces. This is done through both desk research, individual interviews as well as focus groups discussions, and workshops.

Data gathered at this initial phase, as part of the Urban Context, were grouped and analysed by drawing on CRPT's three analytical lenses: the WHAT, WHY, and WHO, which allowed the following:

- A thorough knowledge of the context's characteristics and attributes - the What lens, meaning the resilience of What;

- The identifications of shocks and stresses that have occurred in the past, continue to happen frequently in the present, as well as new and plausible ones in the future, their drivers and potential impacts – Why urban resilience;

- An initial understanding of local governance, administrative structures and stakeholders that can play crucial roles in shaping urban resilience in the city, these can be public actors at multiple levels of government, private entities, civil society organisation and community groups, to name but a few. This set of information is analysed through the Who lens – resilience by who and for whom.
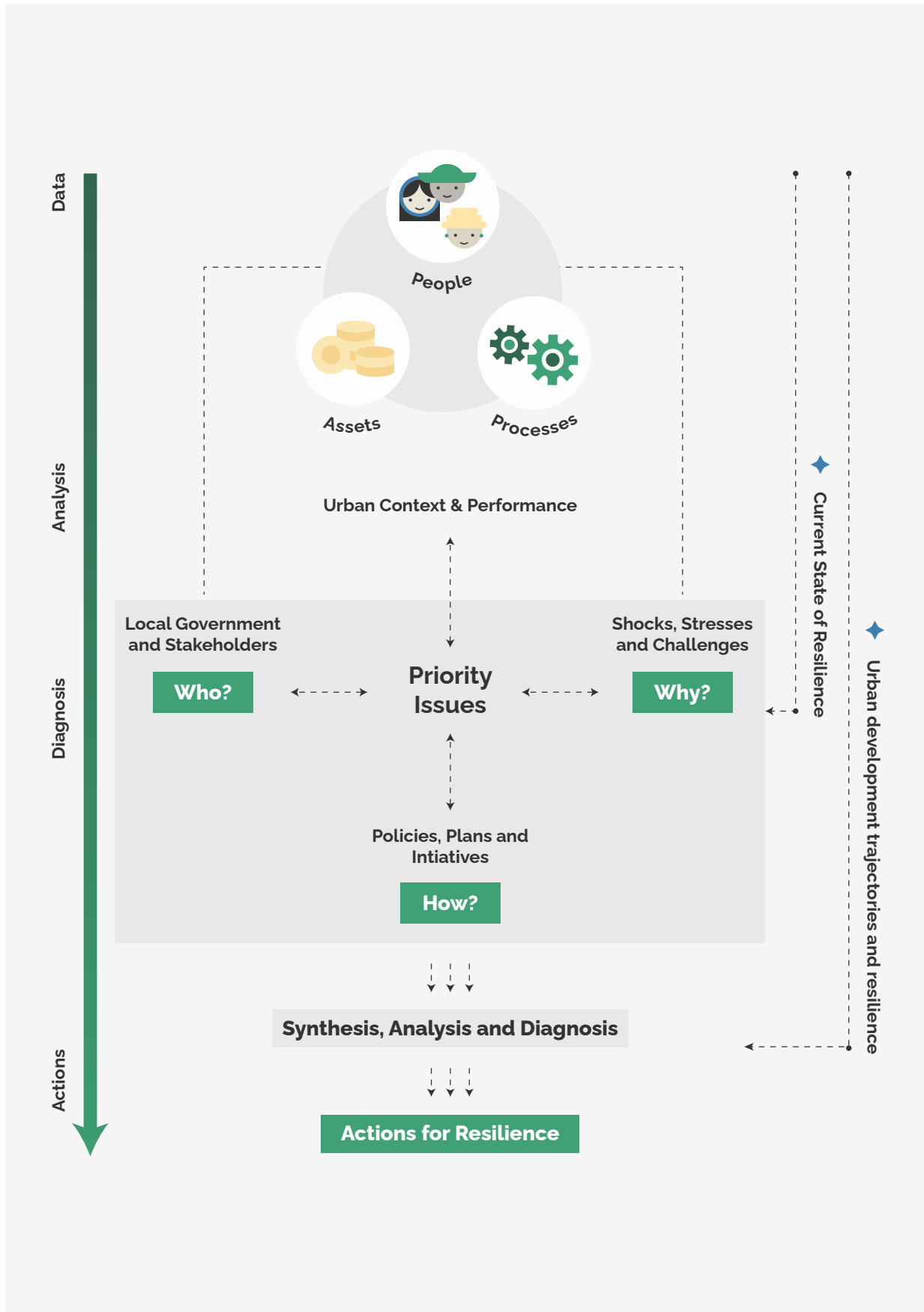
Figure: CRGP methodological framework diagram. Source: CRGP (2018).

The knowledge acquired through the Urban Context phase paved the way for an informative debate with and among different stakeholders through the Priority Matters workshops. The aim was to build consensus on areas of concern that need priority attention by the local government and stakeholders in order to enhance the city's resilience. To this end, Urban Context data were displayed and shared with workshop participants, and interactive systems mapping tools and techniques were utilised (see annex I – Risk and Priority Matters Workshops in Teresina). The system mapping allowed for the exploration of links - and their nature - between shocks and stresses that have occurred in the past and continue to pose serious risks for the city and its inhabitants, in addition to new plausible ones. Through this mapping, participants illustrated how combinations of shocks and stresses can drive the constitution of complex issues – Priority Matters - in light of existing contextual and emerging challenges such as climate change. The outcome of these workshop(s) was the identification of Priority Matters for building and enhancing the city's resilience. The majority of risks to the urban system converge and concentrate around these Matters, characterised by certain challenges or constraints, however, when addressed adequately, they also offer opportunities to maximise the outcome of targeted actions.

The next step was evidence-based validation, and characterisation of the workshops' findings. This step is completed through the CRPT's Urban Performance - an in-depth indicators-based approach. The CRPT provides an inventory of indicators to assess multiple elements and components of urban systems in terms of resilience. This phase of CRPT implementation was focused on collecting objective data, information and knowledge, localised through Urban Context and centred around specific Priority Matters for urban resilience (co-identified and co-prioritised in the priority matters workshop(s)). Furthermore, these data provide a basis to characterise (and quantify if necessary) some of the drivers of the identified Priority Matters as well as latter's effects and associated risks.

The analysis of indicator data, together with a review of existing, or under-development plans, policies and initiatives, answered the How lens, which aimed at examining how different priority matters and their drivers play out in light of existing, or under-development policies, plans and initiatives. The review provided Information on the existing development efforts, based on established policy and/or legal frameworks, which guide the future development of the city including those concerning risk reduction measures.

Synthesising the analysis outcomes of the four lenses – what, why, who, and how - led to the formulation of Urban Resilience Diagnosis, which draws a picture of the urban trajectories in terms of resilience and in the wider context of the priority matters identified, challenges and constraints encountered by the local government in Teresina, and ongoing urban and territorial development trends.

The Actions phase, also referred to as the Actions for Resilience (A4R) phase, entailed co-producing a roadmap with the local government and relevant stakeholders, based on the Diagnosis and potential trends of risk and resilience in the city, and with a view to initiating positive change through verifiable evidence.

At this phase of implementation, outcomes are prioritised and implementable Lines of Actions are identified and agreed upon with the local government and stakeholders, to address the Priority Matters.

Along each Line of Action, Recommendations for Actions for Resilience are developed in order to co-create a resilient and sustainable roadmap for the city. These actions are intended to be both implementable and feasible, yet precise and ambitious in their expected impact.

Alignment with international frameworks and agendas

CRGP's approach, and its CRPT tool were developed in alignment with globally agreed inter-governmental frameworks, namely: Sustainable Development Goals, Sendai Framework for Disaster Risk Reduction, Paris Agreement on Climate Change, World Humanitarian Summit - Agenda for Humanity, and the New Urban Agenda. Aligning CRGP's work with these frameworks enables the local governments who have implemented it to better understand, report, and deliver on targets.

Sendai Framework for Disaster Risk Reduction

The Sendai Framework requires resilience at all levels of planning, local, regional, and national. The CRGP contributes to the overall objective of the framework in implementing cities, like in Teresina, by: reducing vulnerability to disasters and increasing preparedness for response and recovery, and contributing to the four priorities for action:

- **Priority 1:** Build knowledge based on evidence on disaster risk reduction;
- **Priority 2:** Strengthen governance frameworks against disaster risk through the adoption of plans;
- **Priority 3:** Invest in risk reduction and resilience;
- **Priority 4:** Expand the preparation of the stakeholders and an "early recovery" approach.

Sustainable Development Goals

Urban resilience is related to key elements of sustainable urban development and to the objectives of the Post-2015 Sustainable Development Agenda, in particular with Objectives 1, 2, 3, 9, 11, 13 and 14, where reference is made to resilience, but also with other objectives where it appears implicitly. Resilience is an important component of many of the objectives set out in the entire preamble and paragraphs 7, 9, 14, 23, 29 and 33 of the Declaration to the SDGs. Cities implementing the CRGP's approach and tool, such as Teresina, are well-positioned to move towards the targets and indicators set out in the SDG framework.

Paris Agreement on Climate Change

Brazil is a signatory of the Paris Agreement and, as such, Teresina has a shared responsibility to contribute to its goals. CRPT implementation should assist the city to work towards Article 7, which requires the strengthening of resilience in the face of climate change as a premise of sustainable development. Resilience in cities requires the involvement of local governments in the following principles of the Paris Agreement:

- Adaptation to the impacts of climate change;
- Minimisation of losses and damages related to climate change;
- Local resilience construction.

World Humanitarian Summit – Agenda for Humanity

The main responsibilities defined in the World Humanitarian Summit are related to the construction of resilience. The approach adopted by UN-Habitat to build resilience, and showcased through the collaborative implementation of the programme's approach in partnership with cities like Teresina,contributes to priorities 1D, 4A, 4B, 4C and 5A.

New Urban Agenda

Resilience is related to some of the key objectives of the New Urban Agenda agreed by Member States during Habitat III. Through the collaborative implementation of the CRPT, Teresina is supporting:
a. New paradigms of urban planning for resilience.
b. Legal and regulatory frameworks that allow adequate governance in urban development.
c. Analysis of inherent risks in urban areas.
d. Promotion of good practices related to the local economy and strategies to promote safe and sustainable cities.

CRGP: Implementation Process in Teresina

Teresina Urban Resilience Programme

The Programme's approach is, first, to generate metrics of urban resilience to establish a baseline (or 'profile') that covers the entire urban system in search of weaknesses, vulnerabilities and strengths, and to prioritise lines of actions, to develop concrete and actionable strategies for strengthened resilience. The approach follows a multi-sectoral, multi-hazard and stress, and multi-scale approach, and is based on the understanding that cities function as a set of integrated and interdependent systems, regardless of their size, culture, location, economy and or political environment.

The implementation process in Teresina was divided into two main phases. The first year of implementation (2020), concentrated efforts on data collection, analysis, diagnosis and proposition of Actions for Resilience. The second year concentrated on strategic actions, implementation roadmaps, financing and communication of the proposed lines of action. In this first year, three main products were produced from the programme's activities: The City Profile (City ID), consolidating the information from the Urban Context; the City Resilience Diagnosis (City Diagnosis), an analysis of data collection and urban performance findings, actors and processes; and, finally, the Urban Performance Indicators Benchmark Report. During the second year of implementation, two main products were delivered by the cooperation: the Recommended Actions for Resilience and Sustainability (RAR-S Report), a strategic planning document that guides paths towards a more resilient Teresina; and the RAR-S Implementation Roadmap, identifying short, mid and long-term strategies for enhancing implementation and building a monitoring framework.

Image: Teresina, Brazil. Source: David Jales.

Feb 2020	**Inception Training (Remote)** Project Kick-Off CRGP Training 2020 Workplan	**Cooperation Agreement**
May-Jun 2020	**City Profile Report Preparation** CRPT DRR Training **Formalisation of Resilience Commission**	**City Profile Report**
Jul-Sep 2020	**3 workshops** on risks **2 workshops** on Financing DRR **Data Collection** Shocks and Characterisation	
Oct-Dec 2020	**3 workshops** Stresses Priority matters **Data Collection** Indicators PPI Inventory	
Oct-Dec 2020	**Diagnostic** Current state of Resilience Resilience **trajectories** in Teresina	**Teresina Urban Resilience Diagnosis Report** / **Teresina Urban Performance Indicators Report**
Jan-Mar 2021	**2021 Work-plan** **RC Training** **Experts Hiring**	**Teresina Urban Resilience Diagnosis Report (EN)**
Apr-Jun 2021	**RAR-S induction** RAR-S methodology Experts On-board Workshops **RAR-S Theory of Change** **In-Depth** on A4R	
Jul-Sep 2021	**2 Stakeholders Workshops** on Actions **2 Local Gov Interdepartmental workshops** on Actions for Resilience Preliminary actions and recommendations	
Oct-Dec 2021		
Jan-Mar 2022	**RAR-R Report preparation** Report writing, revision and validation	**Teresina RAR-S Report (PT/EN)**
	RAR-S Implementation Monitoring & Evaluation Strategy **2 Workshops** implementation M&E strategy	**Teresina RAR-S Implementation Roadmap (EN)**
Apr-Jun 2022	CRGP Wrap-UP Mission Programme evaluation and reporting	**Cooperation Closure**

Figure: CRPT implementation in Teresina. Source: CRGP (2022).

Report Structure

The organisation of this report does not necessarily follow the steps mentioned above in the methodological framework. It is rather structured around the main findings as a result of the different activities conducted as part of the implementation process - namely data collection, analysis, and diagnosis. The report has four main interrelated chapters: Chapter 1 - Urban Context, Chapter 2 - The current state of Urban Resilience in Teresina, Chapter 3 - Urban development and Resilience Trajectory in Teresina, and Chapter 4 - Synthesis and Diagnosis.

Chapter 1: Urban Context

Urban Context presents an overview of the findings of both CRGP desk research and stakeholders' participatory workshops. It brings together qualitative and quantitative data on various aspects including historical background, population and demographics, spatial dimensions, local economy and livelihood, the composition of local government and municipal departments, and present resilience related challenges and opportunities.

Chapter 2: The Current State of Urban Resilience

The current state of Urban Resilience in Teresina displays the main priority matters for urban resilience in Teresina that were co-identified and co-prioritized through stakeholders' participatory workshops, validated and further characterised through indicators-based urban performance assessment. Particularly, this analytical chapter illustrates the different combinations of shocks and stresses that are shaped by present urban challenges (see chapter 1 - Challenges and opportunities) leading to the emergence of each priority matter. It further presents the characterisation of each priority matter through an urban performance assessment, which relies on CRPT indicators to evaluate the strengths and weaknesses of different urban elements linked to priority matters.

Chapter 3: Urban Development and Resilience Trajectory

Urban Development and Resilience Trajectory in Teresina presents ongoing context-related trends, namely climate change, the unfolding impacts of the COVID-19 pandemic, and urban development trends that have the potential to directly or indirectly promote or undermine resilience building. To this end, the chapter illustrates the result of an extensive review of policies, plans, initiatives and risk reduction measures in place or under-development that have the potential to influence, on different levels, priority matters for resilience in Teresina.

Chapter 4: Synthesis & Diagnosis

Synthesis and Diagnosis brings together the findings of the three previous chapters with the aim of drawing a picture of the urban trajectories in terms of resilience to the priority matters identified, challenges and constraints encountered by the local government in Teresina, and ongoing urban and territorial development trends. It is hoped that this analysis synthesis will establish the ground for a well-informed roadmap to be jointly co-designed by CRPT's Actions for Resilience experts, the municipality of Teresina, and local stakeholders to strengthen urban resilience and sustainability

Chapter 5: Recommended Actions for Resilience and Sustainability

Actions for Resilience presents a roadmap co-produced with the local government and relevant stakeholders, based on the Diagnosis and potential trends of risk and resilience in the city, to initiate positive change through verifiable evidence. Furthermore, it recommends several activities and necessary inputs along three main Lines of Actions: 1. The institutionalisation of urban resilience in city planning and local operations; 2. Improving urban management mechanisms for sustainable urban development; 3. Building a strong and resilient local economy.
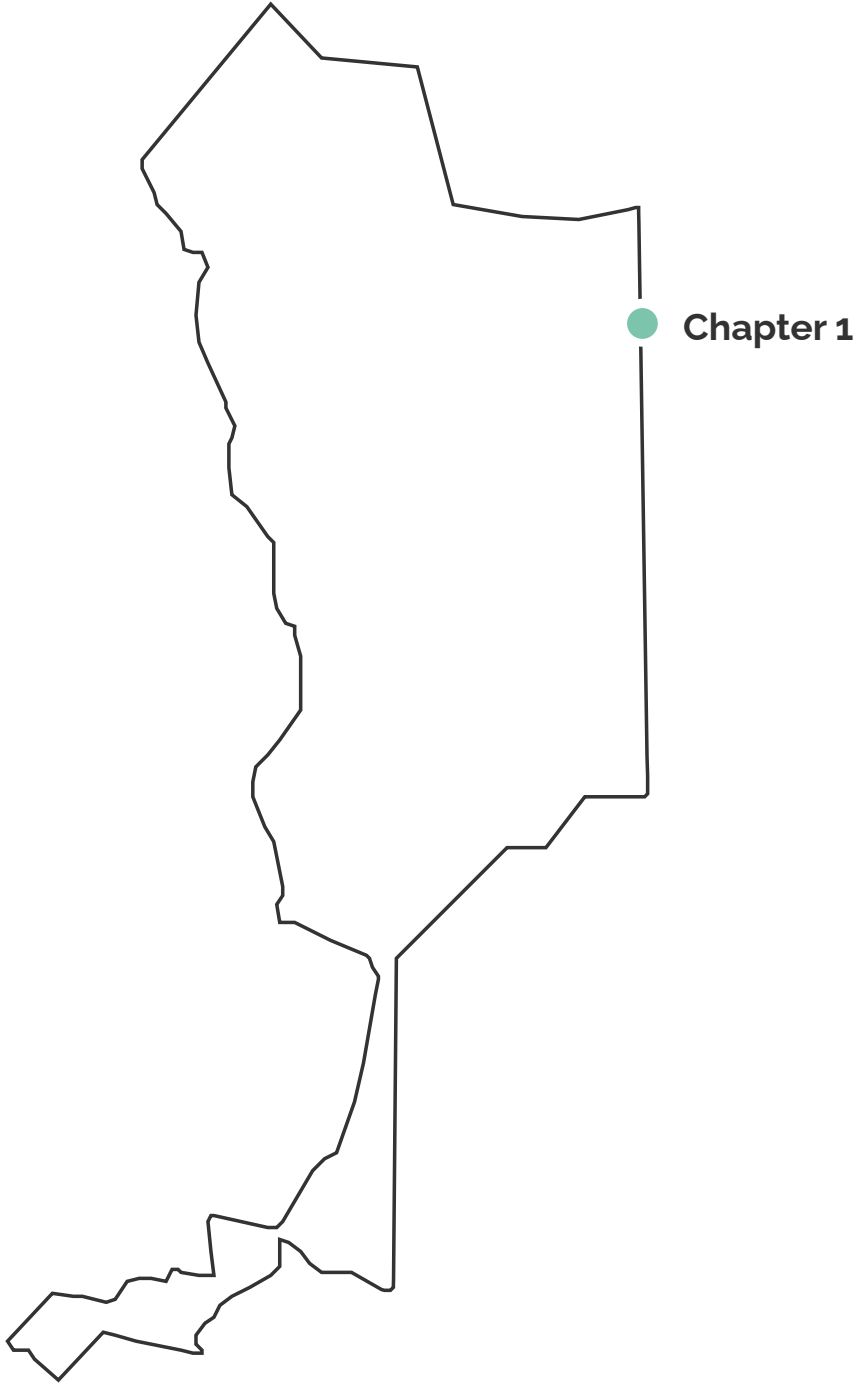
Chapter 1

Chapter 1
Urban Context

Chapter 1
Urban Context

1.1. City Context and History of Teresina

The city of Teresina is the capital of the State of Piauí and is the only capital of the Brazilian northeast not located on the Atlantic coast. Nevertheless, its relationship with water is strong as the city is crossed by the mighty Parnaíba and Poti rivers, and numerous hydrological lakes and streams. The Parnaíba River separates Teresina from the city of Timon, in the neighbouring State of Maranhão, although the two are by the historic Metal Bridge, among other new connections. Despite its 169 years and the region's structural development deficit, Teresina is growing as a regional reference in education and health services, and is harbouring an emerging service sector, which attracts people from surrounding cities and states who commute daily to the town and overflow the capacities of its municipal public facilities.

Teresina is a sparsely populated city, with its 871,126 inhabitants (2021) settled in a river plain area of 1391 km² at 72 metres above sea level. In the Koeppen-Geiger climate classification, Teresina is part of the Tropical Group (A) with Savanna climate (Aw), with two defined climatic seasons (summer and winter), as well as two annual seasonal variations with periods of drought (September-December) and heavy rainfall wet weather (January-April).

The rainy season concentrates more than 70% of the year's rainfall in just four months. Increasing rainfall intensity is putting pressure on urban infrastructure and exacerbating existing risks of fluvial and pluvial flooding. The dry season is severe, with August having only 06mm of average rainfall and reaching intense temperatures. October is the hottest month, with highs of 41ºC. The heat in the city has worsened in recent decades, with an average warming twice that of the global average. The number of very hot days has also increased sharply, rising from an average of 240 days a year in the 1960s, to a current average of between 332 and 360 days, which has increased the need for artificial cooling for the whole year.

Regarding the socio-economic characteristics of its population, it is important to understand the background of intense rural-urban migration from the 1960s onwards. The intense migratory flow to the city was not accompanied by adequate investment in infrastructure, giving rise to a deficit in housing and basic urban services, associated with the challenges of peripheral development of the region and subsequent poverty and inequality.

Despite the above challenges, the city has undertaken a set of structural, organisational, and administrative arrangements to accelerate development, universalise access to basic urban services and improve the quality of public educational and health services. Currently Teresina is the leading capital in public education with the best result in national assessment.

Image 2: Teresina, Brazil. Source: Bruno Vinelli.

Figure 3: Teresina spatial location. Source: IBGE Brazil.
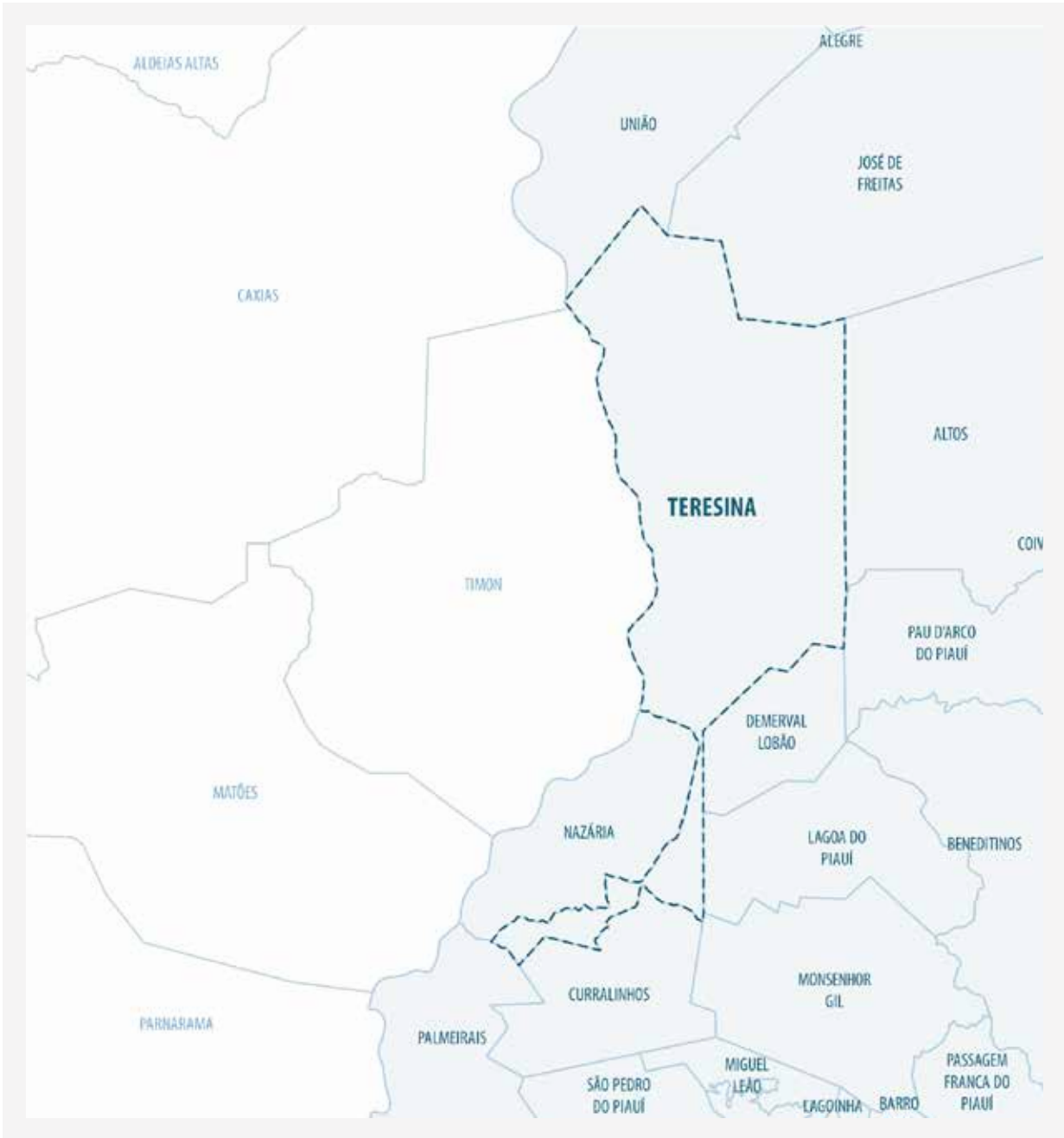
TERESINA | MUNICIPAL BOUNDARY

Municipal Location

Municipal boundary and neighboring municipalities

⌐⌐ Teresina Municipal Boundary

Piauí State
☐ Municipal Boundaries

Maranhão State
☐ Municipal Boundaries

Source: Municipality of Teresina, IBGE Brazil

0   5   10 km

△ N

Figure 4: Municipal boundaries of Teresina. Source: Municipality of Teresina and IBGE Brazil.

Foundation of the City

Teresina has its origins at the confluence of the Parnaíba and Poti rivers. The earliest settlement was called Barra do Poti in 1760. The privileged location between the rivers was a transit route for merchants who travelled from Oeiras, then the capital of Piauí, to Parnaíba, a coastal city in the State. Commercial and agricultural activities were developed in the region and the small settlement was elevated to the category of Village, Vila do Poti, which was later called Vila Nova do Poti.

In the middle of the 19th century the President of the Piauí Province intended to change the capital of the Piauí Province for a more strategic location with better access to waterway transport, and to escape from the arid backlands of the then distant capital Oeiras. Cities such as Campo Maior, Amarante and Parnaíba coveted the position, but in 1852 the Vila Nova do Poti was chosen to become the capital, from then on called Teresina. The definitive transfer of the capital occurred on August 16 of the same year.

The new capital was the first in Brazil to grow in a geometric plan, conceived by the Province President, José Antônio Saraiva. The city would be developed between the rivers with parallel lines, symmetrically arranged, all starting from the Parnaíba River, towards the Poti River. The City Hall, public agencies and churches were the references for the following urban development plans.

Population growth has proved to be a challenge since the city's initial foundation. The organised urbe idealised by Saraiva could not bear the large number of migrants arriving through Rua dos Viajantes from the interior of Piauí and neighbouring provinces of Maranhão, Ceará and Pará in search of better social conditions and fleeing the severe drought that devastated the rural countryside at the end of the 19th century.

Without infrastructure, sanitation, water supply or energy, the newly arrived immigrants crowded into straw houses on the outskirts of downtown Teresina, which had high-standard houses for the Teresina elite. According to records at the time, the shacks were so close to each other that it was difficult for people to pass between one and another; the sewage ran in the open spreading diseases. The conditions were propitious for tragedies and, in the decade of 1940, many fires occurred in the outskirts of Teresina due to the high temperatures. Alternative hypothesis suggest that these may have been criminal fires as they often started concurrently. However, the undisputed fact is that thousands of people lost their lives and many others were left homeless due to the precarious living conditions at that time.

From the 1950s, Teresina followed the sharp national trend of rapid urban population growth, spreading the territorial limits through low density occupation. In the national context, the rise of agribusiness from the 1970s onwards brought great prosperity to the large Brazilian producers with the substitution of labour by powerful agricultural machinery. However, in the regional context, there were hundreds of thousands of rural workers and small farmers who, faced with hunger and unemployment, were forced to migrate to the already crowded urban centres, including Teresina. During the military dictatorship, the situation was aggravated by the strong support for urbanisation from the national government. Major infrastructure projects took place with the construction of large urban corridors, relevant even today, such as Avenida Marechal Castelo Branco, Avenida Maranhão, Avenida Duque de Caxias, and large-scale public facilities such as the Albertão Stadium, Getúlio Vargas Hospital, among others. The wave of grey infrastructure flooded the "Green City", the city's former title, compromising the green infrastructure and exacerbating the heat island effect.

In this context, low-income neighbourhoods such as Buenos Aires and Água Mineral emerged. Their names make reference to the distance from the city centre and the lack of basic services, such as water supply, energy and public transportation, which were non-existent at the time. The 1980s, known as the lost decade, brought a strong economic crisis with stratospheric levels of inflation and unemployment. The city grew, but its infrastructure remained short of Teresina's needs. Informal settlements multiplied, which were later urbanised by the Vila-Bairro project. However, 20th century vulnerabilities remain in the 21st century, making it even more necessary to think about an inclusive, sustainable and resilient urban development.

Image 3: São Benedito Church. Early 20th Century. Source: Arquivo Público do Estado do Piauí.
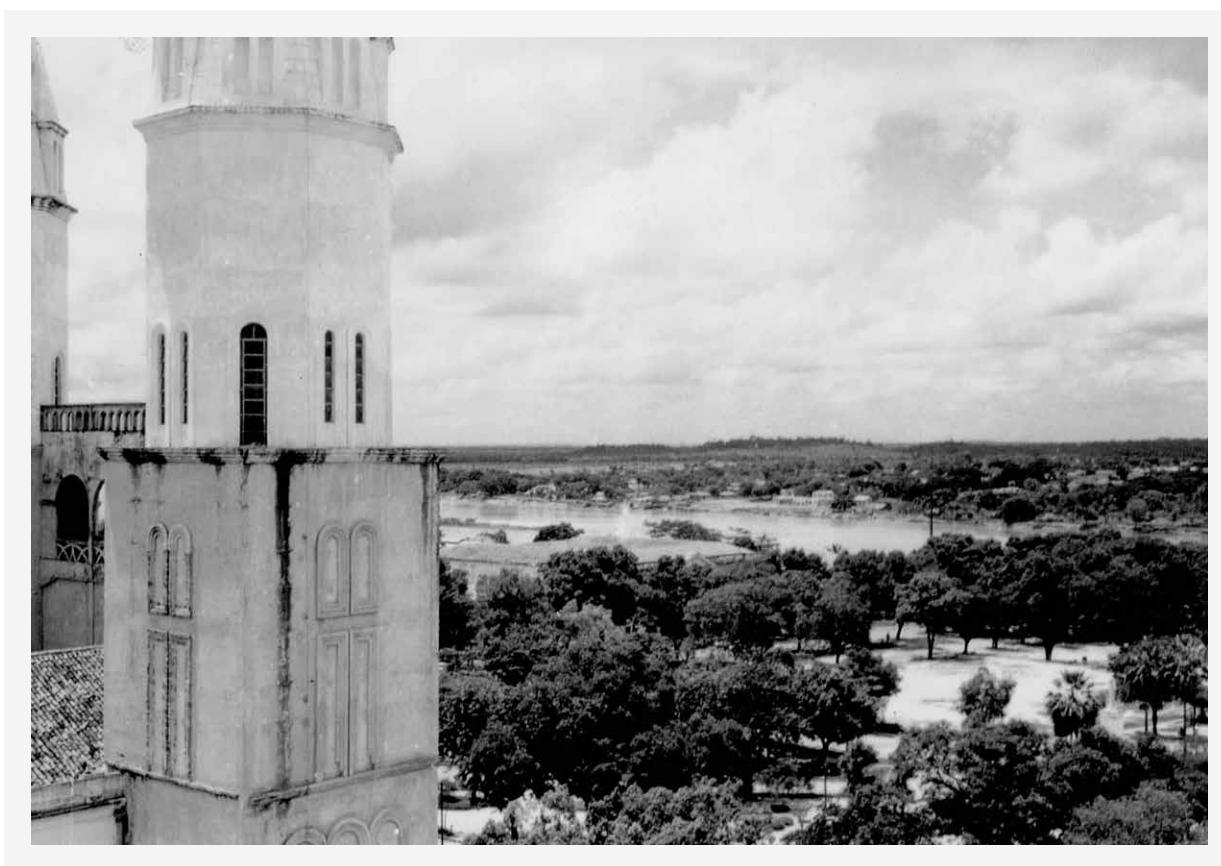
Image 4: Parnaíba River, Teresina (PI) - 1957. Source: IBGE.

Functions of the City

Teresina is the main city in the Integrated Development Region of Greater Teresina, concentrating most of the territory's resources and opportunities. However, there is not much diversity in local activities. To a large extent, it can be said that the main activities of the city are related to public services, commerce, health and education.

In this regard, it is important to highlight the health sector because, according to recent research by the IBGE, Teresina is the Brazilian city with the highest number of displacements for health services of high complexity, being the destination of 300 Brazilian cities. Education in this city is also a national reference. Teresina is the city with the highest score (National Development Index for Basic Education - IDEB) for early childhood education among the Brazilian capitals with the city's public schools consistently scoring top performances in national assessments. Regarding trade, the city's relevance at state level generates many job opportunities and all these factors contribute to a significant commuter movement to the capital of Piauí. Data from 2010 IBGE indicate that Teresina was the destination of 8,568 pendular movements made for reasons of study and 19,373 for reasons of work.

The data highlights the importance of thinking about resilience and sustainability for Teresina due to its leading role in the region and reinforces the need to pursue integrated and innovative solutions that result in impacts not only within the territorial limits, but throughout the surroundings.

Teresina key data	
Area	1.301km^2
Altitude	72m
Climate (Köppen-Geiger)	Aw Tropical Savanic
Average temperature	27,6ºC
Annual Precipitation	1.349 mm
Municipality Area	1391,99 km^2
Urban area	263,94 km^2
Population	864.845 (2019)
Population Density	621,72/km^2
Life expectancy	74,2 years
Official Languages	100% Portuguese
Mortality rate	0,6%
Infant Mortality	1,62%
Illiteracy rate	8,78%
GDP / Municipal Capita	USD 3.889,09 (2017)
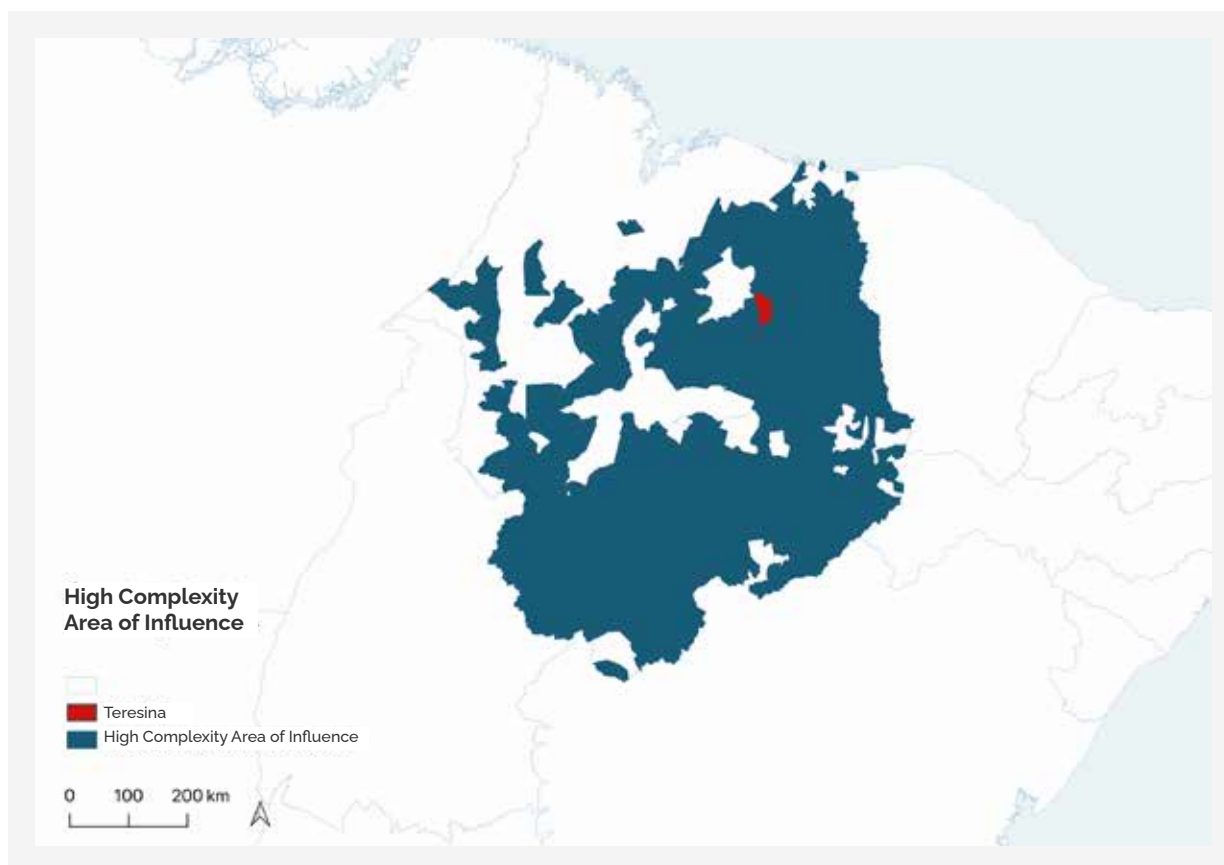
Figure 5: Area of Influence of High Complexity Health Services. Source: CRGP, with data from IBGE (2018).
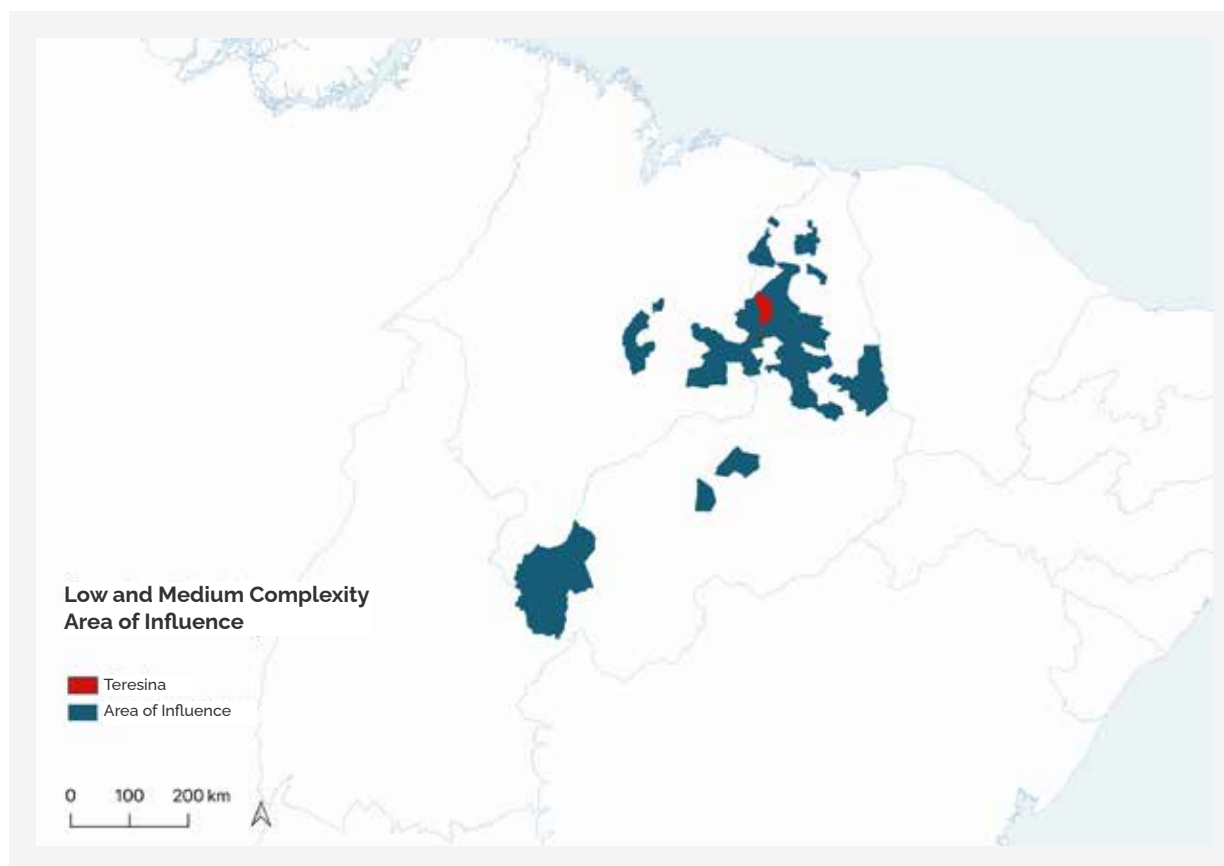
Figure 6: Influence Area of Medium and Low Complexity Health Services. Source: CRGP, with data from IBGE (2018).
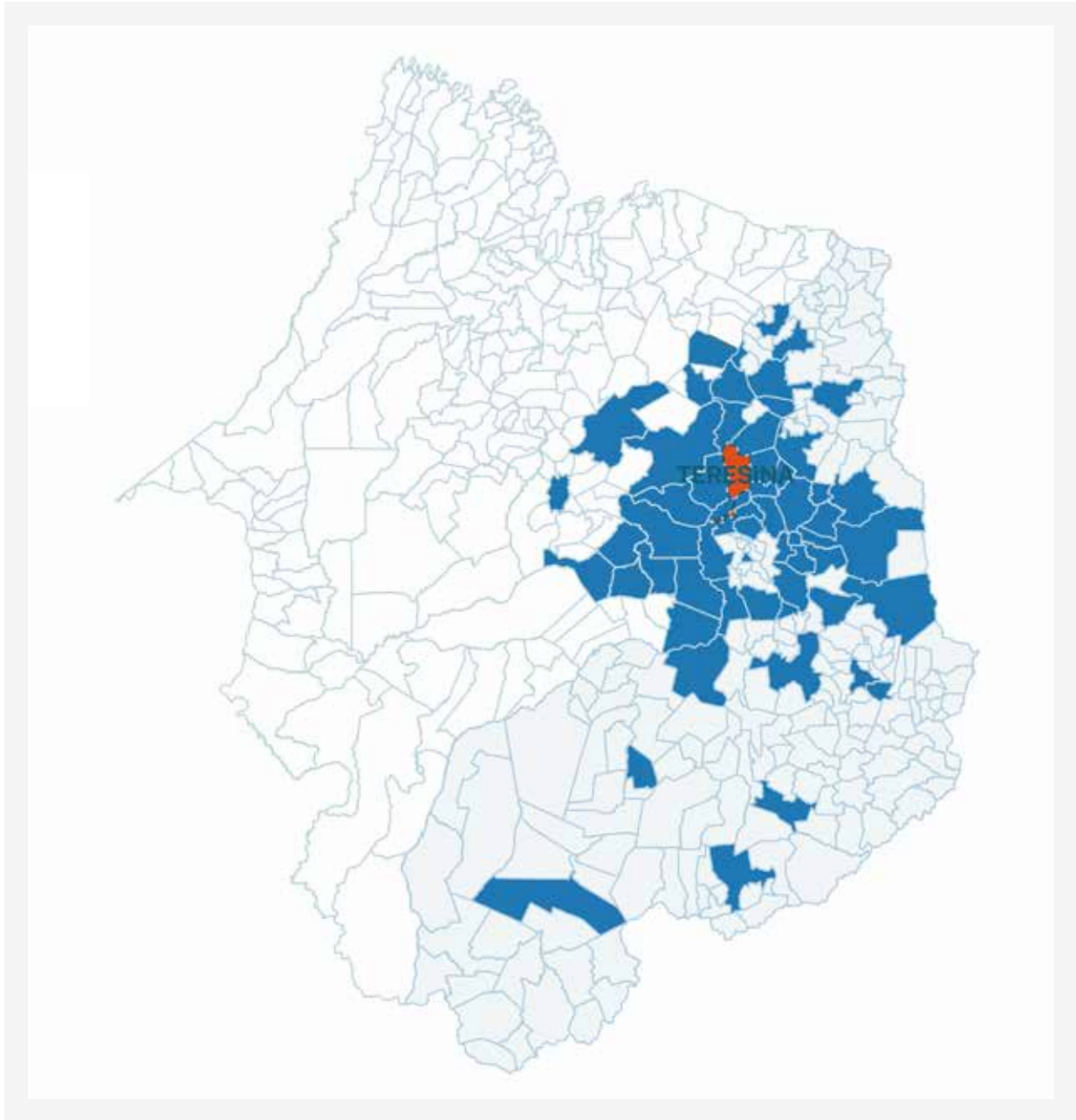
TERESINA | INFLUENCE AREA

Municipal Location

Influence Area for Shopping

⌐⌐ Teresina Municipal Boundary

Piauí State
☐ Municipal Boundaries

Maranhão State
☐ Municipal Boundaries

Source: Municipality of Teresina, IBGE Brazil
0   50   100 km
△ N

0   250   500 km

Figure 7: Teresina Trade Influence Area. Source: CRGP, with data from IBGE (2018).

1.2. Population and Demographics

The last national census in Brazil was carried out in 2010 and found that the country's population was 190,755,799 inhabitants. The population estimate for 2019 by the IBGE was around 210,147,125 inhabitants, an increase of more than 10.16%. Of this total, approximately 48.97% were men and 51.03% were women in 2010.

Teresina's Population

Based on official IBGE data, the estimated population of Teresina is 871.126 inhabitants (2021). According to the last national census, approximately 46.75% were men and 53.25% were women. This is a majority urban population, which represented 94.27%, while the rural population was 5.73%.

Although the city experienced rapid growth according to the national censuses of 1960 and 1990, increasing its population by more than 70% in 1980 (57.28% - IBGE, 1960, 54.52% - IBGE 1970, 71.34% - IBGE 1980, 58.63% - IBGE 1990), there was a reduced growth rate in the previous decades, with 9.38% in 2000 and 24.22% in 2010. This rate decrease was noticeable for 2019, with a population estimated by the IBGE of 864,845 inhabitants, representing an increase of only 6.22% - below the Brazilian average.

Regarding race, 60% self-declared mixed-race; 26.19% white; 11.00% black; 2.49% Asian; and 0,21% indigenous people. The predominant religion is the Christianism - about 93,80% of the population self-declared to be Cristian; 4.49% answered the don't have a religion; 0,85% identifies with Spiritism; and 0,30% with African Matrix Religions; among others of reduced representativeness.

Population	
Population	871.126 (2021)
Density	621.72 hab/km^2
Life expectancy	74.2 years (IBGE, 2010)
Race	60% mixed-race; 26.19% white; 11.00% black; 2.49% Asian; and 0.21% indigenous people.(IBGE, 2010)
Predominant religions	Christianism (93.80%); Without Religion (4.49%); Spiritism 0.85%); African Matrix Religions (0.30%); among less expressive others. (IBGE, 2010)
Schooling 6 to 14 years	97.8% (IBGE, 2010)
Mortality rate	0.6%
Child mortality rate	1.62%

Households Information

According to the last national Census (IBGE, 2010), there were 222,154 households in the city. The land tenure types were distributed in the following way: 79.65% owner-occupied; 13.51% rented; 5.55% lent by employer or others; and 1.29% under other conditions. The predominant household typology is single houses, which represent 90.36% of total habitations. The other typologies were apartments (8.20%); House in Villas or Gated-Communities (1.17%); and tenement housing (0.27%). The most prevalent construction materials are masonry (bricks), specifically 42.75% stucco brick walls and 25.63% unfinished exposed bricks. The second most common type is made from vernacular techniques, such as wattle and daub cob walls - with 12.42% having a finishing layer, and 13.69% raw. Additional materials, such as makeshift wood, straw houses, and others represent 5.49%.

Regarding the occupancy, 26.23% of housing has less than 2 dwellers; 61.84% has between 3-5 residents; 11.93% has more than 6 residents. The density of residents per dormitory was 34.5% to 1 or less residents/dormitory; 48% between 1-2 residents/dormitory; 13.65% between 2-3 residents/dormitory; and 3.78% with more than 3 residents/dormitory.

Households Information	
Household Occupancy	1 Dweller: 8.55%
	2 Dwellers: 17.68%
	3 Dwellers: 23.32%
	4 Dwellers: 24.22%
	5 Dwellers: 14.30%
	6 or More Dwellers: 11.93%
Housing Tenure Types	Rented 13.51%
	Owned 79.65%
	Lent 5.55%
	Other conditions: 1.29%
Housing typologies	Single House 90.36%
	Multi-Unit Single Building Housing (Apartments) 8.20%
	Housing in Villa or Gated Community 1.17%
	Tenement Housing 0.27%
Housing Materials	Stucco Brick Walls 42.75%
	Exposed Brick Walls 25.63%
	Wattle and Daub Cob Walls 26.11%
	Others 5.49%
Density of Residents/ Dormitory	1 or less: 34.5%
	1-2: 48.00%
	2-3 13.65%
	Above 3: 3.78%

1.3. Spatial Dimension

The spatial dimension overview offers a summary of factors that shape the geographic space and urbanisation of the city. In this section we highlight the main information that characterises the Climate, the Ecosystem, Urbanisation, Water Supply, Energy, Basic Sanitation, and Mobility.

Climate

Due to specific factors such as its continental geographical location and altitude in relation to sea level (below 100m), the temperature in Teresina does not suffer significant variations throughout the year. Located close to the Equator, the sun's rays fall on the city with an angle close to 90º, which results in intense radiation. Therefore Teresina is in a zone of tropical savanna climate with high temperatures during most of the year.

The most intense heat occurs from September to December (dry winter) and this period is characterised by maximum temperatures above 40ºC, with relative humidity reaching 20%. It causes thermal discomfort and low labour productivity. Also, it increases the incidence of respiratory illnesses, in addition to causing spontaneous fires in several points of the urban and rural areas (see distribution of fire alerts). The months of February and March are those with the highest air humidity, and August to October, with the smallest averages.

Climate and Ecosystem	
Climate	Aw - Tropical Dry Winter Savannah
Altitude	72m
Average temperature	27.6ºC
Highest recorded maximum	41.1 ° C (October 24, 2012)
Average Annual Precipitation	1,349 mm
Highest Accumulation Accumulation	138.2 mm (24 November 1966)
Ecosystems	Seasonal Mixed Semi Deciduous Forest: contact area between Cerrado and Mata dos Cocais Tropical

Table 5: Climate and Ecosystem. Source: CRGP, with data from IBGE.

The average annual precipitation is approximately 1,349 mm, with concentrated rainfall during the rainy summer, that is, between January and May, and with a few rain showers starting in November, with March being the month with the highest average accumulation of precipitation.

The highest accumulation of precipitation recorded in 24 hours corresponds to 138.2 mm, on November 24, 1966. The predominant rainfall regime in Teresina is torrential, due to the conditions of regional circulation of air masses. It defines variations of the ITC (Intertropical Convergence) position, which are characterised by the meeting of the North, Equatorial Continental and the Atlantic Masses. Torrential rains are marked by intensity and speed, which results in flash floods throughout the city. In the municipality, convective rains also occur, which generally fall in a punctual and discontinuous manner in space (PMSB, 2018).

Notwithstanding, the average temperature in Teresina increased by 2º Celsius in the last century, at a rate twice higher than the global warming average, which is 1ºC. The trend is that the temperature will rise even more, while the relative humidity of the air will continue to decrease.

Ecosystems

According to the IBGE Biomes map (2003), Teresina is part of the Cerrado Biome, the second largest ecosystem in South America, occupying about 22% of the national territory, characterised by medium and dense vegetation cover. Cerrado has an abundance of endemic species but suffers a constant loss of habitat due to anthropisation processes.

The Municipality of Teresina is located in an intersectional area between Cerrado and Mata dos Cocais, with mixed seasonal semi-deciduous forest vegetation. Brazilian seasonal forests are classified as semi-deciduous when the percentage of tree individuals defoliated in the dry season is between 20% and 50% of the total. The dual climatic seasonality is also a condition of the ecological concept of this type of vegetation, including a tropical season with intense summer rains, followed by a season of severe drought (IBGE 1992).
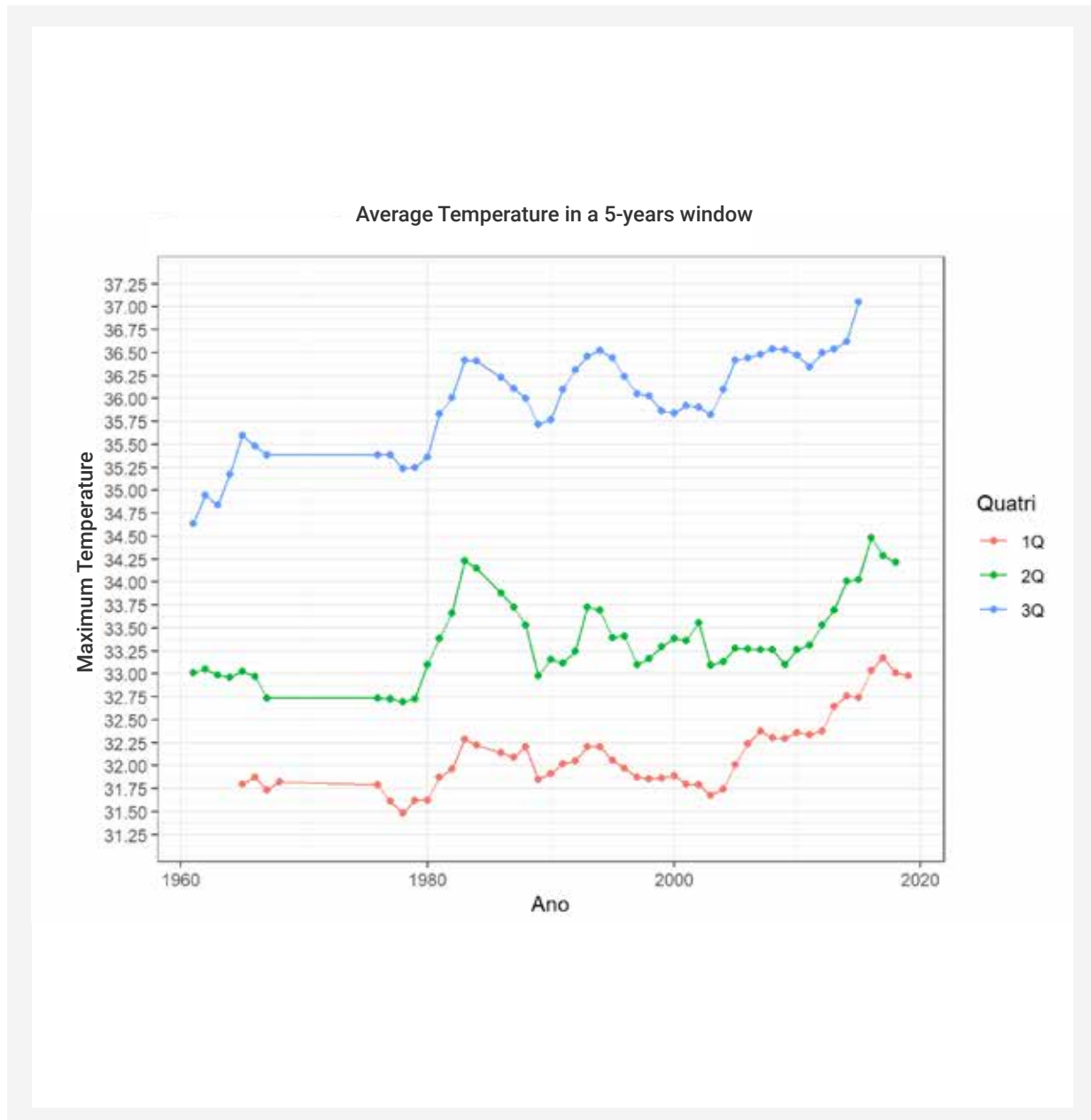
Figure 8: Maximum temperature averages with a 5-year window, per year and per four-month period. Average annual rainfall with a 3-year window. Source: CRGP, with data from INMET (2020).
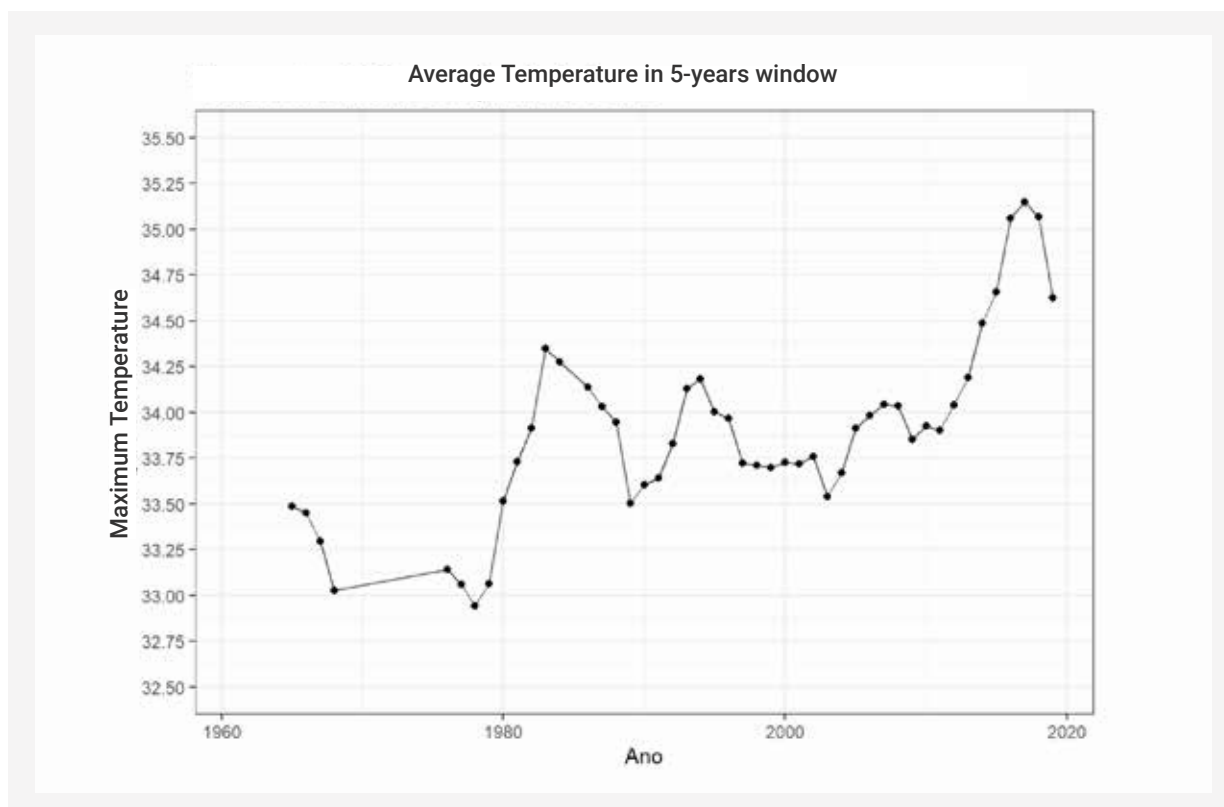
Figure 9: Maximum temperature averages with a 5-year window, per year and per four-month period.
Source: CRGP, with data from INMET (2020).
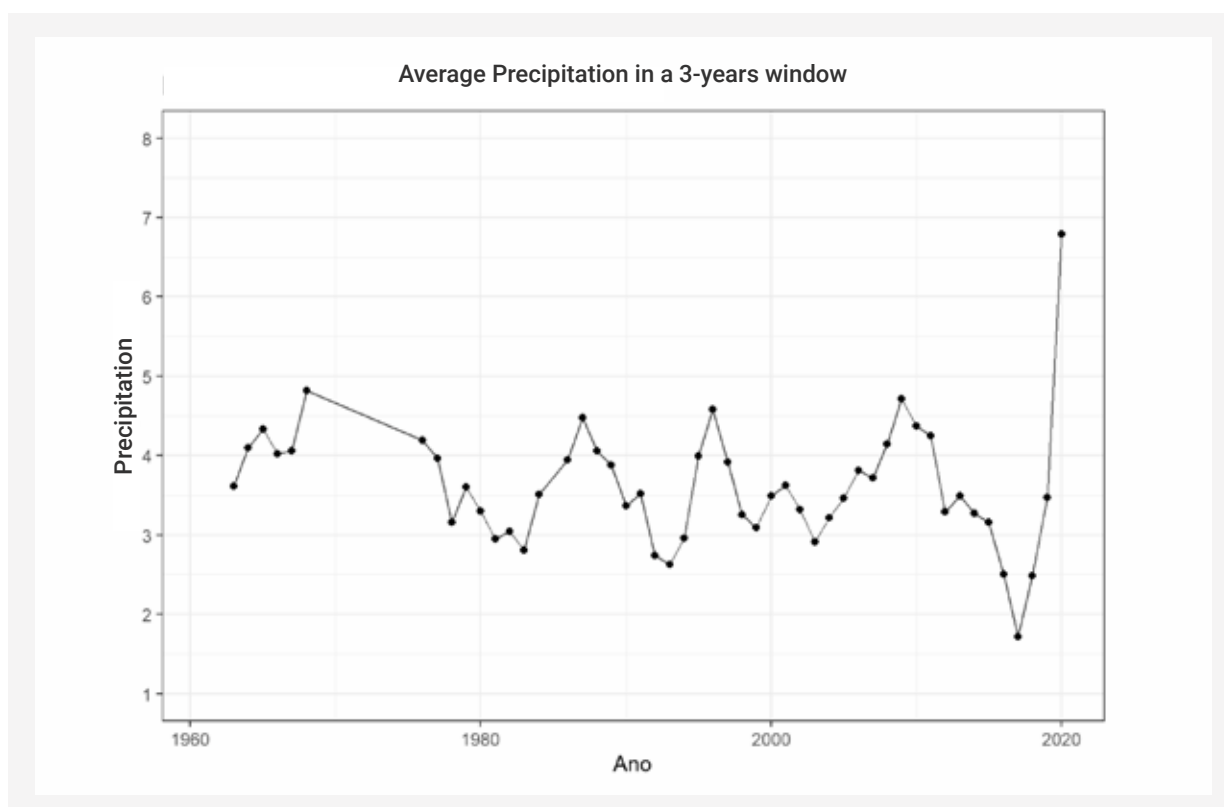
Figure 10: Average annual rainfall with a 3-year window. Source: CRGP, with data from INMET (2020).

Boxplots de Aumento de Temperatura por Quadrimestre e Década
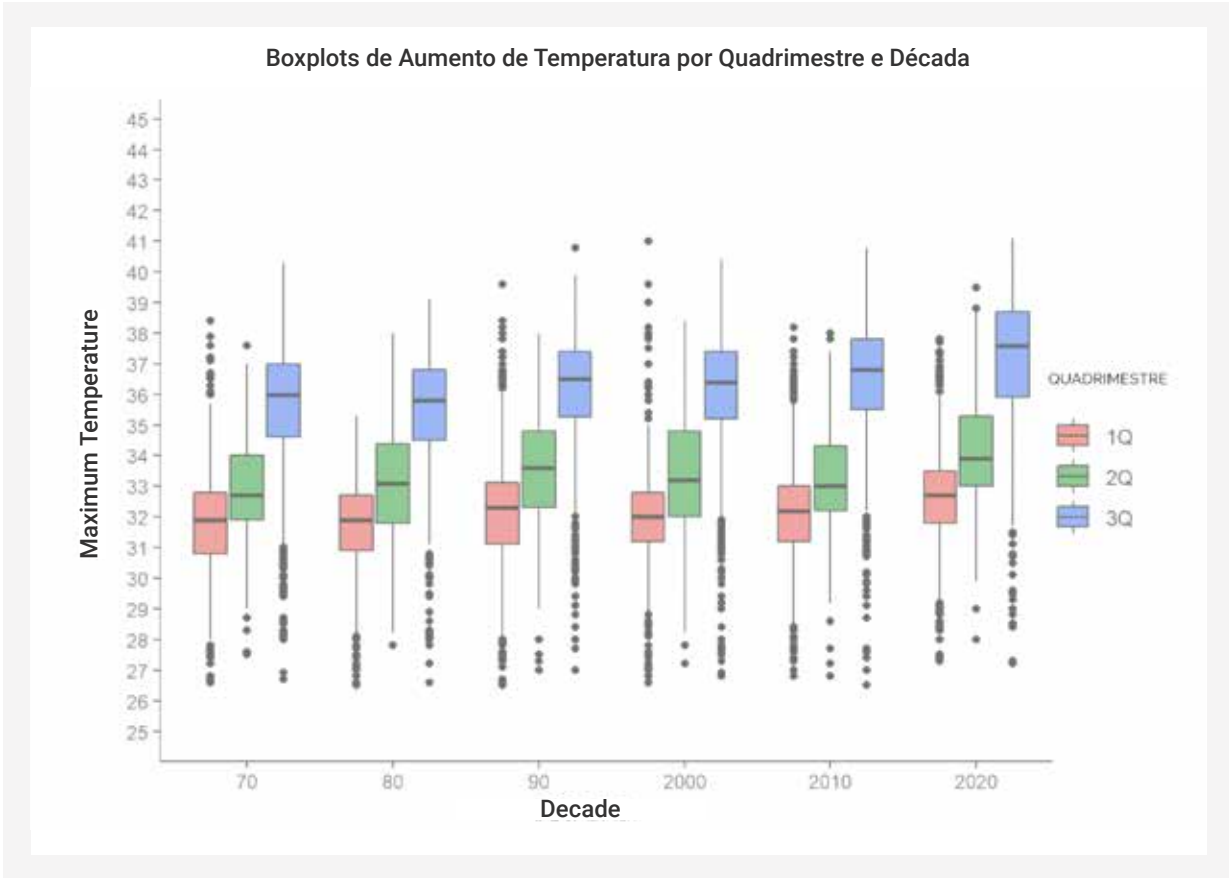
Figure 11: Increase in maximum temperatures per four-month period. Source: CRGP, with data from INMET (2020).
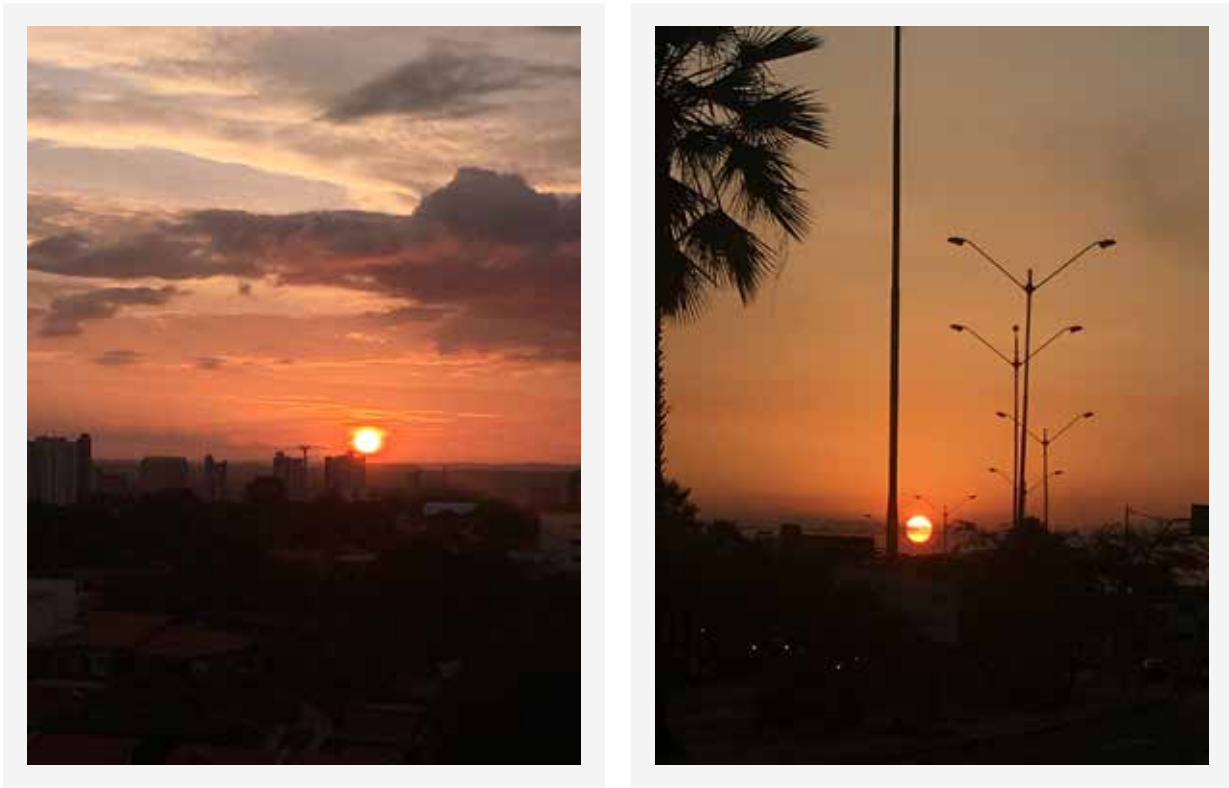
Image 5/6: City of Teresina during the 3rd Quadrimester. Source: CRGP (2019).

Water Provision

The Municipality of Teresina has its administrative limits within three sub-basins of the Parnaíba River: the Longá river basin to the North, the Parnaíba II basin and the Poti River basin (on the urban perimeter). About 75% of the Parnaíba basin area is located in the State of Piauí, 19% in Maranhão and 6% in Ceará. Teresina is crossed by two rivers (Poti and Parnaíba) and their streams, which make up a total of 70 micro basins. Thus, a considerable part of its territory is classified as an area prone to floods and landslides.

Since July 7, 2017, Águas de Teresina has been the concessionaire responsible for the water supply service in the municipality. The company currently serves 853,463 people with treated water (99% of the population). The concessionaire aims to universalise water supply in up to three years and reduce the loss rate from 59% to 25% in 10 years, avoiding the waste of 4,304,541m³ per month. The company's term of operations in the municipality is 30 years, and pledged investments are about R$ 1.7 billion.

Teresina has two Water Supply Treatment Plants: ETA Sul and ETA Norte, both drawing water from the Parnaíba River. The treated water supply system in the city has 75 additional active deep tubular wells; about 2470km of distribution network; 19 water pumping stations; 32 large reservoirs and 53 small reservoirs. The water consumption tariff structure in Teresina is divided into metered and non-metered connections. Hydro-metered connections have different tariffs according to the type of activity (Residential Subsidised and Non-Subsidised, Small Commerces, Commercial, Industrial and Public) with lower prices for smaller consumption ranges. Non-metered connections are charged according to use (residential, commercial, industrial, and public).

Power

The primary source in the Teresina energy matrix is hydroelectric, produced at the Boa Esperança Plant. The plant is located approximately 340km south of the capital, on the banks of the Parnaíba River. Electricity distribution in Teresina is under the responsibility of Equatorial Piauí, which serves 224 other municipalities in the State.

In the capital, the company serves 377,147 consumer units (equivalent to 99.79% of the population) with service at 220V and 60Hz, at low voltage, and 69KV at high voltage. Based on data from Equatorial Piauí, the company points to the following main threats to energy distribution operations: increasing tariffs during economic crisis periods directly reflecting on energy consumption reduction; annual consumption retraction (1.59% of the commercial users, directly related to the Free Contracting Environment scheme migration); and hydrological risks.

Teresina follows the Tariff Flags System, established by ANEEL (National Electric Energy Agency) in January 2015. It aims to signal to consumers the real costs of electricity generation, using colour-coded tariff schemes (green, yellow and red) to inform additional costs to energy production and distribution.

The average electricity tariff in the State of Piauí corresponds to R$0.569/ kWh (equivalent to approximately 0.10 USD/ kWh), slightly above the national average of R$0.560/kWh (equivalent to approximately US$0.10/kWh). The Electricity Social Tariff (TSEE) is a special discount on electric bills created by the National Government, aiming to support low-income families.

As for the participation of other renewable energy sources in the internal energy supply matrix, a total of 7,450.20kW of solar energy was produced in Teresina in 2018.

Water Provision and Power	
Hydrological sub-basins	Rio Parnaíba II, Rio Poty and Rio Longá
Number of Micro-Basins	70
Water supply	over 99% of the population
Main Energy Sources	Hydroelectric Plant (Usina BoaEsperança)
Participation of alternative sources of clean energy	Solar: 7 450.20 kW
Electricity Coverage	99.79% of the population
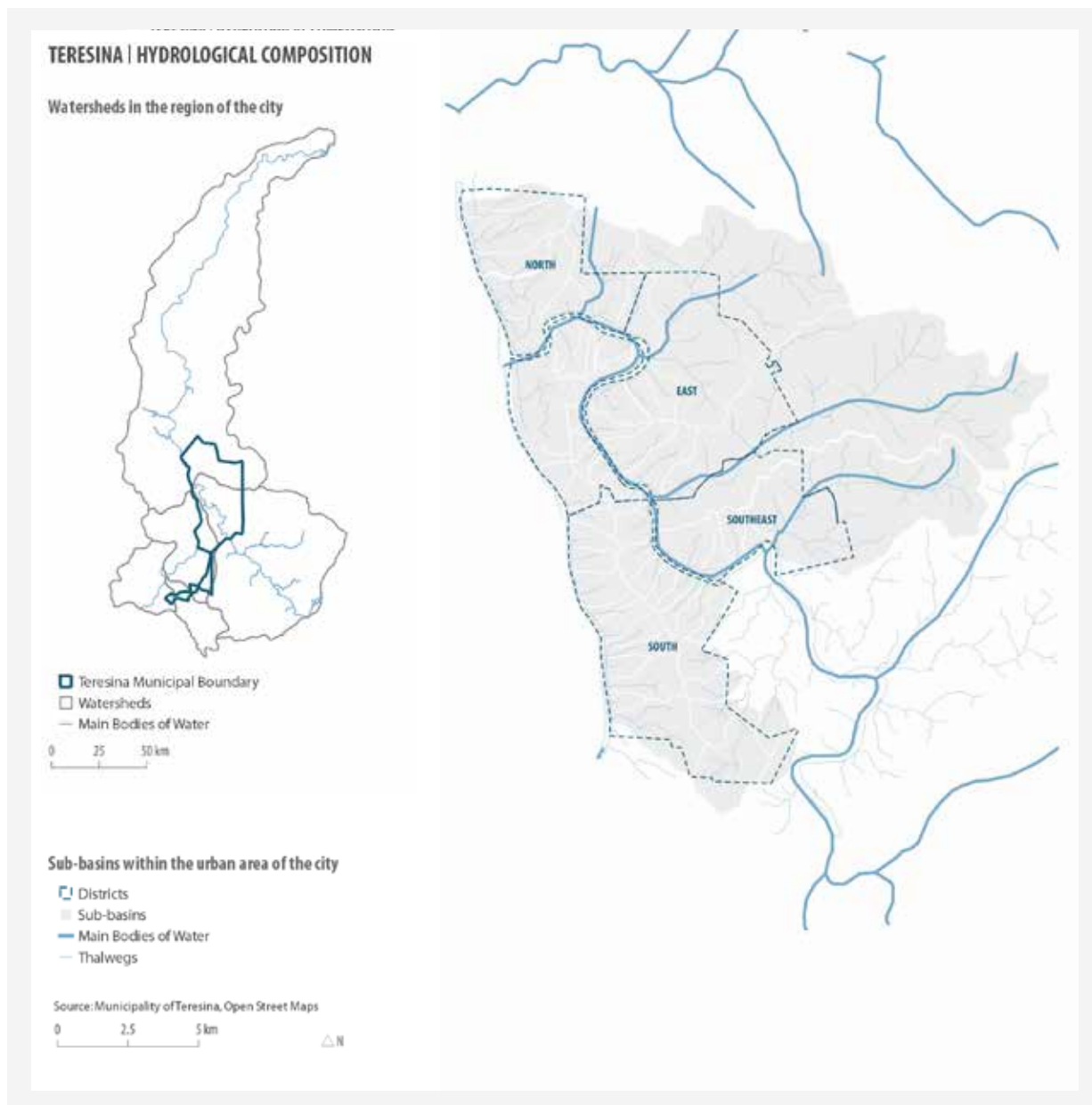
Figure 12: Hydrological Composition. Source: CRGP, with data from the PMT (2019).

Wastewater Treatment

In addition to the water supply service, Águas de Teresina is also responsible for sewage treatment in Teresina. The sewer network reaches 269,039 residents in the municipality, that is, only 31% of the total population, through 505.14 km of the collection system. According to the Teresina Municipal Basic Sanitation Plan (2018), the city's sewage system consists of:

17 Sewage Lift Stations (EEE): Sewage Lift Stations (EEE) are installations capable of transporting sewage from a suction or inlet level to a discharge or outlet level. It has the function of lifting grey waters in lower levels and depression areas.

5 Interceptors: Interceptors are pipes installed along with watercourses with the function of receiving and leading the collected sewage to outfall installations, which, in turn, leads to the treatment plants.

3 Sewage Treatment Stations (ETE in the Portuguese acronym): Various operations and processes are used in sewage treatment units to separate suspended and dissolved pollutants and water to be discharged into the receiving body - one of which is stabilisation ponds. The Teresina ETEs are East ETE, Pirajá ETE and Alegria ETE. East and Alegria ETEs discharge their effluents into the Poti River, and ETE Pirajá discharges them into the Parnaíba River.

Wastewater Treatment	
Sewerage Coverage	31% of the population
Sewerage Extension	505.14km
Annual Volume of Wastewater	22,727,000 m3 / year
Annual volume / Inhabitant	76.42 litres / day
% without access to any type of sewage system	2.65% (IBGE, 2010)
% rudimentary sanitation (ditches, rudimentary pits, etc.)	35.50% (IBGE, 2010)

The best-served neighbourhoods are those located close to ETEs, such as Frei Serafim and Vila Operária (both with 96%), Jockey and São Cristóvão (both with 95%). Due to the lack of infrastructure, the option available to residents of urban and rural areas without sewage network coverage is individual sewage systems, such as septic tanks, sinks and infiltration ditches.

According to the Teresina 2030 Agenda document (2013), of the 112 neighbourhoods in the municipality, only 15 reached a rate higher than 70% of the sewage service - however, with the expressed increase in the network in recent years, these values need to be revised. Due to the lack of infrastructure, the options available to residents of urban and rural areas without sewage coverage are individual sewage systems, such as septic tanks, sinks and infiltration ditches.

In the urban area, individual sewage treatment systems are the majority. According to IBGE (2010), there were about 210,000 urban permanent private households; of which 41% have a septic tank system and 31% have a rudimentary cesspool system. The survey, however, does not provide information on the conditions of these systems. It is estimated that, in the urban area of Teresina, a total volume of 22,712,000 cubic metres of sewage is produced per year, which is equivalent to approximately 76.42 litres per inhabitant/day. The sewage tariff, managed by Águas de Teresina, corresponds to 80% of the water supply consumption bill.
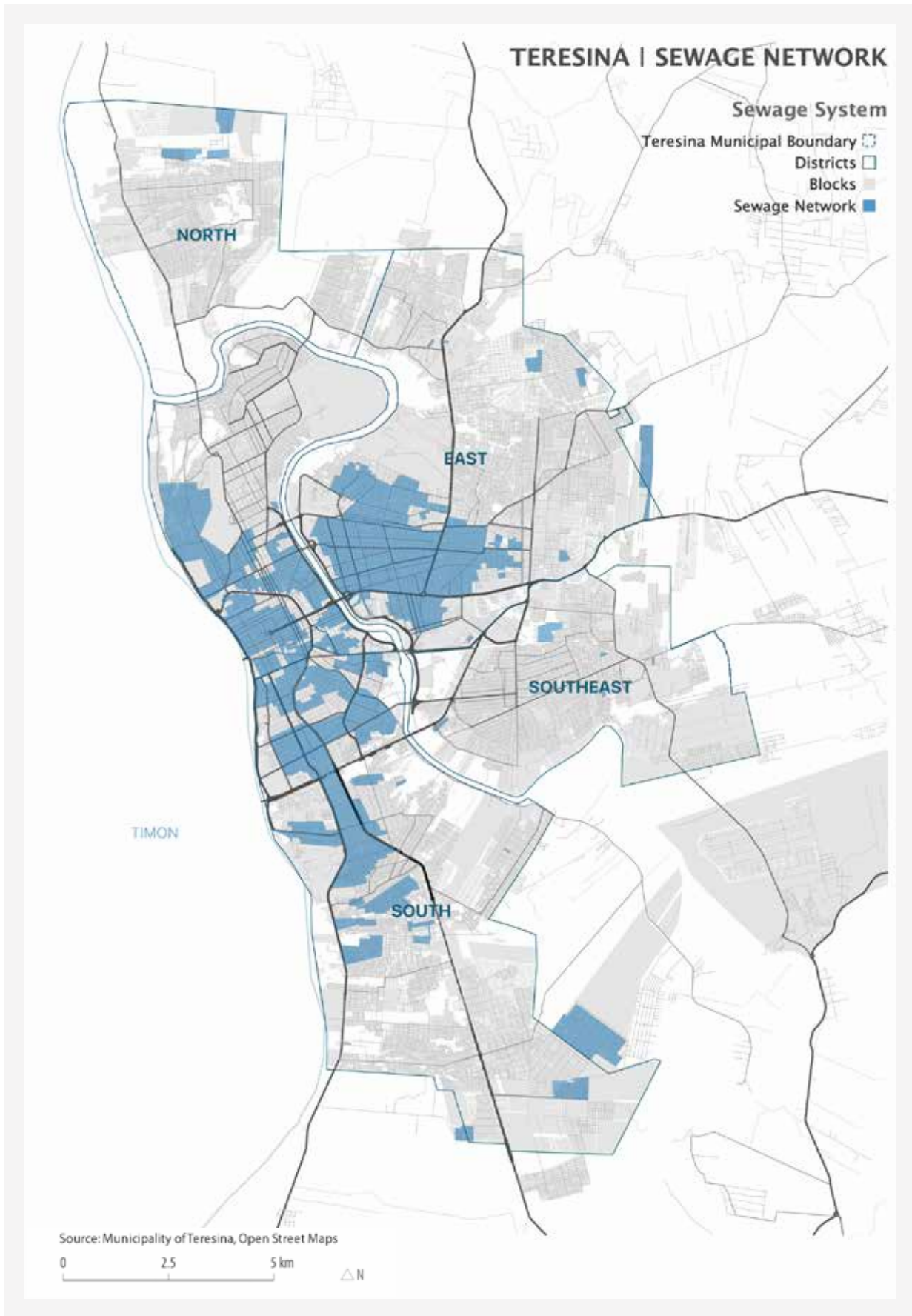
Figure 13: Coverage of the Sewerage Network. Source: CRGP, with data from the PMT and Open Street Maps (2019).

Waste Collection and Recycling

Teresina generates, on average, 1,200 tons of garbage daily (household waste, public waste, health waste, remains from open markets, tree pruning, etc.). When considering only household waste, this value is 543 tonnes/day. In 2018, the city's garbage services collected a total of 209 312.25 tons of waste.

Household, public, recyclable and hospital waste collection (from municipal health units) is carried out by two concessionaires hired via municipal public bidding processes: the Teresina Ambiental Consortium - CTA; and Sterlix Ambiental Piauí Tratamento de Resíduos Ltda. CTA carries out the conventional collection, and STERLIX carries out the collection and treatment of hospital waste produced by Municipality Health Units. Due to the weight of the health sector activities in Teresina, in 2018 the sector produced about 0.61 tonnes/per capita of special waste (hospital), representing a total of 528.4 tons, from which 100% received adequate treatment.

The estimated population served by the garbage collection is 817,455 people. The service hires about 389 employees and uses 33 special vehicles (compacting trucks and other specific vehicles for hospital waste collection). All the households' collected waste is sent to the city's controlled landfill.

In Teresina, there is also a waste recycling programme operating with the support of cooperatives and waste pickers. The programme aims to promote the recycling of paper, plastic, glass and metals. The Municipality offers several recycling points with segregated bins spread across the city, where the local population can deposit separate waste. There is a service to collect this waste and take it to recycling cooperatives. At the recycling cooperatives and associations, the materials are screened and prepared for commercialisation. So far, there are 21 voluntary recycling collection points, with nine 10 m³ stations, and twelve 1.20m³ stations. Door-to-door collection services to larger users (condominium, companies, institutions, bars, hotels, and bigger commercial establishments) are also in place to facilitate and promote recycling habits, requiring prior registration and scheduling.

According to statistical data from the Department of Urban Development and Housing - SEMDUH, ne2.85 tons of recyclable waste are collected per day, which corresponds to 0.54% of total household collection waste. In 2018, the total recyclable waste collected was 829.96 tons.

Waste Collection and Recycling	
Household Garbage Collection Coverage	94.52%
Daily Waste Generation	1.2 ton / day
Daily Residential Generation	543ton / day
Annual Waste Generation	312.25 ton / year
Hospital Waste Generation	528.4 ton / year
Recycling Collection Points	21 Voluntary Delivery Points
Recyclable Waste Collection	2.85 ton / day
Annual Recyclable Waste Collection	829.96 ton / year
Data SEMDUH, 2018	

Urban Area

The city of Teresina builds its urban spaces amid its two rivers, Parnaíba and Poty. The urbanised area of Teresina, at the time of its foundation, began on the right bank of the Parnaíba River. As the city developed it gradually expanded to the North, meeting the earlier established settlement of Vila Velha do Poty - located by the Rivers mouth, to the East - towards the River Poty, and further towards the South - filling the space between rivers.

The built area of the city remained stable during its first decades of existence. However, in the last decades of the 20th century, it faced a fast-paced low-density urban sprawl. The statutory urban perimeter underwent several amendments to comprise new developments until reaching the current 264km^2. Besides the sprawl, the urban area remains a modest share of 18.9% of the total municipal area of about 1392km^2. The remaining 81% form the rural area, mainly formed by scattered occupation and scarce economic activities, implying in most of its territory in native vegetation. Since 2015 the urban perimeter has been frozen to favour density development and occupy vacant urban lands.

Despite the increment in land consumption, vacant lands inside the urban perimeter remain significant. Considering the total urban boundary, the share of the territory under urbanised conditions (parcelled land connected to the road network) is about 75.7%. Notwithstanding, the occupation is significantly low; total buildings footprint is around 14.1%.

The local zoning code covers the urban perimeter entirely. It is a positive incentive to orderly development in compliance with the city's urban planning guidelines. The city is in the process of approving the new local master plan, which changes the current zoning map (shown below). It will replace the current instrument characterised by the strong segregation of urban activities - characteristic of modern Brazilian planning from preceding decades - with more flexible mixed-use systems with a focus on mitigating uncomfortable uses. The new master plan also prioritises enhancing urban density and protecting risky areas or demanding constrained urbanisation.

Urban Area	
Municipality Area	1391.99 km^2
Urban area	263.94 km^2
Urbanised Area	199.9 km^2
Buildings Area	37.20 km^2
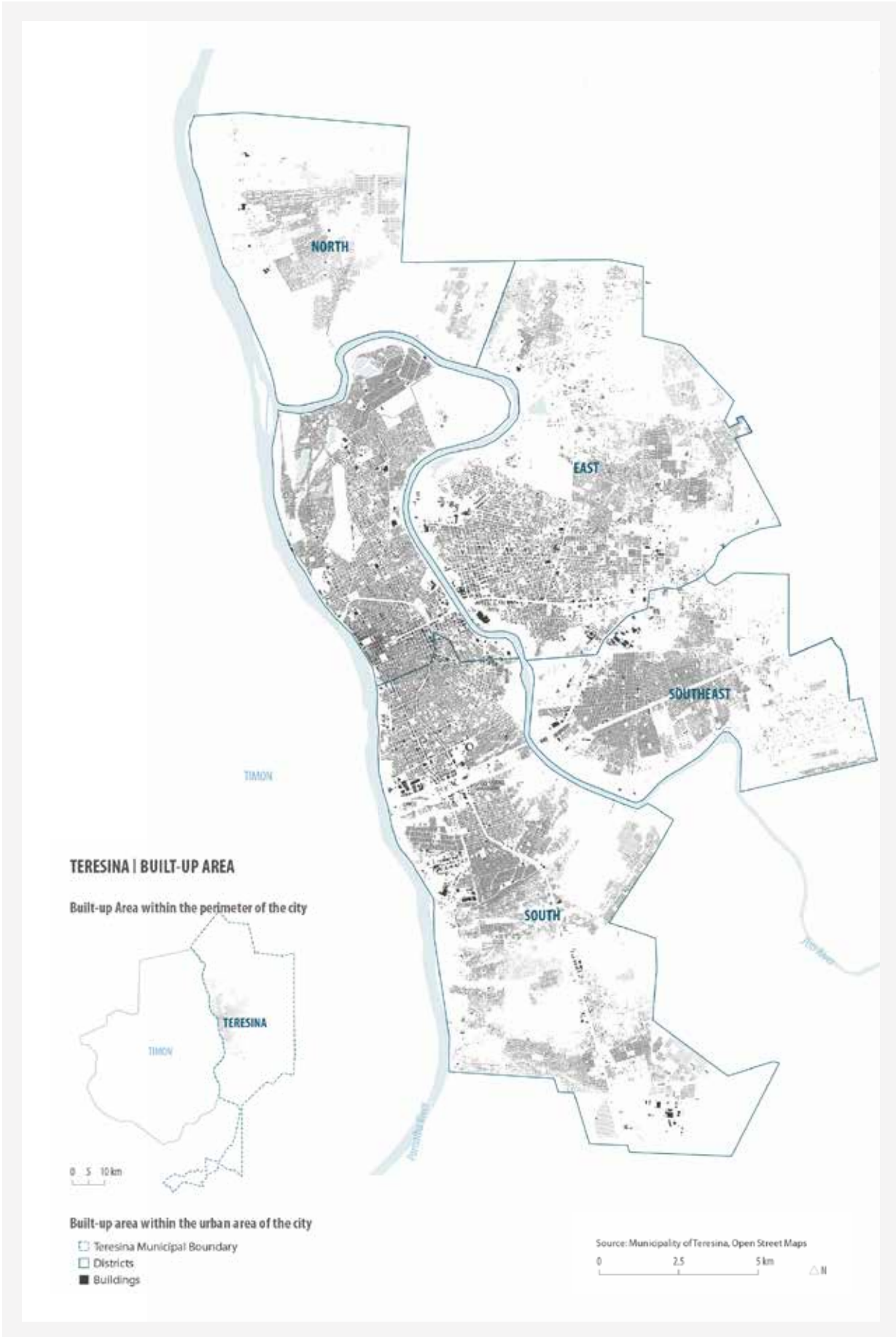
Figure 14: Teresina built area. Source: CRGP, with data from PMT and Open Street Maps (2020).

TERESINA | LANDUSE

Landuse Zoning - Law 3.560/2006

☐ Teresina Municipal Boundary
☐ Districts

Landuse Zoning - Law 3.560/2006
■ Commercial Zone
■ Industrial Zone
  Residential Zone
■ Service Zone
■ Special Zone
■ Preservation Zone
  Lagoon
■ River

TIMON

Source: Municipality of Teresina, Google Maps

0   2.5   5 km

△N
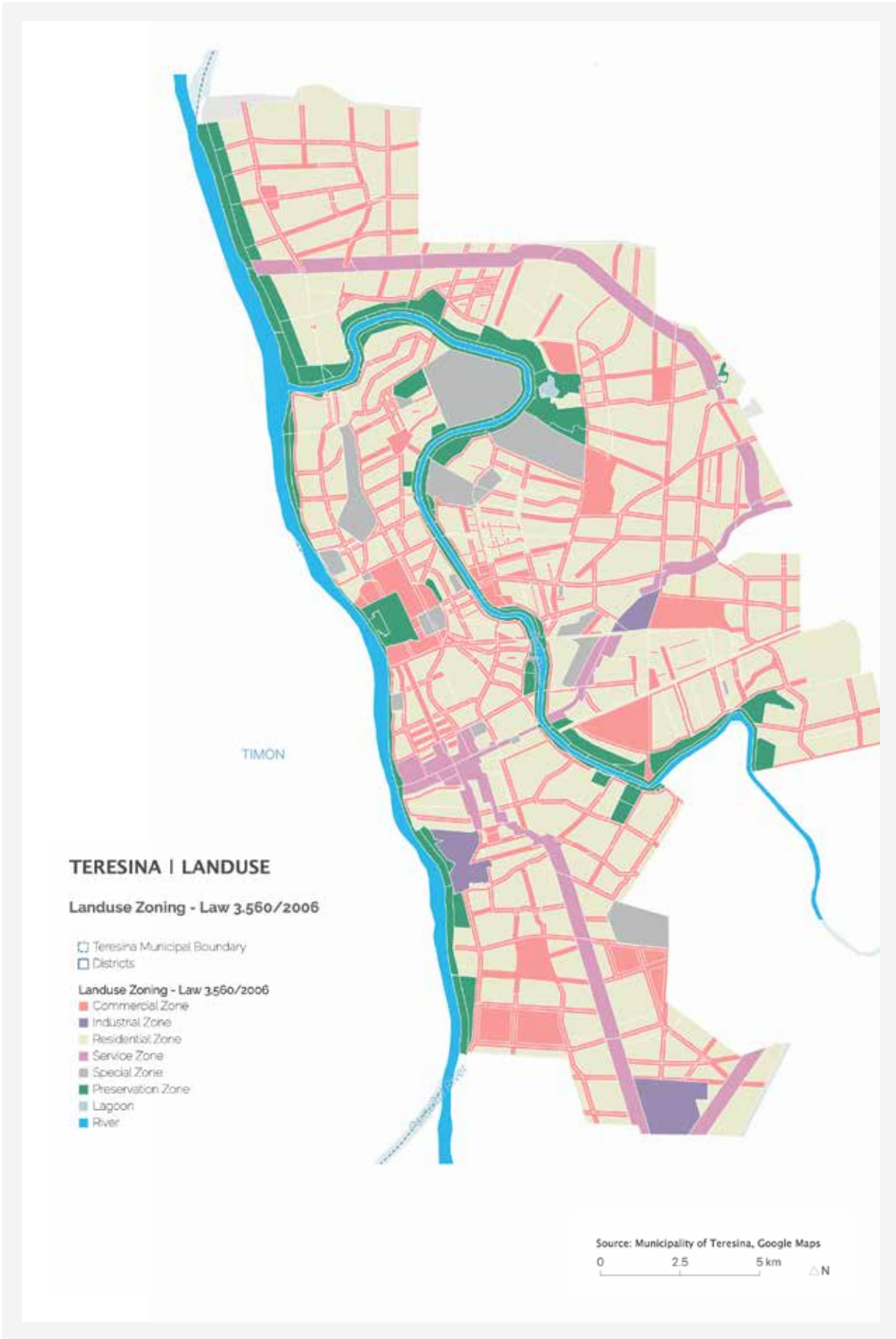
Figure 15: Teresina Zoning Map. Source: CRGP, with data from PMT and Google Maps (2020).

Image 7: Teresina, Brazil. Aerial view. Source: Gabriela Uchoa (2019).

Public Transportation

The public transportation system is composed of individual and collective modal choices. The individual public modality offers the services of taxi and moto-taxi under licensed services regulated by the municipality. The total taxi licensed fleet in the city is 1,995 vehicles, which makes a ratio of 2.31 taxi/1,000hab. The moto-taxi service offers 2,297 licensed bi-wheel vehicles, which makes a ratio of 2.66 moto-taxi/1,000hab.

The collective public transportation offer includes regular bus, bus-rapid transit and tram services. Four private consortia operate Regular Buses and BRT bus services under a municipal public concession scheme which follows a public bidding process. The municipal local transport authority is in charge of service planning and operation monitoring. In total, there are 87 bus routes, organised in a feeder-trunk BRT system. The feeder lines connect the neighbourhoods of each city zone to main bus terminals (2 per zone, 8 in total). From the bus terminals depart the trunk services, operating in segregated bus lanes connecting zone terminals to 3 downtown terminals. The average number of daily bus journeys for weekdays is about 235,174.4 trips.

The State Government offers tram services that link the southeast zone to the city centre. Recent investments for the modernisation of the tram system included three new Light Rail Vehicles (LRVs) for 600 passengers each, improvements to the whole metro line and nine stations (Matinha, Ilhotas, Renascença, Itararé, Frei Serafim, Piçarra, Boa Esperança, Parque Ideal and Dirceu II), and the construction of an Operational Control Centre.

The Teresina urban mobility network also comprises a mixed-type set of cycle paths. In total, Teresina has 64.20 kilometres of cycle lanes. The Master Plan for the Cycle Network proposes the implementation of a structural network of more than 220 kilometres of cycle paths; however, the city is still implementing the plan's first phase (minimum network).

Public Transportation	
Main Public Transport Modes	Bus, Taxi and Moto-Taxi
Number of Bus Routes	87 routes
Average Bus Journeys/Day	235,174.4 passenger trips
Licensed Taxi/Population	2.31/1,000 inhab
Licensed Moto-Taxi/ Population	2.66 moto-taxi/1,000 inhabitants
Cycle Network	64.20 km

Integration
Point

NORTH

Buenos
Aires
Terminal

Zoobotânico
Terminal

EAST

Rui
Barbosa
Terminal

Parque da
Cidade
Station

Piçarreira
Station

Parque
Universitário
Station

Lagoas do
Norte
Station

Matadouro
Station

Ininga
Station

Santa Lia
Terminal

Hospital
Primavera
Station

Dom
Severino
Station

Pres.
Kennedy
Station

Vilmacy
Station

Dnit
Station

Balão São
Cristóvão
Station

Homero
Station

Livramento
Terminal

Av. Higino
Cunha
Station

Itararé
Terminal

SOUTHEAST

Baixa do
Chicão
Station

Macaúba
Station

Três
Andares
Station

Bairro São
Pedro
Station

Cidade
Nova
Station

Justiça
Federal
Station

Tabuleta
Station

Chesf
Station

Bairro
Parque
Piauí
Station

Saci
Station

Juizado
Especial
Station

Bela Vista
Terminal

Parque
Piauí
Terminal

SOUTH

TIMON

TERESINA | BRT SYSTEM

Bus Rapid Transit Lines and Stations

☐ Teresina Municipal Boundary
☐ Districts
▦ Blocks
• Stations
— Lines

Source: Municipality of Teresina, Open Street Maps

0   2.5   5 km

△ N

Figure 16: Public Transportation Map. Source: CRGP, with data from PMT and Open Street Maps (2020).

Physical Assets

The city of Teresina, due to its relevance as a capital of the State of Piauí, and functionality at the regional level in the provision of education and health services, has critical physical assets. It is essential to identify, locate and monitor exposure to risks in sites containing critical physical assets as its failure can provoke secondary shocks in crisis periods. The critical facilities in Teresina have importance at both local and regional levels. At the regional level, there are airports, transportation terminals, hospitals and healthcare services, and universities, among others. At the local level, heritage sites, education and health facilities, logistics and supply chain routes, water and electricity distribution facilities, are examples.

Concerning intermunicipal transportation, a relevant entry point is the city's coach station "Terminal Petronio Portela". It connects the city to roughly 400 regional and national destinations. There are 19 bus operators, with more than 300 bus services/day. The total passenger flow is around 2,000 passengers on weekdays and approximately 5,000 on weekends. According to the last user's survey (Piauí, 2020), the main destinations were to the states of Maranhão, Ceará, Pernambuco, Federal District and Bahia.

Teresina is also home to Petronio Portela Airport, located near the city centre, which is the main airport in the State of Piauí. It primarily serves the Integrated Development Region of the Greater Teresina, as well as the State of Piauí, also including a noteworthy part of the State of Maranhão and a small portion of western Ceará. The airport operates national and regional domestic flights with a Passenger Terminal and a Cargo Logistics Terminal. According to the last published Infraero Statistics (2018), the airport had 13.823 flights that year, with 1.07% share in the national network. The total number of passengers/year was 1.073.570 (representing 1.27% of total national passengers), and through its cargo terminal, 5,071 tons were handled (1.27% of national flight cargo).

Physical Assets	
Airport	Petronio Portela Airport (THE)
Annual Passengers	1,073,570 (2018)
Annual Cargo	5,071 ton (2018)
Bus Terminal	Terminal Lucídio Portela
Passenger Flow	2,000 pax / week 5,000 pax / weekend

In addition to logistics and supply chain assets, there are rail and road networks. The rail network connects Teresina to São Luis - Capital of the State of Maranhão, and Fortaleza -Capital of the State of Ceará; and thus to 3 ports in these cities - Port of Itaqui (Maranhão), Port of Pecém (Ceará), and Port of Mucuripe (Ceará). Ferrovia Transnordestina Logistica (FTL) operates the rail services through a national public concession. FTL runs 105 locomotives and 1,377 wagons. In 2019, the company transported 2.2 million tons, of which 1.1 million tons of cellulose, 563,000 tons in fuels and 275,000 in cement. The railway is the primary network for fuel supply to the entire state of Piaui; it arrives by train to Teresina Rail Terminal from the Port of Itaqui (REF).

Finally, the main transportation route is by road network. Teresina is traversed by 3 national highways, the BR-226, BR-343 and BR-316. The BR-343 connects the state coast to its hinterlands passing through Teresina. The BR-316 is a vital highway that links Brazil's North and Northeast regions - linking Teresina to cities in the Amazonia, such as Belém, in the state of Pará, to the east coast capitals, such as Maceió, in Alagoas. It has a total length of 2,054 km. The BR-226 is a 2,164.0 km long national road that connects the Northeast Region to the Brazilian Midwest, passing through the states of Rio Grande do Norte, Ceará, Piauí, Maranhão and Tocantins. Other relevant entry routes are the state highways that connect the capital to other locations inside the state, namely PI-112 to the North, PI-113 to the east and PI-130 to the south.

TERESINA | ROAD SYSTEM

Road System

- Teresina Municipal Boundary
- Districts
- Blocks

Road System Classification
— Trunk
— Primary
— Secondary
— Tertiary
— Residential
— Others

Source: Municipality of Teresina, Open Street Maps

0   2.5   5 km

△ N
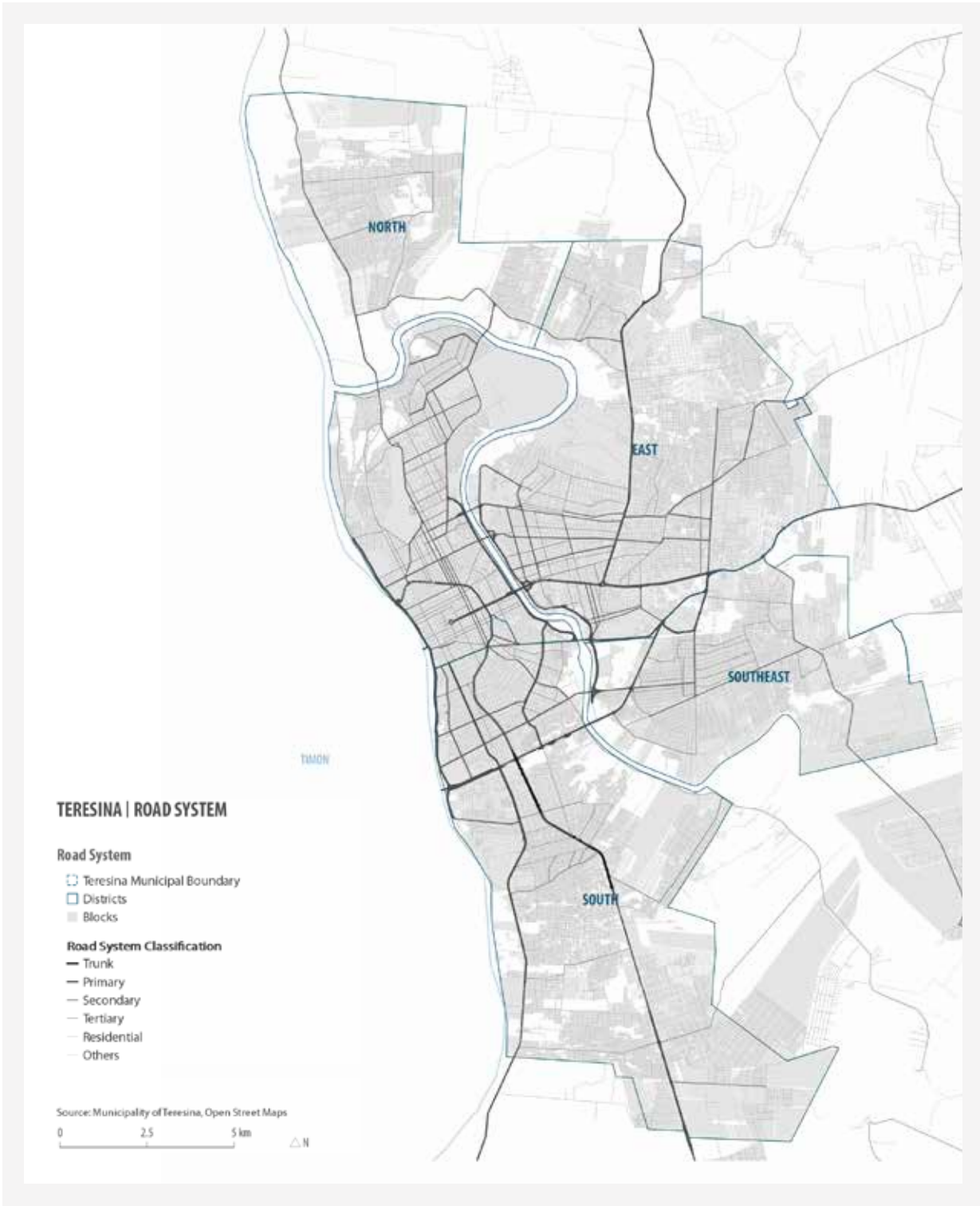
Figure 17: Road System Map. Source: CRGP, with data from PMT and Open Street Maps (2020).
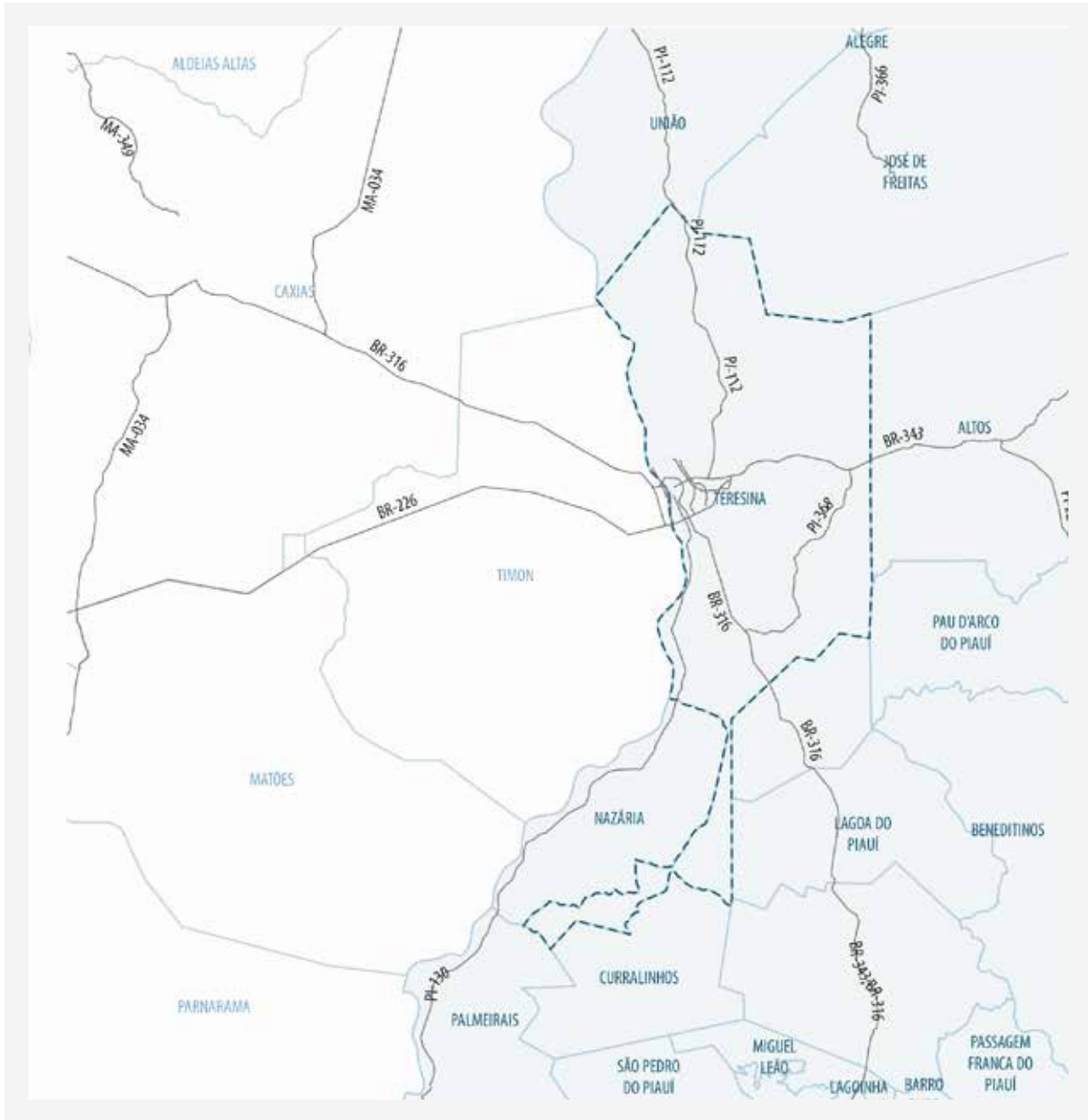
TERESINA | ROAD JUNCTION

Municipal Location

Municipal boundary and neighboring municipalities

⌐⌐ Teresina Municipal Boundary

Piauí State
☐ Municipal Boundaries

Maranhão State
☐ Municipal Boundaries

Source: Municipality of Teresina, IBGE Brazil, Open Street

0   5   10 km   △ N

Figure 18: Road Joint Map. Source: CRGP, with data from PMT, IBGE and Open Street Maps (2020).

Urban Road	
Urban Road Network	4.731 km
Trunk Roads	281 km
Primary and Secondary Roads	662 km
Residential Roads	3144 km
Others	644 km
National Roads	BR-226; BR-343; BR-316; BR-343
State Roads	PI-112; PI-113; PI-130

Table 12: Urban Road. Source: CRGP, with data from IBGE.

Due to its functionality as a health and education hub on a regional scale, health and learning facilities are significant physical assets. Among relevant health facilities, it is worthy to mention that the city centre medical hub is the home of several state-owned hospitals such as the Hospital Getúlio Vargas; Hospital Infantil Lucídio Portella; Hospital de Doenças Infectocontagiosas; and private run hospitals such as Hospital São Marcos; Hospital Santa Maria; Hospital Med Imagem; Hospital ProntoMed; Hospital de Terapia Intensiva; and Hospital Unimed. Outside the central medical hub, the municipal public network offers several considerable hospitals such as the Hospital de Urgências de Teresina - offering state coverage for trauma patients; Hospital do Monte Castelo; Hospital do Matadouro; Hospital da Primavera; Hospital do Parque Piauí; UPA Promorar; UPA Renascença; Hospital Alberto Neto - Dirceu Arcoverde; Hospital Mariano Gayoso Castelo Branco; Hospital-Maternidade do Buenos Aires; Hospital Maternidade do Satélite; and Maternidade Wall Ferraz. Other important public hospitals administered by other governmental spheres are the Hospital Universitário; Hospital da Polícia Militar; Hospital Areolino de Abreu; and Maternidade Evangelina Rosa.

In the educational sector, public administration critical facilities at the regional level are the university campuses of the Federal University of Piauí - Campus Petrônio Portella; of the State University of Piauí - Campus Torquato Neto and Campus Clóvis Moura; Federal Institute of Piauí - Campus Teresina Central; Teresina Sul and Teresina Dirceu Arcoverde.

The built and natural heritage is also part of critical physical assets, and the mapping of relevant historical sites is essential for monitoring risks derived from shocks and stresses. In Teresina, the assets listed by the national heritage are the Parque da Floresta Fóssil; São Benedito Church, Teresina Railway Heritage Site and the Ponte Metálica. In other levels of protection are several sites, mostly located in the urban centre, which make up the landscape of squares and streets that recover the city's historical image. Examples include the Museu do Piauí; Palácio da Cidade; Intendência de Teresina - now Fundação Wall Ferraz; Companhia Editorial do Piauí - now Fundação de Cultura do Piauí; Teatro 4 de Setembro; Cine Rex; Clube dos Diários; Casa do Barão de Gurguéia - Casa da Cultura; Palácio do Karnak - among others.
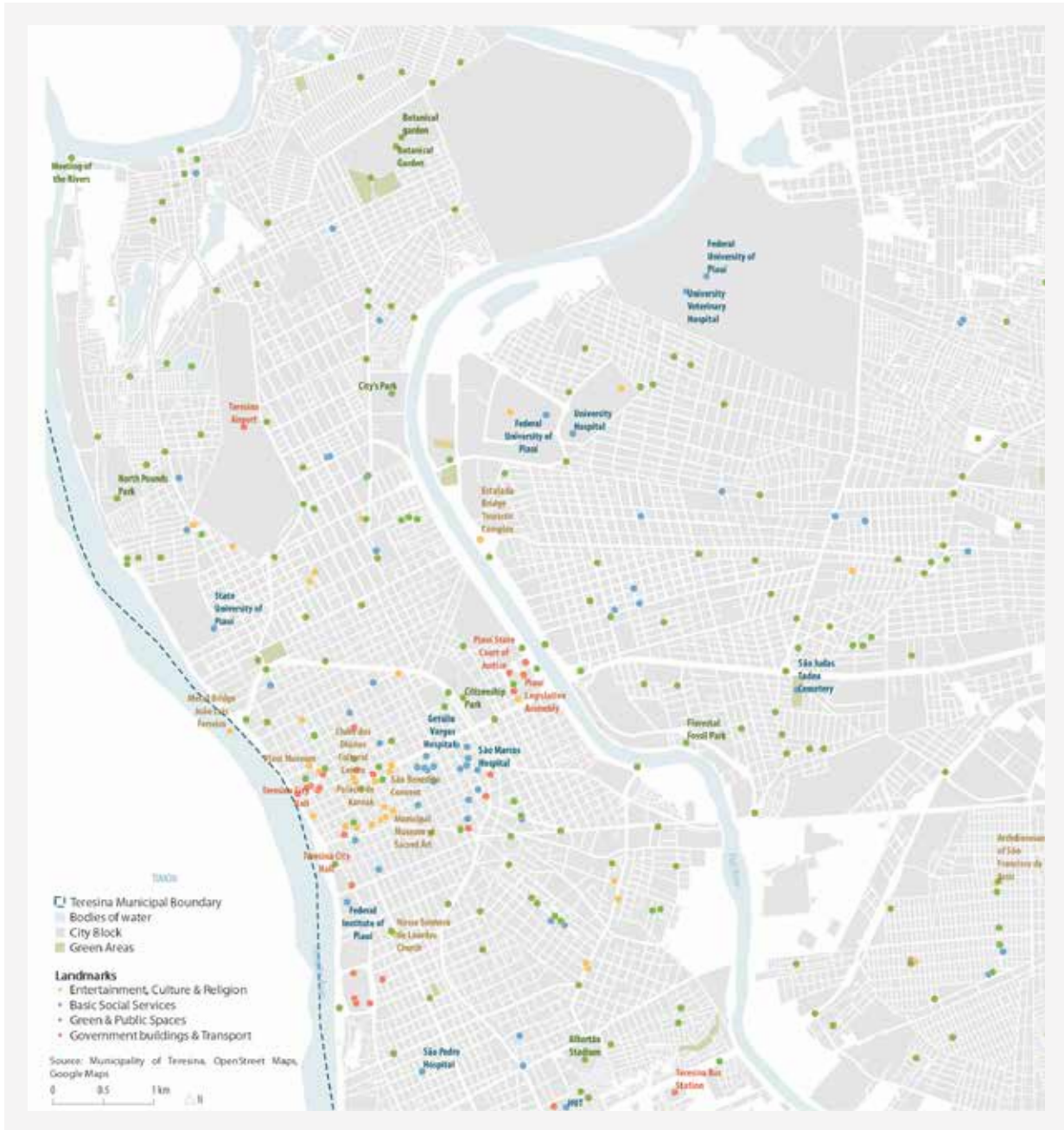
TERESINA | LANDMARKS

Diagrams with cathegorized landmarks
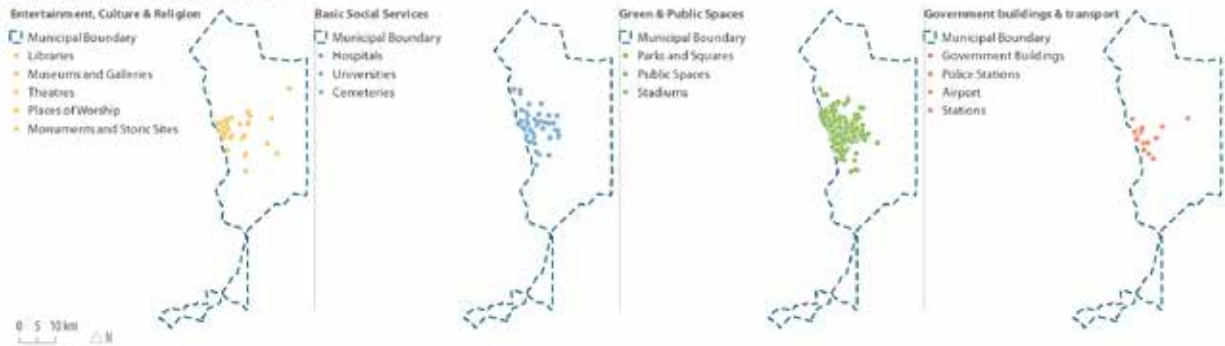
Figure 19: Map of Points of Interest. Source: CRGP, with data from PMT, Google Maps and Open Street Maps (2020).

TERESINA | HEALTH FACILITIES

Health Facilities within the perimeter of the city

Health Facilities within the urban area of the city

⬚ Teresina Municipal Boundary
☐ Districts
• Health Facilities
■ Zones with concentration of Health Facilities

Source: Municipality of Teresina, Google Maps
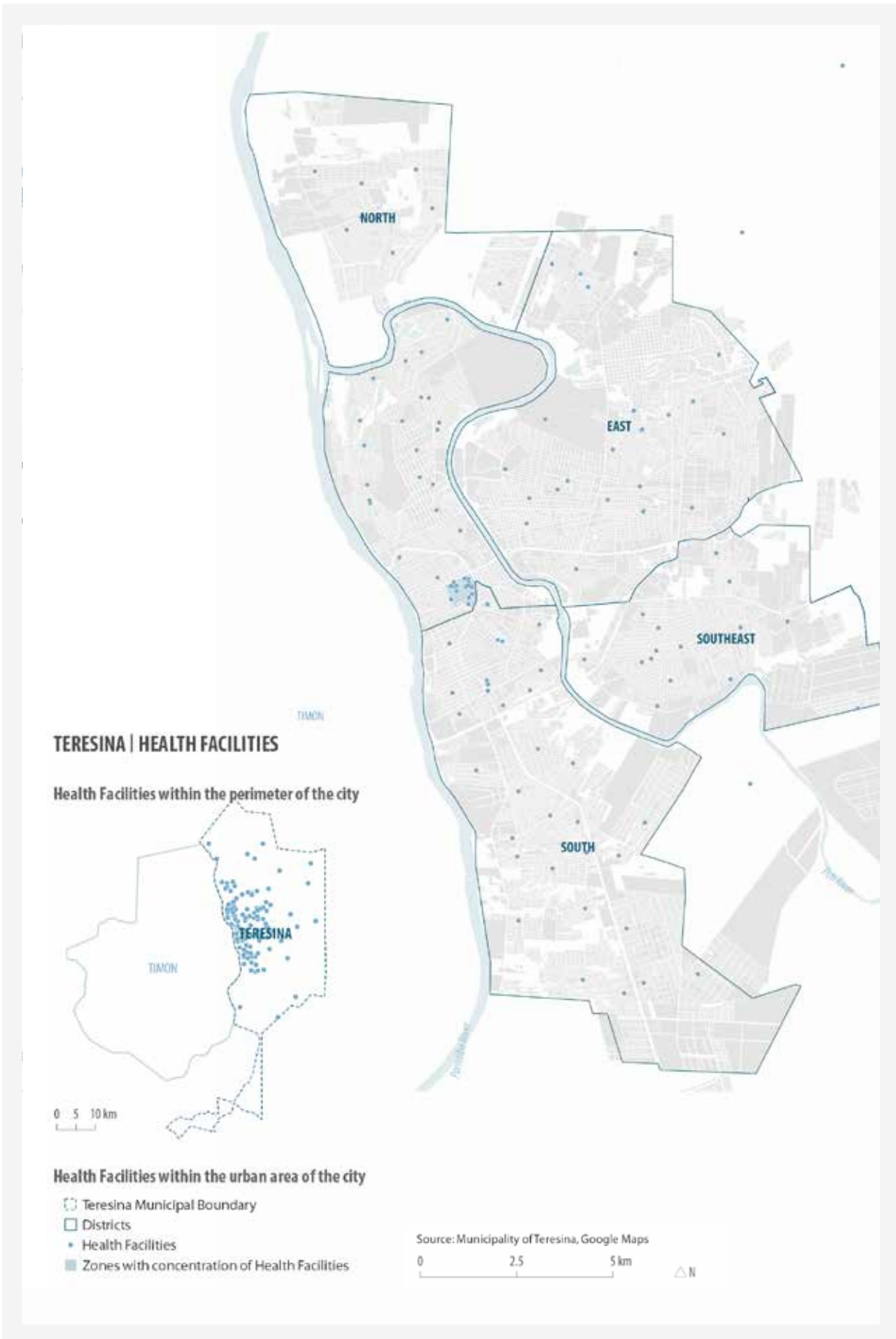
Figure 20: Health Equipment Map. Source: CRGP, with data from PMT and Google Maps (2020).

Figure 21: Map of Urban Gardens of the PMT. Source: CRGP, with data from the PMT, and Google Maps (2020).

1.4. Economy and Livelihoods

For a better understanding of economic context, data is also presented on a national and regional scale, since macro and microeconomic policies are mainly directed by national governments and are closely interrelated with the fiscal and financial scenario at the higher levels.

National Economy

Brazil is the largest and most populous country in Latin America. With a nominal GDP of $1.87 trillion (World Bank, 2018), Brazil is the 9th economy in the world. At the beginning of the 21st century, the country enjoyed growth and development stemming from the commodity wave. Lately, it has been suffering multiple hindrances with the end of the commodity supercycle, in addition to internal problems derived from political instability, which discouraged the investment and business environment. During 2006–2010, the country grew at an average of 4.5%, moderating to around 2.8% in 2011–2013. By 2014, it was hardly growing at 0.1%. In 2016, Brazil contracted by 3.5% before bouncing by 1% in 2017.

The national exports are some USD 240 billion and are primarily related to natural products. Mineral products represent 22.3% of exports - crude petroleum and iron ore being the most significant. Agricultural goods are the second leading export sector with a share of 18% - with a predominance of soybeans. Asia and Europe are the main destinations of Brazilian products, corresponding to USD 108 billion and USD 44 billion respectively. The biggest export partner is China, which imports 26.8% of total Brazilian exports, followed by the United States with 12%, and Argentina with 6.2%.

The country imports a total of USD 181 billion (2018). The main import sectors are Machines (22.5%) - especially Integrated Circuits, Telephones, and Broadcasting Accessories; Chemical Products (20.2%) - mainly medicaments, agricultural fertilisers, and pesticides; Mineral Products (15.5%) - refined and crude petroleum, petroleum gas, coal briquettes, copper, and others; Transportation (13.95) - drilling platforms, vehicle parts, cars, trucks, aircraft; Metals (6.3%); and Plastic and Rubbers (5.7%). Concerning its origins, 19.2% of the goods come from China, the major Brazilian trade partner, followed by the United States (16%), Argentina (6.1%), and Germany (5.8%)

The relation of the country's imports and exports is given by the National Import and Export Ratio, that is 0.75, representing a surplus on the trade balance.

Regional Economy

The State of Piauí is the 21st economy among all 27 Brazilian federation units with a GDP of about USD 7Bi. The major economic sectors are, in order of importance, retail and services, public administration and social security, administrative services, education, health, transformation industry, and construction.

The Northeast of Brazil has a smaller export share compared to all the other regions, being responsible for about USD 17 billion of the country's total exports. Considering only the State of Piaui, the share is only about USD 283 million. The main export sectors of the state are related to Vegetable products (76.4%) and Animal and Vegetation biproducts (9.2%), and Foodstuffs (6.5%). The principal exportation product is soybeans, representing 76% of Piauí's exports, followed by vegetable waxes (9.2%) and soybean meal (6.5%).

The imports represent a total of USD 137 million, and the main demanded sectors are Metals (42.5%) - Coated Flat-Rolled Iron Products, Cold-Rolled Iron Products, Copper Wire, etc.; Chemical Products (21%) - Fertilisers, Laboratory Reagents, and others; Mineral Products (10%) - refined petroleum, coal tar oil, calcium phosphates; Vegetable Products (8.2%) - wheat, coconuts, Brazil nuts, and cashews, Machines (7%) - electrical control boards electric motors, microphones and headphones, leather machinery, etc.; and Transportation (7.5%) - aircraft, bi-wheel vehicle parts. More than a third of the products come from China (38.8%). Other trade partners are the United States (14.6%), Ukraine (8.5%), Israel (5.7%), Spain (4.4%), and Russia (4.2%).

Urban Economy

Teresina's GDP is R$19.1 billion (2017), which represents about USD 3.3 billion and is the most important economic unit of the State of Piauí. The GDP per capita of the city is around R$ 22.5 thousand (USD 3.8 thousand), placing Teresina in 1944º position among all 5570 Brazilian cities, and 13º among 224 municipalities in Piauí. The services sector is the principal driver, representing 61.95% of the city's GDP. It is followed by the public administration, including administration, defence, public education and health services, and social security, representing 22.19%. The industrial sector accounts for about 15.50% of the local GDP, while the Agro sector corresponds to 0.36%.

In comparison to other municipalities, the local administration revenues position the city in 21º place among a total of 5570 Brazilian cities. In 2019, the total local government estimated revenues were about R$ 3.47 billion (USD 600 million), following a continuous increasing trend in the last decade - municipal revenue has tripled in the past decade. It is important to note that, given the structure of the Brazilian federative pact, these revenues are made up of more than 60% external sources. The increase in revenue also demonstrates enhanced access to national and international resources to finance local projects. Of the entire local revenue, relevant sources are: 56.43% from transfers, 15.68% from local taxes and fees, and 7.98% from credit operations, among other sources.

Notwithstanding, the current COVID-19 global crisis poses severe threats for the local government's budget. Cities must strengthen public services and boost the local economy while suffering from sharp falls in revenues. Teresina is no exception in this scenario.

Concerning international trade activities at the local level, Teresina's total exports are about USD 1.29 million, a humble share in national and regional contexts. The city's exports matrix is mainly composed of Chemical Products (39%) - Mixed Mineral or Chemical Fertilisers, Make-up, and hair products; Metals (37.3%) - including scrap copper; vegetable products (23.1%) - mainly soybeans. Regarding trade partners, 59.3% of Teresina's exports go to Venezuela, and 37.3% to China. Regarding export logistics, the last decade has seen a shift from the ports of Fortaleza and Pecém (both in Ceará) in the early 2000s; to the port of Santos (São Paulo) which currently services 99%.

The number of imports hugely exceeds exports, totalling USD86,9 million. This relation creates a negative trade balance deficit; the local import/export ratio is 67.37. The main imported goods are Metals (63%) - Coated Flat-Rolled Iron Products, Hot-Rolled & Cold Rolled Iron Products; Mineral Products (14.1%) - Refined Petroleum and Coal Tar Oil; Vegetable Products (7.6%) - Wheat; Machines (5.3%) - Electric Motors, Other Machinery, microphones, and headphones; Transportation (4.8%) - Bi-Wheel Vehicle Parts; among others with reduced relevance. From the total, USD 52.5 million comes from Asia, with China as the leading import partner with 53% of market share; then North America with USD 20.2 million in imported goods (United States - 15.6%; Canada - 7.6%); and, finally, Europe selling USD 12.6 million to the city (Ukraine - 13.3%; Germany - 0.4%). During the last decade, the Port of Pecém was the main entry route for goods imported by the city. However, the Port of Maceió has been growing in relevance and today receives 37.9% of the city's imports. The other shares are the Port of Pecém with 40.8%; Port of Fortaleza 7.7%; Rio de Janeiro Port of Sepetiba 7.1%; and Port of Santos 3.5%.

Economy	
National GDP	$ 1.869 trillion (2018)
GDP / National Capital	$ 8,920.76 (2018)
Imp./Exp. National Ration	$ 181 million / $ 240 million = 0.75
GDP Teresina	$ 3.306 billion (2017)
GDP / Capita Teresina	USD 3,889.09 (2017)
Teresina Imports	$ 86.9 million (2018)
Teresina Exports	$ 1.29 million (2018)
Imp./Exp. Ratio	67.36

Jobs, Wages and Income

Despite a slight downward trend, the unemployment rate in Brazil is still significant, reaching around 10.6% (IBGE, 2019). In the Brazilian Northeast region, this figure is even higher, rising to 13.6%. The informality rate in the country reached 41% in the fourth quarter of 2019, a contingent of 38.4 million people. According to IBGE, the unemployment rate in Teresina increased from 13.8%, registered in the 3rd quarter of 2019, to 15.20%, in the 4th quarter and, in Teresina, there were around 70 thousand unemployed people in the 4th quarter of 2019.

The most recent Sintesis of Social Indicators from IBGE (SIS/IBGE 2019, annual data from 2018), situated the unemployment situation of the city between national and regional ranges. Brazil had about 12% unemployment in 2018 while in the Northeast region it was about 14.5%. In Teresina, the indicator was 13.7%. The gender gap in unemployment is 0.2%, the male group faced 13.6% and female 13.8%. The gap is higher when considering data disaggregated by skin colour, White population 10.9%; Black and Mixed-Race population 14.2%. The disaggregation for age groups displays a significant gap between younger and older occupied populations - Young <29 years 24%; 30-49 years 10.6%; above 50 years 7.2%. Among these workers, only 54.9% were under formal employment, considerably above state and regional figures (Piauí 35%; Northeast Region 41.4%). Regarding formal jobs in Teresina, 77.3% are employees, 21.2% are self-employed, and 1.5% are employers.

Among the primary job sectors in the city, as a state capital, the most prominent is the Public Administration, accountable for 27.6% of the workers according to RAIS data from 2017. It is followed by the retail sector (17.8%); Administrative Activities (13.6%) - in especial call centres; Human Healthcare and Social Services (7.9%) - mostly hospital services; Education (6.3%); Processing Industries (5.7%); Construction (5.5%); Lodging and Food (3.6%); Transport and Postal Services (3.1%); and others.

According to the national household's survey, for the first quarter of 2020, the average income in Teresina was BRL 1,999 (USD 350). The results were lower than the national average of R$ 2,398 (USD 420), however considerably above regional and state-level figures, respectively BLR 1,648 (USD 288) and BRL 1,401 (USD 245). Notwithstanding, the wage gender gap is relevant. Disaggregated data reveals that the average income for men in Teresina was BRL 2888 (USD 505), while women received an average of BRL 2274 (USD 398). Regarding informal jobs, the 2018 national household survey estimated that average income for informal occupation was BRL 1140 (about USD 200), and gender gaps remained - women wages were 20% lower than men. The differences also manifest in skin colour disaggregation, where the white population had an average income about 1.4 times higher than black and mixed-race for formal jobs, and about 1.9 times higher for informal earnings.

Despite these figures, inequality in Teresina is below national and regional estimates. The local GINI coefficient is 0.511 (IBGE, 2018), while national and regional are both 0.545 - the closer to 1, the higher the inequality. In the city, the richest 10% earned on average 10.3 times more than the poorest 40%. At the national level, the ratio is 13 times, and being higher in the Brazilian Northeast where the ratio is 14.1. Following this pattern, the number of people living under the world's extreme poverty line is less than national averages, and considerably less than regional and state figures. In 2018, 5,3% of its inhabitants were living below the extreme poverty line (less than USD1,9/day PPP 2011) in comparison to 6,5% estimates for the whole country, 13.6% at regional level and 14.2% at state-level. When considered as people living with less than USD 5,5/day (PPP 2011), the figure was 29.3% of Teresina's population. For the same indicator, the country has 25,3%, the region 53,6%, and the state 41.9%.

Jobs, Wages and Income	
Unemployment rate (2018)	Brazil: 12%
	Northeast: 14.5%
	Teresina 13.7%
Employment Teresina (2018)	Freelancers 76,019
	Employers 5,317
	Employees 277,273
Average Income (2018)	Brazil: R $ 2,163
	Northeast: R $ 1,441
	Teresina: R $ 1781
	Average Income Formal Occupation: R $ 2,282
	Average Income Informal occupation: R $ 1,140
Poverty and Inequality (2018)	Population living below the world extreme poverty line (below US $ 1.9 PPP 2011)
	Brazil: 6.5%
	Northeast Region: 13.6%
	Piauí 14.2%
	Teresina: 5.3%
Population living below the world poverty line (below US $ 5.5 PPP 2011)	Brazil: 25.3%
	Northeast Region: 43.6%
	Piauí: 41.9%
	Teresina: 29.3%
Gini coefficient	Brazil: 0.545
	Northeast Region: 0.545
	Teresina: 0.511
Income ratio between the richest 10% and the poorest 40%	Brazil: 13.0
	Northeast Region: 14.1
	Teresina: 10.5
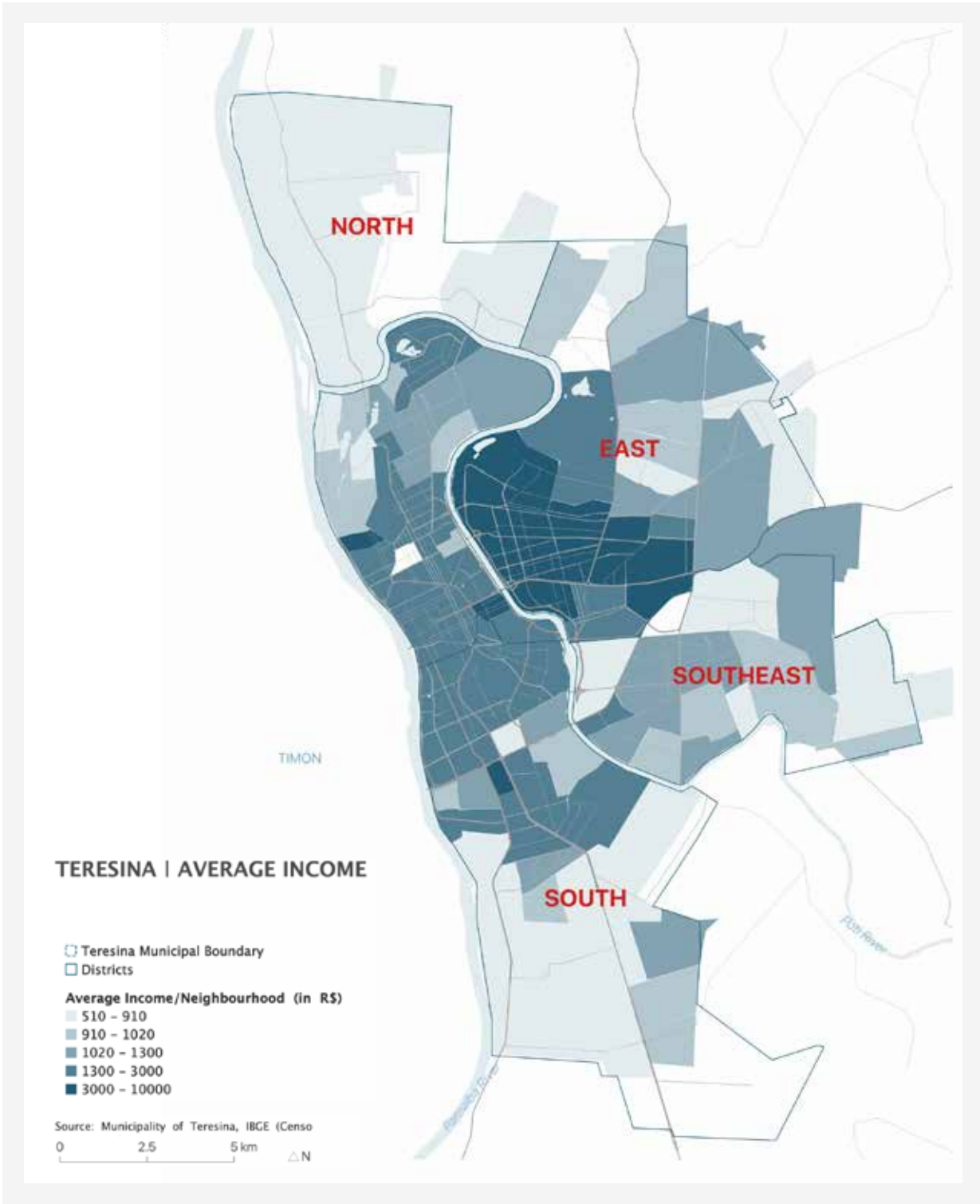
Figure 22: Map of Average Income by neighborhood. Source: CRGP, with data from PMT, and IBGE (2010 Census).

1.5. Local Government and Public Administration

Administrative Structure

Teresina's policy follows the model established in the Federal Constitution in the form of a republican government, a system of local government composed of the Mayor and Vice Mayor, representatives of the executive branch elected for four-year terms with re-election only once in a row, and councillors, representatives of the Legislative Power in the City Council, also elected for four-year terms, with re-election possible for several consecutive terms, both through democratic elections with direct, secret and mandatory voting. At the municipal level, there are no representatives in the Judiciary Branch, which acts locally through the State and Federal Courts.

Although the councillors have no limits on the number of re-elections they can run for, Teresians seek renewal of their councillors. In the last two elections, the renovation was approximately 50% of the house, and included local community leaders, business leaders, religious and former politicians.

Local Government Organisational Structure and Characteristics

Teresina is governed by the Municipal Organic Law, approved by the Municipal Council, which establishes the limits, competences, principles, objectives and rights, and individual and collective guarantees of the municipality and the citizens.

The Federal Constitution and the Municipal Organic Law assign the functions of legislating on matters of local interest to the Municipality; institute and collect taxes; grant licences; prepare and execute urban development master plan; perform works or services directly or by concession; among others.

The Municipal Executive Power is exercised in the City Hall and performs public services with the support of Secretaries, which are part of the direct administration of the municipality, for sectorized technical works. Public companies and foundations are part of the indirect administration and also perform services of their nature with greater autonomy conferred by law.

The city hall also has the Urban Development Superintendencies, which are equivalent to sub-prefectures and focused on the execution of works and provision of basic services to the community, such as paving, sweeping, and housing. They are divided according to the administrative regions of the city: Centre-North; South; Southeast and East. Urban Development Superintendents are freely appointed and dismissed by the Mayor for political office. In early 2022, the Municipality is working on a revised organisational structure and a new organisational chart is expected to replace the one illustrated in the image below.

Superintendências

SEMPLAN

SDU
Centro/Norte

SDU
Leste

SDU
Sul

SDU
Sudeste

PRODATER
T. Informação

SDR
Des. Rural

STRANS
Mobilidade

CHEFE DO PODER EXECUTIVO
Prefeito

GABINETE
Prefeito

SEMGOV
Governo

VICE
Prefeito

PGM
Procuradoria

ASSISTENCIA MILITAR

SEMCOM
Comunicação

Autarquias

IPMT
Previdencia

FMS
Saúde

FCMC
Cultura

ARSETE
Saneamento

FWF
Capacitação

ETURB
Serv. Urbanos

Secretarias de Gestão

SEMA
Administração e RH

SEMPLAN
Planejamento

SEMF
Finanças

Secretarias Temáticas

SEMEC
Educação

SEMAM
Meio Ambiente

SEMEL
Esporte e Lazer

SEMCASPI
Ass. Social
Pol Integradas

SEMDEC
Economia
Turismo

SEMCOP
Concessões
Parceria

SEMDUH
Urbanização
Habitação

SMPM
Pol. Mulheres

SEMEST
Econ.
Solidária

Figure 23: Organization chart of the Teresina City Hall. Source: CRGP, with data from the PMT (2020).
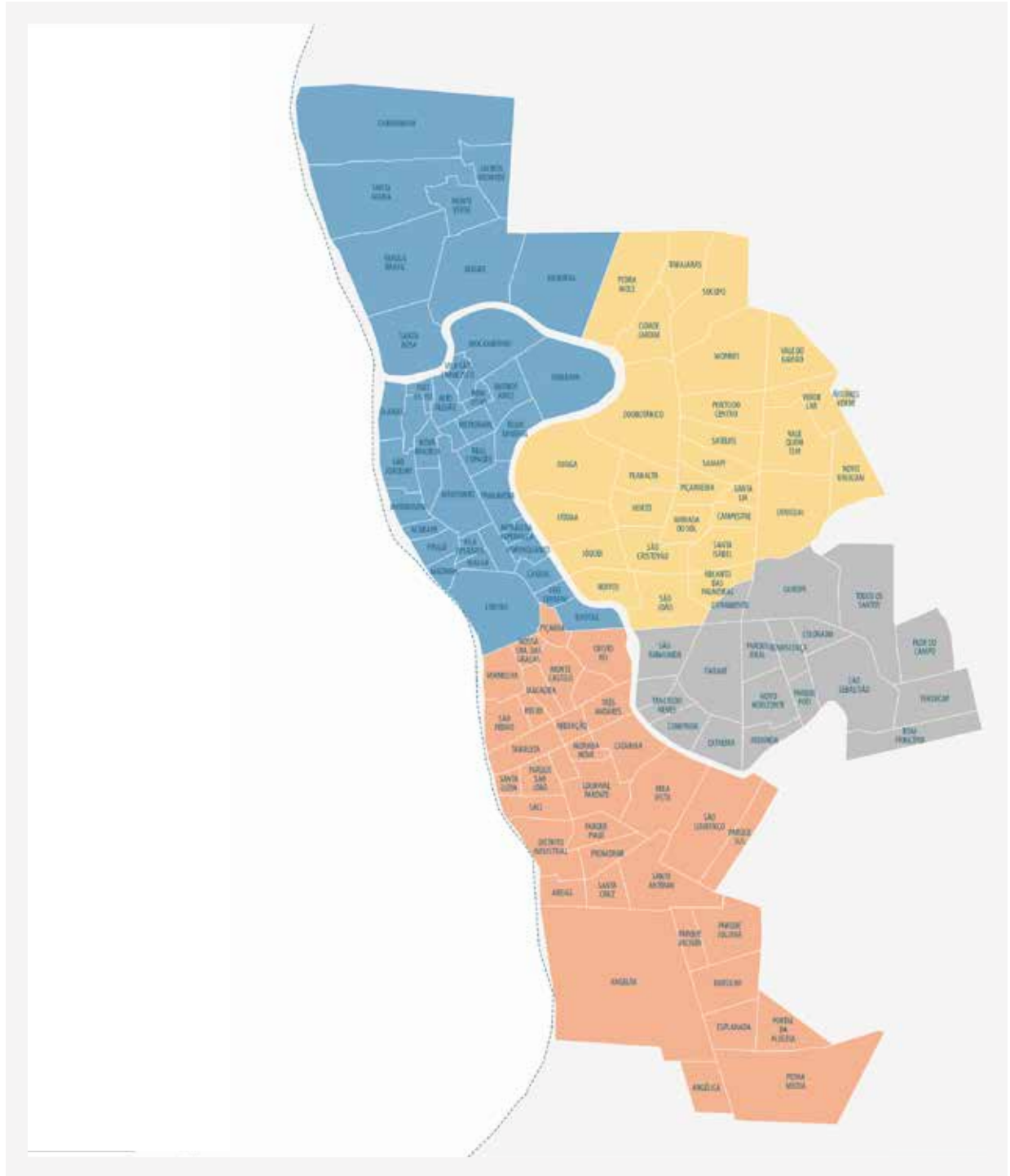
TERESINA | ADMINISTRATIVE REGIONS AND DISTRICTS

Urban and Rural Zone

Administrative Regions

⬚ Teresina Municipal Boundary

Teresina Administrative Regions
- 🟨 EAST
- 🟦 NORTH
- ⬜ SOUTHEAST
- 🟧 SOUTH

Source: Municipality of Teresina

0 — 2.5 — 5 km   △N

Figure 24: PMT Administrative Regions (Zones).
Source: CRGP, with data from the PMT (2020).

1.6. Challenges and Opportunities

Challenges refer to contextual or environmental conditions that have the potential to impact upon the ability and capacity of an urban system to address emerging risks and opportunities.[2] Challenges in Teresina can be classified into two major groups: those that Teresina has been facing since its formation and have become intrinsic characteristics of the city, referred to as 'enduring challenging', whereas 'emerging challenges' denote pressures extrinsic to the urban system brought forward due to changes occurring in this interconnected world. These identified challenges serve as overarching factors of which some require Teresina's continued adaptation in order to advance on its development targets.

Enduring Challenges

The Peripheral nature of the region

The colonisation process of the territory of Piauí is key to understanding the peripheral nature of the region's development, and its current economic and social structure. Piaui's colonisation was defined by the regime of large land properties called 'sesmarias'. The concession of 'sesmarias' benefited mainly Bahia and Pernambuco potentates, none of whom considered transferring their residences, or living and working in the hinterlands. This regime was not conducive to cultivation and use of the land for agriculture but was aimed at territorial expansion in order to increase the area available for the pasture (occupation of pastures by cattle ensured the appropriation of land by the owners) and consequently increased the power of the farmers. Instead of orienting production towards the foreign market, the main objective of the Brazilian colonial economy, the herds supplied the internal market.

Hence, the economic development of Piauí was based on extensive and extractive occupation, of a loose character, and influenced by the severe local droughts and weak central investment. With almost no slavery and capital investment, it developed economic activities of little significance in the colonial economy, differentiating itself from the coastal northeast, with its semi-bourgeois sugar economy directly linked to international capital. It was, instead, a supplier and subordinate to the mercantile capital of the coast in Salvador and Recife in the production and circulation of goods, and cattle. This subordinate link made the region more vulnerable during the decline of the sugar economy. Only in the 19th century did the region take its goods to the global scale, with cotton, maniçoba rubber, and carnauba wax exports. However, the situation of foreign markets and the distance from consumer centres determined the low competitiveness of Piaui's products. The very primitive form of production that characterised the colonial period has been accompanied by the continuous degeneration of the production structure, and has contributed significantly to the peripheral nature of the local economy. Reversing this structural condition is the great challenge of modern Piauí.

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[2] ISO 22370

BRAZIL | Human Development Index

Brazilian's States Human Development Index

BRAZIL'S HDI

- 0,000-0,499
- 0,500-0,599
- 0,600-0,699
- 0,700-0,799
- 0,800-1,000

0   250   500 km

△ N
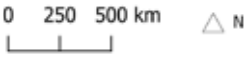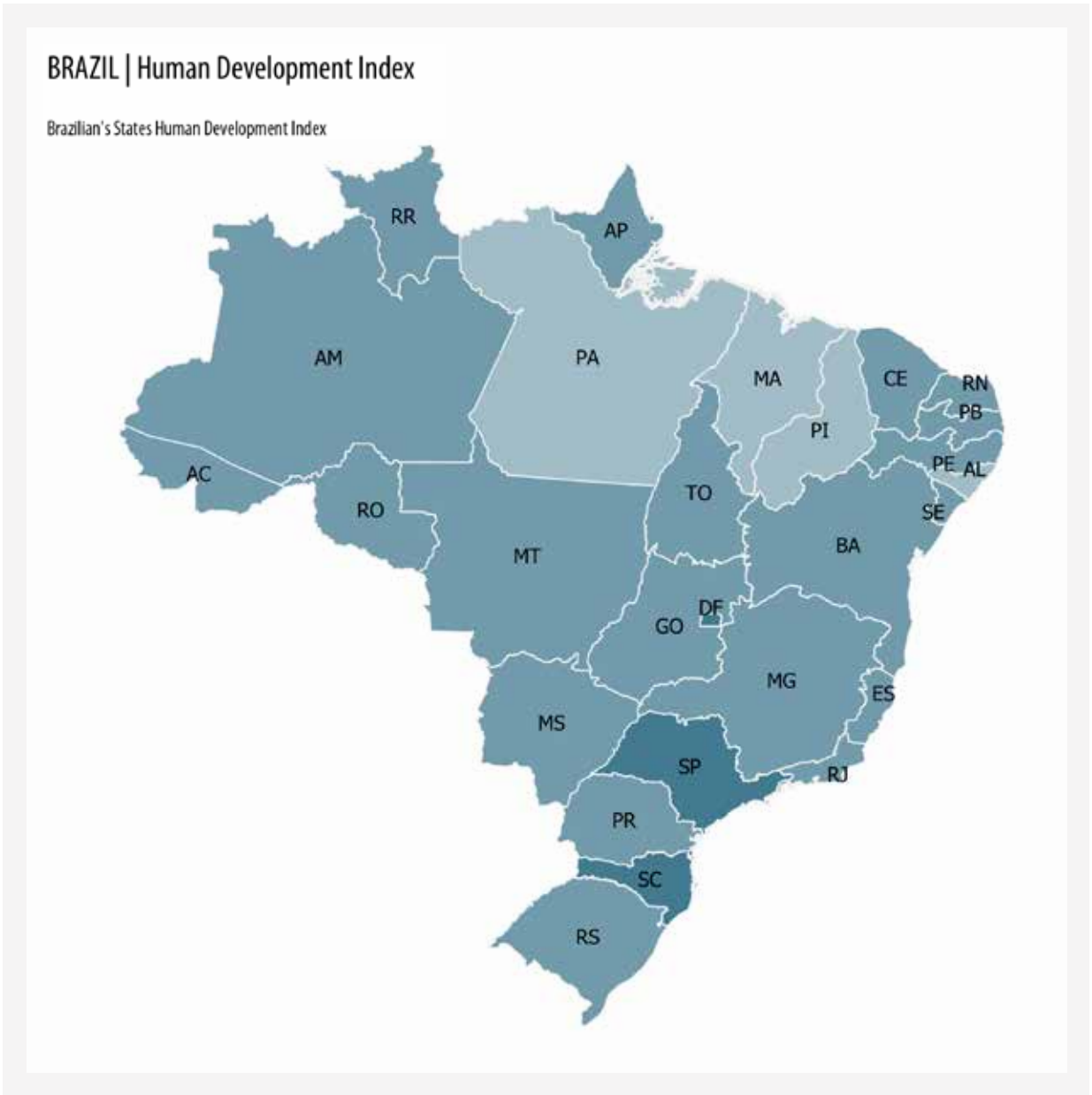
Figure 25: Human Development Index by Brazilian States.
Source: CRGP, with data from the IBGE (2020).

BRAZIL | GINI COEFFICIENT

Brazil's GINI Coefficient analysis

░	0,400-0,450
░	0,450-0,500
▓	0,500-0,550
▓	0,550-0,600
▓	>0,600

0   250   500 km

△ N
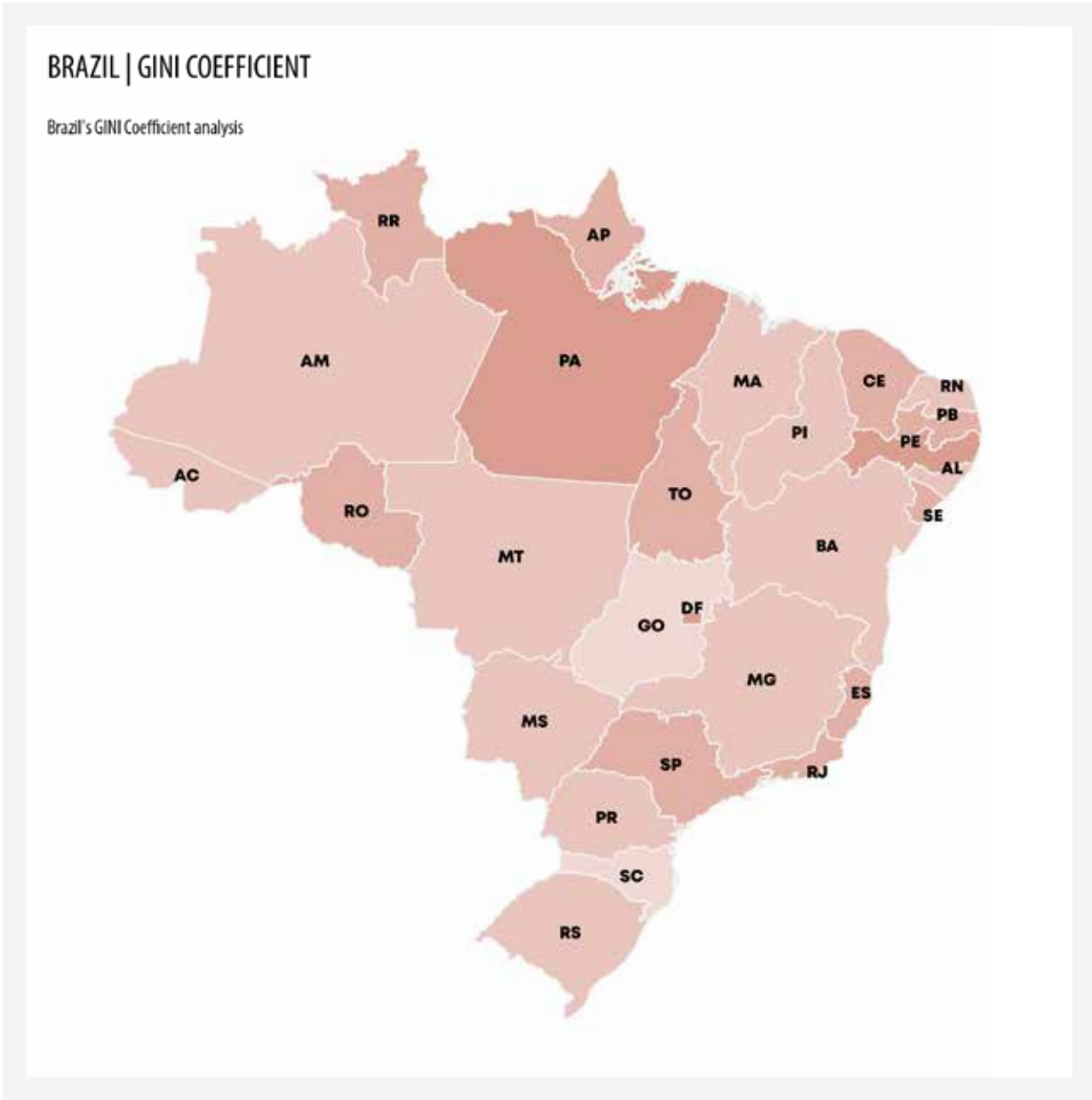
Figure 26: Gross Domestic Product (GDP) by Brazilian States.
Source: CRGP, with data from the IBGE (2020).

Poverty and inequality

The structuring factors and the peripheral nature of the region also shaped inequalities and the impoverishment of the region. Far from being determinants, these practices resulted from the domestic centre-periphery link, which reinforced and allowed the region to enter the 20th century without an established economy supported by domestic consumption and a consolidated middle class. As a result of the colonial process, Piauí housed, in the middle of its development, a fractured and unequal society, composed of a proprietary elite representing the government and, conversely, a large group without assets, composed of displaced populations, refugees, fugitives, and herdsmen and settlers without salary/property rights working in vassal-like regimes.

In the 20th century Piauí, these conditions resulted in high levels of social inequality, poverty, low levels of education, and deficient public investment in the provision of satisfactory basic services. The labour market was uneven and poorly developed, with low dynamism in several territories and with little capacity to generate sufficient wealth to provide a minimum quality of life for the majority of its population. Teresina, as the capital city, has gradually moved away from the State level poverty and inequality indicators over the past few decades. However, due to the structural nature of these conditions, this is a persistent challenge that will require decades of investment to transform society and reach satisfactory levels of development and equality.

BRAZIL | POVERTY LINE

People bellow Poverty Line in Brazilian's States
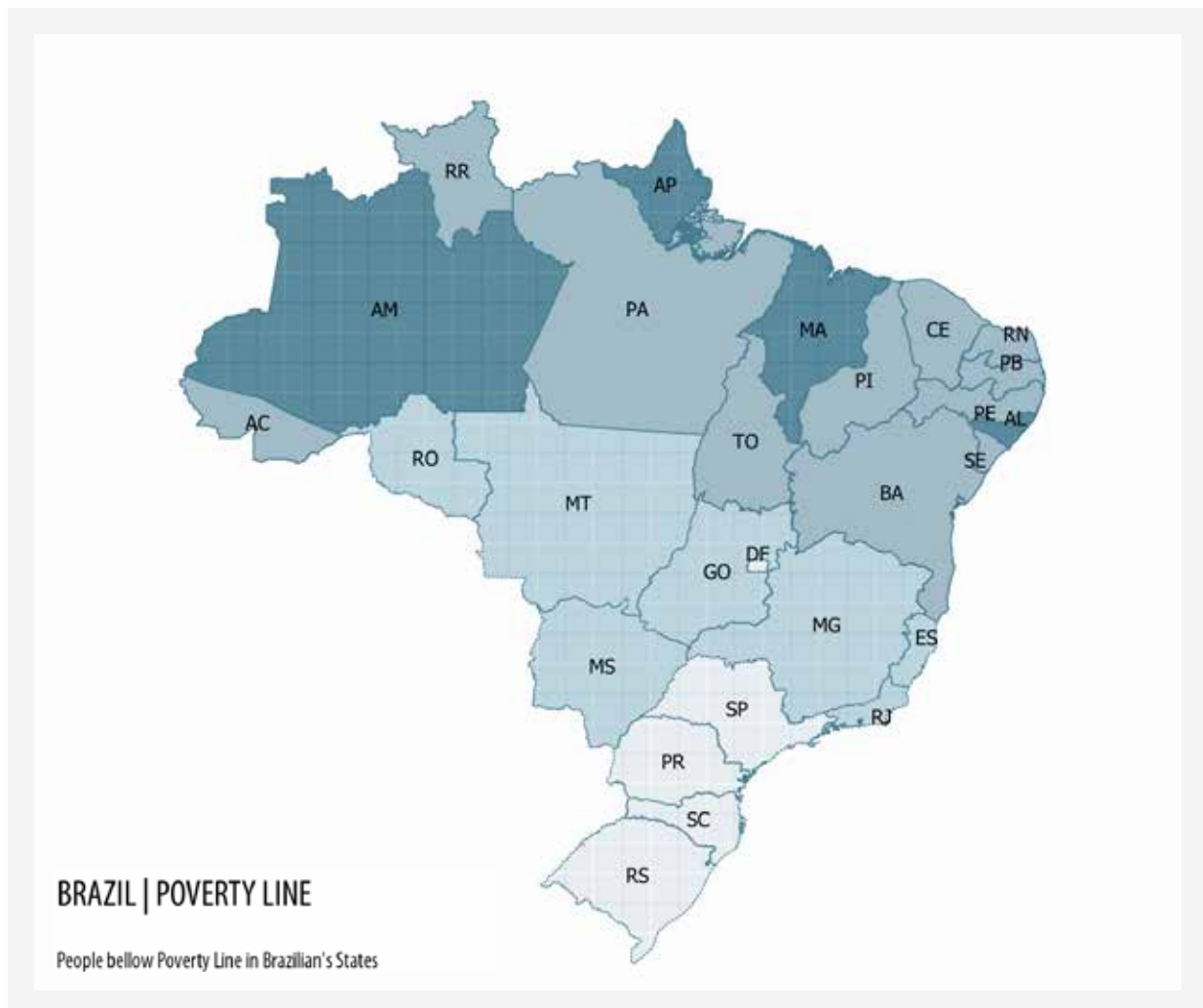
People bellow Poverty Line
- Less than 15%
- From 15 to 30%
- From 30 to 45%
- More than 60%

0   250   500 km   △ N

Figure 27: People below the poverty line in Brazilian States.
Source: CRGP, with data from the IBGE (2020).

BRAZIL | GROSS DOMESTIC PRODUCT

Brazil's GDP

BRAZIL'S GDP
- + 2 trillions
- + 640 billions
- + 320 billions
- +160 billions

0   250   500 km   △ N
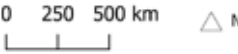
Figure 28: GINI Coefficient by Brazilian States.
Source: CRGP, with data from the PNAD (2020).

Weak intergovernmental coordination

The administration of financial resources in large countries tends to be a challenge for its public managers. In Brazil, the Constitution establishes an organisational arrangement with three levels of government (federal, state and municipal government) in an attempt to overcome unequal income distribution and lack of resources to finance the welfare state. This design in practice has several inefficiencies, particularly for small and medium-sized municipalities, whose actions are limited by their own resource scarcity and hence the dependence of state and federal governments for budgetary support. In cases like Teresina, the local resources are essentially limited to the fulfilment of its minimum constitutional obligations. The dependence on external sources curbs its actions to state and/or federal public policies that are not always aligned with the municipal administration. The policy implementation depends not only on the city's capacity to develop projects and programmes, - this is common to all federal or state entities - but also neglects the participation of local stakeholders in policy design. Far from their reality or needs, this process often exacerbates difficulties in the execution of the most suitable solutions, adapted to the local realities, and feasible in their implementation, particularly over the long-term. Therefore, the municipality has to adapt to these proposals in a creative/alternative way and increase its range of financing to be more resilient at project implementation.

In addition to the unequal income distribution, intermediary and small Brazilian cities also struggle with the inefficiency of institutions. Teresina, in particular, has the distinct challenge of being one of the three metropolitan areas in Brazil located in an area covering more than one state. This situation, in the federal arrangement, creates the need for national oversight to implement a functioning metropolitan administration. The so-called RIDE Great Teresina (RIDE Grande Teresina - Integrated Administrative Development Region of the Great Teresina), the local metropolitan administration is ineffective in practice due to the distancing of the federal government from the local reality. This institutional framework design creates power imbalances that are not compatible with the stakeholder's interests since national governments have few incentives to act at the local level. Consequently, it deters municipalities to seek solutions for urban planning for the region collectively, acting independently and dispersed, and so reducing the effectiveness of their actions.

Emerging challenges

Climate Change Effects

One of the main challenges in the city of Teresina is the current trend of climate warming above the global average. In the last century, the region's temperature warming was between 2-4ºC, while the average global warming was around 1-2ºC. Climate change, beyond increasing temperatures and causing more extensive and more frequent heat waves, exacerbates extreme climatic phenomena, such as storm intensity and duration of the rain season. It can change the occurrence of the already frequent fluvial, pluvial, and flash floods. It can also exacerbate droughts, migratory phenomena of the affected population in areas of regional influence, thereby causing economic crises, urban conflicts, and failures in the provision of infrastructure and services.

The following image shows the change in average surface air temperature during the Teresina drought season period (October-December) for the last 50 years. Teresina is in a red area, which reinforces the exceptionality of the average temperature rise of the city compared to Latin-American situation, and other parts of the globe.
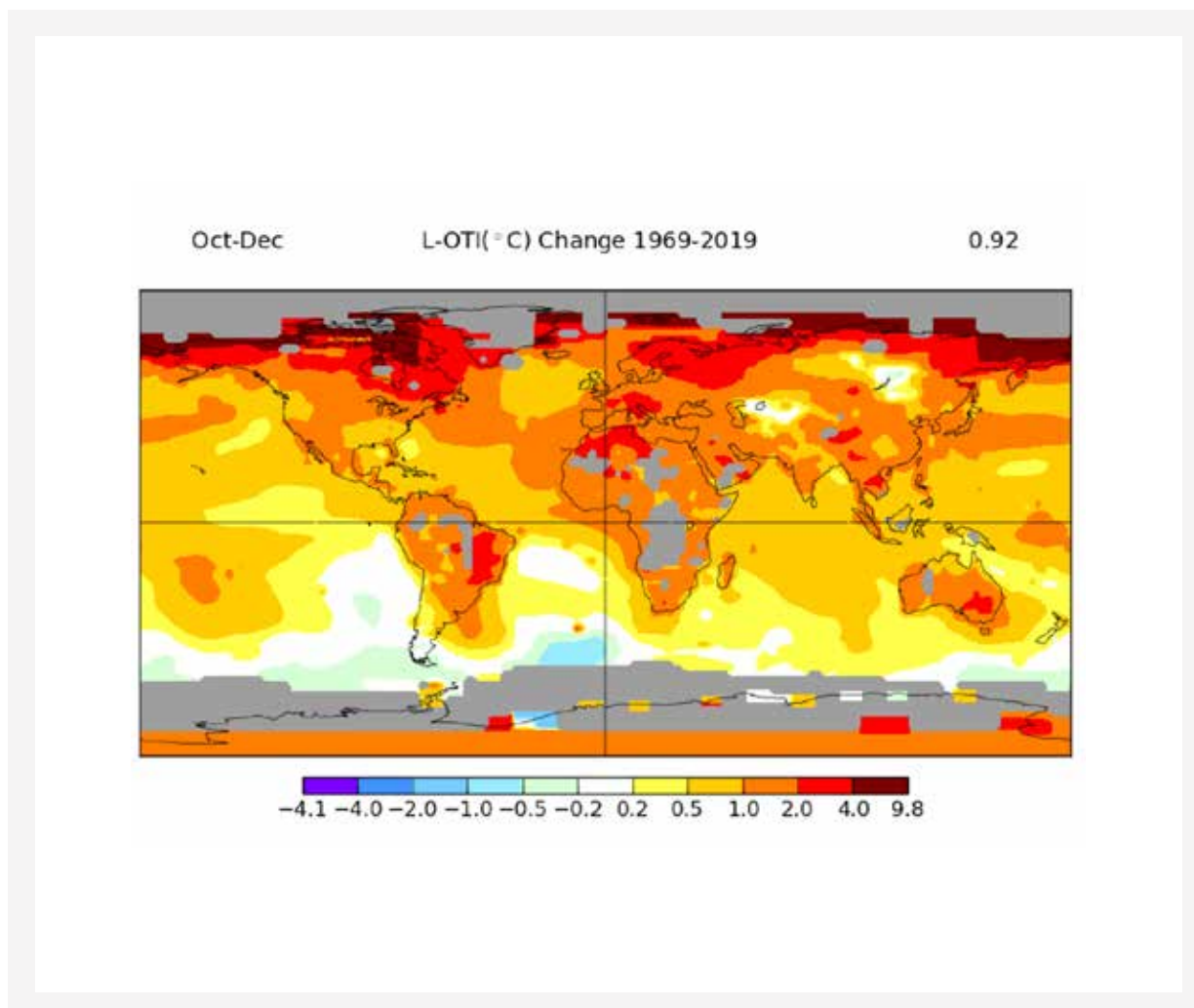
Figure 29: Global average surface air temperature for Oct-Dec from 1969 to 2019. Source: NASA GISS..Note: Gray areas signify missing data. (2019).

Safety and Crime

Problems related to the rise in crime rates, the increased sense of insecurity, especially in large urban centres, the degradation of public space, ineffective criminal justice institutions, police violence, the weak preventive capacity of organisations and precariousness of the prison system, among many others, represent conjunctural challenges for Brazilian society. For two decades, from the 1980s, the national homicide rate increased sharply. It presented relative stability in the early 2000s, but then the rates started to grow again in 2008. Today, with 27 more homicides for every 100,000 inhabitants,[3] Brazil is considered one of the most violent countries in the world. The death rate among the black population (black and mixed-race, as defined by the IBGE -Brazil Statistics and Geography Institute) is 37.8 per 100 thousand inhabitants, while that of non-blacks is 13.9 (2020).

WhWhile the growth of urban violence is a problem that afflicts Brazilian municipal governments, consolidated instruments, and competences in the matter, such as the criminal sphere and police operation, are stated in the Constitution as functions of the state and national governments. However, in recent years, municipalities have emerged as important actors in the design, implementation, and monitoring of public security policies to restrain the escalation of urban violence and crime. In Teresina, urban violence increased sharply in the first decade of the 21st century. In 1996, the homicide rate per 100,000 inhabitants was 11.29. This indicator rose to 28.80 in 2006 and increased again reaching 44.13 ten years later (2016).[4] However, the most recent report by the Piauí Public Security Secretariat (SSP-PI) shows that, in the last five years, this value has decreased by -45.74%.[5] Among the neighbourhoods in the city that most registered intentional lethal violent crimes in the city (SSP-PI, 2019) take place in Poty Velho, São Joaquim, Alegre, Pedra Mole, Verde Lar, Centro, Beira Rio, Santo Antonio, Promorar and Esplanada.
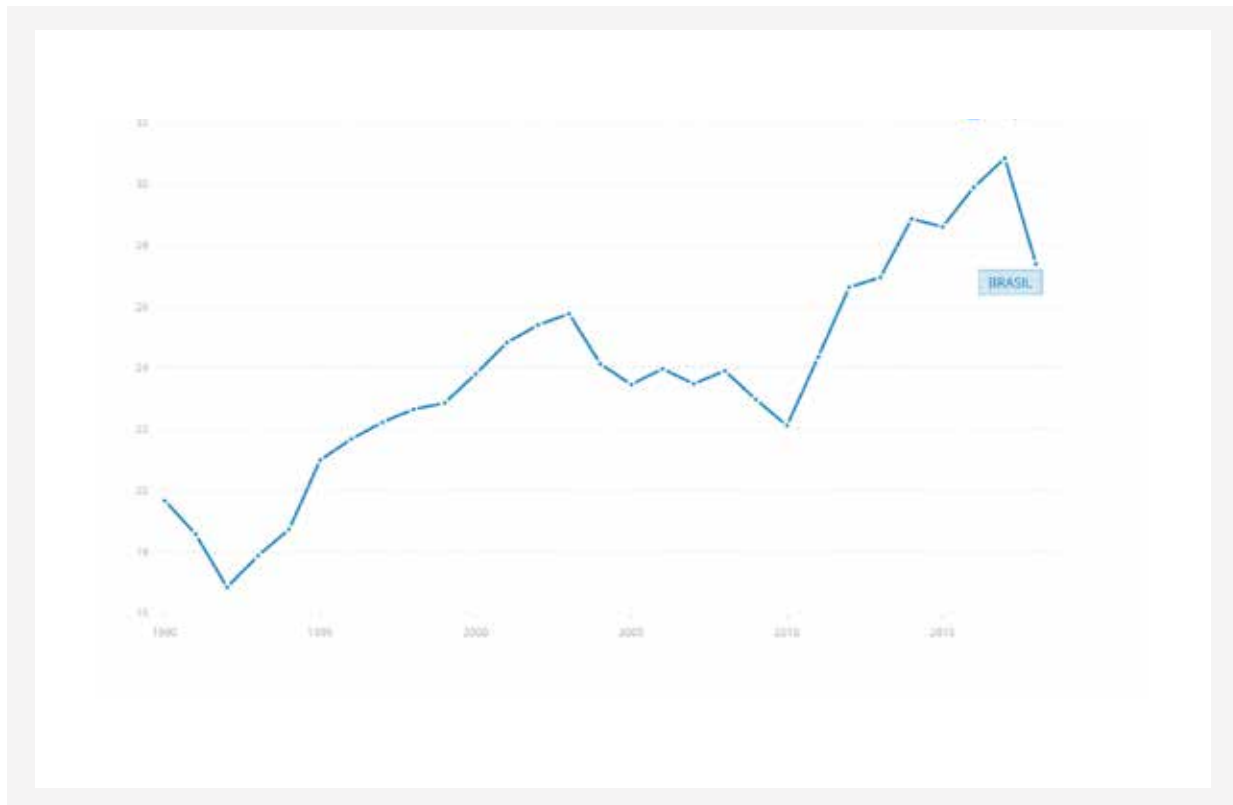
Figure 30: Violent Deaths Rate in Brazil per Year. Source: World Bank Data.

———————

[3] Cerqueira et al., 2020

[4] IPEA.n.d.

[5] SSP-PI, 2020

TERESINA | CRIMINALITY

Comparision of criminality rates in 1980 and 2017 in Brazil
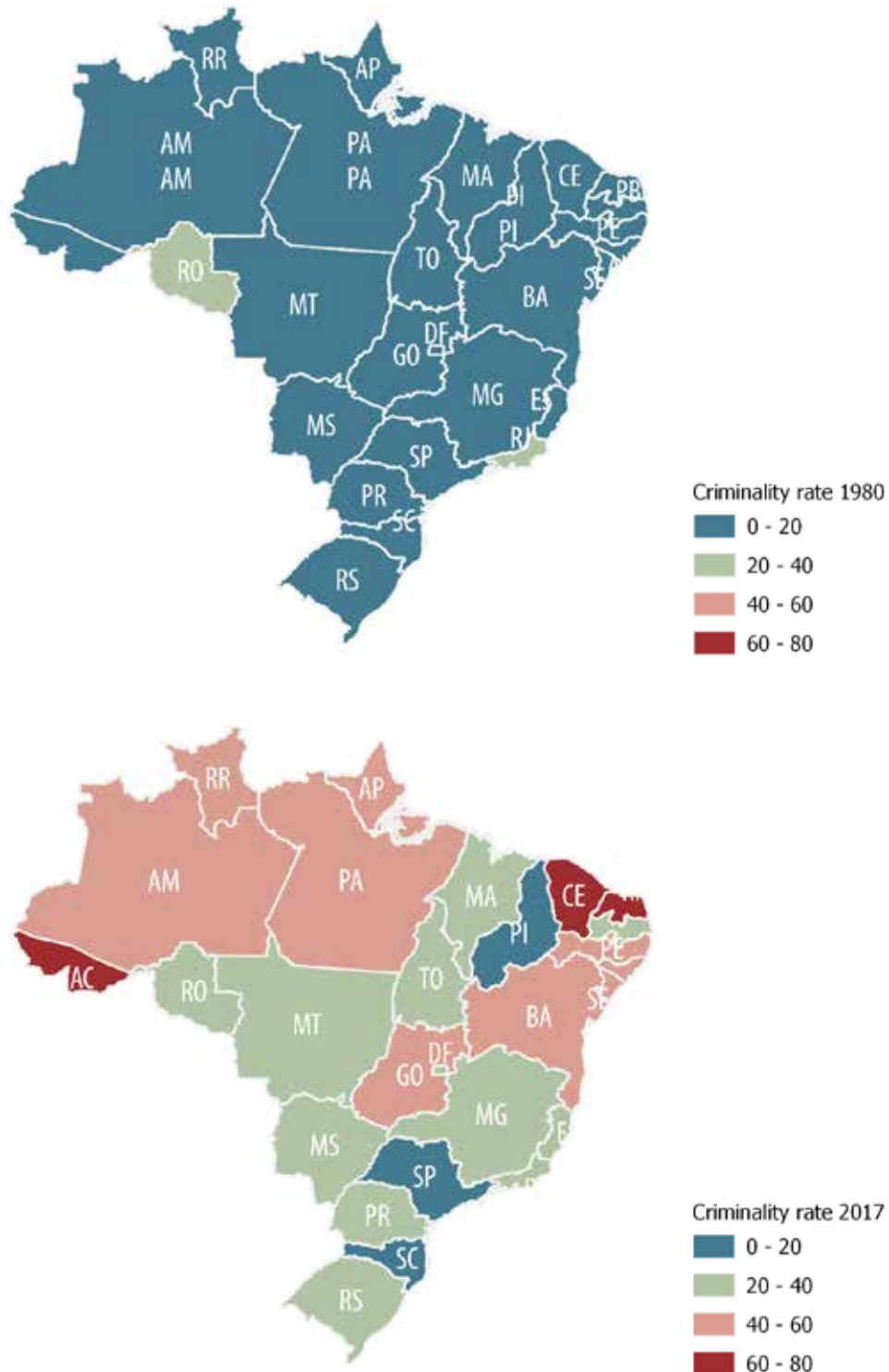
Figure 31: Crime Rate per Brazilian States in 1980 and in 2017.
Source: CRGP, with data from the IPEA.

TERESINA | CRIME RATE

Robberies quantity in Teresina in 2019
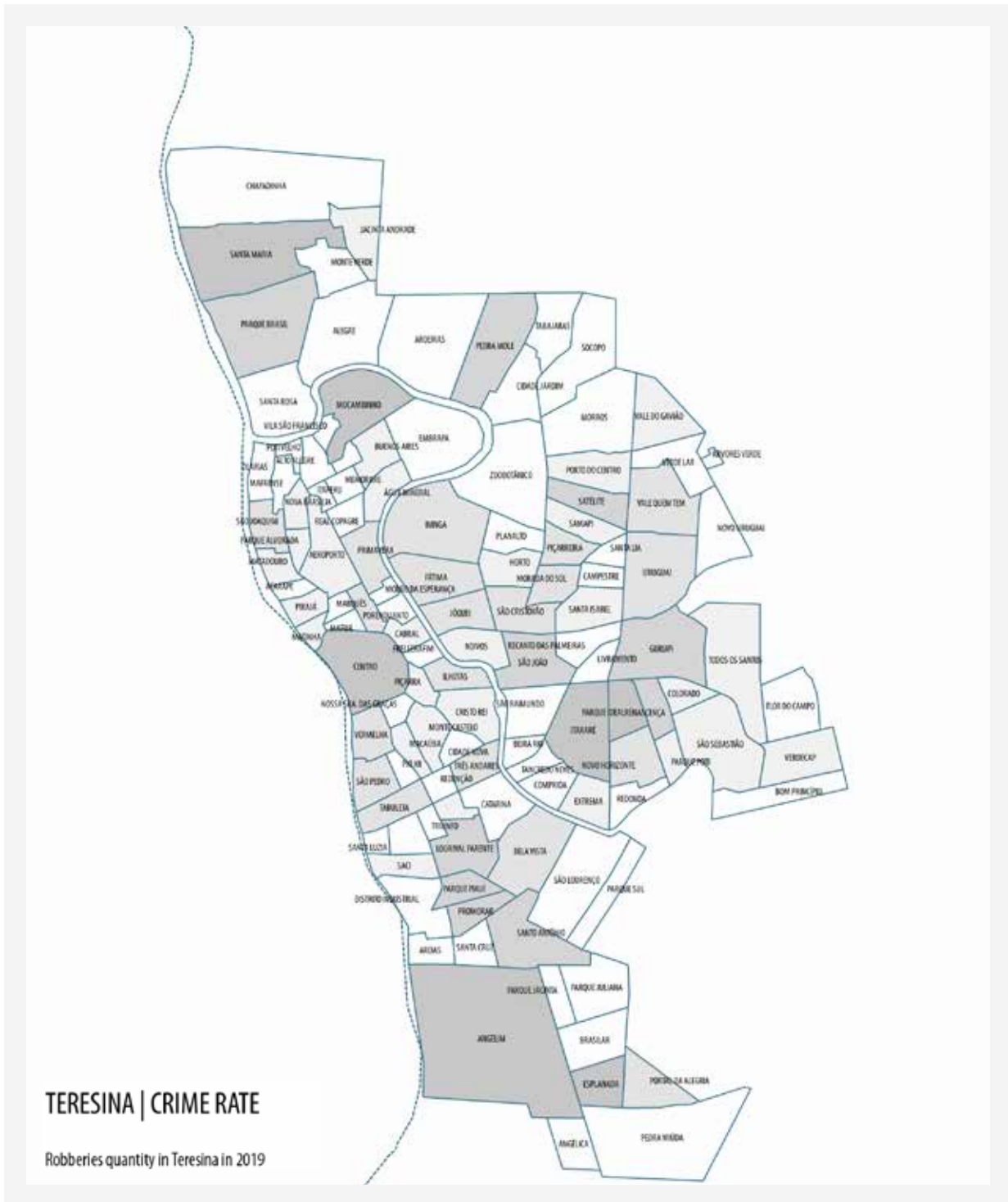
Robberies in 2019
- ☐ 0 - 100
- ☐ 100 - 200
- ☐ 200 - 350
- ☐ 350 - 500
- ☐ 500 - 1787
- ☐ Teresina's Perimeter

0   2,5   5 km

△ N

Figure 32: Crime Rate, Robberies in Teresina per Neighbourhood, in 2019.
Source: CRGP, with data from SSP-PI.

Opportunities

Despite the numerous challenges in Teresina, a number of structural, organisational as well as administrative changes and arrangements are emerging in the city, resulting in opportunities that have the potential to alleviate the effects of risks and challenges encountered by the city as a whole. These opportunities are highlighted below:

Growing coverage and provision of basic infrastructure and social services

Latin American cities faced extraordinary challenges from accelerated urbanisation after the massive rural-urban migration from the second half of the last century, becoming the most urbanised region in the world. Urban planning frameworks and policies at the time did not reflect and accommodate these issues satisfactorily. The provision of public services did not keep up with the demand for urban transformations, leading Brazilian cities to arrive in the 21st century with significant challenges even from the last centuries, such as the weak access to basic sanitation services. However, in the last two decades, the population growth rate stabilised, which has reduced the pressure on the supply of services. The freezing of the urban perimeter in the last decade has also contributed positively to reducing the rate of consumption of urban land and spreading the city, favouring population density and thus greater efficiency in the provision of services.

In 2020, Teresina achieved universal access to clean water with 100% of the population receiving safely managed water services. The coverage of the electricity supply is 99,7%, and the garbage collection reaches 99% of the city's urban population. The coverage of sewage networks remains remarkably low, but figures increased from 6% to 35% in the last decade. The city still faces the challenge of increasing its stormwater solutions to guarantee more safe and resilient urbanisation, especially among the most vulnerable population. Regarding the provision of basic social services, the city of Teresina has the highest investment/capita in public health among the Brazilian capitals, being the most comprehensive regional hub for high complexity health services according to the IBGE. Finally, the municipal public education in Teresina is considered the best among all Brazilian capitals, being recurrently in the highest ranking in all national indicators that measure the performance of basic education in the country.
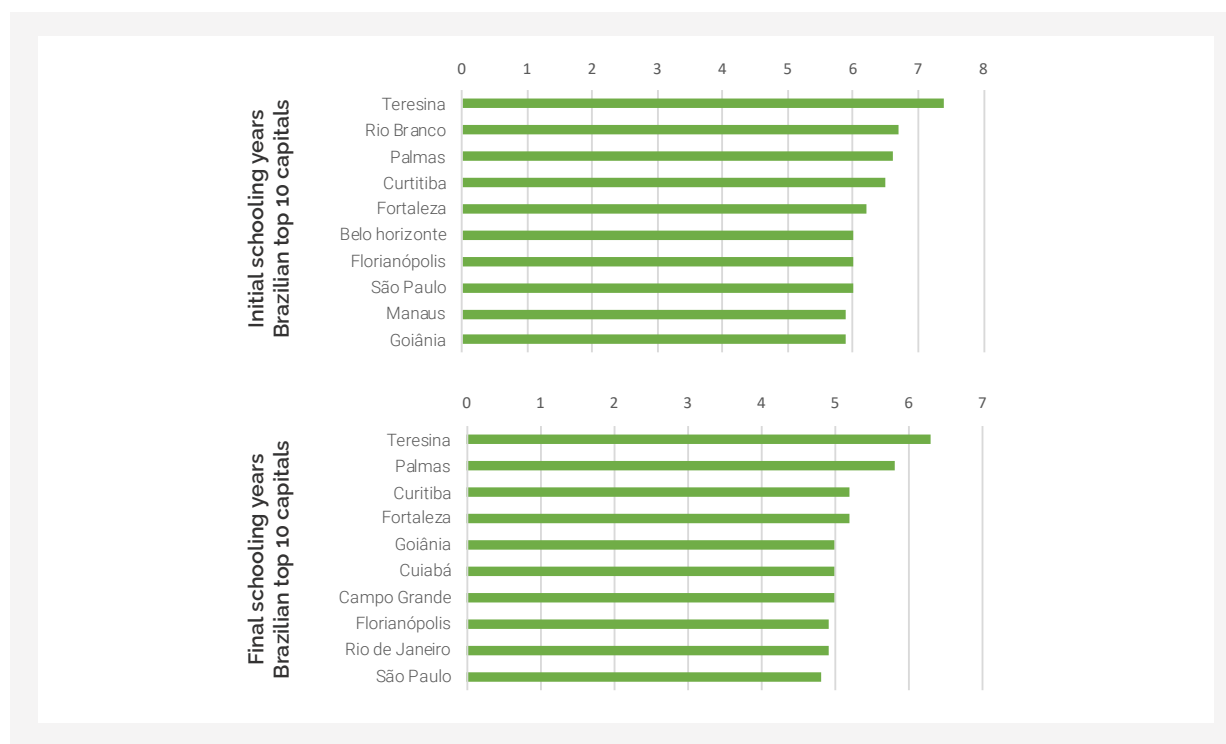
Figure 33: Top 10 capitals according to national basic education index for initial and final years.
Source: Ministry of Education/Brazil (2020).

Municipal revenue growth

Another strength to be considered in Teresina is the current trend of economic growth, reflected both in the growth of local GDP and in the municipality's own revenues. During the last decade, local GDP (at current prices), as well as GDP/capita, has been on a growth trend. The exception is during the 2015 national economic crisis, which had a wider effect on Brazilian municipalities more generally. Even so, the economy experienced a rapid recovery, currently remaining at stable levels. The most recent IBGE survey estimates the GDP at around R$ 19 billion in 2017, while GDP/capita was estimated at R$ 22,481.67. With these figures, Teresina was ranked 46th among Brazilian cities, a significant jump compared to the 64th position occupied in 2005 when a GDP of around R$ 13 billion (R$ 13.049/capita) was recorded, in current values. The municipal revenue collection followed these economic trends in the second half of the decade, including through the fluctuations. While in the first years the value of own resources remained stable, as of 2016 these values started to rise, only to decrease severely as a result of the impact of the national crisis on public finances. After a period of local budgetary reforms, municipal revenues resumed sharp growth until the early 2020s, when it was again impacted this time by the COVID-19 health crisis.

GDP per capita / revised series (Unidade: R$)
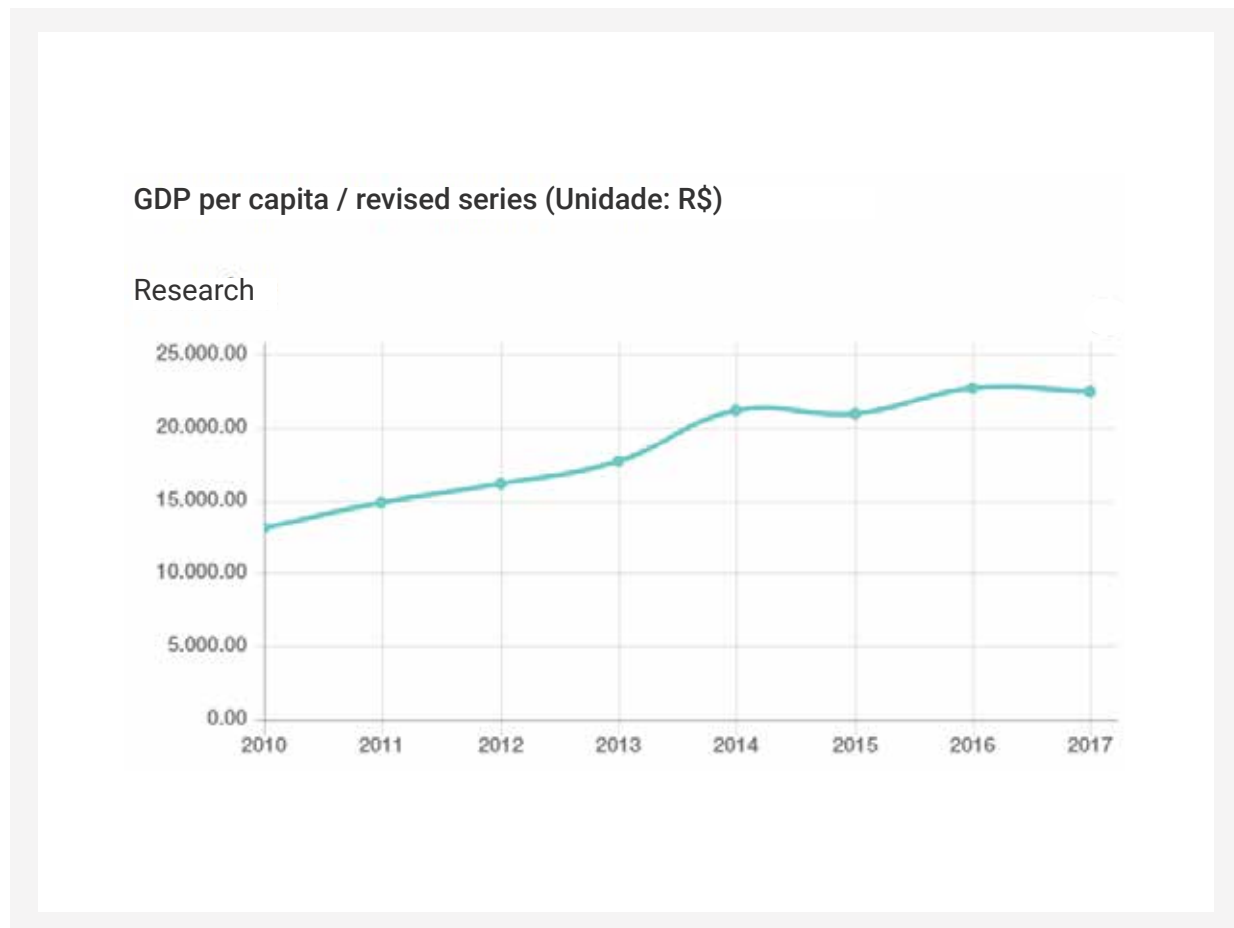
Research

Figure 34: Evolution on Teresina GDP/capita. Source: IBGE (2020).

GDP to current prices/ revised series (Unidade: R$ x 1000)

Research
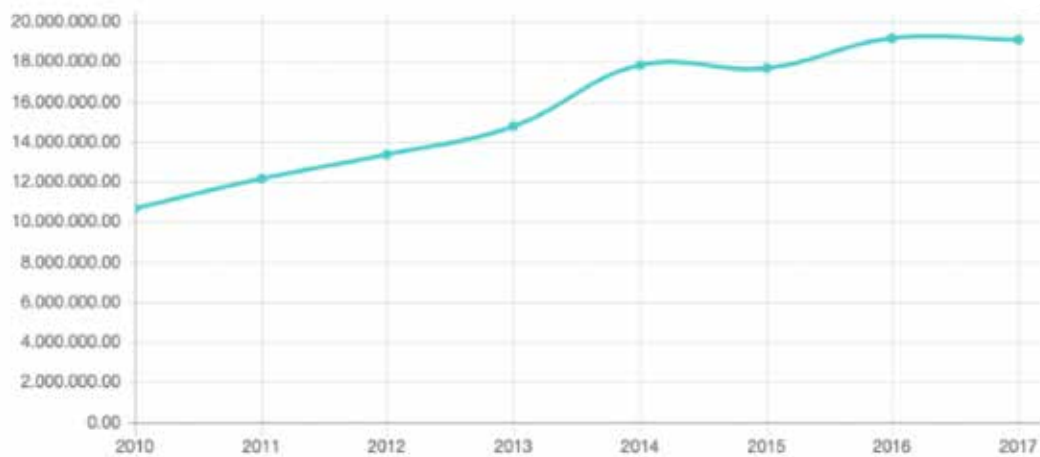
Figure 35: Evolution on Teresina GDP in current prices. Source: IBGE (2020).
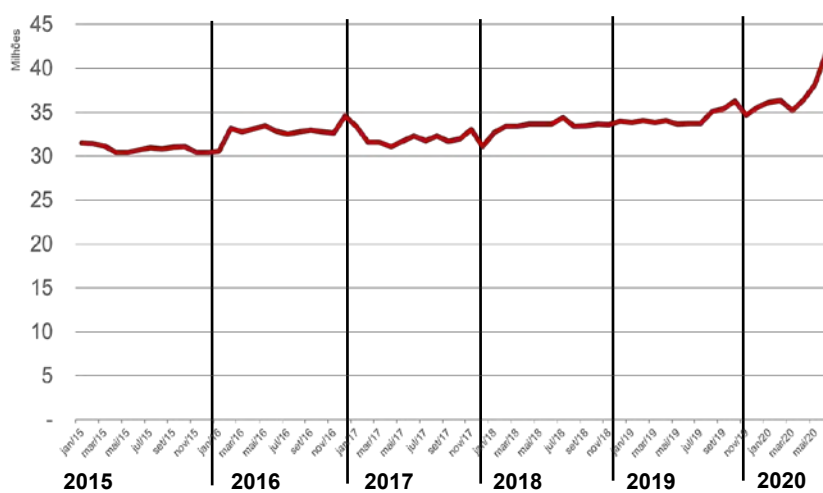
Figure 36: Evolution on Teresina Own Revenues. Source: PMT (2020).

Partnerships from local, to regional and international levels for increased technical and financial capacity

As a response to the challenge of weak intergovernmental coordination and the peripheral nature of its development, the city of Teresina had to seek alternative solutions, partnerships, and networks in different levels (local, provincial, national and international) to build greater technical, financial and institutional capacities. As an example, in the area of education, the Municipal Department of Education has partnerships with relevant national NGOs in the field, such as Instituto Ayrton Senna and Comunitas, in addition to being part of the Juntos Program. Also in this area, a recent partnership with the Novo Banco de Desenvolvimento provides financing for the Teresina Educational Infrastructure Program which also invests in improving urbanisation in the municipal schools' neighbouring areas. In the mitigation and adaptation to flood risks in the north, the municipality has a long partnership with the World Bank, which finances the implementation of the Lagoas do Norte Project.

Towards sustainable urban development, the municipality signed a cooperation agreement with the UN-Habitat City Resilience Global Programme to build technical capacities for a resilient and sustainable future. In its efforts for a more sustainable city that responds to the call of the 2030 Agenda, the city has signed a cooperation agreement with the French Development Agency to fund a comprehensive programme to meet the SDG targets. In the transport sector, a partnership financed by the European Union, with support from ITDP Brasil, is analysing the modernization and transparency of the municipal public transport service, and it is also part of the Mobilize Your City network. The municipality is a member of different networks for climate action such as the ICLEI Covenant of Mayors, and ICLEI's TAP - Transformative Action Programme. As an example of a partnership at the local level, there is a shared strategy for recovering from COVID-19 impacts. The municipality coordinates the Teresina Activa strategy, with the support of local actors such as the Federal University of Piauí, CDL, representatives of retail/industries (restaurants, hostelry, municipal markets, construction, etc.); and local actors from national entities such as SEBRAE, FIEPI, CAIXA, Banco do Brasil, Banco do Nordeste, among others. These partnerships allow data and information sharing to build a diagnosis of the crisis and to advance on recovery alternatives.
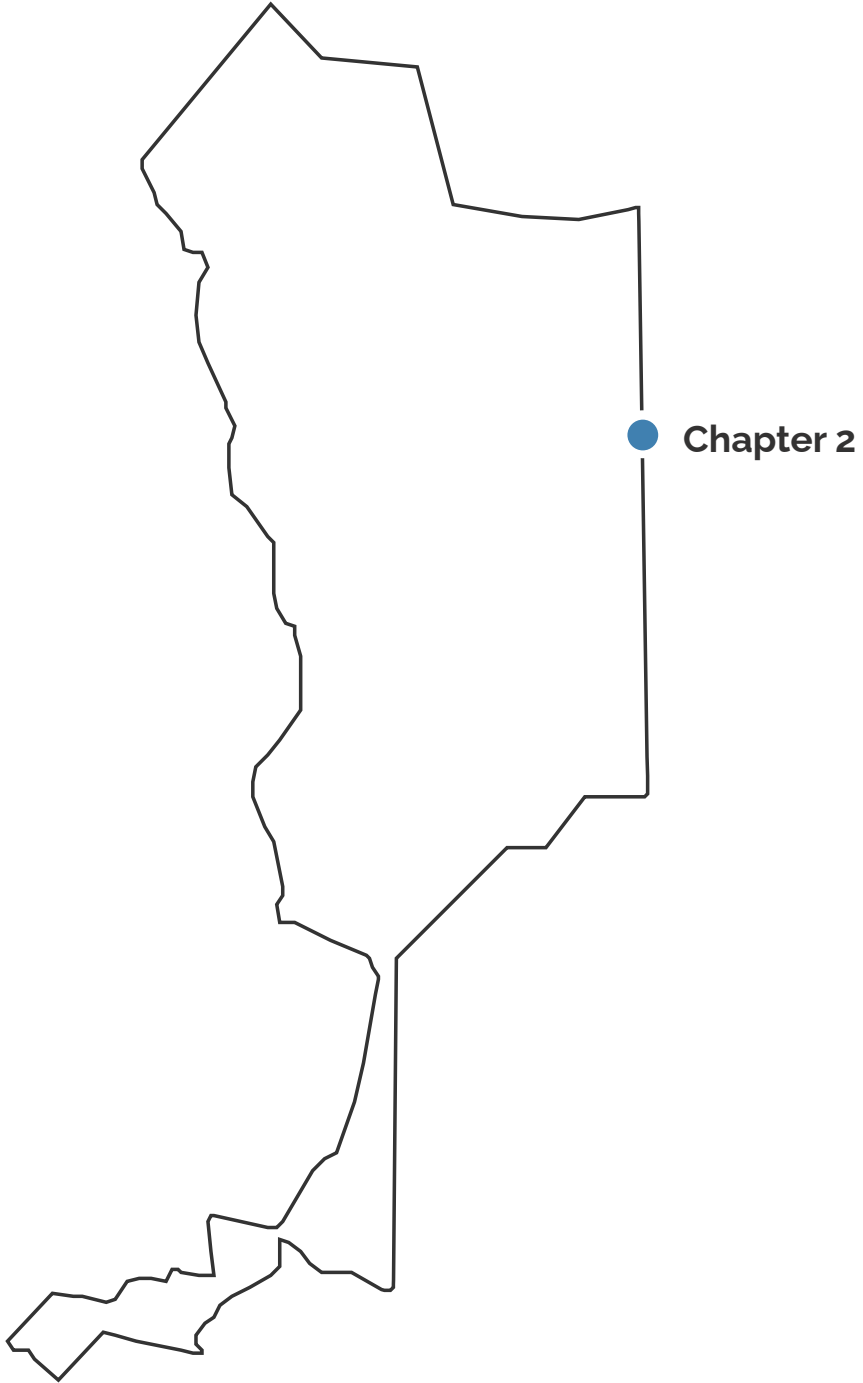
Chapter 2

Chapter 2
The Current State of
Urban Resilience in Teresina

Chapter 2
The Current State of Urban Resilience in Teresina

As described in the introduction, the methodology which guided the CRGP implementation in Teresina relies upon a series of interconnected and overlapping processes to form a resilience analysis and diagnosis in order to recommend actions to build resilience in the city. This chapter presents the city's Current State of Urban Resilience, a combination of information derived from statistical, documentary and qualitative analysis of various municipal data and documents, combined with the outcomes of stakeholders' consultations. This section presents the main priority matters for urban resilience in Teresina that were co-prioritized through consultation workshops, validated and further characterised through an indicator-based urban performance assessment. This analytical chapter illustrates the different combinations of shocks and stresses that are shaped by present urban challenges (see chapter 1, Section 1.6: Challenges and Opportunities) leading to the emergence of each priority matter. It further presents the characterisation of each priority matter through an urban performance assessment which relies on CRPT indicators to evaluate the strengths and weaknesses of different urban elements interlinked to these priority matters.

2.1. Priority Matters

Priority matters are where the majority of risks to the urban system converge and concentrate in the presence of certain challenges or constraints, but they are also where opportunities to maximise the outcome of targeted actions lie.

The determination of priority matters in Teresina was the outcome of a series of workshops held by CRGP together with the Teresina Resilience Commission, which is composed of representatives from 14 municipal departments. Taking stock of local knowledge and expertise, these workshops served as spaces to discuss the multiplicity of risks, including shocks and stresses, in Teresina. The workshops identified the interdependencies of risks, how these are shaped by present challenges, and constraints leading to the emergence of certain issues seen as priority matters, meaning they are crucial for building and strengthening urban resilience in Teresina (See Annex 01 for more detail on these workshops).

The findings of these workshops were corroborated by an evidence-based analysis using CRPT urban performance indicators and with the goal of carrying out an in-depth investigation into the underlying drivers of each priority matter identified during the aforementioned workshops (See annex 02 for more detail on CRPT urban performance indicators and their findings in Teresina).

The following sections will provide detailed descriptions of the three priority matters, data collection and analysis findings. For each priority matter, a brief introduction is provided. This introduction is followed by a display of the driving factors behind each matter, and the risks associated, including both shocks and stresses.

2.1.1. Priority Matter 1: Water Cycle Mismanagement

This priority matter is concerned with the management of both the natural and urban water cycle in Teresina, which in the light of unfolding climate change impacts, trigger different types of shocks and chronic stresses in the urban system. Moreover, water cycle mismanagement is strongly interrelated with the issue of Ecosystem Balance (Priority Matter 2).

The water cycle, also known as the hydrologic cycle, is the phenomena of the circulation of water between the biosphere, atmosphere, lithosphere, and hydrosphere. Water circulates among the different storage sites such as oceans, lakes, rivers, or groundwater aquifers through processes such as evaporation, condensation, precipitation, or infiltration. In cities, the natural cycle of water is affected and modified by urbanisation, industrialisation, and population growth, and it becomes more complex with the need to properly manage water supply, drainage, and wastewater collection[6]. The urban water cycle is essential for urban planning and water cycle mismanagement refers to a lack in the conditions and/or means for the effective protection and conservation of water resources, and/or there is a poor assessment and planning of both water resources and water demands, its rational use, and comprehensive monitoring[7]. A good water cycle management would ensure long-term water availability in both quantity and quality in all locations and have a low environmental impact.

The following subsections illustrate how processes of urbanisation, framed by poverty and inequality, have altered the natural water flows leading to an increase in the frequency of multiple shocks with severe socio-economic impacts. Concurrently, the absence of sustainable approaches to manage the urban metabolism, particularly solid waste, wastewater, and stormwater systems, further undermine the urban water cycle management and have serious implications on the city's ecological balance, with increased potential for more risks to emerge.

The following subsections describe and explain two different aspects related to water cycle mismanagement in Teresina: The 'drivers', which refer to varieties of factors including urban processes and risks that jointly lead to the emergence of water cycle mismanagement; and 'associated risks', which touch on both shocks and stresses happening as consequences of this priority matter.

Divers of Water Cycle Mismanagement in Teresina		
Stresses	Disruption of natural hydrological dynamics	Mismanagement of urban metabolism

Risk Associated with Water Cycle Mismanagement in Teresina		
Shocks	Floods	Waterborne diseases
	Landslides	Infrastructure failure
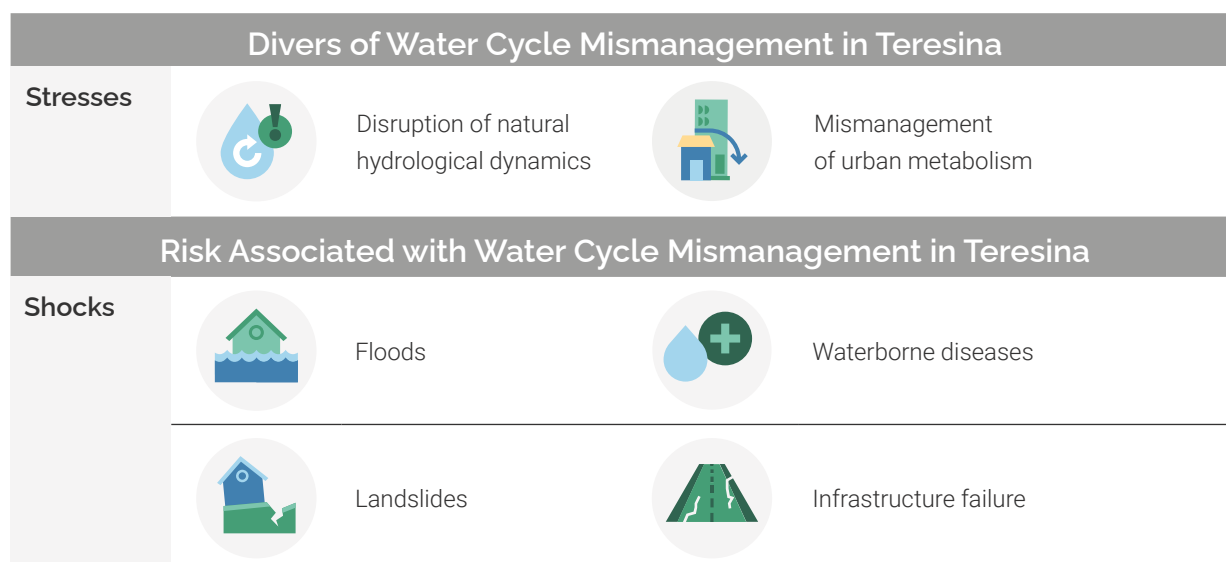
Insights from CRPT Urban Performance Indicators		
1.1.1	(Net) Urban population density	3.091 hab/km²
1.1.1.1	Land consumption to population growth rate	1.05
1.3.1.1	Percentage of city area considered informal:	2%

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[6] Marsalek et al., 2007

[7] Dyck, 1990
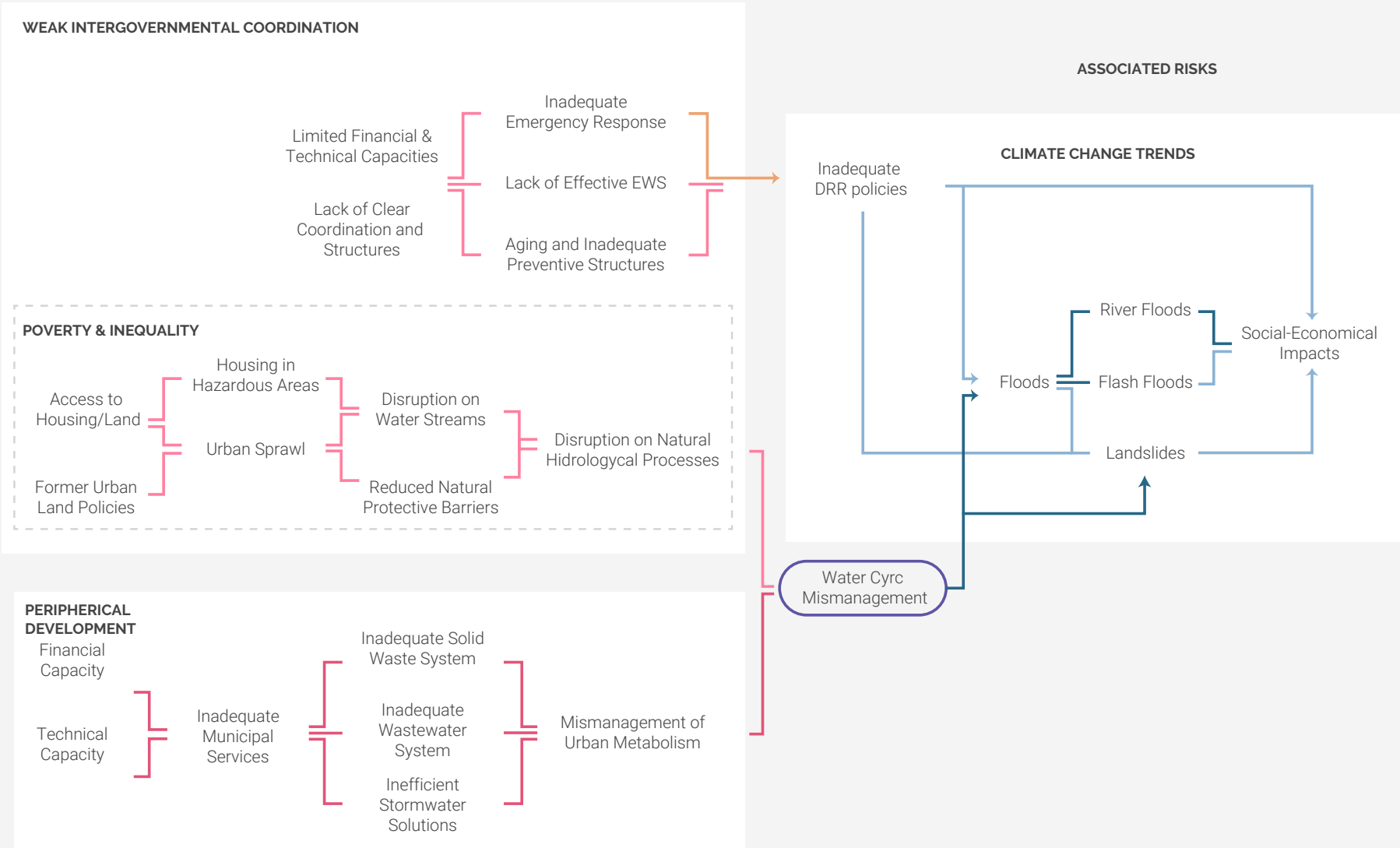
Figure 37: Cause and effects of Urban Water Cycle Management. Source: CRGP (2020).

WEAK INTERGOVERNMENTAL COORDINATION

Limited Financial & Technical Capacities

Lack of Clear Coordination and Structures

Inadequate Emergency Response

Lack of Effective EWS

Aging and Inadequate Preventive Structures

POVERTY & INEQUALITY

Access to Housing/Land

Housing in Hazardous Areas

Former Urban Land Policies

Urban Sprawl

Disruption on Water Streams

Reduced Natural Protective Barriers

Disruption on Natural Hidrologycal Processes

PERIPHERICAL DEVELOPMENT

Financial Capacity

Technical Capacity

Inadequate Municipal Services

Inadequate Solid Waste System

Inadequate Wastewater System

Inefficient Stormwater Solutions

Mismanagement of Urban Metabolism

ASSOCIATED RISKS

Inadequate DRR policies

CLIMATE CHANGE TRENDS

River Floods

Flash Floods

Floods

Landslides

Social-Economical Impacts

Water Cyrc Mismanagement

Divers of Water Cycle Mismanagement in Teresina

Disruption of natural hydrological dynamics

Stressors: Urban sprawl and housing in hazardous areas

Between 1996 and 2000, Teresina's population grew at a rate of about 2.5% annually, higher than the average growth rate in Brazil of around 1.6% per year. During the same period, there was also a depopulation of urban centres, with a -3.1% decrease, and an intense growth in the peripheral zones, mostly the southeast, in neighbourhoods such as Gurupi, with an annual increase of over 10%.[8]

Teresina's rapid spatial growth is attributed to a number of factors, namely the general tendency by urban planning authorities at the time (Teresina Structural Plan I and II) which favoured horizontal spatial growth and low-density developments inspired by urban planning trends in the US. In addition, a lack of access to land and housing for many socio-economically disadvantaged populations meant moving to peripheral zones where land and housing was more affordable. The construction of various low-income housing developments, financed by BNH (Banco Nacional da Habitação) took place during this period. At first, these new neighbourhoods were totally disconnected from the urban area, built in remote locations, and acting as satellite cities. Today, these neighbourhoods are already incorporated into the urban fabric of the city.[9] Moreover, for those who couldn't afford any of these options, informal settlements in floodplains and peripheral zones, where risks of pluvial floods are high or access to basic urban services is minimal, were the only option.

The implications of this rapid growth and expansion for natural and urban water cycles are summarised below:

- Alteration of natural terrains.
- Disruption to water streams and their micro basins, hence alteration of water flow and circulation.
- Removal of natural vegetative barriers and increased risks of soil erosion, floods, and landslides.
- Surface sealing through the use of impermeable materials for buildings and pavements that undermine natural drainage processes.
- As the new developments lacked services, the necessary basic infrastructure for solid waste and wastewater, unsustainable methods of disposing of solid waste and wastewater caused environmental damage.
- The spread of informal settlements in floodplains and peripheral zones led to soil degradation and increased the danger of flooding, posing additional risks on the residences of these settlements. In some instances, such as the Olarias area, building along constructed flood barriers has endangered the existing structures while putting the life of residence, their livelihood, and properties into acute risk.

In the light of weak inter-governmental coordination, addressing some of the above-mentioned issues has been very challenging. Particularly, as both the Parnaiba and Poti rivers are considered preservation areas and falling within federal jurisdictions. Water resource management is under state competences and judicial oversight meaning that the economic and environmental development of this preservation areas requires prior authorization from the other governmental powers and levels. Securing authorisation is both challenging and extremely time consuming.

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[8] Secretaria Municipal de Planejamento e Coordenação, 2012, p.16

[9] Carvalho & Collet, 2009

Mismanagement of urban metabolism

Stressors: Solid waste mismanagement, wastewater mismanagement and inefficient stormwater solutions

The urban metabolism as a concept focuses on the potential of sustainable patterns of consumption and production in an urban system by connecting material and non-material flows with ecological and social processes.[10] The degradation of the natural and urban water cycles in Teresina is strongly linked with the management of flow and circulation processes, particularly the unsustainable management of solid waste, wastewater, and stormwater.

Inadequate solid waste management

The way solid waste is managed can have a direct impact on water quality. In most developing countries, solid waste is dumped without adequate sanitary landfilling practises. During rainfalls, water can mix with waste, and the resulting mixture of liquids eventually infiltrates into the soil and change its composition, thus contaminate groundwater.[11]

In the case of Teresina, the city is trying to solve this issue by improving its solid waste management. The administration of conventional solid waste collection is carried out by a municipal concession, through the Secretariat for Urban Development and Housing (SEMDUH), which is also responsible for all the outsourced companies. Most households have garbage collection, and, in most cases, collection is 3 times a week. In rural areas, the responsibility of waste collection is of the Rural Development Secretariat (SDR), with a frequency of once a week.[12]

Teresina generates, on average, 1,200 tons of garbage daily including household waste, public waste, health waste, tree pruning, etc. When considering only household waste, this value is 543 tonnes/day. In 2018, the city's garbage services collected a total of 209,31225 tons of waste. The estimated population served by the garbage collection is 817,455 people (which accounts for 99% of the city's urban population).

Waste management in Teresina is seen as inadequate in relation to its environmental impacts. The capital of Piaui performs poorly compared to other Brazilian capitals regarding the adequate disposal of solid waste. There is also a lack of public awareness programmes about sustainable methods for waste disposal, especially for those residues that are not to be managed by household collection. Nevertheless, the city is improving its recycling system through selective waste collection in Voluntary Delivery Points, which are exclusively in the urban area of the city.

Waste collected is taken to the Controlled Landfill located in the southern part of the city, in the Santo Antônio neighbourhood. At first, the landfill had no treatment and produced the consequent issues, but this has been improved. In addition to improvements to the old site, a new sanitary landfill was built next to it to comply with the current environmental standards and the proper treatment of 547 tons of waste per day. Despite these efforts, there are still many irregular garbage disposal places in the city, which, if not managed properly, could have the potential of affecting water quality and the water cycle.

Reports point to the significant amount of construction solid waste generated by Construction. In this sector, the disposal of the produced waste is outsourced to different private service providers, which in turn dump waste into a number of landfills without being subjected to any treatment processes. The current Civil Construction Waste management RCD framework in Teresina shows indiscriminate waste collection that does not follow any materials separation or segregation procedures.

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[10] Broto et. al., 2012

[11] Vasanthi et al., 2008

[12] Latus Consultoria, 2017

Despite the existence regulations on landfill management, such as CONAMA Resolution No. 307/2002 and the PNRS on Civil Construction Waste management (RCD) in Teresina, companies still do not comply with the established guidelines due to the absence of an enforcement mechanisms and regular inspection by any of the environmental agencies present in the state, be it a municipal, state or federal body. This increases the danger of such practises on the environment given that these landfill sites are in areas with visible damage to the local natural system.

Insights from CRPT Urban Performance Indicators

3.3.1.1	Proportion of solid waste collected out of total solid waste generated by the city.	Total solid waste generated (all types of waste)= 449.148,10 ton
3.3.1.1.2	If informal solid waste collection exists, please characterise the amount collected	116.434,71 ton
3.3.2.1	Percentage of population with regular municipal solid waste collection service (at least once a week)	99%
3.3.3.2	Main method(s) used for solid waste pre-treatment	No pre-treatment methods exist
3.3.7.1	For collection and for treatment, what maintenance and monitoring measures are applied?	Asset databases for solid waste, operations and maintenance plan for waste management, regular cleaning of collection points and drop of facilities (incl. within treatment sites), regular maintenance of vehicles and machineries of solid waste systems, regular monitoring and replacing of ageing infrastructure
3.3.7.2	Remaining useful life of the site where the landfill is located (in years, based on capacity and municipal solid waste generation projections)	5

Inadequate wastewater management

Only 35% of the total population has access to a proper wastewater network through the 505.14 km of collection system. For the rest of the city's residents, the available options for the disposal of wastewater are individual sewage systems such as septic tanks, sinks and infiltration ditches. According to IBGE (2010), there were about 210,000 urban permanent private households; of which 41% have a septic tank system and 31% have a rudimentary cesspool system. Data show significant disparities between different neighbourhoods in the city in terms of access to an adequate sewage system, hereby suggesting marked levels of environmental injustices.

It is estimated that, in the urban area of Teresina, a total volume of 22,712,000 cubic metres of sewage is produced per year, which is equivalent to approximately 76.42 litres per inhabitant / day. Considering the limited coverage of households covered by a proper network of sewage, the vast majority of produced wastewater is being disposed of with only on-site treatment processes. Wastewater produced by the parts of the city covered by the sewerage network, is treated in three Sewage Treatment Plants (Estações de Tratamento de Esgoto, ETE), ETE Leste, ETE Pirajá and ETE Alegria. The ETEs aim to reduce the pollution present in sewage before returning the water to the rivers and, in the case of Teresina, stabilisation ponds. This process follows a sequence of preliminary treatment, aerated pond, optional pond, maturation pond and effluent discharge. ETE Pirajá, the oldest plant located on the right bank of the Parnaíba River, serves the population of the North and part of the Central area of the city.

ETE Alegria, located on the left bank of the Poti River, is in an area prone to flooding, and ETE Leste is located on the right bank of the River Poti. 5 independent subsystems integrate the sewage collection network, with 17 sewage pumping stations.[13]

Notwithstanding, since only 35% of the city population is covered by the wastewater network, many of those who lack access to the network resort to clandestine connections where wastewater produced by households and businesses is channelled into the drainage network which, in turn, ends up in the rivers. According to a study in 2012 by a number of environmental experts, due to the disproportionate concentration of Cu, Ni and Cr, the Poty river water was neither suitable for recreational activities, nor for agricultural uses.[14]

Furthermore, the study findings showed high molar conductivity in all tested samples, which meant that treatments by AGESPISA for dissolving inorganic substances were not effective at the time. "PCA statistical analysis of the results obtained in this study showed the effects of seasonality, as the metal concentrations were higher in the period of heaviest rainfall due to diffused sources of pollution displaced by the floods discharged into the Poty River." [15]

The existence of diffused and untreated sources of pollutants reaching the rivers through the drainage of rainwater is episodes of high levels of nutrients in rivers and a decrease in the oxygen rate in the water and increase in the incidence of algae and plants which, in turn, results in ecosystem imbalance with environmental impacts like the death of fish and unpleasant odours.

Insights from CRPT Urban Performance Indicators		
3.2.2.2.1	Percentage of households connected to a wastewater network	35%
3.2.2.2.1.1	If percentage is considered inadequate (or less than 60%), please indicate reason(s)	Normative and institutional frameworks
3.2.2.3.1	Proportion of wastewater that is safely treated	34%
3.2.2.5.2	Is regular sampling of wastewater discharge for compliance with water quality standards	Yes, regular sampling

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[13] Latus Consultoria, 2017

[14] Damasceno et al., 2017

[15] Ibid

Inefficient stormwater solutions

As indicated previously, rapid urban spatial expansion from the 1960s through the nineties and the beginning of the century resulted in major alteration to land terrains and disruptions in water streams. Moreover, construction methods and impermeable pavement materials have led to surface sealing. Consequently, natural water flows have been altered and stormwater has become an issue. Teresina does not, however, have a proper drainage system to collect and reuse stormwater.

Stormwater is contaminated when it comes into contact with urban surfaces such as roofs, roads, and footpaths, due to the existence of oil, metals, litter and other pollutants, which means pollutants are carried directly into waterways, rivers and streams.

This has been already highlighted by studies testing the level of pollutants in the Poti River. From August to December, garbage accumulation in the margins, sand of banks, exposed soils, ciliary forest degradation, minerals dredge operation, erosion, and sanded areas, in several spaces were observed. It was verified that values of sodium carbonate were higher than the recommended limits by legislation for DO, NH3 and thermo tolerant coliform, suggesting serious concern for the aquatic balance[16] and the overall ecological balance.

Insights from CRPT Urban Performance Indicators

3.2.3.1.1	Percentage of urban area covered by stormwater collection system	Not Covered: 24,5% Street Network with curb/gutter system connected to wastewater system - 75,5%
3.2.3.1.2	Is the city's drainage system currently able to cope with seasonal increase in rain/stormwater?	Yes, for a 25-year recurrence interval (Note: only limited parts of the city are covered by the network)
3.2.3.1.3	Is the city reusing rainwater collected stormwater and/reclaimed water	No
3.2.3.4.1	What monitoring and maintenance measures are applied?	Regular clearing of storm drains and street sweeping; Regular monitoring of illicit sewer connections and elimination; Regular monitoring and replacing of ageing infrastructure.
3.2.3.2.3	Do zoning rules, building codes and standards that address water sensitive urban design and/or onsite stormwater solutions exist, are widely applied, properly enforced, and verified?	Yes PDOT, Sidewalks Act, Building Code and Drainage Act / Lei de Drenagem 4724 de 03/06/2015

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[16] Damasceno et al., 2017

Inadequate Risk Reduction Policies

Risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and, therefore, to the achievement of sustainable development.

Most of the risks (floods, landslides, disease outbreaks) associated with water cycle mismanagement in Teresina are not entirely of natural origin (as will be seen through the following subsections), but are rather the result of unsustainable urbanisation processes, increasing exposure to risk conditions and pervasive vulnerabilities which render the effects of a natural event extremely dangerous. Thus, while acting on such exposure and vulnerabilities require long-term urban planning and development strategies, disaster risk reduction policies and measures are essential to ensure the risk of hazards are minimised and their effects are mitigated and responded to adequately and timely.

Although the city has initiated a number of plans and programmes over several years to address vulnerability drivers in particular zones of the city (such as "The Lagos do Norte Project - PLN - explained in detail in Chapter 3), a meaningful mainstreaming of DRR into urban planning and policy, such as into local land use plans, building codes and regulations and urban services provision, is still lacking. One of the major factors constraining Teresina's efforts to legislate and adopt useful DRR measures, specifically prevention and mitigation, is the challenging context of intergovernmental coordination, particularly on the vertical dimensions. In Teresina's context, this is very relevant and crucial for DRR as many of the zones within the city's boundaries, characterised as 'of high risk' are subject to multiple jurisdictions ranging from local, to state and federal level. This situation means that for a DRR-related policy to be approved in such areas, extensive negotiations efforts and resources are necessary. Moreover, as legislating meaningful DRR policies and measures involves a great deal of environmental protection policies against deforestation and vegetation loss, orchestrated coordination efforts across the different levels of the government become crucial.

Nonetheless, a number of initiatives in place prove that such a task is attainable. For instance, the National Civil Defence System which was approved in 2010 and provided support to local and regional authorities by conducting risk assessment and studies. As part of this legislation, the national government financed and conducted the Teresina's risk-prone areas cadastre. Moreover, it created a national early warning system that informs municipalities when a risk is imminent. Citizens can also register using their postal codes to receive push alerts via phone in the case of an event in their areas. The establishment of the S2iD (Integrated Disaster Information System) was an important initiative by the national government in cooperation with local authorities across Brazil and aims at gathering and providing real-time information and data regarding on-going threatening events in the country per city. These services are provided through the S2iD platform publicly accessible for everyone.

Apart from coordination challenges, financial and human resources on the local level are seen as insufficient for the adoption and enforcement of integrated DRR policies, plans and measures. Teresina still lacks adequate civil protection units with the right skills and capacity for emergency response and preparedness to hazardous events. In several cases of flooding and disease outbreaks, for instance during the Zika epidemic in 2016, the city had to rely on Piauí's state civil protection units and, in some cases, on national military forces.

Risks Associated with Water Cycle Mismanagement

Floods

Sub-type: fluvial, pluvial and flash floods
Triggered secondary shocks: Infrastructure failure, water borne diseases

Owing to its tropical climate with intense seasonal rainfall and its geographic location that is crossed by the Poti and Parnaíba, Teresina has been historically prone to the risk of floods. Riverine floods of the Poti and Parnaíba rivers were already an issue in the 19th and 20th centuries due to natural and cyclical phenomenon related to water flow regime and rivers dynamics.[17] Starting from the 1960s, the city experienced rapid population growth and spatial expansion towards areas beyond the bed of the Poti River. In the 1990s, its urban area started to cover floodplains to the north, east and south through both private and public housing programs.[18]

Rapid expansion did not take into account the rivers, grounding lagoons and fluvial plains and construction practises caused major alterations to natural terrains and water streams alongside the destruction of natural flood barriers and the erosion of riversides, which directly affected the natural water cycle. The new neighbourhoods were not properly planned, with inadequate drainage and sewage systems, and risks of pluvial and flash floods increased significantly.[19]

While floods occur throughout the year, especially during the rainy seasons, the incidences of flooding and their impacts are not homogeneous in all areas of the city. Some areas experience higher environmental risks resulting in marked social vulnerability. This is the case of neighbourhoods like Poti Velho, Olarias, Alto Alegre or São Francisco. In the North, centre and eastern parts of the city, the neighborhoods of Cidade Industrial, Chapadinha, Mafrense, São Joaquim, Mocambinho, Primavera, Cabral, Ilhotas, Ininga, Fátima, Noivos, and São João are especially vulnerable to flooding and its effects. Areas in the northern part, in the riverbed of the Poti River, have a type of soil that is favourable to flooding.[20] In the South and Southeast neighbourhoods, São Pedro, VIla da Paz, Torquato Neto, Itararé, Extrema, São Sebastião and Recanto da Palmeira, are areas that have recently been seriously affected by floods.

Relevant recent flooding events include the Fluvial Flood of March 20, 2020, that affected Conj SãoPaulo, Novo Milênio and São Sebastião, a marginal area bordering the Poti River, which is subject to flooding with a return period of approximately 10 years. Those affected are mainly informal settlers. Concurrently, the areas in Parque Dagma Mazza experienced major flooding along drainage lines and although these flooding events have not caused major life loss, they have caused significant economic material loss and displacement movements.

In terms of socio environmental vulnerability, the North, South and Southeast areas of Teresina are most at risk to both social and environmental issues, including high risk of flooding. Research suggests that the areas vulnerable to floods are also characterised as low-income, with low levels of education and low sewage coverage. These areas of high environmental risk, which often having informal settlements, present precarious urban services, and economic deprivation. In the northern area, 64.9% of the sectors are in a situation of high vulnerability in the income indicator and 48.2% in a situation of high social vulnerability in the education indicator. Combined with the high probability of floods due to geographical reasons, this area is the most socio-environmentally vulnerable of all.[21]

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[17] Lima, 2002

[18] Lima, 2016

[19] Ibid

[20] Feitosa, Nobrega & Junior, 2016

[21] Vieira and Gomes, 2011

Insights from CRPT Urban Performance Indicators		
3.2.3.3.1	Percentage of dwellings damaged by intense flooding (10 years)	No data
3.2.3.3.2	What level of disruptions on road traffic due to waterlogging does the service face?	Recurrent/ Seasonal disruptions
1.3.1.1	What level of disruption of access to public services due to waterlogging does the service face?	Recurrent/ Seasonal disruptions

Water-borne diseases

Sub-types: Dengue and Zika
Triggered secondary shocks: Health emergency

Floods not only cause landslides, they can also provoke a rise in infectious diseases when combined with the effects of Inadequate solid waste and wastewater management. It is reported that there are "zoonosis diseases" outbreaks as secondary shocks in the city, both of viral and bacterial nature. Mosquito-borne viral diseases like Zika and Dengue have been a major issue in Teresina.

In 2012, there was a significant dengue epidemic, being the year with the highest number of dengue cases reported among the population of Teresina in the historical series from 2007 to 2019. This epidemic directly affected 7,142 people, with 4 fatalities, and also had marked economic impacts as a result of halting work for 15 working days in the city. In 2016, there was an epidemic increase in the occurrence and notification of Zika cases in Teresina, directly affecting 333 people with 42 falling seriously ill.

The occurrence of most diseases normally reflects inequality and is linked to poor social and economic conditions, especially in terms of affected population distribution. The case of dengue is an exception and the distribution of cases in the city is quite heterogeneous in terms of social class and purchasing power, but for different reasons. While dengue cases in poorer areas are more related to water storage in containers and inadequate sanitation, infrastructure, and water supply, in high income areas the main factors linked to the cases of vectors are uncovered storage places and the presence of plant pots and other ornamental objects.[22]

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[22] Gonçalves da Silva and Silva, 2019

Insights from CRPT Urban Performance Indicators		
5.2.2.3	Presence of notification mechanism on communicable disease occurrence or outbreaks	Yes
5.2.2.4	Existence of early warning and rapid alert systems in case of diseases outbreak	Yes, general public
5.2.2.5	Existence of awareness-raising activities as means of prevention and control of communicable diseases	Yes, general public
5.2.2.5.1	Please specify the five most relevant emergency events occurred in the last five year	2020 - COVID-19 2019 - Dengue, Zika, chikungunya, Leishmaniose
6.3.2.1.1	Physical Capacity of Health Facilities	Number of Hospitals: 0,14/1000hab Hospital beds: 3,73/1000hab Physicians: 70,65/1000hab Nursing Personnel: 71,65/1000hab
6.3.2.1.3	Do local or national early warning systems for disease control exist (e.g. Ebola outbreak)?	Yes
6.3.2.1.4	Are there protocols in place for monitoring infectious diseases	Yes
6.3.2.3.1	What level of disruption is faced in the healthcare system?	Significant
6.3.2.3.1.2	If disruptions in provision of health service are significant, please describe the cause(s) of the disruption(s)	Fiscal/Budgetary Constraints or Mismanagement Administrative/Health Provider Disruption

Landslides

Sub-type: mass movement
Triggered secondary shocks: Infrastructure failure

Landslides and mass movement are recurring phenomena in Teresina and their triggers are multiple: some are triggered by intense rainfalls and pluvial floods, whereas other events have happened as indirect results of urban spatial expansion and the consequent alteration to land terrains, disruption of water stream and the removal of vegetative barriers leading to soil erosion, thus reducing soil cohesion, and rendering it highly vulnerable to mass movements.

Such events have caused severe damage to properties and mass displacement. In 2000, at Parque Afonso Gil, intense rain caused a series of mass movements, sliding and flooding of buildings in embankments in a drainage line subject to flooding.

On April 6, 2020, a landslide was induced by pluvial floods at Vila Nova Esperança, an area with irregular occupation on a land with great unevenness. The soil characteristics make it vulnerable to landslides during intense rainfall. Five people were directly affected and 15 indirectly. Bem Viver has also been subject to landslides, which result in further soil degradation, with such events recorded in March 20, 2019 and March 15, 2016, affecting 1,600 and 30 people, respectively.

Infrastructure Failure

Historically, the infrastructure of the city of Teresina has also experienced a series of issues and failures due to floods.

In 1985, the waters of the Poti River, after invading the northern zone of Teresina and joining with the existing lagoons, were able to cross the Boa Esperança dike, causing a breakdown of its structure around the current pumphouse. This event directly affected over 50,000 people and more than 70,000 were indirectly affected, with important damage to infrastructure, households, commerce, industry, and agricultural activities. After this incident, the lagoons were connected and the Poti Dyke was built, in addition to the installation of a rainwater pumping station. There is also an urban and environmental requalification project for the Boa Esperança Dam under preparation.

However, despite efforts to prevent these types of episodes, infrastructure failure in Teresina associated with floods is still a recurrent problem. On March 30, 2018, a section of BR343 highway yielded as a consequence of the heavy rain. A drainpipe below the highway broke due to 12h of continuous rain, with the consequent mobility system breakdown associated with it. 4 people were injured during this incident.

Insights from CRPT Urban Performance Indicators		
1.2.2.1	Percentage of homes with inadequate structure	Greater than 20%
1.2.2.2	Percentage of critical infrastructures with inadequate structure	Less than 10%
1.2.1.1	Percentage of urban footprint located in hazardous areas	7,745%
1.2.1.1.1	Percentage of built assets located in hazardous areas	3,81% of Built Assets (Including close to 1% of the Critical Infrastructure)

TERESINA | INFORMAL SETTLEMENTS, PROTECTED AREAS, SHOCKS

Urban expansion, storm water systems, informal settlements and water streams + preventive natural and manmade structure geo-spatially located
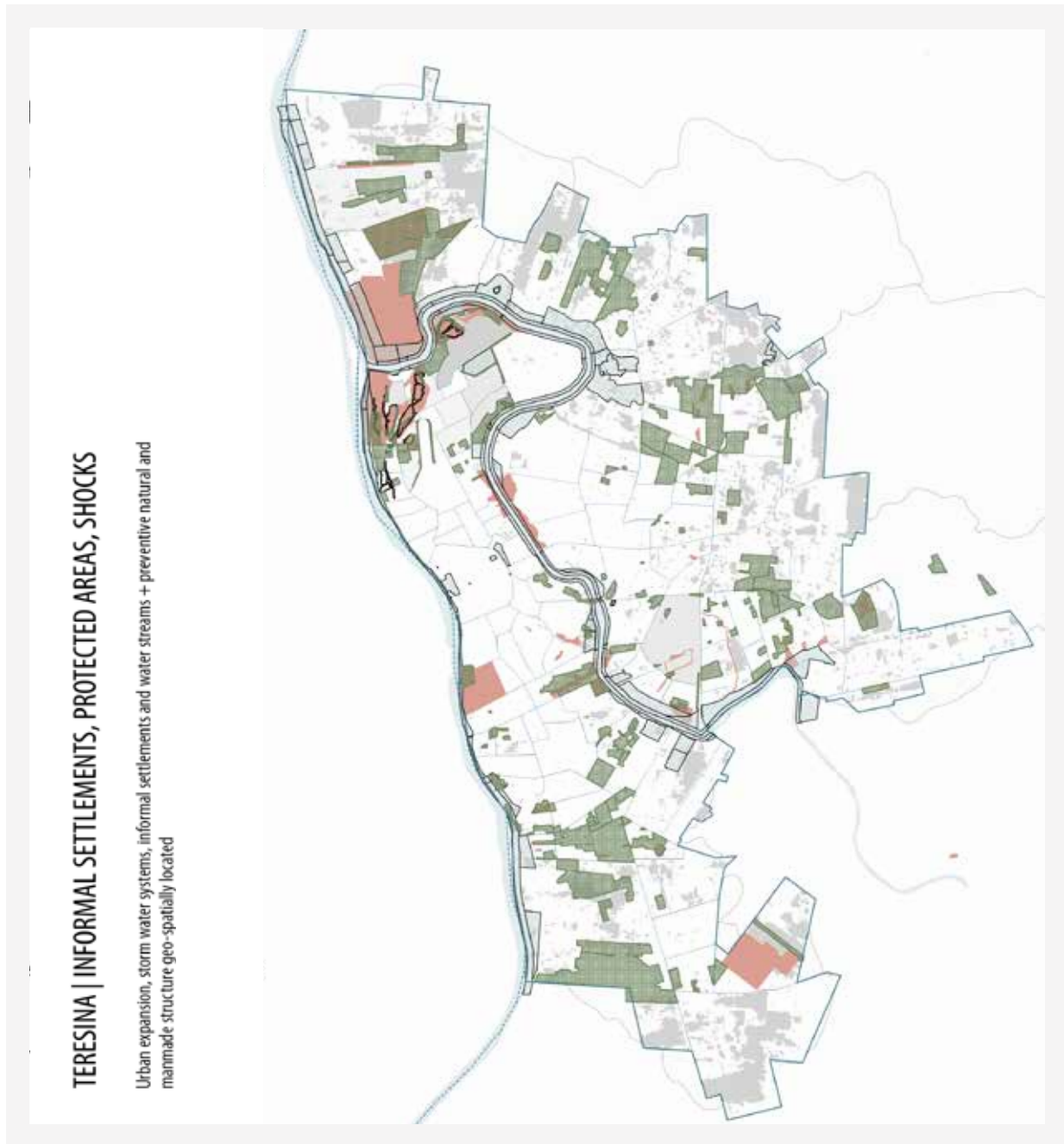
Informal Settlements

Protected Areas

Shocks

Teresina's Urban Perimeter

Teresina's Perimeter

Urban Vegetation Loss

Number of Dengue Cases by Neighborhoods

0 - 20

20 - 40

40 - 60

60 - 80

80 - 106

Water streams

Storm water systems

Timon

Source: CRGP with SEMPLAN, 2020

0   2,5   5 km

△ N

Figure 38: Combined factors related to the mismanagement of the water cycle. Source: CRGP with SEMPLAN (2020).

2.1.2. Priority Matter 2 – Ecosystem Imbalance

Ecosystem/ ecological imbalance refers to disruptions to the balance of a natural ecosystem due to natural or anthropogenic causes. For an ecosystem to maintain its ecological balance, a number of processes are crucial:[23]

1. The cyclic flow of materials from abiotic[24] environment to the biosphere and then back to the abiotic environment.
2. Upholding the equilibrium of interaction inside food webs.

Numerous factors can contribute to the disruption of these processes, which consequently undermine the balance of the ecosystem, namely: global warming and greenhouse effects, and pollution. Locally, some of the major causes are rapid urbanisation, disposal of toxic waste in water bodies, soil erosion, deforestation, agricultural practises among others.

The effects of this issue are becoming quite evident in Teresina through various events, mainly biodiversity loss, and insects, animals and plants infestation which, in turn, cause both marked public health problems and considerable socio-economic impacts. In the following sections, a detailed explanation of associated risks and drivers of ecological imbalance in Teresina is provided.

Drivers of Ecosystem Imbalance in Teresina		
Stresses		Environmental pollution
		Vegetation Loss
Shocks		Wildfires

Risk associated with Ecosystem Imbalance in Teresina		
Stresses		Urban Heat Islands
Shocks		Insects, animals and plants infestation

---

[23] Agudo, 2017

[24] Abiotic parts such as the soil, air, water etc

DRIVERS OF ECOSYSTEM IMBALANCE

Inadequat Solid Waste Management

Financial & Technical Capacities

Inadequate Wastewater Systems

Mismanagement of Urban Metabolism

Soil Degradation

Inland Water Contamination

Environmental Pollution

WEAK INTERGOVERNMENTAL COORDINATION

PERIPHERICAL DEVELOPMENT
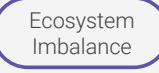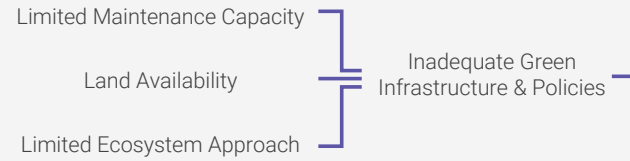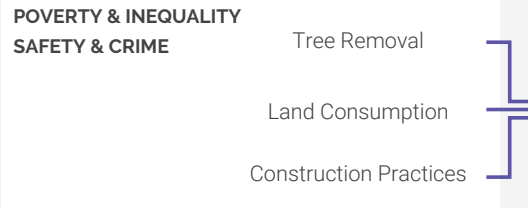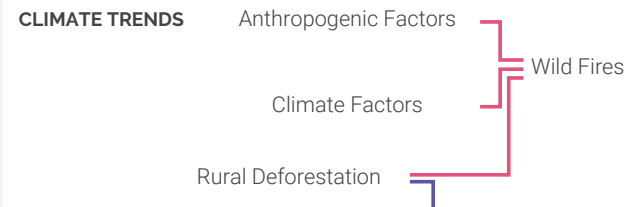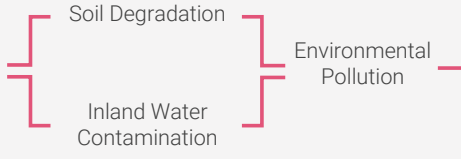
ASSOCIATED RISKS

CLIMATE TRENDS

Heat Waves

Heat Islands

Health Impacts

Insects, Animal & Plants Infestation

Biodiversity Loss

Social & Economic Impacts

CLIMATE TRENDS

Anthropogenic Factors

Climate Factors

Wild Fires

Rural Deforestation

Ecosystem Imbalance

POVERTY & INEQUALITY

SAFETY & CRIME

Tree Removal

Land Consumption

Construction Practices

Urban Vegetation Loss

Vegetation Loss

Limited Maintenance Capacity

Land Availability

Limited Ecosystem Approach

Inadequate Green Infrastructure & Policies

TERESINA | VEGETATION LOSS AND WILDFIRES

Urban expansion and vegetation loss in 10 years. Wildfires registration from October 2019-2020

TIMON

Urban Perimeter 2010
Urban Perimeter 2019
Wildfires
Vegetation Loss
Water streams

0   2,5   5 km

△ N

Figure 40: Vegetation Loss and Wildfires.
Source: Global Forest Watch (2020).

Drivers of Ecosystem Imbalance in Teresina

Environmental pollution

Stressors: Water contamination and Soil degradation

During the years of rapid urban growth, unregulated occupation of the riverbanks of the Poti and Parnaíba Rivers took place in the absence of adequate planning and building regulations. This brought about many clandestine connections of raw sewage in rainwater drainage pipes, which have caused serious health and environmental consequences, most notable in deprived areas without basic infrastructure.[25] Apart from the effects of the unregulated spatial expansion in these areas, the inadequate management of wastewater in the city has greatly affected the quality of the water resources, leading to serious levels of soil and water contamination in the basins. With almost 70% of Teresina's population without access to proper wastewater networks, individual sewage systems such as septic tanks, sinks and infiltration ditches are the only options available for the majority of the city's residents, raising concerns regarding soil and groundwater contamination.

The Poty River in Teresina receives several stormwater lines without pre-treatment measures resulting in water contamination through illegal sewage connections and debris and sediments carried out by water runoff resulting in river sedimentation. The ecological damage caused by erosion and sedimentation due to anthropological factors is visible in the Parnaíba river, most notably during the dry season when the free passage of vessels is almost not feasible.[26] The soil of the Parnaíba riverbanks is composed predominantly of sand and clay. Its original vegetation consists of riparian forests. These types of forests work as ecological corridors between other forests while guarding biodiversity. They also act as filters, protecting the soil against erosion and water contamination, retaining pesticides and sediments that otherwise would end up in the water courses, hence affecting the flora, fauna, and human populations.

Although there are many laws and legislations aimed at protecting the riparian forest, in reality the riverbanks have already been affected by urban development from the previous decades. The river suffers from the disposal of illegal sewage connections, and from man-made fires that happen frequently and damage the vegetation. Furthermore, urbanisation processes, the construction of roads and hydroelectric plants in upstream areas put additional pressure on the riparian forest, raising the risks of riverside erosion and water contamination.

[25] Alves & Lima, 2017

[26] Clímaco de Lima, N. et al., 2008

Vegetation Loss

Stressors: Deforestation, urban vegetation loss, and inadequate green infrastructures and nature-based solutions

Urban vegetation contributes to improving environmental qualities, leisure, recreation, and wellbeing in cities, while it also helps to reduce temperature levels and energy consumption.

Rapid urban expansion in Teresina has meant significant loss of vegetation cover over the past 2 decades as a result of deforestation. While marked cover of vegetation still exists in the city as part of backyards, private gardens, and sidewalks within private residential complexes, these are mostly private disconnected green areas with no access for the public. Also, the city lacks adequate coverage of green areas which can form connected green networks that provide integrated habitats for urban wildlife, and play a role in improving the quality of life in the city.

The main causes of vegetation loss in Teresina are:

- Rapid urbanisation and urban sprawl at the expense of green fields.
- Lack of effective enforcement mechanisms for environmental protection.
- Safety and crime: residents tend to remove sidewalk trees that have the potential to be used for trespassing into properties for robbery or create darker spots in sidewalks at night.

The major implications of vegetation loss in Teresina are increased surface temperature due to high concentration of built-up areas. These temperatures tend to get milder in the outskirts of the city, where more green areas exist.

Insights from CRPT Urban Performance Indicators

8.3.1.3	Proportion of natural areas and urban green spaces in the city as a percentage of the urban area	Natural areas	1,26
		Urban green space	44,19%
8.3.1.4	Specify the urban green space per capita and disaggregate, if possible, by sex, age and groups in vulnerable situation	13.43 ha/1000pop	
8.3.1.5	Proportion of urban green space cover (including vegetation canopy cover and blue areas), as percentage of the size of the functional area.	76.88%	
8.3.2.1	Please, specify the proportion of natural urban areas in the region that is protected	21.4%	
8.3.2.3	Please specify the total size of the number of areas (in ha) that connect protected natural areas and urban green spaces in the city, using the Green Infrastructure Index as measure.	No data	

Wildfires

Causes: Natural, manmade, and rural deforestation
Triggered secondary shocks: Sudden air pollution, health emergency (respiratory diseases)

Teresina's climate and its environmental conditions have the potential to increase the incidence of wildfires due to both natural and man-made causes. While fires happen throughout the year in Teresina, the occurrence of these fires intensifies between July and December and decreases from January onwards. The regions in the far north and the far south of the city seem to be most affected, but fires are increasing yearly in the municipality as a whole. These fires also result in sudden air pollution and in the formation of sudden heat islands in the urban perimeter, increasing the already high temperatures, affecting urban living conditions, and triggering health issues such as respiratory problems.

There is a lack of effective preventive and mitigating actions from the public sector, and inadequate environmental policies to regulate land use in rural and peripheral areas conducive to reducing the risks of wildfires, in order to prevent and control fires in the rural areas and protect biomes.[27] In addition, the city still lacks civil protection units that could support emergency responses in such events.

Important wildfire events registered in the city include the incident of the 12th of October 2016, when a large-scale fire hit the Palmares National Forest, located between the municipalities of Teresina and Altos, and lasted for 7 days. Fires were recorded on the outskirts of the city, especially on the BR 342, between Teresina and Altos, and on the PI-112 and PI 113 highways that connect the capital to the municipalities of União and José de Freitas. The incident affected 300 people directly and 1,000 indirectly, mostly vulnerable groups in informal settlements, with major impacts on the environment and infrastructure. As a consequence of this fire, there was a sudden air pollution. Teresina was covered by a smoke screen and humidity reached 13%. This caused serious health issues affecting approximately 40,000 people.

On the 15th of October 2017, a fire devastated shacks in the 8 de Março settlement in Teresina, destroying multiple homes, affecting 800 people, and killing a child. Likewise, this caused a sudden air pollution incident and subsequent health issues.

While many fires are from natural origin, others can be man-made and clandestine. In informal settlements where access to proper services and public awareness is lacking, the population still uses fire to dispose of domestic waste.[28] Apart from domestic burning, fires in Teresina are also found in the regions of the extreme north and the south of the city, outside the urban perimeter, in areas characterised by the presence of agricultural crops, suggesting there is a relation between agriculture and some of these fires. The fires also intensify in the period from June to December, which coincides with the drought season.

Insights from CRPT Urban Performance Indicators

5.5.1.1	Fire emergency services operating in the city, with respective capacities	Defesa Civil (Civil Defense) e Corpo de Bombeiros (Firefighters)
5.5.1.3	Emergency services available in the city, with respective staffing and equipment capacities	No data

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27 Gomes et al., 2019
28 Santos Gomes, 2017

TERESINA | WILDFIRES

Annual Frequency Wildfire Teresina. 2019
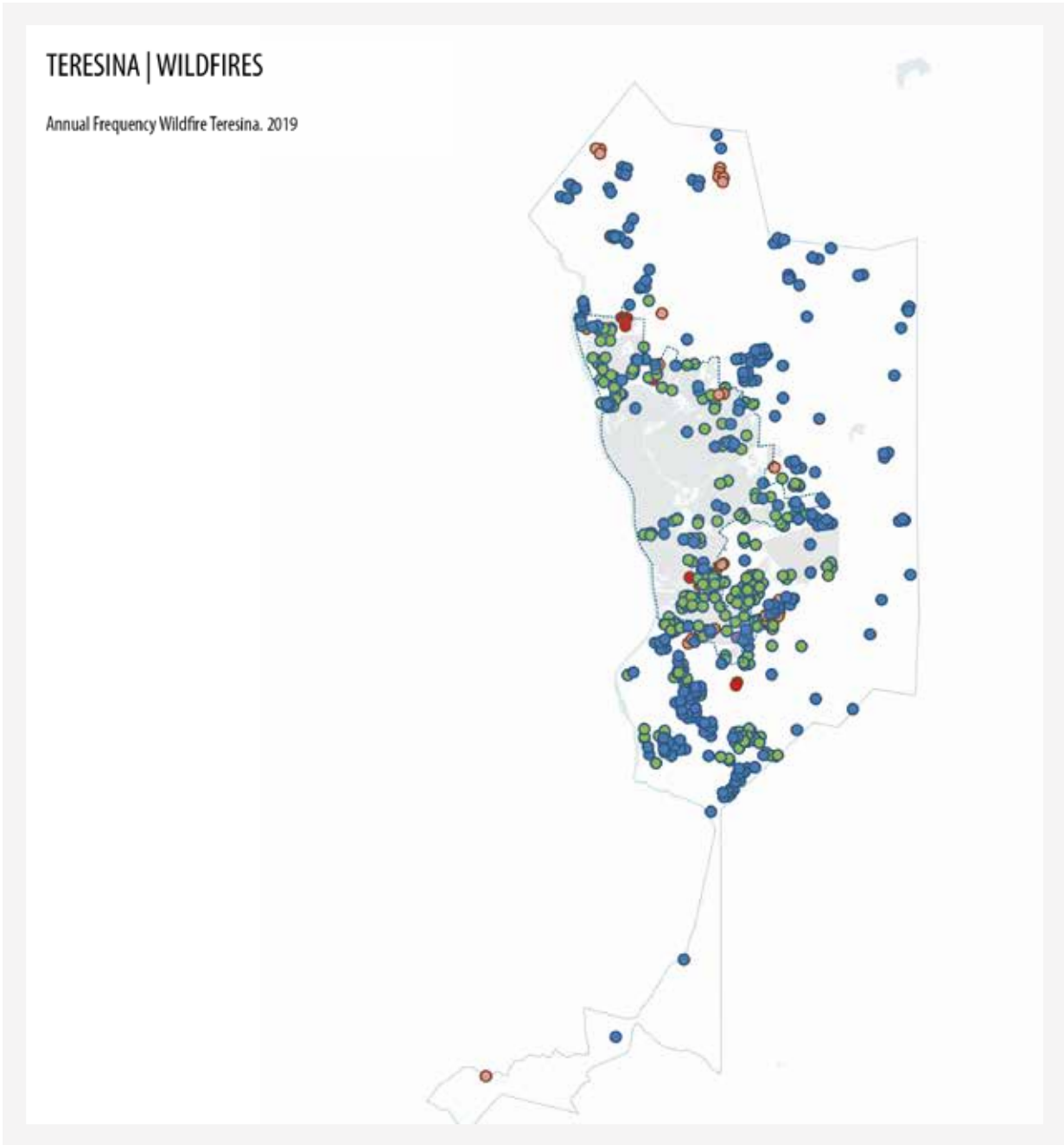
Urban Perimeter
City Blocks
Wildfire
● October - December 2019
● January - March 2020
● April - June 2020
● July - September 2020
● October 2020
Vegetation Loss
Natural streams

0 2,5 5 km

△ N

Figure 41: Wildfire frequency annually.
Source: Global Forest Watch (2020).

Risk associated with Ecosystem Imbalance in Teresina

Urban Heat Islands

Stressors: Inadequate green cover, impermeable surfaces, thermal mass

Urban heat islands in the city are difficult to measure since the environmental departments lack the proper environmental sensors to track reliable data for comparison. According to research studies, the formation of heat islands is visible in the centre-north neighbourhoods such as Poti Velho and Aeroporto, especially around the Centenário avenue, a space of great housing density and no afforestation. This avenue has high levels of traffic and acts as an important link between the north and downtown areas of Teresina. Maranhão Avenue is another point where heat islands form, with an air temperature of 1.7°C hotter than the surrounding points and 2.7°C on the smallest measure among the transects.[29]

The impact of vegetation can be seen in the areas after the Mariano Castelo Branco bridge. The areas with native vegetation have lower temperature levels than the areas that consist of open fields. At the same time, the hottest and coldest areas coincide, respectively, with the areas of urban density and demographic voids. While urban vegetation is mostly beneficial, not all trees function the same way to prevent the formation of heat islands: Avenida Santos Dumont, that borders the neighbourhoods of Pirajá and Vila Operária, has trees with closed canopies. These trees provide shade during the early hours of the morning, preventing solar radiation from reaching the ground. However, closed canopies also prevent the release of heat to the upper layers of the atmosphere, and the trees of Avenida Santos Dumont hinder the dispersion of heat. This explains the higher air temperatures on this avenue during the afternoon measurements.

Insights from CRPT Urban Performance Indicators

1.1.2	Percentage of open areas within the urban footprint	46%
1.1.2.2	Public open space per 100 000 population	57 ha/pop

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[29] Araujo & Andrade, 2017

Insects, animals and plants infestation

Triggered secondary shocks: Biodiversity loss and socio-economic crisis

The impacts of ecosystem imbalance and the consequent ecosystem degradation are becoming evident through recurrent incidents of animal and plant infestation in Teresina. Water hyacinths (Eichhornia crassipes), locally known as aguapés, are an example of a plant infestation in Teresina. Water hyacinth is a free-floating and flowering invasive aquatic plant originating from the Amazon Basin.[30] While the plant is beneficial when existing in moderate numbers, its infestation suppresses local aquatic biodiversity in rivers and waterbodies. In fact, Its excessive infestation is an indicator of the river's water quality. The release of effluents of organic residues from sewages to the rivers without undergoing adequate treatment, increases the concentration of organic matter and nitrite content that is linked to the increase of aguapés.[31]

This plant feeds on the residues that are suspended in the water, which are more abundant with reduced rainfall and lower river water levels, fostering aguapés proliferation. Its infestation has caused over the years significant sudden and long-term environmental and socioeconomic impacts in Teresina. In recent years, there has been an increase in the proliferation of water hyacinths in the Poti River, mostly during the dry season. Forming a plant mate, aguapés cover the surface of the river, blocking other aquatic plants from sunlight and causing their decay and death, leading oxygen in the water to dissolve. The low levels of oxygen then endanger the life of many types of fish and aquatic important species resulting in socioeconomic impacts for the fishing community.[32] "Water hyacinth has significant negative impacts on ecosystem services and limits cultural services that people obtain from an ecosystem. It significantly affects the lake hydrology by increasing the evapotranspiration of lake water and creates a favourable environment for the production of snails and mosquitos that cause diseases like Bilharzia and malaria".[33]

Moreover, local reports indicate an increase in insect infestation such as crickets in the urban area during the dry season, attributing this to the deforestation process and vegetation loss which destroy the natural habitat of such insects' predators.

Insights from CRPT Urban Performance Indicators

8.3.2.4	Does the city take the biodiversity in these corridors [green corridors], and in their green spaces and blue areas in general, into consideration?	Yes (Master Plan for Urban Afforestation for Teresina)
8.3.1.1	Change in number of native species over the past ten years (please disaggregate by species on the Red List of the threatened species, if available)	586 species on the Red List of Threatened Species, of which 2 are classified as Endangered and 8 as Vulnerable. The others are classified as Near Threatened (12), Least Concern (554) and Data Deficient (10)
8.3.1.2	Percentage of invasive alien species as percentage of all species	No data
8.3.2.2	Does the local government take measures (regulation, monitoring, enforcement) to prevent or control invasive alien species.	Yes (partially)

[30] Dersseh et al., 2019
[31] Sousa et al., 2008
[32] G1, 2018
[33] Dersseh et al., 2019

2.1.3. Priority Issue 3: Economic Underperformance

As the capital city of one of the least developed regions of Brazil, Teresina has also historically suffered the consequences of being peripheral and located far away or at the fringes of major national economic hubs and their sphere of influence. It has therefore never developed any major strategic industries or relevant infrastructure. This also left the region and the city under-served by well-connected national and interregional networks of transportation and supply chains, which in turn have undermined the city's economic development and growth.

The symptoms of this issue manifest through an environment that is less attractiveness businesses, characterised by high rates of unemployment and limited municipal revenue, which, when combined, exacerbate existing poverty and socio-economic inequalities, increasing crime levels, and reduced safety, posing considerable risks of social unrest.

The Brazilian financial crisis of 2015 exacerbated economic performance further in Teresina, with effects mostly evident in commercial and industrial activities. This led to an increase in the unemployment rate, especially among the youth, and resulted in spikes in informal commerce and subsistence economy.

The crisis affected the city's budget severely. Teresina had to engage in a programme to increase the efficiency of recurrent costs, make strong adjustments in the recurrent expenditure in the years 2017 and 2018, and reduce most contracts. All expenses were analysed and lowered in order to face the decrease in revenues. In the period between 2018 and 2020, the city was on a path of relative recovery, but the COVID-19 crisis is expected to reverse this progress.

The following subsections provide a thorough explanation of the major driving factors for economic underperformance in Teresina and the implications arising from this priority matter.

Drivers of Economic Underperformance in Teresina		
Stresses	Limited business attractiveness	Informal economy
	Weak economic diversity	Reduced productivity
Risk Associated with Economic Underperformance in Teresina		
Stresses	Social unrest	
Shocks	Unemployment	Local revenue losses
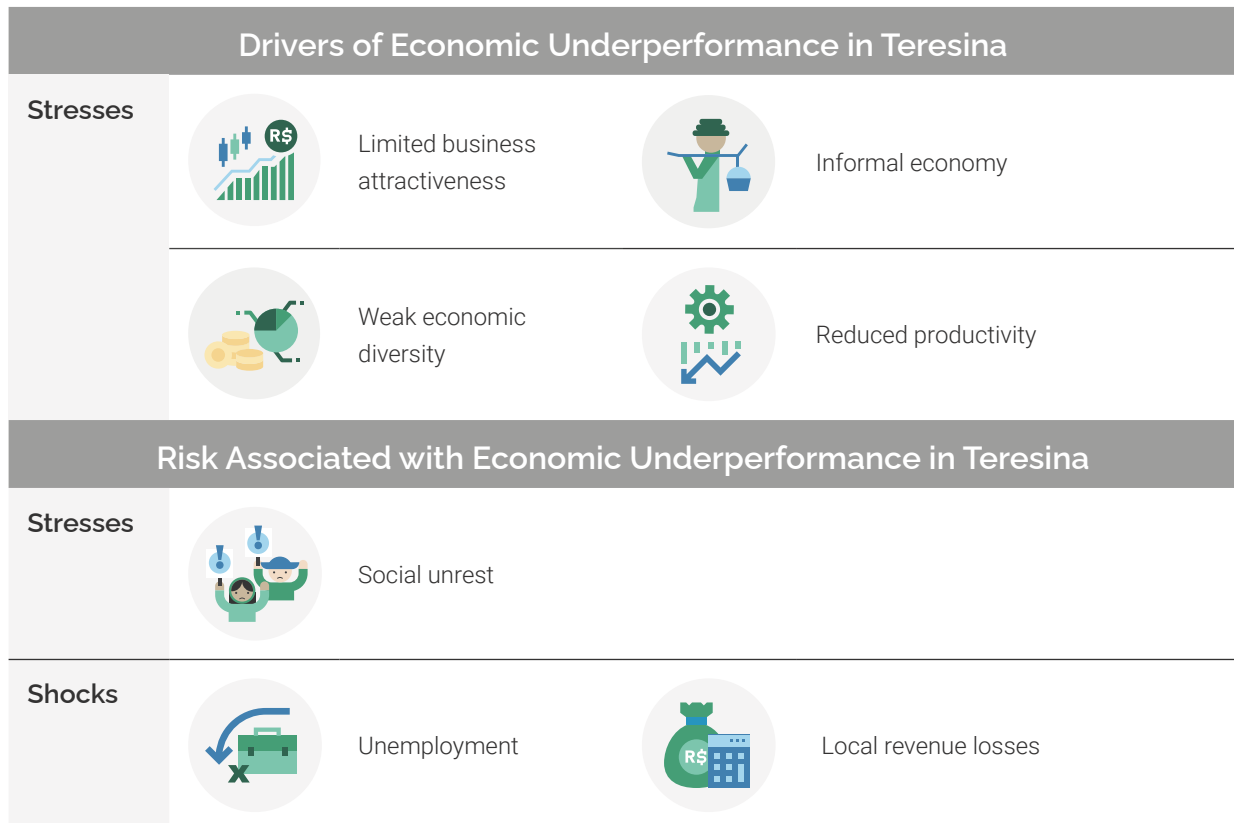
		Insights from CRPT Urban Performance Indicators		
7.1.1.2	Gross City Product (GCP) and GCP per capita for the past 10 years	Average Growth Rate GCP (current US$)		0,00%
		Average Growth Rate GCP per Capita (current US$)		-0,64%
		Average Growth Rate GCP (R$)		7,73%
		Average Growth Rate GCP per Capita (R$)		7,04%
7.1.4.2	Proportion of the households below the poverty line			29,3%
7.1.4.3	Provide GINI Coefficient at local level the last year available			0,511
7.3.2.3	Currency volatility over the past decade	Total 2011-2020		68,71%

DRIVERS OF ECONOMIC UNDERPERFORMANCE

Mismanagement of Urban Mobility

Reduced Productivity

WEAK INTERGOVERNMENTAL COORDINATION

Inefficient Trasport Networks/Supply Chain

Market Conectivity

National Rules & Regulations

Inefficiencies in Local Public Services

Limited Business Attractiveness

Limited Availability of Capital & Human Resources

CLIMATE TRENDS

Weak Economic DIversity

Reduced Formal Jobs Opportunities

Weak Labour Market

POVERTY & INEQUALITY

Informal Economy

PERIPHERICAL DEVELOPMENT

National Economic Crisis

Underperforming Economy
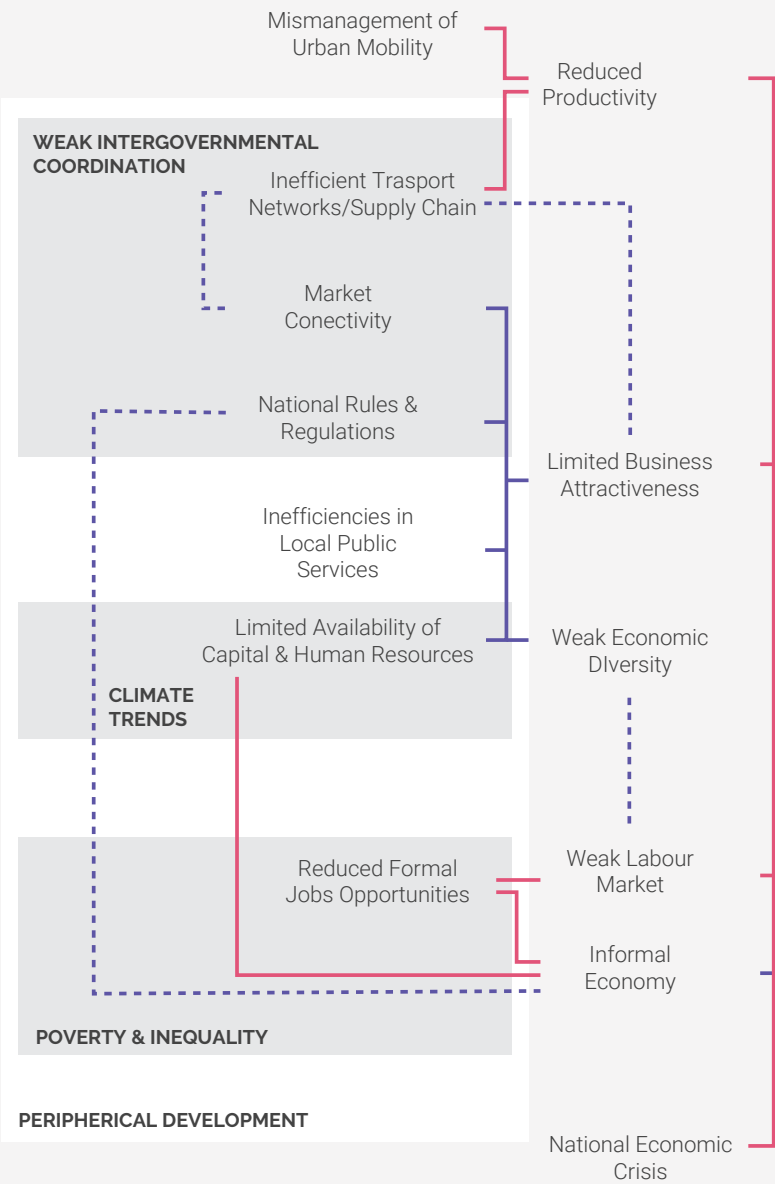
ASSOCIATED RISKS

SAFETY & CRIME

Exacerbated Poverty and Inequalities

Unemployment Crisis

Exacerbated Crime and Safety Issues

Social Unrest

Undermined Public Services Provision

Local Revenue Losses

Fiscal Deficit

Fiscal Crisis
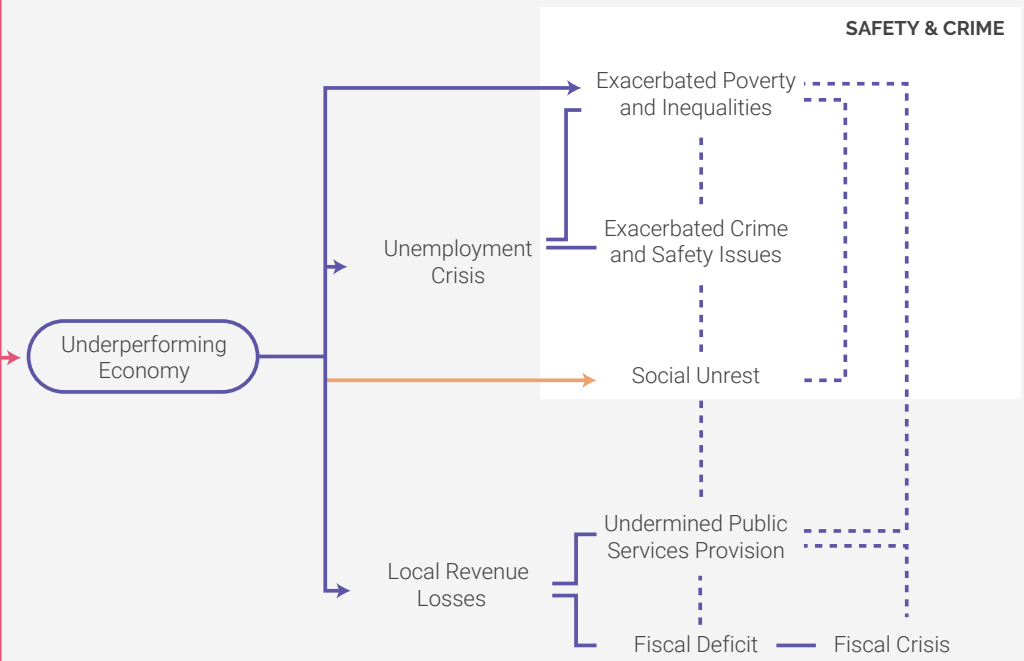
Drivers of Economic Underperformance
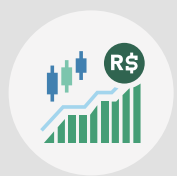
Limited Business Attractiveness

Limited business attractiveness

Stressors: Market disconnectivity, national rules and regulations, inefficiency of local public services, and limited availability of capital and human resources

Teresina has been struggling to establish an environment that is attractive for businesses due to a combination of multiple factors. Historically, the northeast of Brazil as a region has always been poorer than the south-east as a result of uneven distribution of national development policies and opportunities, the availability of fewer resources and the peripheral nature of Teresina's location. These historical, geographic, and developmental conditions have had major implications for the city's connectivity and economic integration on the national and regional level. The city lacks adequate infrastructure to enable intra-national and international mobility, namely roads, highways and an active airport essential to attract businesses despite its relative proximity to Maranhão and the Amazon Forest.

Concurrently, local development policies and local bureaucratic mechanisms still lag behind in terms of providing a competitive business environment. Moreover, despite the recent progress in local basic service provision, inadequate distribution of electricity and sanitation in Teresina also play marked roles in making the city less alluring.

In addition to the aforementioned factors, a lack of industries, skilled labour and higher levels of illiteracy make the city under-developed in terms of economic knowledge.

Insights from CRPT Urban Performance Indicators

7.1.1.1.1	Manufacturing share of Local City Product		5,7
7.1.2.2	Total number of business establishments per square kilometre		77,61
7.3.1.2	Market Connectivity - Commercial banks per 100000 inhabitants		6,13
7.3.2.1	National Business Freedom measure according to the Index of Economic Freedom		63,8
7.3.2.1.1	Trade Freedom measure		73,9
7.3.2.4	Largest cities located between 200 and 500 km that have greater than 150,000 inhabitants	Parnaíba-PI	153.482hab under 340km
		Sobral-CE	210.711hab under 360km
		São Luís-MA	958.545hab under 439km
7.1.3.6	Are worker training and retraining programs available for city inhabitants?		Yes

Weak economic diversity

Stressors: Market disconnectivity, and limited availability of capital and human resources

Economic diversity measures the degree to which a region utilises a broad mix of economic activities, transforming the economy by using multiple sources of income from primary, secondary, and tertiary sectors and involving large sections of the population, as opposed to using just a single source or relying too much on one sector.[34] Diversified economies are correlated with higher economic growth as a result of lower output volatility. At the local level, the city's increased productivity can be achieved through greater professional diversity.[35]

In terms of resilience, "Economically diverse cities provide residents some insurance against major economic downturns, globalisation, changing legislation, and natural technological progress, each of which is likely to have a differential effect on various industries and occupations," according to Andrew J. Hussey, Associate Professor of Economics at the University of Memphis.

The weak economic diversity is ascribed to multiple issues, namely weak regional connectivity, weak business attraction, lack of skilled human capital, weak development and growth management strategies, and lack of loans and entrepreneurs. The interest rate in Brazil is now high in comparison to other countries despite the recent reductions to adjust to inflation rates. According to many observers, both the state and municipality have been unsuccessful when designing economic development strategies.

[34] UNFCCC, 2016

[35] Bettencourt, Samaniego & Youn, 2014

Insights from CRPT Urban Performance Indicators

7.1.1.1	Industrial diversity using composition by city product sector shares	Public administration	36%
		Retail sector	11%
		Administrative activities	8%
		Human healthcare and social services	7%
		Education	8%
		Processing industries	5%
		Construction	3%
		Lodging and food	3%
		Transport and postal services	3%
		Others	7%
		Specialized services	2%
		Agriculture	0%
		Electricity and gas	2%
		Domestic Services	0%
		Extractive industry	0%
		Information and communication	0%
		Arts, entertainment and recreation	3%
		Real estate activities	0%
		Financial activities	2%
7.1.2.2	Total number of business establishments per square kilometre		77,61/km^2

Informal economy

Stressors: Reduced formal job opportunities, and national rules and regulations

Informal economy refers to parts of "any economy that is neither taxed nor monitored by any form of government".[36]

Informality in Brazil is a national issue and the Federal Government has been unsuccessful in bringing people into formality due to a lack of incentives in the formal market. In Teresina specifically, informality is higher than the national average, which sits at around 40%. It is partially attributed to the absence of legal, regulatory and policy frameworks essential for organising and regulating businesses and labour markets. In addition, low education levels, poverty, lack of access to resources, financial services and markets are micro-level factors that lead many into the informal economy.

The implications of Teresina's informal economy are complex and are becoming challenging in light of the current COVID-19 crisis. The significant size of the informal sector means that many workers are exposed to exploitation and lack the rights to decent working conditions as most businesses within the sector are not monitored by any regulatory authorities. Moreover, most informal businesses are neither taxed nor monitored resulting in reduced municipal public revenues which, in turn, undermines the municipality's capacity for service provision. This has become a major challenge for local and federal authorities during the current Covid-19 crisis as they strive to set and provide   social support schemes and financial stimulus in a context where the majority of the sector is not even recognised, pushing many into poverty while increasing inequalities.

Despite the recent efforts by the federal state as well as the municipality of Teresina through initiatives led by local departments such as, "Economia Solidária" to address informality and promote the formalisation of businesses and jobs, evidence shows that more is needed. Entering into formal sectors requires high education levels and are often financially less rewarding, which is disincentivizing to formalisation efforts.

Insights from CRPT Urban Performance Indicators

7.1.2.3	Proportion of total businesses that can be classified as informal		58,80% of informal workers in Piaui, in the 1st semester of 2020
7.1.3.3	Informal employment rate (please disaggregate by sex and vulnerable groups, if possible)	Total	44,7
		Male	50,1
		Female	49,9

---

[36] The Economist, 2004

Reduced productivity

Stressors: Labour market dynamics, mismanagement of urban mobility, and inefficient transport networks and supply chains

While reduced productivity is normally driven by diverse economic and social factors shaped by existing fiscal and regulatory policies, at the local level, additional factors - namely urban mobility and inadequate provision of public services - have the potential to exacerbate low productivity. This is particularly relevant in Teresina.

The city centre of Teresina is where major busy avenues such as Avenidas Maranhão, Frei Serafim, Miguel Rosa and Joaquim Ribeiro intersect owing to the monocentric nature of the city's development. Despite the attempts of the Structural Plan II of Teresina to modify the urban roads network towards an orthogonal grid and poly centric distribution of activities, the city remains hugely mono-centric.[37] Most bus lines pass through the city centre, undermining the efficiency and effectiveness of public transport systems including Teresina's BRT and leading to longer commuting times for those reliant on public transport. These dynamics have consequently impacted the economic activities of the area leading to major daily economic losses as a result of reduced productivity.

Teresina is considered the Northeast capital city with largest rural area.[38] Yet, connectivity and coordination between Teresina and the municipalities that form the Teresina metropolitan area are poor. The creation of RIDE Grande Teresina, intended to serve as a tool for economic integration, collaboration, and inclusive policies, has so far made limited progress as there is a lack of clear management strategies and wide political and economic differences among municipalities, creating a centre-periphery dichotomy that culminates in divergent interests and prevents a fructiferous integration. However, the management of RIDE, as well as the review of governing instruments, are under the competences of the federal administration.

Insights from CRPT Urban Performance Indicators

4.1.1.1	Percentage of commuting trips using each one of the following modes	Private modes	28
		Public modes	26
		Sustainable modes	46
4.1.1.2	Percentage of population using paratransit modes of transportation		9,23
4.1.3.5	Average commuting time using various modes of transport		No updated data
4.1.4.4	What is the average travel speed on major thoroughfares during peak hours?		35 km/h

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[37] Branco de Vasconcelos Filho, 2019

[38] Carcará & Leal Junior, 2016

TERESINA | BUSINESSES

Business geographical distribution across Teresina.
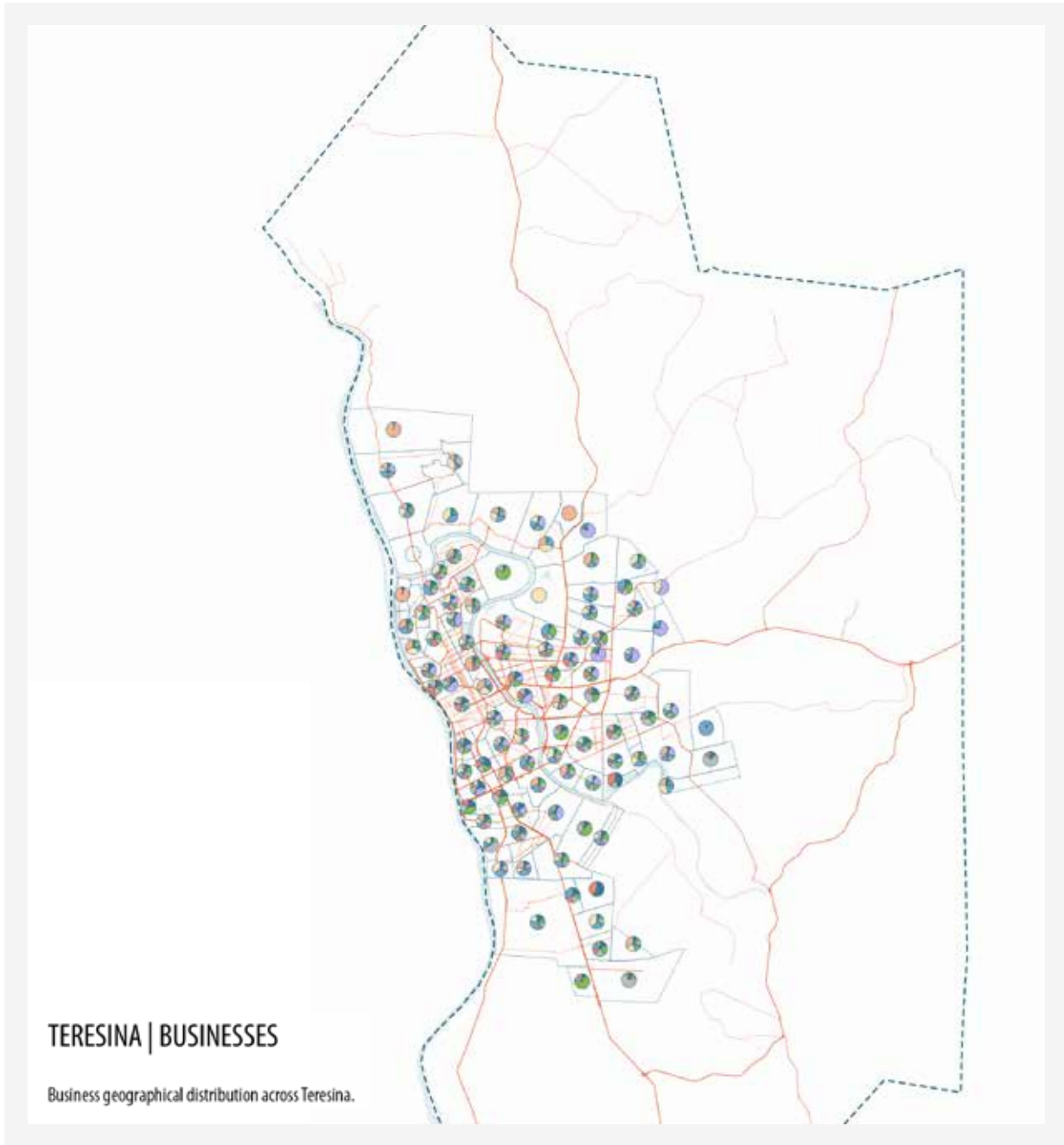
Total Number Businesses
- Retail
- Agriculture
- Construction
- Industry
- Services
- Education
- Health
- Leisure, Culture and Turism

Road System
- trunk
- primary
- secondary
- tertiary
- Teresina's Perimeter
- Water streams

0   2,5   5 km

N

Figure 43: City Business. Source: SEMPLAN and SEBRAE (2018).

TERESINA | REGIONAL CONNECTIVITY

Regional Connectivity between main cities
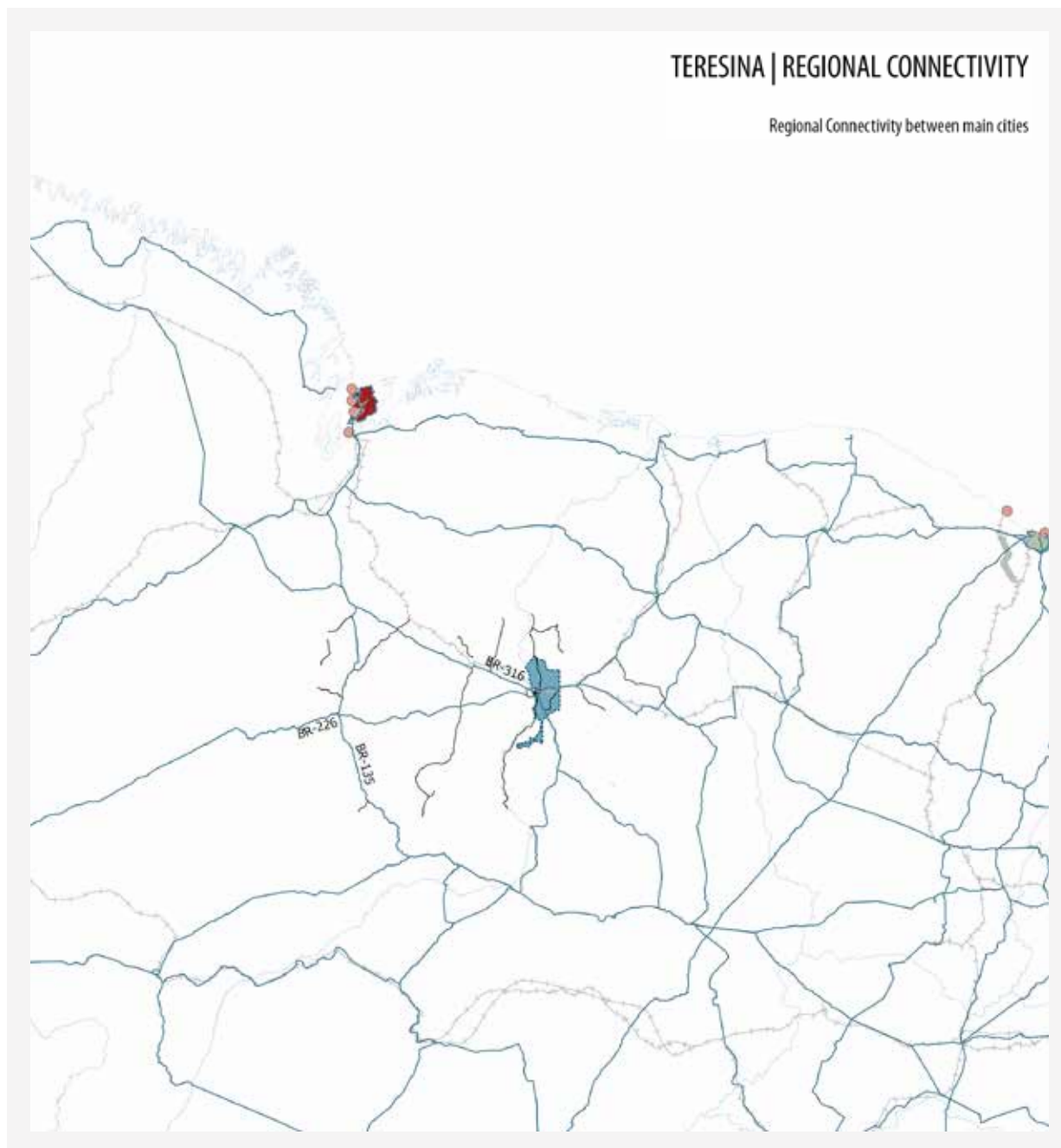
limites mun. e cidades vizinhas

— Highways

⊢—⊢ Railways

● Ports

— Regionals Railways

▨ Teresina

☐ Brazil

▨ Fortaleza

■ São Luis

0   75   150 km   △ N
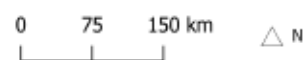
Figure 44: Regional Connectivity. Source: IBGE (2020).

Risks Associated with Economic Underperformance

Local revenue losses

While municipal revenue witnessed a sharp growth in the first half of the decade, manifesting an impressive performance nationally, the municipality's own revenue started to plunge by mid 2016 as the effects of the national financial crisis propagated across the country. This fall in revenues undermined the municipality's capacity for service provision. This new situation forced the local government to undertake major budgetary reforms and fiscal policy changes, which were conducive to resuming revenue growth, in addition to seeking external financing. This trend started to change again in early 2020 due to the COVID-19 crisis and the consequent lockdown. In short, while Teresina's municipal growth has been generally steady, the city's economic underperformance (explained above) has made the city more vulnerable to the impacts of national and international financial threats.

Insights from CRPT Urban Performance Indicators

7.2.1.2	Proportion of total local government revenue that is own-source		22,5%
7.2.1.3	Trends in own-source revenue (last 5 years)	Increased	45%
7.2.2.3	Existence of performance indicators and goals for tracking budget execution	Yes and results from performance indicators and goals are incorporated into the following budget	

Unemployment

The levels of unemployment on the local scale strongly follow the trends of the national economy, with small particular variations in the city. The Brazilian economy, with the strong impact of the national financial crisis, showed strong growth in the unemployment rate as of 2015, reaching its peak in 2017. In recent years, the unemployment rate has fallen again, albeit slowly. The local unemployment rate is higher than the national estimate, but lower than regional figures. These data demonstrate a greater economic vulnerability in the region, which may be more impacted by future financial crises. With the current COVID-19 crisis, in the event of a weak economic recovery, growing unemployment is a risk that must be considered.

Insights from CRPT Urban Performance Indicators

7.1.3.1.2	Local government job share		40%
7.1.3.1.1	Manufacturing job share		5%
7.1.3.1.3	Self-employed job share		31%
7.1.3.2	Unemployment rate	Total	13,7%
		Female	13,8%
		Male	13,6%
		Age under 29	24%
		Age 30-49	10,6%
		Age above >50	7,2%
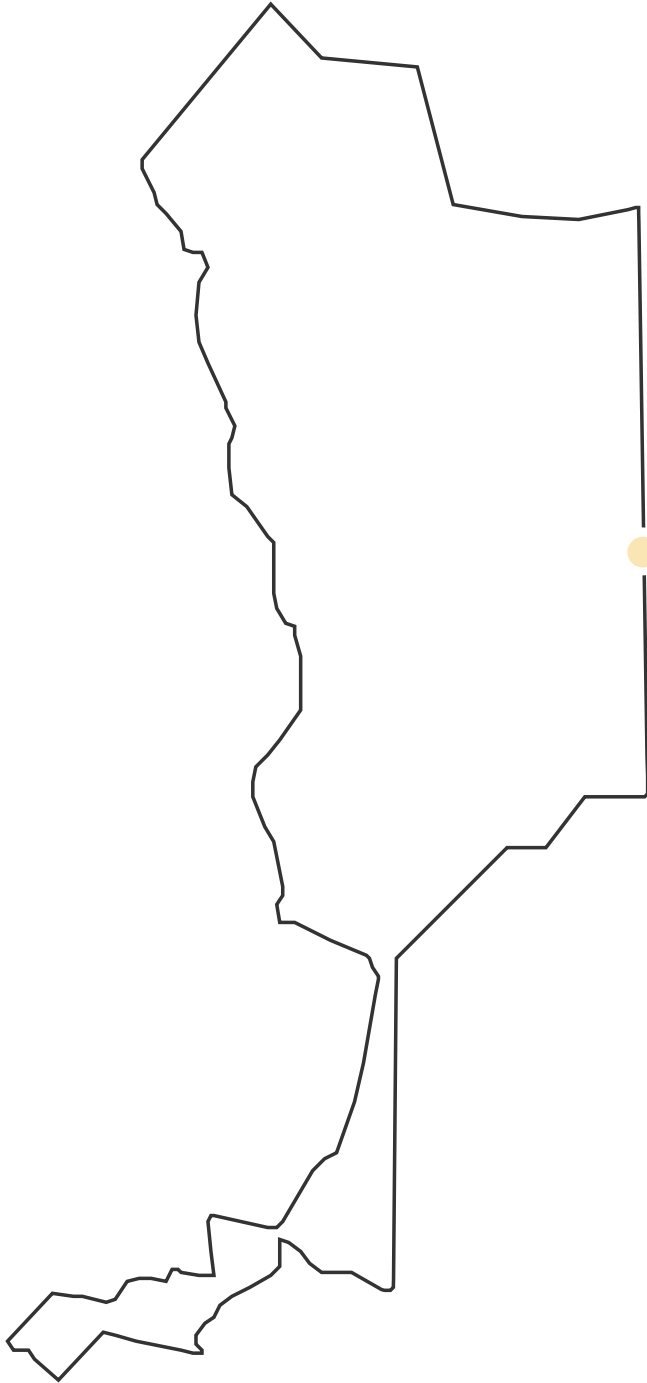
Chapter 3

Chapter 3
Urban Development and Resilience Trajectory

Chapter 3
Urban Development and
Resilience Trajectory

Building upon the findings displayed in Chapter 2 - the current state of urban resilience in Teresina, this chapter illustrates the results of an extensive review of policies, plans, initiatives, including risk reduction measures, in place or under-development that have the potential to influence, on different levels, priority matters for resilience in Teresina. Through the study of the policy context, awareness of the risks and how they interact, and a review of the existing plans and initiatives in Teresina to address these issues, the urban development and resilience trajectory of the city through each determined priority matter is mapped out and key findings are derived.

Before delving into the review of policies, plans and initiatives (PPI) per each determined priority matter, this chapter provides a brief display of some global trends, namely the COVID-19 pandemic, and its local implications in Teresina. In addition, the chapter presents the outcomes of a number of studies and projects on context-specific climate change trends. Given the rapidly changing situations due to COVID-19 and climate change trends, this display is essential to highlight the extent to which existing policy contexts can adapt and maintain continuity in the light of these new realities.

3.1. Covid-19: Emerging trends

The COVID-19 crisis poses a global threat to social development and economic growth as the pandemic has triggered the most severe economic crisis in a century. Considering the Latin American context, it affected a region already struggling with low growth, and in the Brazilian case of growing poverty and extreme poverty, it has accentuated vulnerabilities and inequality, high polarisation and weakening social cohesion. While measures preventing physical social interaction are needed to constrain the virus' spread and life losses, it is leading to more unemployment and decreasing personal and household earnings. According to the Economic Commission for Latin American and the Caribbean, income losses are primarily hitting those living in or vulnerable to poverty, including workers more exposed to layoffs and pay cuts and, in general, those in precarious jobs.

As the crisis continues, the COVID-19 pandemic has brought about extreme uncertainty, with more than half of the world's population enduring lockdowns or strict containment restrictions, while European countries are experiencing the second wave of the pandemic. The Organisation for Economic Cooperation and Development (OECD) prognosticates world GDP to fall between 6% and 7.6% in 2020, depending on the impacts of the second wave of infections. According to the Teresina Finance Department, there was high uncertainty in local budget estimates for 2020 (See Annex 4), but multiple scenario modelling has indicated the negative impacts of COVID-19 crisis on local fiscal stability. The first scenario projected in 2020, before the crisis outbreak, estimated a GDP growth of about 2.3%. The second scenario was elaborated in May 2020. Taking in consideration the economic conjuncture, by the end of 2020 it would have a retraction of 7% in its production with an inflation (IPCA) of 1.59 %. This would result in an estimated amount of R$1,530,128,092.40 and consequently a reduction of 10.5% in relation to the previously projected figures. The third scenario, elaborated at the same time as the partial reopening of the economy, started shows a situation of recovery, with the GDP pointing to -4.8% and IPCA with an expectation of 3.4% resulting in a revenue expectation of around R$ 1,568,050,953.63.

According to the World Economic Forum (2020) the shock's impacts will be felt for a prolonged time as the direct response, and subsequent recovery and rebuilding efforts, may last for years. In the case of Brazil, many households benefited from emergency financial aid, and resuming these benefits next year brings uncertainties for the cities' local economies. In Teresina, according to the municipality, the economy has managed to survive with the injection of income through the national Emergency Aid, which covers 38,.8% of the city's population. In total, almost half a billion

BRL were directed to Teresina's citizens from April-July. In the state of Piaui, data from IBGE shows that more than 60% of the households received the benefit.[39]

The resulting economic crisis may inflate unemployment rates, more profound inequality, generational conflicts and continued stress on well-being. Governments should also consider the risks of failing public services if the situation is prolonged, with safety nets and public goods under pressure. Moreover, COVID-19 related priorities (largely healthcare and unemployment compensations) risk disrupting already limited funding available for other societal imperatives and reduce investments in education, housing, urban development, environment, among other policies.

On the other hand, the pandemic crisis accelerated the digitisation of public and private services, and Teresina is no exception. The necessary switch of the internal government procedures and online services for citizens signals a trend that is certain to be accentuated. It also accelerated data governance given that sound and refined statistics and data analysis have become essential, especially for services and sectors facing limited capacities. In the private sector, it has fueled innovation by boosting a tech-enabled contact-free economy, including online retail, telemedicine, and social distancing delivery and logistics, which is expected to expand employment in particular sectors. While telematics services, like education and health, have become common, the region's large digital disparity should be kept in mind. The opportunities and skills to access communication technologies, ensuring equitable access to digital city services, to remote health care, to online public schools, and to remote work possibilities, need to be addressed as a priority to reduce vulnerability gaps.

While the effects on urban development patterns are uncertain in the long run, many municipalities are already advocating for polycentric sustainable cities, encouraging active mobility, and adapting public transportation systems. Cities in developing countries are struggling with the maintenance of public transportation services in the face of decreasing revenues. According to the Brazilian National Association of Urban Transport Operators, daily fare losses are estimated to have cost as much as USD188 million/day.[40] Limitations in public transportation provision also pose a risk of increasing paratransit modes.

With the challenge of overcoming these impacts and seeking opportunities for adaptation and growth, cities need comprehensive strategies that involve not only the different levels of government but also communities, companies, and universities. Local governments can benefit from platforms to facilitate constructive dialogues that look not only at the city and regional level but discuss neighbourhood-by-neighbourhood impacts.

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[39] IBGE, 2020
[40] Ibold et al., 2020
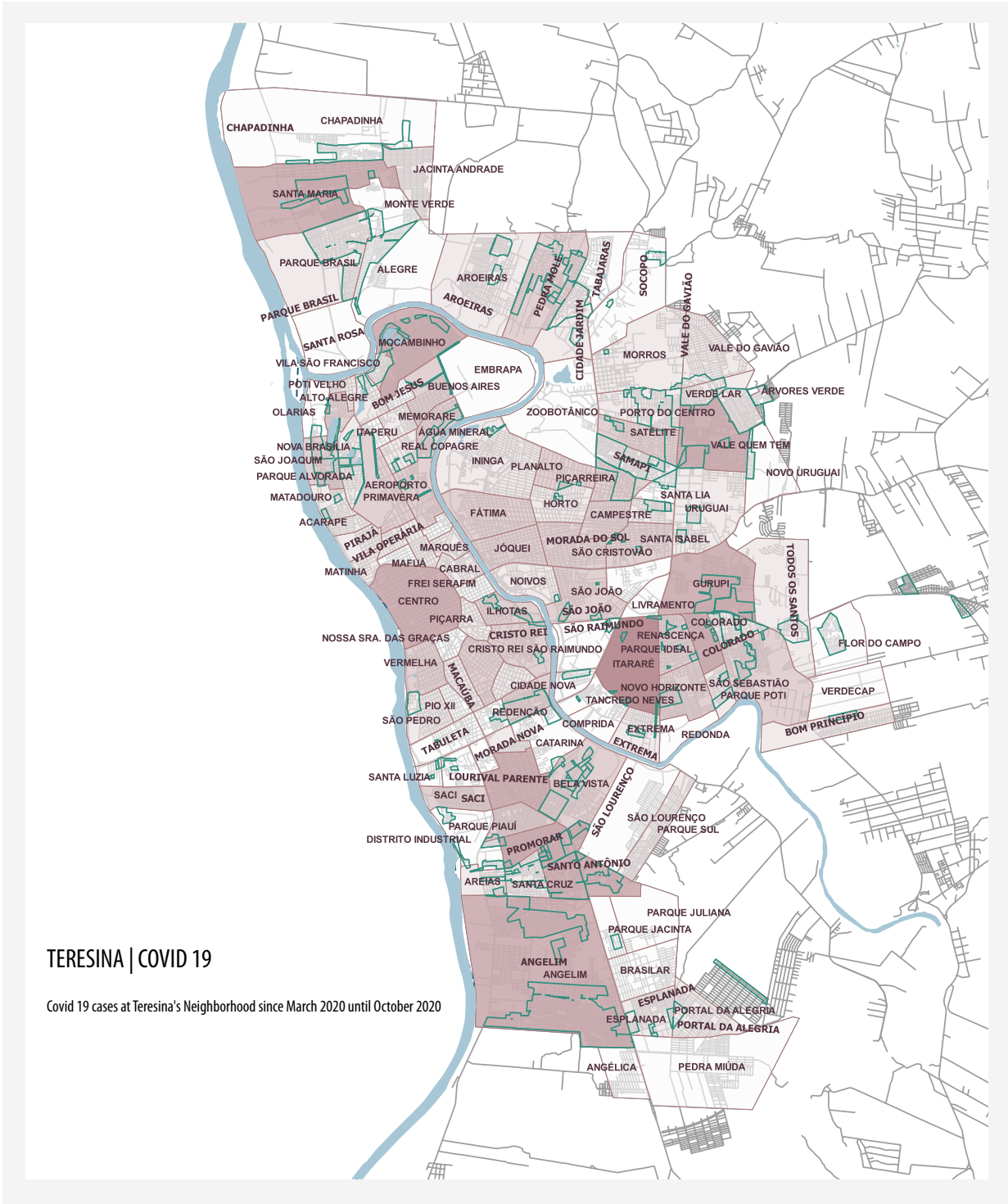
TERESINA | COVID 19

Covid 19 cases at Teresina's Neighborhood since March 2020 until October 2020

Quantity of Covid Cases

- 0 - 113
- 113 - 294
- 294 - 567
- 567 - 1132
- 1132 - 2319
- Teresina's Perimeter

0   2,5   5 km

N
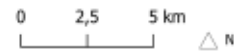
Figure 45: COVID 19 cases at Teresina's Neighborhoods since March 2020 until October 2020. Source: CRGP/SEMPLAN (2020).

3.2. Climate change trends

3.2.1. Climate Change Impact Trends in Brazil and the Brazilian Northeast

The IPCC Fourth Assessment Report, under the Technical Summary of Working Group II, presents a review on "Impacts, Adaptation and Vulnerability" to major adverse impacts that may affect Brazil and South America in the future as a result of global climate change. Among the key findings from the 4th report is the extremely high probability that areas in the arid and semi-arid Brazilian Northeast are particularly vulnerable to the impacts of global climate change in terms of water resources, with reduced water supply. This scenario is especially concerning when considering that population growth leads to an expected increase in demand for water.

Regarding impacts on biodiversity, it reports a high probability of a considerable number of species going extinct in the coming decades in the tropical region of Latin America. It also foresees the replacement of tropical forests by cerrado biome, in the Amazon eastern region, and some semi-arid areas by arid, in Northeastern Brazil (desertification), due to temperature rise and reduced groundwater. Northeastern Brazil already faces water scarcity, and the population and ecosystems are vulnerable to less frequent and more variable rainfall due to global climate change which leads to severe consequences for agricultural and food production in the region.

Figure 46: Estimated changes in precipitation and temperature for the Brazilian Northeast 2071-2100. Source: INPE (2020).
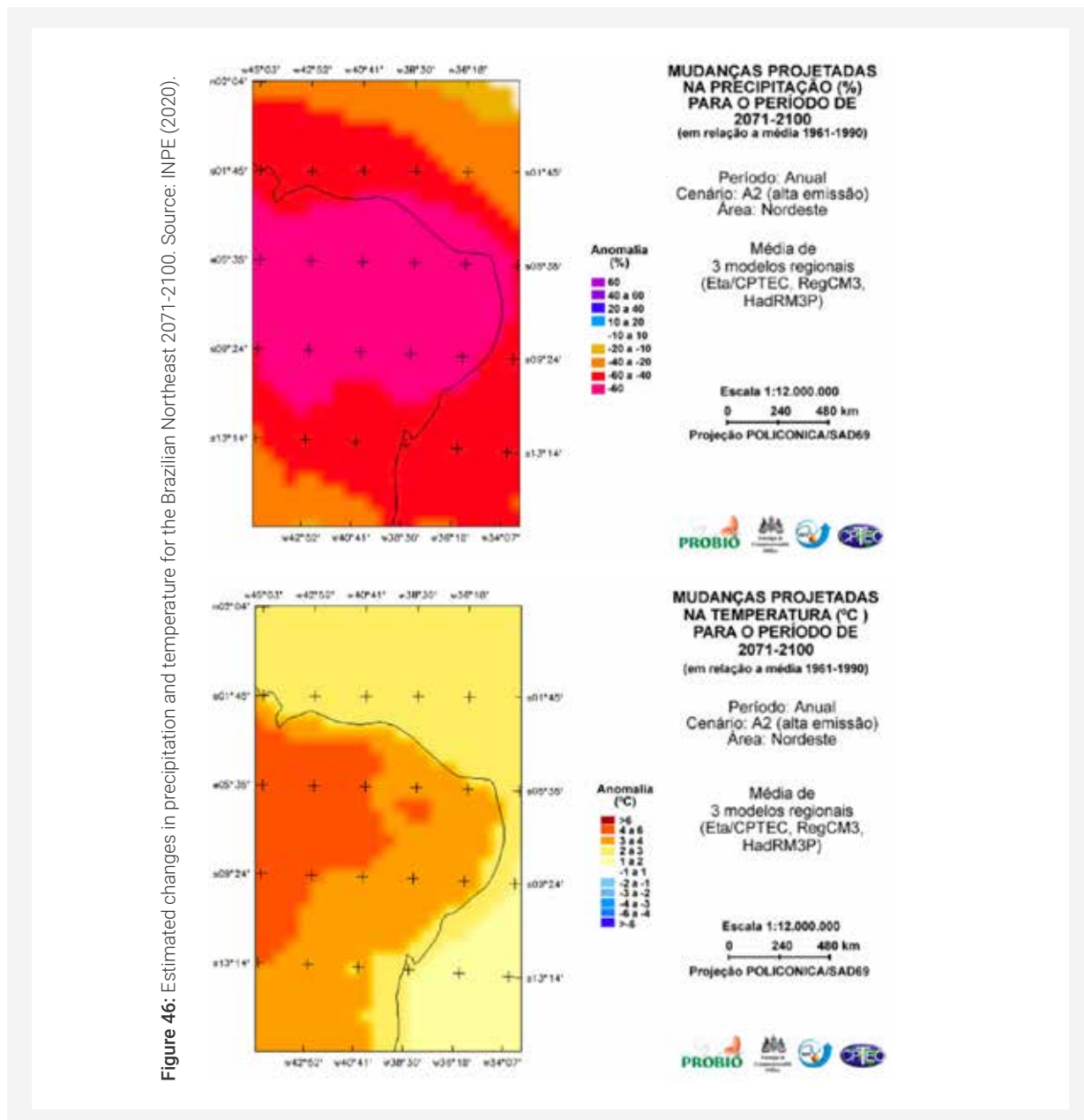
Since higher rainfall is the principal climate change-related factor that will exacerbate erosion impacts, Northeastern Brazil is particularly vulnerable as erosion in this region has already caused the sedimentation of reservoirs and, consequently, reduced storage capacity and water supply. Also, urban areas in developing regions are especially vulnerable to erosion, especially to landslide occurrences in risk-prone informal settlements.

Finally, global climate change may impact the city's public health, as cases of flood-related diseases have been reported in Brazil, such as diarrhoea, and an increase in schistosomiasis cases (Schistosoma genus). Increase in wildfires also impacts public health due to its impacts on local air quality. According to studies from the global Heat and Health Network, future changes in heatwave-related excess mortality are highly affected by greenhouse gas emissions and human adaptation to climate change. Heatwave-related excess mortality is expected to increase the most in tropical and subtropical countries/regions, including in Teresina, as illustrated in the following map.
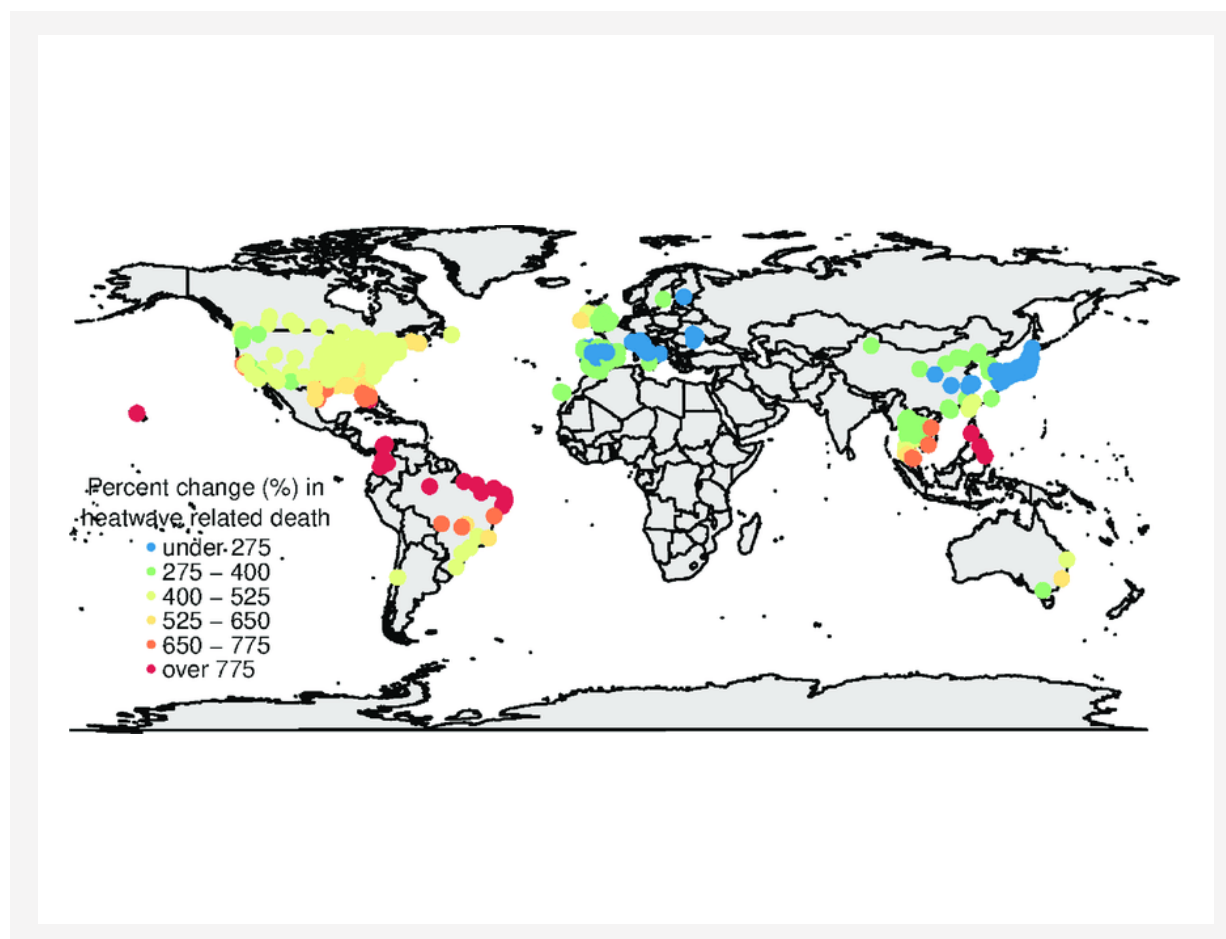
Figure 47: Locations of communities and mean percent change of heatwave-related excess deaths in 2031–2080 compared to 1971–2020, under RCP8.5 scenario and high-variant population scenario, with assumption of non adaptation. Source: Guo Y, Gasparrini A, Li S, Sera F, Vicedo-Cabrera AM, de Sousa Zanotti Stagliorio Coelho M, et al. (2018).

3.2.2. Downscaled Climate Trends for Teresina Region

As part of its cooperation with UN-Habitat CRGP, Lobelia carried out climate change trends research into the consequent effects in Teresina over the next 80 years (See Annex V). This report aimed at (1) assessing the magnitude of climate risks in Teresina through analysis of climate trends; (2) executing the Lobelia Climate Engine methodology to provide evidence in support of CRGP climate resilience plans at the urban scale; and (3) providing an assessment report for Teresina with key messages and associated key values of climate projections and local extreme event indices

Using a multi-model that ensembles 4 regional climate projections from the South-America CORDEX domain with a spatial resolution of 0.22° (~22km) and a daily temporal resolution, the projected changes describe the possible future evolutions of the local urban climate for the next 80 years, over three time horizons (near future — 2011-2040; mid-future — 2041-2070; and far-future — 2071-2100). The projections cover the expected changes in air temperature (mean, maximum and minimum), precipitation and some associated extremes.

The findings are presented per two main scenarios: one representing climate change projection in a stringent mitigation scenario which implies a major change in the global socio-economic system in order to reduce net global CO_2 emissions to 0 by year 2050, aiming at maintaining the mean global warming below 2°C (RCP2.5); the second one is the business as usual scenario, represented by RCP8.5, and accounting for a pathway without additional efforts to constrain emission.

In summary, the report findings suggest the following trends to take place in Teresina:

- The local climate will grow warmer and drier throughout most of the year.
- Local warming will be significant both during night-time and daytime.
- Heat waves will become more frequent and much more persistent.
- Warm (tropical) nights will become very frequent in most months of the year, especially at the beginning of the hot season (June to August interval).
- The dry season will become drier and hotter.
- The hot season will become hotter, longer, and drier (especially in June, September and October).
- Precipitation will decrease throughout most of the year under both emission scenarios.
- Dry spells will become more persistent favouring the gradual transition towards a drier local climate.
- The frequency of heavy rainfall events and the extreme rainfall amounts in time sequences of 1 and 5 days will significantly increase (20%-40%) over the December to February interval (the beginning of the wet season), especially in the mid- and far-future under RCP8.5; a slight increase in the extreme precipitation amounts is also expected at the end of the wet season (from March to May).

According to the report, annual mean temperatures are expected to increase significantly for both scenarios (RCP2.6 and RCP8.5) although with a clear distinction between them (figure 48). A dramatic increase in the frequency and duration of hot weather extremes is expected in the area of Teresina city.
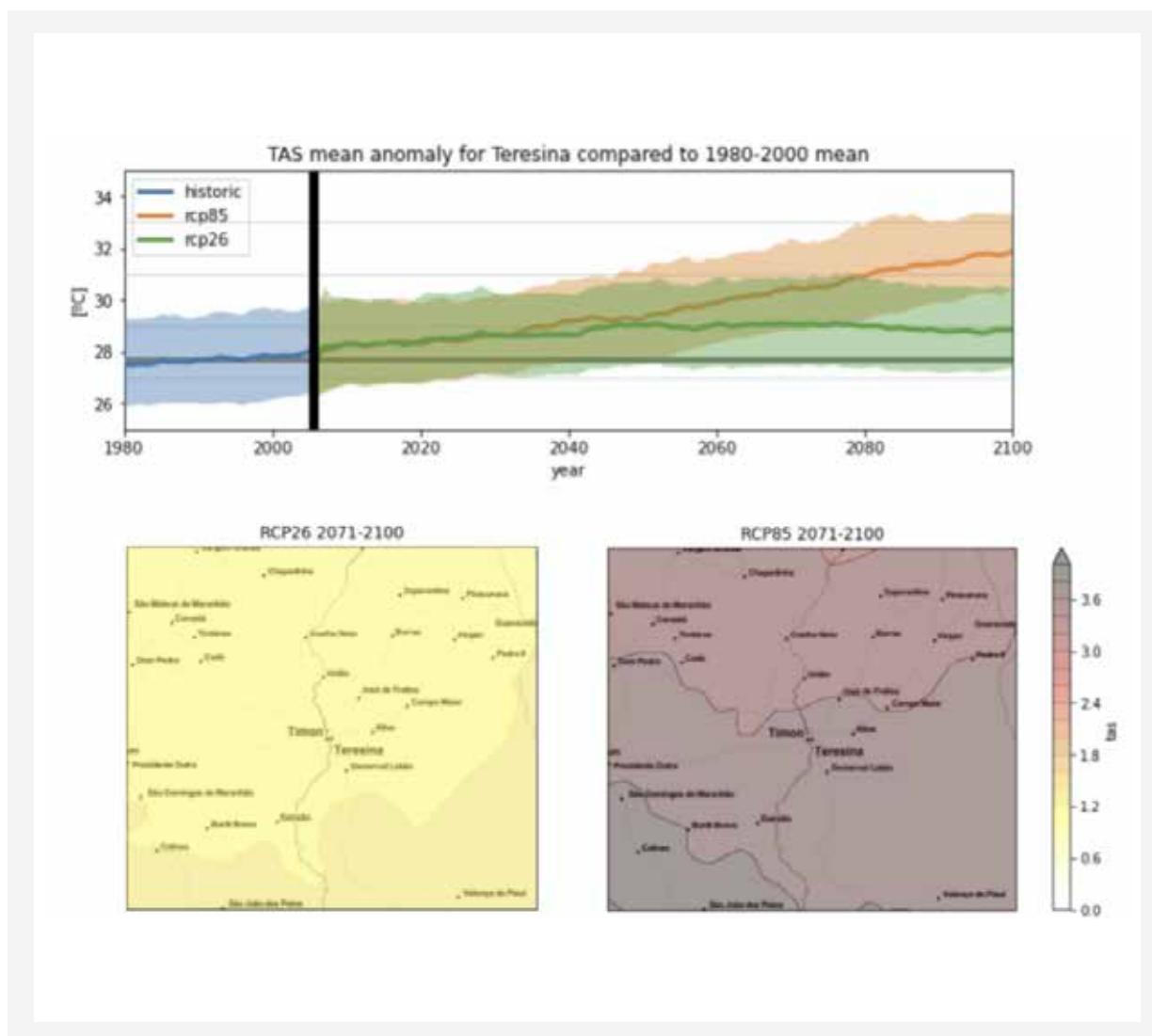
Figure 48: Top panel: Time series of the projected annual mean surface temperature [°C] in Teresina during XXI century for the two scenarios (RCP2.6 and RCP8.5). Shaded coloured area represents the region between the minimum and maximum values within the multi-model ensemble. This interval provides an estimation of the uncertainty related to the natural variability, i.e. the interannual variation for a given year may fall within this shaded area. Horizontal grey line indicates the average annual temperature for the historical period. Bottom panel: Projected annual mean change in surface temperature [°C] for period 2071-2100 with respect to the reference period (1980-2000) for the two scenarios. Positive values indicate an increase in temperature in the future. Source: Lobelia (2021).

Future climate change is expected to aggravate the existing environmental, health and urban problems and to increase risk, especially for communities already living in vulnerable conditions. Increasing heat-health risks, due to the augmented heat stress and urban heat island effects, in response to the significant temperature increase in both daytime and night time; additional risks for residents and tourists is expected to be posed by the increasing frequency of warm (tropical) nights and heat wave duration.

Owing to its location, at the confluence of the Parnaiba and Poti rivers, Teresina will be increasingly exposed to the risk of fluvial and pluvial floods in the light of observed climate change projections, particularly due to increasing torrential rainfalls (e.g. heavy precipitation days with at least 20 mm and extreme rainfall amounts in 1 and 5 consecutive days) projected at the beginning of the wet season (from December to February). Given the analysis findings displayed in Chapter 2, if the current inadequate waste management continues in future, these plausible fluvial floods will pose major contamination levels for local water surfaces and soil in the adjacent areas, leading to marked social vulnerabilities along these zones.

Most importantly, this will lead to rising levels of exposure to health risks, namely diseases such as dengue, zika e chikungunya, which have been endemic in Teresina. However, other factors (e.g. individual behaviour, immunity and socioeconomic factors), showing non-linear relationships with the disease incidence, together with the effectiveness

of implemented preventive measures such as vaccination campaigns, disease surveillance and vector control might be more relevant in understanding the seasonal timing of outbreaks under the future climate.

On the other hand, the increasing duration of dry spells is likely to have hydrological and agricultural implications, through more occurrences of hydrological drought events, deficiencies in water supply and decreased soil moisture. This has the potential to increase socio-economic challenges in Teresina due to migration movements from rural areas towards the city.
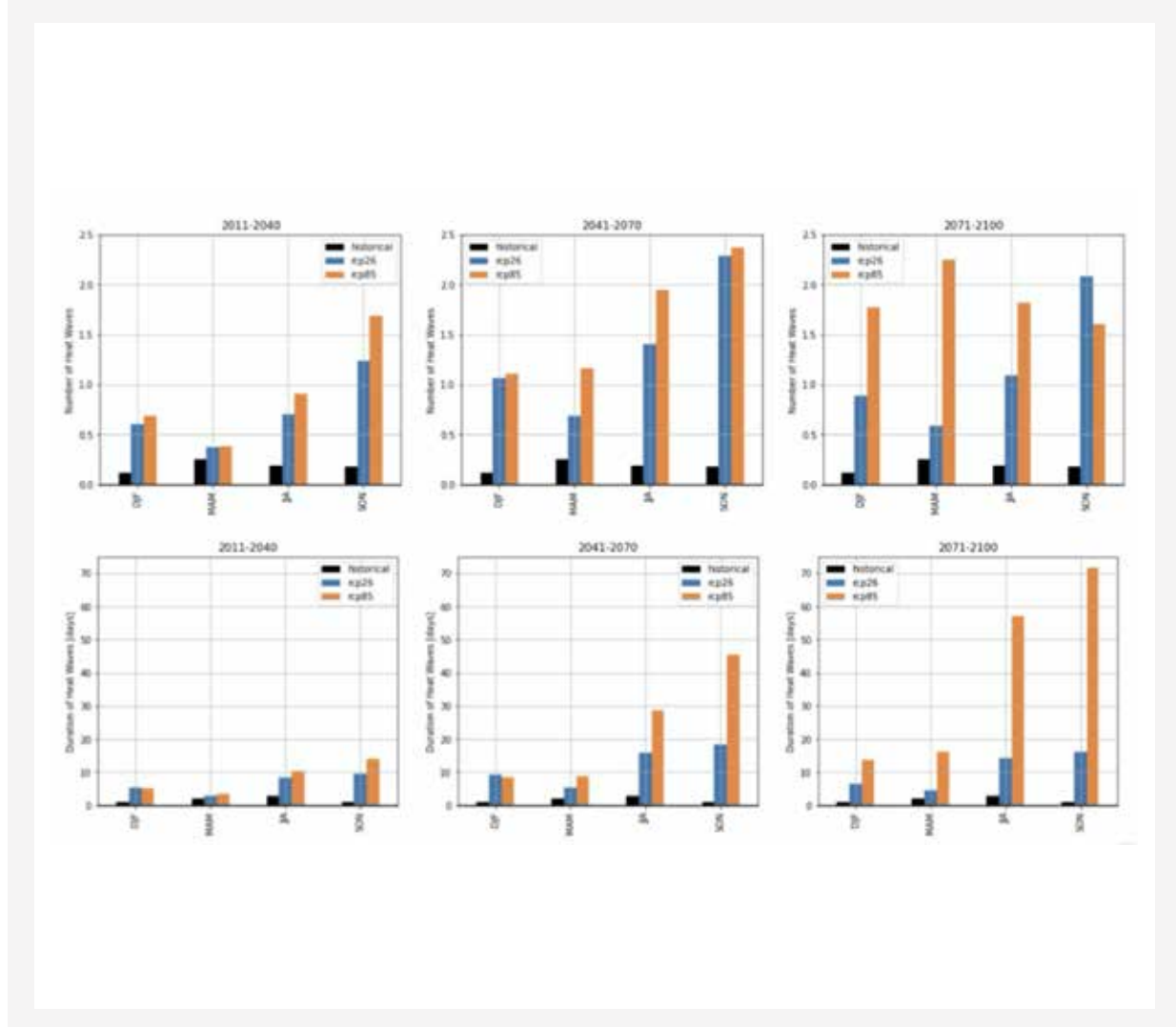
Figure 49: Average number (top) and duration in days (bottom) of heat waves for different periods and scenarios.
Source: Lobelia (2021).

3.3 Priority Matters and Urban Development trajectories A review of Policie, Plans, and Initiatives in Teresina

The review was conducted by selecting relevant legal documents during the data collection process, as well as additional reports, studies, articles, and interviews with different department representatives from the municipality. The value of this analysis lies in its ability to not only highlight the multitude of policies, legislations, initiatives, and projects in place, but to also identify gaps in the policy context for which actions to address them will be proposed as part of the Actions for Resilience phase. In short, the findings of this review will lay the ground for the formulation of Recommendations for Actions for Resilience. An inventory of all policies, plans, and initiatives (reviewed below) is presented in Annex III.

Priority Matter 1: Water Cycle Mismanagement

Disruption of natural hydrological dynamics

Mismanagement of urban metabolism
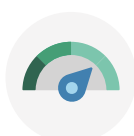
Inadequate Risk Reduction Measures

Additional Programmes and Projects

Priority Matter 2: Ecosystem Imbalance

Environmental Pollution

Vegetation Loss

Additional Programmes and Projects

Priority Matter 3: Economic Underperformance

Limited Business Attractiveness
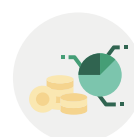
Weak Economic Diversification

Reduced Productivity

3.3.1. Priority Matter 1: Water Cycle Mismanagement

As it was explained extensively in Chapter 2, rapid urbanisation and spatial expansion in Teresina over the past two decades, coupled with poverty, lack of access to land and housing, and mainstream urban planning ideologies - especially during the eighties and nineties - resulted in an altered i natural water flow due to deforestation, the disruption of water streams and destruction of natural protective structures. Moreover, the lack of sustainable approaches to urban metabolism management, particularly solid waste, wastewater, and stormwater systems, further undermined the urban water cycle management with serious implications for the city's ecological balance. Notably, it increased the potential for more risks such as floods, landslides, infrastructure failure in addition to the marked socio-economic impacts on the city's inhabitants.

The review of policies plans and initiatives across different levels of the government shows that overall, there is a clear consensus on the importance of addressing the root causes of this priority matter rather than merely focusing on short-term emergency response to the associated risks of water cycle mismanagement. Nonetheless, many of the PPIs displayed below are quite recent (either recently approved or under development), which means it is still early to evaluate their impacts and implications. Therefore, it should be noted that this review and evaluation of policies, plans, and initiative is mostly based on the content of their respective documents and the stated aims and goals.

While the organisation of the outcomes of PPI review for each priority matter (including water cycle management) is detailed per each underlying driver, some policies, plans, or initiatives are territorial and cross-sectoral and touch on every driver of water cycle mismanagement in Teresina, most notably **Teresina's Urban Development Master Plan (PDOT 2020)**.

Geared towards promoting sustainable urban planning and growth, the newly approved plan (2020) is a Transit-Oriented Development Plan, aiming at increasing density around transit infrastructure, while reducing urban sprawl and low-density developments. Thus, the plan promotes a shift towards a rather poly-centric spatial configuration. For this purpose, the plan incentivises the real estate sector to stop sprawling and concentrate development around the projected new sub-centres. Further, the plan restricts developments in risk-prone areas and urban greenfields. More importantly, the plan is associated with powerful means that ensure its implementation, mainly the requirement of developer to comply with zoning codes and planning regulations.

While the masterplan appears to be conceptually a very strong document in promoting sustainability and enhancing urban resilience, the next several years should unveil the extent to which it addresses the current issues in Teresina. However, drawing on the analysis findings in Chapter 2, a number of concerns can be raised regarding its potential. Namely, the transit-oriented development and the consequent polycentric urban form. Considering the implications of the current public transport system and network in Teresina, which have proved to be inefficient and with major consequences for efficient mobility and economic productivity, it is not clear the extent to which those new centres promoted are based on a comprehensive transport network analysis. The analysis must go beyond the mere land use adjustment around transit infrastructure to observe how changes in origins and destinations affect interaction flows between zones. This perspective is essential for ensuring the viability of the goals and objectives of **Teresina's Urban Development Master Plan** since the urban transport network plays a major role in the distribution of economic activities and opportunities.

Apart from Teresina's Urban Development Master Plan, an important initiative for addressing water cycle mismanagement more broadly is the recently approved **Integrated and Sustainable Piauí (Inside Piaui PPA)**: a state level initiative that promotes the expansion of the State's conservation areas, and aims to support the state policy for environmental awareness, expanding the access to basic sanitation services, developing water management plans for the hydrological basins, supporting municipalities in setting local DRR strategies, enhancing state-level mobility (roads, and trains, including the Teresina Tram System), reducing state housing deficits, and decreasing wildfires occurrence. It should be noted that although state-level policies and initiatives tend to target the least developed areas rather than the capital itself, given the variation in human, social and financial capacities between the capital and other parts, Teresina benefits indirectly through the growth these policies may create in other cities that are under Teresina's sphere of influence. Nevertheless, given its breadth of objectives and its recentness, it is hard to anticipate how much this initiative can deliver on such ambitious goals.

On addressing the water cycle mismanagement in particular, the 2010 **State Water Resources Plan** included strategies to strengthen state capacities for water resources management, implementing IWRM tools (such as hydrological basins plans, and state water monitoring system). It also included a programme to expand water supply, mitigation measures to reduce water contamination, control of water demand, and mitigation measures to reduce impacts induced by natural or man-made effects on water resources (reforestation of river basins, awareness raising campaigns, flood early warning systems, mapping flood-prone areas). The outcomes of this plan have been regarded as very useful for the city, especially for the state government, who, in agreement with the municipality of Teresina, assigned the implementation of actions to private operators instead of the State-owned water operator. In doing so, the private operators had to comply with the **Municipal Basic Sanitation Plan** and its targets, specifically the 100% universalisation of water supply services, and the expansion of the wastewater network from 6% in 2010 to 33% in 2020. They also improved the water supply withdrawal stations and enhanced the capacity of wastewater treatment plants. The Private operator is also responsible for regularly monitoring water resources quality, including the lakes in the north region that are not for water consumption.

Disruption of natural hydrological dynamics

As was illustrated in Chapter 2, Disruption of natural hydrological dynamics is attributed to disruption of water streams and destruction of natural protective barriers as a result of rapid urban expansion in light of poverty and consequent lack of adequate access to land and housing, and dominant urban planning ideologies over several decades. To constrain rapid expansion, the municipality of Teresina adopted a major policy – **Urban Perimeter Act** – in 2015 to freeze the urban perimeter. While previous local legislations attempted to limit expansion by allowing development to take place nearby existing ones, this meant constant extension of the urban perimeter, the case of many housing developments during the turn of the decade. After long battles with the construction sector, the city council legislated the **Urban Perimeter Act** to stop this permanently and avoid further spatial expansion towards urban greenfields and rural areas. This local policy proved very useful for the effective implementation of the recently approved **Teresina's Urban Development Master Plan**.

While this Act serves as a strong instrument to constrain further urban spatial expansion, it falls short in addressing some factors behind spatial expansion, mainly inadequate access to and unaffordability of land and housing in inner districts of the city. This has in turn led to the emergence of informal settlements, many of which are located in flood and landslides prone areas, lacking adequate sanitation and drainage systems, rendering inhabitants more vulnerable and exacerbating further existing risks.

In tackling the issue of access to land and housing, the national urban policy **City Statute**, approved in 2001, represents a major milestone in Brazil. This policy emphasises what is understood as the right to the city for all citizens and provides guidance for local authorities on how to realise it. While It offered an implementation toolbox for cities, evidence suggests difficulties in regulating these tools at the local level as several cases of conflicts among numerous influential sectors have been reported, namely as it reduces certain stakeholders' privileges in favour of collective interest. For instance, the policy favoured differentiated urban regulation for informal areas or social housing. It also creates the "urban usucapião", which authorises the property rights transfer in case of land occupations for over 5 years, leading to major contestation with traditional property rights.

Against this background, new laws were necessary. **The National Policy for Land Regularization** was approved in 2017 and supports local authorities to advance in land regularisation through the relaxation of certain strict national regulations for special cases, such as informal settlement upgrading. Prior to this legislation, many local land tenure regularisation programmes were hampered by the inability of the local government to grant land titles in informal subdivisions which did not comply with national regulations, like minimum street width, street network/land rates, minimum thresholds of public and green areas. This law exempts informal settlements from such constraining codes and other requirements, hence facilitating the progress of regularisation projects in recent years.

In summary, **City Statute constitutes the umbrella national policy for many national, supra local and local policies**, initiatives, and projects for housing provision. It has increased the importance of supporting land tenure rights for those in informal settlements and risk prone areas. However, inadequate implementation mechanisms meant that, on the local scale, many housing initiatives and projects have triggered new problems, posing new threats on such developments' inhabitants. For instance, the national programme MCMV - **Minha casa, Minha Vida (My House, My Life)** - an extensive national housing programme, which changed the development of many cities as much as the previous **BNH** housing programmes - resulted in major housing developments that are currently where most of flash floods frequently occur. It was a decentralised housing development programme (companies could build and then sell to governments that would pay under a cap price). Many companies were offered large and cheap sites, which consequently underwent deforestation and terrain alteration in the absence of comprehensive environmental policies. Most of the built settlements were low density, which all together created serious drainage problems. Only recently have these implications been addressed through the 2020 **National Housing Programme (Minha Casa Verde Amarela)** which replaces the MCMV.

At the local level, City Statute and **The National Policy for Land Regularization** of 2017 have been translated into local policies, namely through the **Teresina Urban Land Regularization Policy** approved in 2019. This law incorporates at the local level the main points of the legislation already presented at the national level and presents regulations for the application of the national rule at the local level, greatly facilitating land regularisation in the municipality. While it is very early to assess its effectiveness, it is viewed as promising as the 2017 national legislation came to untie several knots that existed in the processes of land regularisation, a response that had been demanded by the city for a long time.

Nevertheless, the municipality of Teresina is still struggling with the localisation of these national policies. The progress in this respect has been described as very slow. A new package of local policies and mechanisms to implement this national policy was set by the Municipality of Teresina recently as part of its Urban Development Master Plan (PDOT). It included mechanisms such as the **Public Concession of Building Rights**, defining a 'free building cap' per each urban zone and conceding fiscal stimulus to build on infrastructured centralities over non-developed areas. The plan also incorporated land-use tools that were regulated previously on a loose basis, such as the **Progressive Property Tax** (2015) which incentivises the development of vacant private properties inside the city.

One of the major issues facing housing provision on the local level is the overlapping of many governmental jurisdictions in certain areas of the city, specifically in local areas that fall within the state or federal jurisdictions, paralysing the municipality in terms of setting any initiatives or programmes. This issue was partially tackled through the **Urban Land Regularization Policy in Piauí** - a state level initiative – in 2019. While not related to Housing in hazardous areas, it facilitates land tenure regularisation exclusively in areas belonging to the state government. Similar to previous initiatives, it is quite early to evaluate its implementation and implications.

In addition to the aforementioned issue of governmental competencies and jurisdictions, there exists in Teresina several state-owned social housing schemes, which previously lacked legal status. During the 1970-1990's the state-owned housing company built several social housing developments without legally approving them with municipalities and with no provision of land registry to those who benefitted from the programmes. The **Minha Casa Legal** (Tenure Formalisation) state level initiative came to action in 2015 and lasted for 5 years to formalise these units by offering property rights documents to the owners. It should be noted that these settlements were not considered informal. Many of these are now middle-income houses. Neighbourhoods in Teresina covered by this initiative are: São Pedro, Saci, Primavera I e II, Angelim I e II Promorar, Dirceu Arcoverde , Morada Nova, Bela Vista , Renascença, Mocambinho, Monte Castelo, Stand de Tiros, DER, Cristo Rei, João Emílio Falcão, Redenção, Tabuleta, Tancredo Neves, Julia Maione, Itaperu, São Joaquim, Cíntya Portela, União I e II, Residencial Deus Quer, Cidade 2000, Boa Esperança, Portal da Esperança, Tenho Fé, Nova Theresina, Condomínios Verde Te Quero Verde, Pasárgada, Alô Teresina, Conjunto O Sonho Não Acabou, Condomínio Santa Luzia –Carteira Iapep/Funprev.

Financially, the above-mentioned national legislation have been supported by some recent national initiatives such as **PRÓ-MORADIA** (2020) - expected to help states, municipalities, or government agencies, through credit systems for urbanisation and regularisation of informal settlements for the urban poor, in addition to the supra level 2019 **Moradia para Todos** (Micro Credit for Housing Improvement). Nevertheless, given the large deficit in housing provision especially for those socio-economically disadvantaged inhabitants and in risk prone zones, more financial instruments are highly needed.

At the local level, the **PLHIS - Local Social Housing Plan** was adopted in Teresina in 2013. The plan mapped most of the informal settlements in the city, informed the city's housing deficit by drawing on the national government statistics. It further estimated the financial capacities required to close the deficit within specific timeframes and scenarios. It served as a base for Informal settlement land regularisation programmes but, while the project provides comprehensive mapping and sets a number of goals, it lacks clear strategies and mechanisms for implementation to meet the project's goals.

Mismanagement of urban metabolism

Urban metabolism as a concept focuses on the potential of sustainable patterns of consumption and production in an urban system by connecting material and non-material flows with ecological and social processes. The degrading natural and urban water cycle in Teresina is strongly linked with the management of such processes of flows and circulation, particularly the unsustainable management of solid waste, wastewater, and stormwater.

In tackling stormwater and drainage issues in Teresina, the Municipality adopted in 2015 the **Drainage Act**, an important piece of local legislation which obliged the private sector to present their drainage infrastructure plans for relevant developments (with footprint greater than 500m2) as a requirement for construction permission. While this local policy has the potential to reduce the risks of flooding and consequent risks, it only covers those developments built after 2015. However, lack of adequate drainage solutions is widespread in Teresina and relates to decades of unsustainable urbanisation and construction practises. To address this significant drainage problem, the municipality set the **Urban Drainage Plan** in 2015 with very clear priorities and goals. The plan mapped all the city's hydrological micro-basins and defined priority actions and regions according to risks and vulnerabilities through a comprehensive drainage system. Despite its massive benefits for the city, especially over the long run, to potentially reduce the dire impacts of flooding and offer an opportunity for better management of stormwater, the costs of the plan were so significant that the city was never able to secure funding from the national government, nor from international partners.

Notwithstanding, the municipality is currently in the process of developing an initiative - **PPP Drainage Systems** – that promotes public private partnership to address the financial challenges encountered by the local government with regard to the drainage issue in Teresina. Accordingly, the City Hall will be able to delegate to private entities the investments necessary to solve the urban drainage problem. The initiative also attributes to private partners the obligation to operate and maintain the structures built for a period of up to 35 years, ensuring its full functionality. The studies were expected to be completed in 2021, allowing the City to tender for the hiring of the private partner who will carry out the works.

As for sanitation services, namely wastewater, the **Municipal Basic Sanitation Plan** was adopted by the local government in 2016. It established the municipal goals for the provision of basic sanitation, for example, the plan set a target of providing 33% of the population with a sewage network by 2019. According to data collected by CRGP on basic infrastructure, the 33% target was met on time. Nevertheless, as explained in Chapter 2, this coverage is still below CRPT's established benchmarks for adequate coverage of wastewater services. Moreover, this limited coverage meant that the majority of people are dependent on unsustainable methods of wastewater disposal, leading to major environmental implications and health threats. Therefore, while performing well, the implementation needs significant acceleration and will require marked human, technical and financial capacities at the local level.

On solid waste management, the **National Solid Waste Policy**, adopted in 2010, is a strong piece of legislation in this field. Beyond merely setting guidelines for national solid waste policy, it led to the creation of useful tools, such as the national solid waste information system, where service providers must update data on solid waste management. This was important in "forcing" relevant departments to gather, process and provide information on waste management. It also obliged Municipal governments to prepare their local solid waste management plans as a prerequisite for access to national funds in this sector. The legislation further highlights the basic aspects on which such plans should be focussed.

In response to this national law, Teresina has been regularly updating its solid waste management plan, most recently through the 2018 **Municipal Plan for Integrated Solid Waste Management**. The goal of this plan is the universalization of waste collection and urban cleaning services. It is estimated that the total amount of investments required to meet the plan's long-term goals is around R $ 2 billion, with landfills taking the biggest share of such investments as they will require massive upgrading processes and adaptation, and closure of some municipal landfills. But the plan has been described as inadequate as it lacks a robust and comprehensive implementation strategy. As a result, unsustainable methods of waste disposal continue to be the case in Teresina with landfills posing serious environmental risks on ecosystem degradation.

Despite the existence of a number of regulations for the landfills management, such as **CONAMA Resolution No. 307/2002** and the **PNRS on Civil Construction Waste management (RCD)** in Teresina, companies still do not comply with the established guidelines due to the absence of enforcement mechanisms and regular inspection by any of the environmental agencies present in the state be it a municipal, state level or a federal body. This increases the danger of such practises on the environment given that these landfill sites are in areas with visible damage to the local natural system.

Inadequate Risk Reduction Measures

This part of the PPI review looks into the following measures in place: risk assessment, early warning systems, risk management, emergency response, and recovery.

Although the **National Civil Defence and Protection Policy**, approved in 2012, established the duties of the different levels of government (national government, the States, the Federal District and the Municipalities) to adopt the necessary measures to reduce the risks of disaster, this has not been accompanied with clear mechanisms for implementation. The 2012 **SINPDEC** was legislated to follow up with the implementation of the established duties in the National Civil Defense and Protection Policy. It should be noted that Teresina still lacks adequate civil defence units essential for timely response in times of emergency.

Nonetheless, a number of national policies and initiatives were adopted to ensure early risk monitoring, assessment and risk communications through the establishment of early warning systems. For instance, the **National Civil Defence System** which was approved in 2010 provided support to local and regional authorities by conducting risk assessment and studies. As part of this legislation, the national government financed and conducted the Teresina's risk-prone areas cadastre. Moreover, it created a national early warning system that informs municipalities when a risk is imminent. Citizens could also register using their postal codes to receive push alerts via phone in the case of an event in their areas.

The establishment of the **S2iD (Integrated Disaster Information System)** is an important initiative by the national government to gather and provide real-time information and data regarding on-going threatening events in the country per city. These services are provided through the S2iD platform which is publicly accessible to everyone.

As for the longer-term risk mitigation measures, a number of national and local initiatives have been adopted, namely:

The **National Plan for the Recovery of Native Vegetation (Planaveg)** approved in 2017. The plan aims to raise awareness of the importance of native vegetation, and facilitate actions for native vegetation conservations and reforestation. While some articles are concerned with vegetation conservation within the urban environment, this plan is mostly focused on rural areas. Given the severe impacts of urbanisation and consequent deforestation in addition to the mismanagement of urban metabolism, the issue of vegetation loss, specifically native plants, constitutes a major challenge in urban areas. Therefore, more policies and initiatives in this respect are highly needed.

Additional Programmes and Projects

Teresina Natural Based Solutions Strategies

This is an under-development local project that is piloting the use of NBS to reduce flash-floods in specific neighbourhoods in Teresina's urban area. The pilot area for this project is the southern district, where many flash-floods are reported. The project was granted financial support by the French Development Agency.

Programa Lagoas do Norte (Northern Lagoons Programme) initiated in 2006

This is the largest and most comprehensive local programme aimed at reducing vulnerabilities to floods and reducing risks. The design of the project began in the 1990s and funding was secured in the 2000s from the World Bank, and implementation started in 2006. This programme has proved effective in increasing hydrological stability in the lake areas of the northern zone, which comprises 14 neighbourhoods. The programme has several components, the infrastructure components which invests in DRR related infrastructure, including dikes, channels, pumping stations, etc., in addition to drainage systems, sewage, drinking water, mobility, urban design, parks and public squares, etc. The social components are focused on reducing vulnerabilities, such as poverty reduction, low schooling, professional training, crime and violence by focusing on marginalised groups and domestic violence. The environmental component of this project is concerned with the decontamination of the lagoons and environmental recovery of riverside areas, and the promotion of campaigns on the preservation of biodiversity.

The program is set to be implemented in 4 phases. It is currently in phase 2 – considered as the heaviest phase and with the largest volume of interventions. Moreover, for effective implementation, this programme has a component of municipal management modernization, which invests heavily in civil servants training, the efficiency of bidding processes and supervision of contracts, and in the improvement of municipal infrastructure such as the improvement of buildings and public facilities, including equipment.

Vila da Paz Urbanisation Project (initiated in 2013)

This local project aims at reducing risks in flood-prone neighbourhoods in the Vila da Paz Region. The programme is already under implementation and involved the removal of residential units within the risk-prone zones, and the construction of the water protective structures (water canals). In addition, a major action of this project was the reforestation of the stream basins, the foundation of a linear park alongside the canal, and construction of some social facilities. However, as this project was financed by national funds, the funds were halted when the government changed, and the project remained incomplete. Although the municipality has been attempting to secure international funds from the CAF to finish the project, as the area's occupation changed when the project stopped, the project needs to be revised and adapted to the new realities.

3.3.2. Priority Matter 2: Ecosystem Imbalance

Numerous factors contribute to undermining the balance of the ecosystem, namely: global warming and greenhouse effects, and pollution. Locally, some of the major causes are rapid urbanisation, disposal of toxic waste in water bodies, soil erosion, deforestation and agricultural practises, among others. The effects of this issue are quite evident in Teresina through various events, mainly biodiversity loss, and insect, animal and plant infestations which, in turn, cause both significant public health problems and considerable socio-economic impacts.

Chapter 02 – priority matter 2 illustrated how a combination of drivers including both shocks and stresses have been among the most pressing factors behind ecosystem imbalance. These are: environmental pollution including soil and water contamination, vegetation loss driven by urbanisation processes and lack of regulations supported by enforcement measures, and wildfires which are becoming more frequent within the region and the metropolitan areas.

The following review of policies, plans and initiatives, therefore, evaluates the policy context and the underlying means and mechanisms related to these main drivers of ecosystem imbalance in Teresina. Overall, the findings of this review show that, so far, ecosystem imbalance has not been explicitly recognized as a serious matter despite its evident effects and associated risks, which are becoming more frequent such as plant and insect infestation and urban heat islands. Further, ecosystem balance is treated as a dividend of the adoption and implementation of certain policies or plans, rather than viewing it as a major issue central to building resilience and sustainability.

A number of policies and initiatives are in place, either on the national, supra local or the local level, which although do not directly aim to address ecosystem imbalance, some of their goals and targets are related to aspects of ecosystem imbalance in the city given the breadth of the scope of such policies and their cross-sectoral nature. Most evidently are Climate Change focused ones. For instance, the State **Policy on Climate Change and Combating Poverty** was adopted in 2011 by the state government of Piaui through its Secretariats and other competent bodies with the goal of creating technical and regulatory structures to develop the **State Plan on Climate Change and Combating Poverty, Environmental Conservation and Sustainable Development of Piauí**. The State government has also put in place its **Ecological ICMS** which is a tax benefit conceded to municipalities that allow a greater allocation of resources from the Tax on Circulation of Goods and Services (ICMS). The higher the number of environmental projects and actions a municipality has, the higher the revenues it can receive through this initiative. Indeed, this programme has been very useful for Teresina as the city has been receiving funds from the state government in return for the implementation of environmental and climate related policies that are annually reported to the state government.

Moreover, the 2010 **State Water Resources Plan**, which is broadly concerned with water cycle management, included strategies to strengthen state capacities for water resources management, implementing IWRM tools (such as hydrological basins plans, and state water monitoring system). It also included a programme to expand water supply, implement mitigation measures to reduce water contamination, control water demand, and introduce mitigation measures to reduce impacts induced by natural or man-made causes on water resources (reforestation of river basins, awareness raising campaigns, flood early warning systems, mapping flood-prone areas).

At the local level, Teresina is currently in the bidding process for the development of its **Climate Action Plan**, which will incorporate the construction of trend scenarios, mitigation strategies and adaptation to the impacts of climate change.

Teresina's Urban Development Master Plan, recently approved in 2020, also has the potential to address several aspects of the ecosystem imbalance through its strong promotion of a more compact urban form and development densification along transit corridors, with the aim of significantly reducing urban sprawl and its consequent deforestation and biodiversity loss.

Environmental Pollution

During the years of rapid urban growth, unregulated occupation of the riverbanks of the Poti and Parnaíba Rivers took place in the absence of adequate planning and building regulations. This brought about many clandestine connections with raw sewage in rainwater drainage pipes which have caused serious health and environmental consequences, most notably in deprived areas without basic infrastructure. Apart from the effects of the unregulated spatial expansion in these areas, the inadequate management of wastewater in the city has greatly affected the quality of the water resources, leading to serious levels of soil and water contamination in the basins. With almost 70% of Teresina's population lacking access to proper wastewater networks, individual sewage systems such as septic tanks, sinks and infiltration ditches are the only options available for the majority of the city's residents, raising concerns regarding soil, rivers and groundwater contamination.

In tackling environmental pollution, particularly soil and water contamination, multiple policies and plans are relevant namely, the **National Policy for Basic Sanitation**, approved in 2007. It established the national basic sanitation guidelines for urban areas. An important advancement in this respect was the creation of **SINISA - the National Basic Sanitation Information System**, which required the collection, processing and dissemination of information on basic sanitation, to support national monitoring of sanitation goals at national, state and local levels.

The **Municipal Basic Sanitation Plan** was adopted by the local government in 2016. It established the municipal goals for the provision of basic sanitation. For example, the plan set a target of providing 33% of the population with a sewage network by 2019. According to data collected by CRGP on basic infrastructure, indeed the 33% target was met on time. Nevertheless, as explained in chapter 2, this coverage is still below CRPT's established benchmarks for adequate coverage of wastewater network. Moreover, this limited coverage meant that the majority of people are dependent on unsustainable methods of wastewater disposal, leading to major environmental implications and health threats. Therefore, while performing well, the implementation needs significant acceleration, the thing which will require marked human, technical and financial capacities at the local level.

On solid waste management, which contributes hugely to water and soil contamination in Teresina due to unsustainable modes of waste disposal, the **National Solid Waste Policy**, adopted in 2010, represents a marked legislation in this field. Beyond merely setting guidelines for national solid waste policy, it led to the creation of useful tools, such as the national solid waste information system, where service providers must update data on solid waste management. This was important in "forcing" relevant departments to gather, process and provide information on waste management. It also obliged Municipal governments to prepare their local solid waste management plans as a prerequisite for access to national funds in this sector. The legislation further informs the basic aspects on which such plans should focus.

In response to this national law, Teresina has been regularly updating its solid waste management plan, most recently is the 2018 **Municipal Plan for Integrated Solid Waste Management**. The goal of this plan is the universalisation of waste collection and urban cleaning services. It is estimated that the total amount of investments required to meet the plan's long-term goals is around R$ 2 billion, with landfills taking the biggest share of such investments as they will require massive upgrading processes and adaptation, and closure of municipal landfill. But the plan has some inadequacies as it lacks a robust and comprehensive implementation strategy. As a result, unsustainable methods of waste disposal continue to be the case in Teresina with landfills posing serious environmental risks on ecosystem degradation.

To alleviate these risks, the municipality has undertaken a number of initiatives, such as the **Teresina Recycling Programme**, which offers 21 recycling points in the city where citizens can deliver separate waste for recycling. The percentage of waste delivered for recycling is still low, but it has been increasing rapidly in the city in recent years (the total amount doubled from 2017 to 2019). Additionally, the **Zero Waste Programme** started in 2013, through which the municipality can collect fines in cases where people throw garbage on public spaces.

It should be noted that similar to many cities around the world, some waste recycling is happening in Teresina thanks to informal waste pickers, nevertheless, when not addressed adequately, this can pose serious health risks on those involved. An initiative has been set very recently (2020) named: **Women for Climate − Recycling**. The initiative works

closely with different vulnerable groups of women and aims to support poor women working in waste recycling to improve their working conditions through the construction of pre-treatment eco points. In return, the women receive electric cargo bikes to support their collection work.

Vegetation Loss

Rapid urban expansion in Teresina meant significant loss of vegetation cover over the past 2 decades as a result of deforestation. While marked cover of vegetation still exists in the city as part of backyards, private gardens and sidewalks within private residential complexes, these are mostly private disconnected green areas with no access for the public. Also, the city lacks adequate coverage of green areas which can form connected green networks that provide integrated habitats for urban wildlife and improve the quality of life in the city.

In short, the major stressors leading to vegetation loss in Teresina are deforestation, urban vegetation loss, and inadequate green infrastructures and nature-based solutions.

On a broader level, two policies are in place, albeit not directly addressing vegetation loss within the urban area directly, are the 2015 national legislation **PAN-Brazil** and the **PAE Piauí** initiative. Both are principally concerned with combating desertification. The PAN-Brazil is more of a general law, which establishes national guidelines and mechanisms to support areas most vulnerable to drought. It has a larger area of activity in the interior parts of the state, in the semi-arid hinterland. Nonetheless, Teresina benefits indirectly from this plan as it has the potential to avoid rural migration to the capital due to the socio-economic impacts of desertification on rural areas.

On the contrary, the **PAE Piauí**, which came as a result of the **PAN Brazil** law, is a state action plan to combat desertification. In the plan, Teresina is considered within the "surrounding areas" of the North-eastern semi-arid area. Although not semi-arid, it states that 67% of the Piaui area is susceptible to desertification. Its main lines of action are focused on reducing poverty in the semi-arid region, increasing educational levels, food security, improving infrastructure for irrigation, institutional capacity building, and investing in research at state universities on adaptation to droughts, which have always been characteristic of the region.

As was mentioned earlier, green cover rates in the city are significantly low according to CRPT's established thresholds for minimum public urban green spaces. In this regard, the municipality of Teresina has undertaken a number of policies and initiatives recently however it is early to assess the extent to which they can address the problem of vegetation loss in Teresina. Below - Additional Programmes and Projects - a summary of their goals and targets is set out. It should be noted that in 2014, Teresina adopted the **Law 4555/2014**, which obliges the construction sector to plant trees in low density urban developments. In addition, Teresina adopted the **Adopt the Green Programme** in 2014, which aims to promote partnerships between the public authorities and the private sector and the third sector, for the maintenance and conservation of municipal green areas, in order to improve public spaces and preserve the environment. Evidence shows that commitment to this program was low due to the lack of incentives for the private sector and NGOs to cooperate.

Additional Programmes and Projects

Teresina 2030: Teresina Natural Based Solutions Strategies and Restructuring and creation of environmental parks

This is a local under-development project financed by the French Development Agency. It comprises several development axes, and includes the Teresina NBS Strategies and the expansion of urban green parks network. Teresina's Natural Based Solutions Strategies is an initiative that aims at piloting the use of NBS to reduce flash-floods in specific neighbourhoods in Teresina's urban area. The pilot area for this project is the southern district, where many

flash-floods are reported. Regarding the expansion of public parks networks, the municipality has two new parks under construction. An additional two park projects are currently under development, and the projects for four new ones are set to be launched for bidding within the Teresina 2030 programme.

The Municipal Afforestation Plan

While this project was approved several years ago, a number of setbacks hindered its development. The municipality obtained the first financing of the plan through CODEVASF, but the bidding process was interrupted by the state judiciary to adapt the contract to specifications required by them. The financing amounts did not accommodate such demands and negotiations reached a deadlock resulting in the municipality missing the deadline to implement the fund. The city had to seek new financing possibilities and initiate a new process to secure resources for the plan. In the last few years, the city managed to advance in a new financing possibility, within the Teresina Sustentável CAF credit programme. Six years later, the municipality finally has the plan under development and it is hoped that it will bring the Tree cadastre for the entire city and increase urban green coverage and protect biodiversity.

GEF RIDE Great Teresina

This project has already been approved by the GEF international and UNEP and is now under development. Specifically, it is currently in the phase of preparing the implementation mechanisms prior to the launch of bidding. The project has three main research outputs:

1. Integrated Urban Planning: aims at developing institutional capacities to adapt management tools for RIDE Grande Teresina, including data sharing platforms between municipalities in the metropolitan region, platforms for coordinated actions, and institutional training for municipalities.
2. Metropolitan Level Studies: Focused mainly on the Metropolitan Basic Sanitation Plan, Metropolitan Resilience Plan, Metropolitan Mobility, and the Metropolitan Drainage Plan, among other plans.
3. Environment and Biodiversity: encompasses studies on mapping threats to biodiversity and conservation strategies; studies on social and demographic changes, including migration scenarios and economic impacts related to climate change; and Heatwave Management Plan.

Some of the projects that are going to be covered by these studies are: Teresina-Timon Low Emission Zone (LEZ): a Study to optimise the use of clean renewable energy (integrated into the state wind / solar energy plan); the Urban Structuring Plan for Teresina / Timon City Centres: (Diagnosis / Action Plan Housing, Density, Built Heritage, Green Areas, Mobility, Drainage, Climate, Carbon Emissions); the LEZ Mobility (improving cycling, Teresina-Timon solar-energy water bus, Teresina-Timon electric buses); the LEZ Public Spaces (Planting 2,000 Trees along the banks of the river in addition to cycling and walking paths; Grants for Vertical Gardens / Green Ceilings; Requalification of Squares in Central Areas; LED lighting); the LEZ Climate Resilience (System for Monitoring Temperature and Air Quality and Early Warning for Heat Waves, Fires, Floods, and tropical diseases); the LEZ Built Heritage (Grants for restoration of historic buildings and Urban Art in the city centre); the LEZ Complete streets (street paving retrofit, arborisation, lighting, furniture, etc.)

Women for Climate - Urban Gardens

This project was selected by the TAP / ICLEI program for funding and is one of the sub-axes of the Women for Climate project. The focus here is on urban female horticultural workers. It aims to improve the infrastructure of urban gardens, provide guidance and support to create cooperatives, train horticulturists in agroecology and finance, develop educational campaigns and encourage diversification of production to meet the demands of the local market, and increase the production of organic food.

A Tree in My Life Project

The project has developed a website through which people can request the municipality's help on the type of plants they would like to have in their private gardens, and how to plant. Experts then provide recommendations on the types of plants people can have, with priority given to native species. Nevertheless, it was pointed out in the consultative workshops with Teresina's Resilience Committee that requests for tree removal continue to outnumber those requesting tree plantation. An issue the municipality must better address.

3.3.3. Priority Matter 3: Economic Underperformance

Teresina is the capital city of one of the least developed regions of Brazil. It has historically suffered the consequences of the peripheral nature of its location, far away or on the fringes of major national economic hubs and their spheres of influence. It has therefore never had any major strategic industries or the accompanying infrastructure. This also left the region and the city under-served by well-connected national and interregional networks of transportation and supply chains, which in turn have undermined the city's economic development and growth.

As was explained in detail in Chapter 2, the main drivers behind the economic underperformance in Teresina are: Limited business attractiveness, weak economic diversification, informal economy and reduced productivity, which together have led to marked implications in terms of low levels of employment, reduced municipal revenues. The following review will focus on policies, plans and initiatives at the national, state and local level intended to stimulate the city's economic performance.

Overall, the review shows that while a diverse portfolio of policies, initiatives and programmes exists in this respect, the majority attempt to address the symptoms of the economic underperformance rather than tackling the root causes such as weak connectivity and regional economic integration, as well as inadequate economic diversification. This will be illustrated further for each driver throughout the review.

It should be noted that the city's economic development strategies and related budgeting are set every four years as part of the **PPA/Piaui** – the state-level budgeting cycle. Each cycle starts during the second year of the mayor/governor term and lasts until the end of the first year of the next government. Accordingly, cities and states are obliged to present all their planned governmental actions and required budgets throughout the 4 years cycle. These are then approved by the legislative body. While local governments are allowed to adopt new actions outside the 4 years development plan, the allocated budget is not allowed to be spent on those additional actions that were not set in the plan. Teresina is reaching the end of the current cycle, which means preparation for the next cycle is ongoing.

Limited Business Attractiveness

Major stressors are market disconnectivity, inefficiency of local public services, and limited availability of capital and human resources.

A combination of policies and initiatives are in place, aimed at incentivising entrepreneurship in the city and attracting businesses. Most prominently is the **National Microentrepreneurs Act**, legislated in 2008. This national act covers micro individual entrepreneurs (MEI) as well as small, medium and large businesses. The incentivises offered through this legislative are certain levels of tax exemptions and bureaucratic requirements in order to facilitate the process of establishing the business.

In practice, a number of national initiatives have been adopted recently with the purpose of helping local governments to attract businesses by offering financial incentives and support, namely the 2020 **PRONAMPE**, a national programme to support micro and small businesses, and the **BNDES Small Business Credit Line**, a national credit programme initiated to manage the effects of COVID-19 crisis on small businesses.

At the local level, the **Popular Bank of Teresina** (BP), a Municipal bank that aims to offer credit lines to microentrepreneurs, is already in operation. By August 2019, a total amount of R$ 1,863,172.98 had been assigned for micro loans. The institution promotes the goals of raising income levels and generating jobs for the low-income population of Teresina.

One of the most prominent steps taken at the local level in terms of generating an environment that is attractive for businesses in the city is the **Teresina Competitiva** funded by the World Bank. This strategy focuses on the biggest value chains in the city: healthcare, construction, education, trying to understand and grasp which aspects require the municipal or state government to adjust in order to have a better business environment. Also, it tries to reduce

bureaucracy that is a burden to these businesses and seek new investments. After 2015, this has been one of the main strategies to plan the economic growth of the city.

Apart from financial incentives and support, other policies and initiatives have been set to tackle administrative inefficiency, and skills building. In the case of the former – administrative inefficiency -, the National initiative **Efficient Brazi**l was established in 2017. It brings together measures to reduce bureaucracy, modernize, and improve the provision of services to society. Among its main outcomes is the Services Portal - a platform that brings together many public services with the aim of eliminating queues, and reducing costs -; the National Digital Driver's License is a service that offers cell phones consultation; and the INSS Digital which provides social security consultation, and the extraction and scheduling of inspections. Moreover, according to this initiative, citizens are no longer obliged to present printed documents that are already in the government database. In this way, **Efficient Brazil** is seen to enable fraud prevention, reduce costs and speed up administrative processes.

The **REDESIM** is another national initiative, in place since 2007, which integrates the processes of all bodies and entities responsible for the registration, alteration, cancellation, and licensing of legal entities, through a single data and document entry point, accessed through the REDESIM Portal. The portal also integrates a set of computerised, interoperable systems that have been made available to citizens to carry out processes of registering and legalising entities. Note this platform now incorporates similar platforms on lower levels such as the state-level **Piaui Digital**, and **Teresinense Digital** initiatives.

While Piauí Digital (established in 2016) is responsible for business registration and licensing in the state, the **Teresinense Digital** 2020 aims at fully transforming municipal administrative services execution to online modes, particularly following the COVID-19 crisis. This initiative represents the full membership of the capital of Piauí to the National Network for the **Simplification of Registration and Legalization of Companies and Businesses - Redesim**. It is estimated that the new average time for opening a company would be 45 days in Teresina, an average similar to that of Rio de Janeiro, according to Doing Business. Currently, it takes an average time of 110 days to start a business in Teresina. For this initiative to become effective, internal municipal processes were revised to clearly define the competencies of the various Municipal and State actors, regarding establishing businesses.

Similar initiatives have been in place to facilitate other administrative services such as the **Construa Fácil** (Easy Building) active since 2018. It is an online system that reduces the bureaucratic procedures needed to obtain civil works licensing in Teresina. Before, the building licensing process was in-person, and paper-based. Now architects and engineers can demand the building permit in all-online modes.

In 2018, the municipality of Teresina started the process of financing the **Teresina Open Data Plan** aimed at: (1) building an integrated inventory of data that must be publicly accessible by different departments at the local government; (2) structuring the process to open data in the city (I.e. Setting clear duties and responsibilities, and workflow); (3) developing the city's open data platform; (4) training and support for data uploading into the platform. The plan is now under a bidding process.

There is a clear tendency towards digitalising municipal administrative services at different levels of the government, which has the potential to massively facilitate business operations, especially at the local level. Nevertheless, more efforts are needed to ensure the full integration of such services and avoid potential fragmentation and work in silos.

As for the promotion of skills building, a number of local plans and initiatives have been taking place. Most obviously is the establishment of the **Professional Training Programs at FWF** which is a local department with the function of training and qualifying the workforce in Teresina. It offers several professional training programmes such as "**Professionalize Teresina, Professionalize Women, My First Job Program**". The skills offered varies, from ICT courses (including software), hairdressing, event organisation, digital media marketing, secretariat, cell phone maintenance, etc. In 2019 the department trained more than 2700 people in the city. **Professionalize Women** offered 14 courses to 294 women, including building painting, cell phone maintenance, social media marketing, cooking, handicrafts, etc.

The **Commercial and Creative Technology** project, initiated in 2020, aimed at training, financing and monitoring small entrepreneurs to use technological and communication resources and tools to publicise their products and service and

make sales. The project's actions aimed at reinserting and developing business support mechanisms to adapt to the new situations implied by the COVID-19 Pandemic.

On a more spatial micro scale, the **Empreende Bairro Project** (Community Entrepreneur Project) was established in 2019. It aims at training the neighbourhood entrepreneurs to strengthen the neighbourhood's economy, generate wealth and increase employment.

To address the COVID-19 impacts, **Active Teresina** (COVID-19 Economic Recovery) was adopted recently to create a policy for the recovery of the city's economy. The policy sets out a path to provide institutional support for companies to help them identify credit solutions, develop new products, services and administrative strategies, and build f new partnerships to promote research and technological innovation.
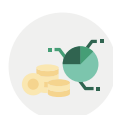
Weak Economic Diversification

The weak economic diversity in Teresina is ascribed to multiple issues, namely weak regional connectivity, weak business attraction, lack of skilled human capital, weak development and growth management strategies, and lack of loans and entrepreneurs. The interest rate in Brazil now is high in comparison to other countries despite the recent reductions in inflation rates. According to many observers, both the state and municipality have been unsuccessful when designing economic development strategies.

The review in this regard shows that although several policies and plans have been adopted across different levels of the government, there is a clear lack of a comprehensive strategy at the local level to directly address the issue of economic diversification in the city.

At the national level, the **Industry 4.0 Action Plan** was adopted in 2019 and is a strategic plan to guide the actions of several institutions at the national level for the promotion and structuring of industries. The plan is translated to the local level through the programmes of different locally active agencies such as the local office of the industry federation, or the business support service. For the state of Piaui, there are 63 mapped initiatives that can be checked here: **www.mapeamento40.mctic.gov.br/#/map-iniciativas**

At the Supra-Local level, in 2016 the **Piaui 2050** - a State-level Economic Development Plan - was adopted. The plan includes several elements related to economic development in Teresina. Particularly, Teresina is placed within the opportunity areas of investment for Tourism (business-related), and Non-Metal Mining and Infrastructure. This is seen to be aligned with the 2011 **Integrated Development Plan for Sustainable Tourism (PDITS)** in Teresina.

At the local level, the **Municipal Governance Program** (CAF) initiated in 2018, is an initiative that comprises a training programme for civil servants in the fields of Public Innovation, Open Government, and Urban Resilience. It is currently in the process of processing a consultancy to carry out training.

In addition, **THEch Programme**, active since 2018, is an innovation hub aimed to foster IT business, and support innovation in the municipality. It is implemented under a PPP scheme. More specifically, the creation of the Teresina TEch Programme came to foster entrepreneurship, innovation and the production culture, as well as to promote research, teaching and institutional development to carry out studies and to support activities for the municipality of Teresina. The municipality of Teresina is the major actor in enabling the work of this hub through the optimisation of the **Innovation Programme** of its Municipal Secretariat for Economic Development and Tourism (SEMDEC) and the execution of Softex. THEch is divided into 5 main axes: THEch Maker, THEch Valley, THEch Educação, THEch Startups and THEch Investments. Targeted groups are young people who develop applications, and open startups, with the objective of transforming the city into a storehouse of innovative projects in several areas, and the creation of a technology space at Praça Ocílio Lago.

Reduced Productivity

While reduced productivity is normally driven by diverse economic and social factors shaped by existing fiscal and regulatory policies, at the local level additional factors, namely urban mobility, have the potential to exacerbate low productivity. This is particularly relevant in Teresina. Therefore, as can be seen in the polices, plans and initiatives displayed below, there is a clear focus on addressing mobility issues in Teresina.

It should be pointed here that one of the most influential policies in this respect is the **National Urban Mobility Policy** which was legislated in 2012. This national Policy made it mandatory for municipalities with more than 20 thousand inhabitants to have an urban mobility plan, with priority to active and more sustainable modes, and the prioritisation of public mode over motorized private ones. Currently, having an approved mobility plan is a condition for accessing national resources in the sector.

A number of initiatives at the national level were adopted to support the funding and financing of mobility plans on local levels, most prominently the **Advancing Cities – Mobility** initiative, approved in 2017. Under this initiative, Teresina made 2 proposals: The Mobility Plan Revision, and the City Centre Streets Retrofit. Neither proposal has been selected for funding so far; however, the city has been able to secure funding through other mechanisms. In addition, the national programme of **REFROTA** was adopted in 2017. It is a credit programme that aims to facilitate financing for private operators to upgrade the urban bus fleet. Indeed, many operators in Teresina have benefited from this programme since its foundation.

At the local level, Teresina was awarded the **Euroclima + Innovation for better Mobility** in 2018 by the EU/DEVCO fund. The programme focuses on promoting innovative practises by bringing technology and social participation closer together to improve public transport quality and ridership. At this point, the project has produced a diagnosis of public transport, and the mapping of various technologies that can contribute to solving the problems raised by research, surveys and public consultation workshops. The next step is an open innovation contest to develop pilots for solving these problems.

Moreover, Teresina started the operation of its **INTHEGRA BRT System** in 2018. However, the full operation of the system is now suspended due to the COVID-19 crisis. This operation highlights issues regarding the adaptive capacity of the system to cope with such a crisis, suggesting the need for serious revision of how the system is operated.

Currently, **Teresina's Sustainable Urban Mobility Plan** is under development. The programme works on several axes, and seeks to improve the economic, social and environmental development of Teresina, aiming mainly at improving mobility, urban-environmental qualities, and improving municipal management. The programme is funded by CAF. Among the various anticipated interventions are the Via Sul avenue and the urban requalification of degraded areas in Vila da Paz, the 2nd phase of the reform of the Central Market, the fossil forest park, with the construction of the Palaeontology Museum, and the elaboration of the project and investment in the Teresina cycling system, among other works and actions.

Furthermore, Teresina was selected to be one of the cities benefiting from the 2019 **IDB/Brazil DOT Technical Cooperation programme**. The aim here is to provide the department of urban planning with the technical skills to improve plans and policies towards Transit Oriented Development strategies. The technical cooperation provided is channeled through capacity building in the form of workshops and training events.

However, the city lacks an adequate integrated assessment of logistics infrastructure. The city is currently developing a PPP framework for a new airport since the expansion of the current one is constrained due to its location, and the city has not been able to make the case for funding a new one through the national government.

The above review indicates that there is a clear absence of policies and strategies to address the issue of the informal economy, which is considered significant in Teresina and has resulted in serious socio-economic implications in addition to its impacts on municipal public revenue. Nevertheless, several initiatives are in place in the city to address the municipal public revenue shortcomings, albeit not addressing the informal economy. Most prominently is the 2015 "**Gestão Cidadã**" Programme, which is still ongoing. The programme aims to optimise expenses in all the municipal agencies of Teresina to overcome the effects of the national economic crisis and the consequent dropping of national and state level financial transfers to the local authorities. The Programme comprises 149 actions proposed to optimise spending and maintain the City's financial balance. The programme now focuses on recovering the municipal finances in the aftermath of COVID-19 crisis.

Some of the actions that the city has adopted to optimise municipal spending is the **Colab Teresina** initiative. It is a framework+app for citizen collaboration and monitoring. Through the Colab app, citizens can notify and open requests to the municipality (example: pavement holes, non-functioning lighting, garbage on the street, not operating services, etc). The app opens a formal request (with an ID) through which citizens can check the progress made on their request. Also, through this service, the municipality conducts public surveys, where users can answer directly through the app or its online website.

Regarding unemployment, Teresina adopted a local policy for the establishment of the **Municipal Employment Council – COMETE**. The council convenes regular meetings with several labour unions in the city to assess and approve employment related policies in the city. In 2019, the council granted tax incentives to 3 companies with estimated investments of R $ 47.3 million, through which an estimated 382 direct jobs will be generated in the city.

As was pointed out in Chapter 2, the local unemployment rate in Teresina is higher than the national rate, but lower than regional figures. Data demonstrates a greater economic vulnerability in the region, which may be more impacted by future financial crises. With the current COVID-19 crisis, in the event of a weak economic recovery, rising unemployment is a risk that must be considered.
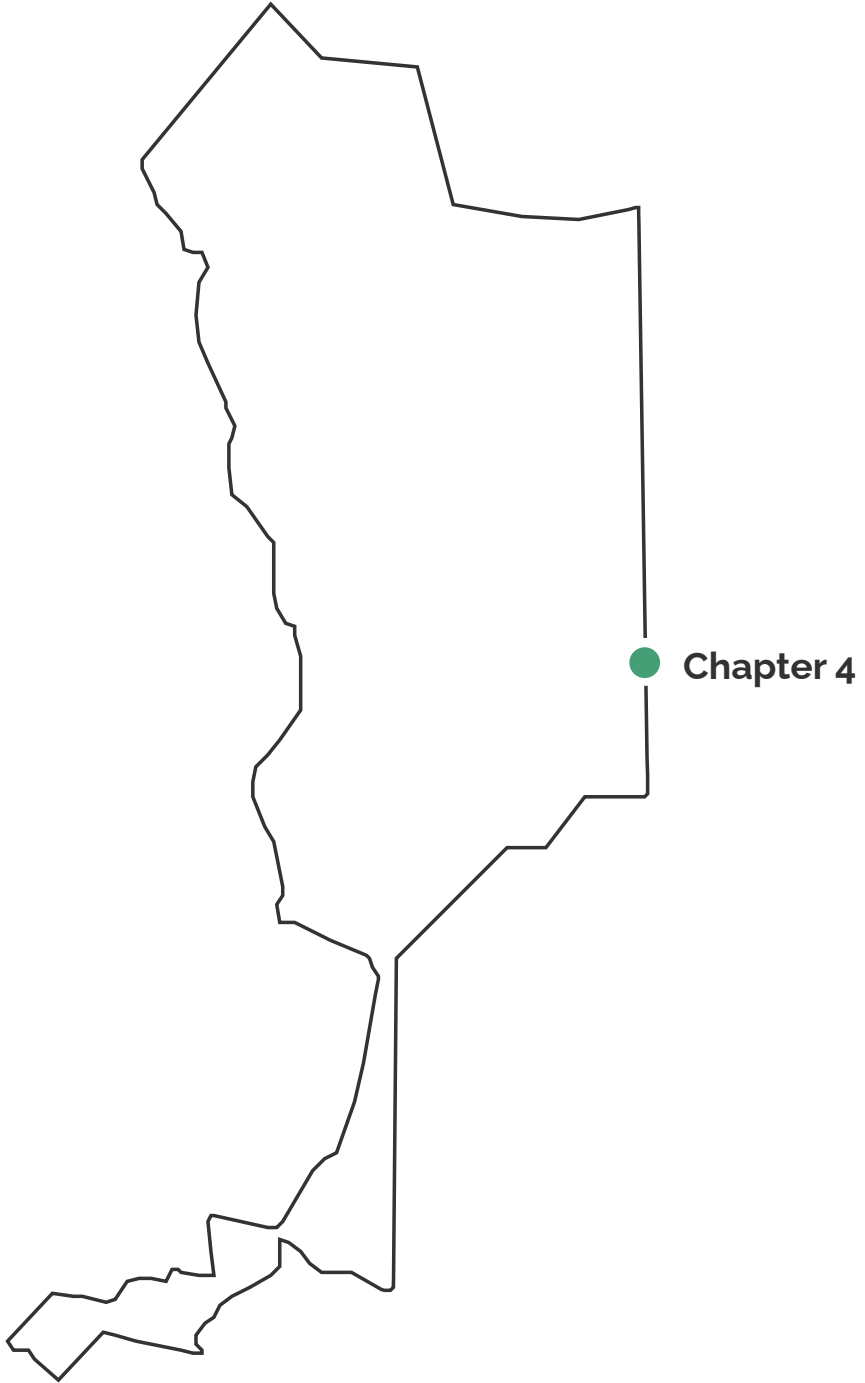
Chapter 4

Chapter 4
Synthesis & Diagnosis

Chapter 4
Synthesis & Diagnosis

This chapter brings together the findings detailed through the previous chapters of the report with the aim of outlining an integrated synthesis of findings and in an attempt to provide a diagnosis of urban resilience in Teresina by drawing on resilience characteristics as a framework for evaluation. This chapter is divided into two parts: synthesis of findings, and diagnosis. While the former provides a combined illustration of risks and constraints in Teresina, the latter evaluates urban development efforts in the city using resilience characteristics as criteria.

4.1. Synthesis of Findings

As seen in the previous chapter, there are a multitude of strategies, plans and programmes that target the stated priority matters, implying that, although many are very recent, if properly implemented and enforced, Teresina is well underway to addressing many of its risks and some of its priority matters. The focus is therefore on the implementation mechanisms, their governance, and the extent to which they embody urban resilience principles and characteristics, rather than creating and developing new measures. Building upon the findings of the previous chapters, namely Chapters 2 and 3, the following observations are inferred:

- The Northeast of Brazil is seen as one of the least developed parts of the country. Teresina as a state capital faces not only the overall developmental difficulties of the region, but also the consequent internal dynamics that they generate in terms of migratory movements from rural areas and less developed cities in Piaui towards Teresina where access to jobs, resources and services is relatively better. This context intensifies pressure on available resources, expanding the informal economy, undermining the municipal fiscal capacities, exacerbating poverty and inequality, and triggering new risks in the city.

- In general, most of the plausible and present risks in Teresina originate in the urban system, and can be traced back to the existence of protracted vulnerabilities on multiple levels, rather than being driven by external natural factors or events. Nevertheless, ongoing climate change trends suggest that external events will increase in frequency and intensity such as heavy rainfall seasons and severe heat waves. This context Implies that while the city urgently needs to address existing vulnerabilities such as securing equal access to basic urban and social services, building and strengthening preventive infrastructures, promotion of coordinated and integrated processes of management and governance, to name but a few, Teresina also needs adaptation strategies to face the new realities posed by climate change and global events such as COVID-19 pandemic.

- The city is prioritising investment to ensure the adequate coverage of urban basic services, such as clear water provision, solid waste collection and sanitation (although relatively less progress has been made in this respect), and drainage systems, which are highly essential. However, efforts have not been adequately accompanied with strategies to ensure sustainable management, and environmentally friendly urban development and growth. For instance, most of the policies and plans reviewed in terms of solid waste, sanitation and drainage systems, lack strategies on waste treatment, landfills and wastewater plants management and the treatment and re-use of stormwater.

- Perhaps one of the major factors limiting effective response to current resilience building issues in Teresina is the multiplicity of government levels, jurisdiction overlaps, and the difficulties these pose in terms of inter-governmental coordination, especially vertical coordination. It was illustrated through many of the policies reviewed that inter-governmental coordination meant lingering development and approval processes, which in many cases resulted in missing funding opportunities or, in some other cases, dead ends. Moreover, such overlaps in Teresina have spatial dimensions where many parts of the city, especially those considered risk-prone areas along the rivers, are subject to different government level competences. For resilience building in particular, this has been very challenging as decision making processes in such areas are described as very bureaucratic and contentious in some incidences, especially those related to housing, economic development and environmental conservation policies.

- Both human and financial capacities are major constraints when it comes to setting innovative approaches for addressing urban resilience-related issues towards enabling transformational changes. While the municipality has made marked progress in narrowing its financial deficit gap by increasing the efficiency of its administrative processes, more is needed in terms of strengthening urban economic performance. To address this issue, the city must intensify its advocacy efforts at state, country and international levels towards improving the city's regional and national connectivity and economic integration.

4.2. Diagnosis of Urban Resilience building in Teresina

Urban Resilience Characteristics

The following characteristics articulate the characteristics of resilient city by describing what comprises being resilient – being persistent, adaptable, and inclusive – and how resilience can be achieved – through being integrated, reflexive and transformative.
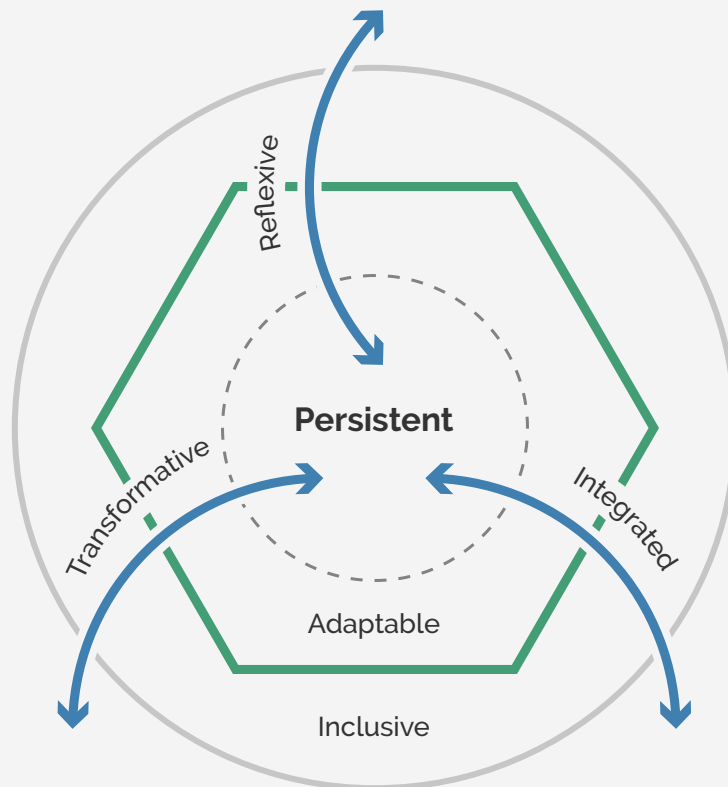
What	Persistent
	Adaptable
	Inclusive
How	Integrated
	Reflexive
	Transformative

Figure 50: Urban Resilience Characteristics. CRGP (2021).

Persistent	A persistent city anticipates impacts in order to prepare itself for current and future shocks and stresses. It builds robustness by incorporating coping mechanisms to withstand disturbances and protect people and assets. It encourages redundancy in its networks by generating spare capacity and back-ups to maintain and restore basic services, ensuring reliability during and after disruption.
Adaptable	An adaptable city considers not only foreseeable risks, but also accepts current and future uncertainty. Going beyond redundancy, it diversifies its services, functions, and processes by establishing alternatives. It is resourceful in its capacity to repurpose human, financial, and physical capital. It pursues a flexibility that encourages it to absorb, adjust and evolve in the face of changing circumstances, dynamically responding by turning change into opportunity.
Inclusive	An inclusive city centres on people by understanding that being resilient entails protecting each person from any negative impact. Recognising that people in vulnerable situations are among the most affected by hazards, it actively strives towards social inclusion by promoting equality, equity, and fulfilment of human rights. It fosters social cohesion and empowers comprehensive and meaningful participation in all governance processes in order to develop resilience.
Integrated	An integrated city appreciates that it is composed of and influenced by indivisible, interdependent, and interacting systems. It combines and aligns many lenses to ensure input is holistic, coherent, and mutually supportive towards a common cause. It enables a transdisciplinary collaboration that encourages open communication and facilitates strategic coordination. It supports the collective functioning of the city and guarantees far reaching, positive, and durable change.
Reflexive	A reflexive city understands that its system and surroundings are continuously changing. It is aware that past trends have shaped current urban processes yet appreciates its potential to transform through shocks and stresses over time. It is reflective, conveying the capacity to learn from knowledge, past experiences, and new information. It also learns by doing and instals mechanisms to iteratively examine progress as well as systematically update and improve structures.
Transformative	A transformative city adopts a proactive approach to building resilience in order to generate positive change. It actively strives to alleviate and ultimately eradicate untenable circumstances. It fosters ingenuity and pursues forward-looking, innovative solutions that over time create a system that is no longer prone to risk. A transformative city is focused and goal-oriented towards a shared vision of the resilient city.

It is evident that there is a continuing concerted effort to build up the **persistence** of the city – ensuring that anticipated risks have been assessed, prepared and accounted for, and the related systems are made more robust in terms of water cycle management and some extent for maintaining the ecological balance. These involve various programmes and projects from the national to local levels on different stages of completion, though the challenge of implementing these measures, many of which require significant financing and technological solutions, and extensive cooperation among various actors, remains. Such efforts are not evident in the case of economic performance as the city remains highly vulnerable to financial shocks due to inadequate economic diversification and regional connectivity.

The city is gradually, albeit slowly, **adapting** itself to some challenges posed by its location and context, through multiple legislations and plans, either recently approved, or under development, such as investment in climate change adaptation strategies, Nature-Based Solutions, and building strategic partnerships with state, national and international actors to secure funding for addressing this matter and the encountered technical and financial barriers. But the process is described very slow and inadequate to cope with ongoing changes.

In tackling water cycle mismanagement, the city recognises the essence of **inclusive** distribution of resources and access to service in reducing pressure on the natural system and alleviating vulnerabilities in the city, it therefore gives particular attention to services provision and increases access to land and housing. Nonetheless, to ensure more

inclusive development, the city needs to further promote active public participation in decision making, which requires strengthening the civil society and third sector and provision of incentives to ensure active participation especially by the most vulnerable and in risk population. As for economic performance, ensuring inclusive development entails significant efforts towards the integration of the informal sector in the city and addressing employment rates, an aspect that has not received enough attention yet.

Integrated processes of management and governing, and inter-departmental coordination, are well underway on the municipal level through a number of recent programmes and initiatives aimed at improving financial resources and administrative processes efficiency and increasing the city's attractiveness for businesses. Such efforts are lacking on vertical levels of governing (between the municipality, state government and national government). This issue poses major challenges for the city when it comes to addressing multi-scalar issues such as environmental and ecosystem related ones or economic integration.

Perhaps these barriers to integrated management and governance explain the city's weak learning and **reflective** capacities to take stock of continuous changes in the urban system and other interrelated systems, learn from past experiences and accumulated local knowledge. This is more evident when it comes to spatial development, housing, informal economy, ecosystem degradation, among others.

Recent policies and plans on different levels of the government suggest a strong tendency towards enabling **transformational** changes in addressing water cycle mismanagement and some drivers of ecosystem imbalance. Yet the absence of clear implementation mechanisms coupled with weak human, technical and financial capacities constrain innovative approaches crucial for the realisation of such transformations. However, in regards to economic performance, while a diverse portfolio of policies, initiatives and programmes exists in this respect, the majority attempts to address the symptoms of the economic underperformance rather than tackling the root causes such as weak connectivity and regional economic integration, as well as inadequate economic diversification.
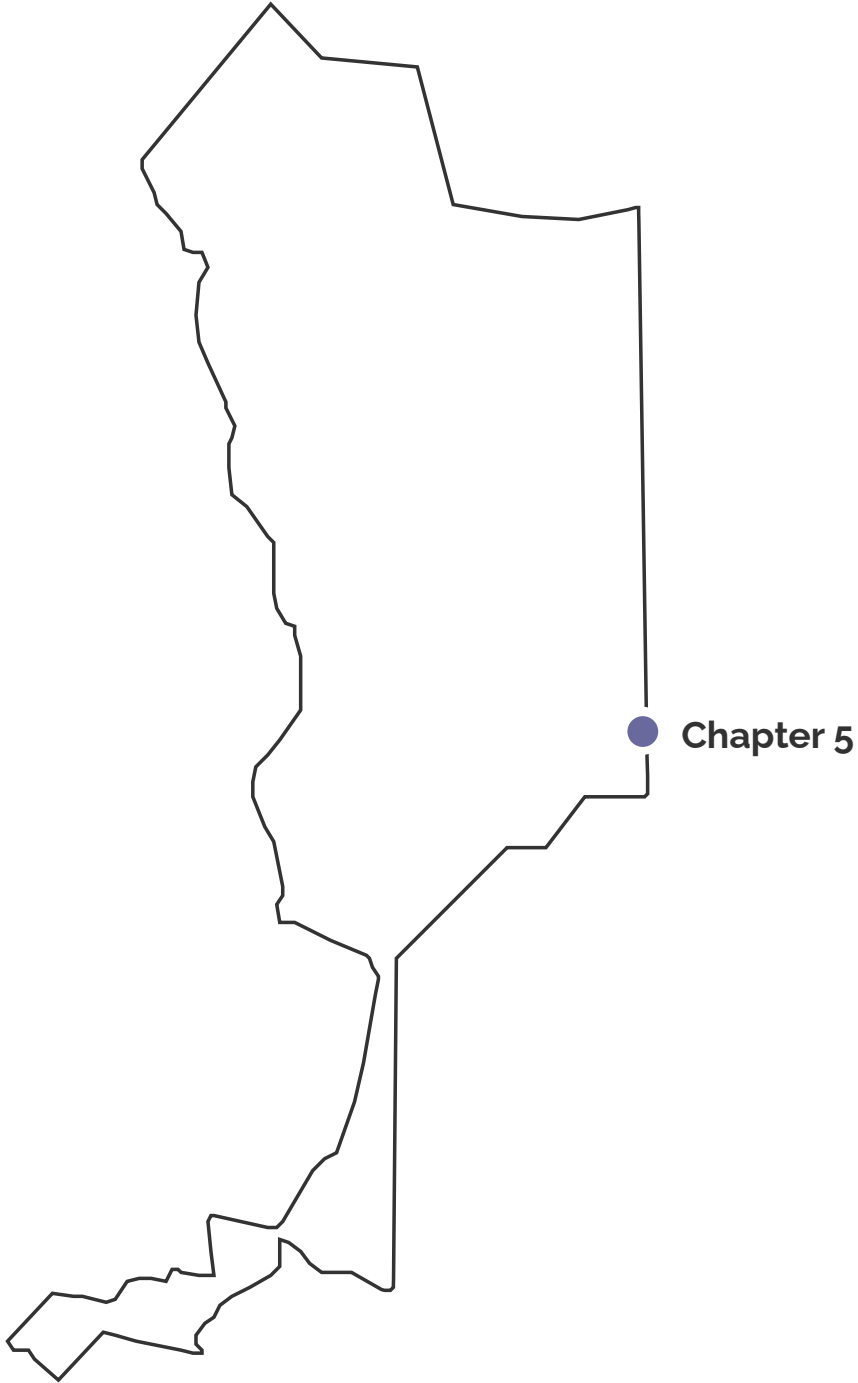
Chapter 5

Chapter 5
Recommended Actions for
Resilience and Sustainability

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From Prioritisation to Actions

The development of Recommended Actions for Resilience and Sustainability is the fruit of collective reflection among various stakeholders including local, regional, national and international actors, as well as different sectors of the government, civil society and private entities. This reflection was built on a thorough understanding of the cause and effects of risks and their drivers, the contextual factors constraining decision making and action in Teresina, and the matters that needed prioritisation and comprehensive actions. The multi-stakeholder collaboration enabled the development of a Theory of Change, focused on seeking points of intervention to maximise the impacts of the recommended actions and activities in Teresina for the 3 priority matters: Water Cycle Management, Ecosystem Balance, and Economic Performance.

These intervention points also considered the set of plans, policies, and initiatives either planned or underway that touch on these issues and influence the city's urban resilience trajectory. It also considered relevant future threats and challenges, such as the evolution of the COVID-19 pandemic, its impacts on local economic resilience, and estimated short-, medium- and long-term impacts caused by potentially dangerous climate change scenarios. In this process, the CRGP and the Municipality of Teresina held 5 workshops to discuss possible ways forward, as well as their feasibility, assumptions, and risks. As a result, CRGP experts together with the city's focal points and local stakeholders formulated lines of logical intervention, which resulted in the Lines of Action proposed below.

Finally, as studies and empirical research increasingly underline the links between place identity, people-place relationship, and increased resilience (Fried, 2000), integrating Teresina's cultural sectors in these efforts was paramount. The identity of the city, its historical relationship with the rivers, with nature, and the characteristic warmth that is part of its imaginary, cannot be neglected in the formulation of actions. For the recommended actions, this implied maintaining the essence of or generating a socio-spatial relationship that further enhances place attachment which, as many studies indicate, enhances feelings of stability, liveability, social capital, and thus social resilience.

This chapter presents the roadmap for the city to act on its priority issues by proposing activities that can bypass contextual challenges, seize the city's opportunities, and leverage sustainable development outcomes and enhance urban resilience thinking inside the local government. It brings forward the city's vision for a more resilient future, with its desired goals to address each priority issue, the path from prioritisation to effective policy making, and the Lines of Actions to deliver on these goals.

The next section is organised along the following strategic Lines of Actions:

The Institutionalisation of Urban Resilience in City Planning and Local Operations

Despite the active role of the local government in Teresina in leading the processes of resilience diagnosis and building consensus around a set of actions, there remains a risk of actions not being implemented (due to staff turnover, election cycles, etc.) as planned over the long run, unless resilience thinking is well embedded in the day-to-day work of the municipality and integrated into municipal departments policies, decision making and way of working.

Throughout the project implementation, a need to create a framework of a shared understanding of urban resilience was commonly agreed by all the stakeholders involved, including municipal departments. The aim was to implement

the actions in an effective and efficient way and sustain the municipality and local actors' commitment to the goals and objectives of this project - strengthening the city's resilience - beyond the project's lifetime.

As a main line of action, institutionalising resilience thinking and planning across the local government is comprised of a series of organisational, capacity building and awareness-raising activities, such as the formalisation of the role of the Resilience Committee and allocating the necessary resources for its tasks, promoting debates on economic development, mobility and environmental topics, and engaging the youth in the promotion of resilience thinking, among others (See section 5.1 for more details).

Improving Urban Management Mechanisms for a Sustainable Urban Development

It was explained in previous chapters that water cycle mismanagement and ecosystem imbalance – identified as priority matters - are driven by the rapid urbanisation process, the precarious basic infrastructure systems, and unsustainable development practices. In order to address and mitigate these issues, the local stakeholders and actors sought a holistic line of action centred around enhancing the sustainable urban development of Teresina.

Accordingly, three main actions were recommended which aim to promote a compact and sustainable urban form, sustainable green and blue infrastructure, and coherent urban planning and implementation. Each recommended action consists of a series of awareness-raising, capacity building, organisational enhancement, and strategic activities. Activities range from participation in international groups and programmes, the execution of training and continuous improvement programmes for the city officers and practitioners, the creation of a fund for the capture and management of land value gains, the execution of Transit Oriented Development programmes, to the creation of a single agency to coordinate the different aspects related to the water cycle management, to name but a few (see section 5.2 for more details)

Building Strong and Resilient Economy

Unemployment, low productivity, weak market connectivity and lack of economic diversity were all identified as factors driving the economic underperformance in Teresina. In order to address this priority issue, which has been exacerbated by the COVID-19 pandemic, a third line of action was agreed upon to focus on building a strong and resilient local economy.

This line of action is broken down into four recommended actions that, respectively, aim to finance economic development, enhance urban mobility management, promote city-rebranding for enhanced investment attraction and innovation, and enhance access to markets and opportunities. Each recommended action comprises a series of awareness-raising, capacity building, organisational adjustments, and strategic activities, such as staff capacity building for increased municipal revenue, the creation of a Local Mobility Agency for Operations, enabling City-to-City cooperation, the creation of a Local Economic Development Agency (LEDA) for territorial marketing, the creation of a committee to gather different stakeholders to work around science, technology, innovation and education, promoting innovation in the city, and the integration of the informal sector.

5.1. The Institutionalisation of Urban Resilience in City Planning and Local Operations

The rationale

A resilient city adapts and transforms positively by taking on an integrated approach to addressing the issues limiting sustainable and resilient urban development, by being inclusive in its processes and reflective about past experiences and responses. The Diagnosis of Urban Resilience in Teresina shows that the city has started its journey towards sustainability and presents several policies, plans and initiatives aimed at adapting to future threats and increasing awareness of challenges such as climate change. However, this diagnosis observed the persistence of barriers to implementation of these policies in an integrated and holistic fashion.

Such a holistic approach requires a shared understanding of the complex issues encountered in Teresina, and consensus building around the actions to be taken, among the various sectors within and outside the local government, including the private sector, civil society and the wider public. Although Teresina's municipality promotes and incorporates mechanisms for public participation, the city needs to expand current efforts towards a model of greater partnership with civil society, academia, and the private sector.

A prerequisite for a broader engagement and partnership is a greater awareness within the local government and among external actors of the localisation of the sustainable development goals and the understanding of the environmental-spatial-economic nexus. This includes understanding how current patterns of urban development negatively influence urban mobility, local economic development, access to jobs - especially the most vulnerable sectors - magnify risks, such as flash floods and landslides, and reduce the efficiency of municipal public services delivery.
Integrated governance for resilience through inclusive decision making and broad engagement of various actors can enable the city to be reflective - an essential feature of resilient cities. A reflective city understands how development phenomena shape the present and future, and draws continuous learning from past experiences, the adopted actions, the knowledge shared by diverse partners, the data produced, and the feedback generated, to systematically update and improve its processes.

Enabling these resilience features in Teresina would enable the institutionalisation of resilience thinking within and outside the local government, ensuring the continuity and sustainability of this way of thinking beyond the lifespan of a single project, an election cycle, or actor turnover.

Line of Action 1
Institutionalising Resilience Thinking inside Local Government

Inputs	Short Term Outputs	Med-Term Outputs	Mid-Term Outcomes	Long-Term Outcomes	Impact Goals
→	→	→	→	→	→
Strengthen cross-sectoral Resilience Commission	Higher degree of Urban Resilience Policy Institutionalisation	Enhanced Technical Capacities	Enhanced support for the ecosystem approach	Increased social level of environmental awareness	Strengthened community resilience

Inputs →	Short Term Outputs →	Med-Term Outputs →	Mid-Term Outcomes →	Long-Term Outcomes →	Impact Goals →
Training and continuous improvement programmes	Increased Cross-sectoral debate	Enhanced Financial Capacities	Improved Municipal Services and Urban Infrastructure in priority areas for urban resilience	Adequate Green Infrastructure and Policies	Improved Water Cycle Management and Reduced Associated Risks
Awareness raising strategies	Enhaced access to Knowledge-sharing Platforms	Enhanced Support for resilience-related policy adoption	Reduced Inneficiencies in Local Public Services	Incentive for local economic development	Climate Resilient Urban Environment
Comprehensive strategy municipal international action	Enhanced Access to Financing Mechanisms		Responsive, inclusive, participatory and representative decision-making at local level	Improved management of Urban Metabolism	More balanced ecosystem
				Increased local revenues and improved public spending	A more resilient and strengthened economy

The activities listed here anchor the city's strategy around the principles of urban resilience adopted by the UN-Habitat CRGP programme. They are anticipated to facilitate coordination between the various sectors of the city administration to progressively build a systemic approach for resilience. They also aim to improve governance processes, consolidate the local government's and actors' ownership for resilience building efforts and actions, and support the implementation of the city's resilience strategy. Furthermore, they aim to ensure the engagement of multiple stakeholders by creating spaces for dialogue, awareness raising and collaboration.

The decision to create the Local Resilience Commission proved to be valuable for the processes of diagnosis, reflection, prioritisation of issues and co-production of the Actions for Resilience. Therefore, this line of action (institutionalising resilience thinking) builds on the successful experience and aims to extend the role of this commission towards a permanent basis, representing an organisational improvement in the municipal administrative structure.

The municipal administrative structure needs not only organisational adjustments, but also better technical capacities at different stages of the policy cycle - from planning to execution, and post-implementation evaluation. Thus, enhancing the capacity of municipal technical staff is deemed fundamental for enabling a shared understanding of urban resilience and its principles, as well as the priority matters. For the proper implementation of these actions, it is also necessary that awareness is raised among external stakeholders, the private sector, and civil society, in addition to improving these actors' technical skills, all of which interact with the public administration, and are co-responsible for spatial development and can trigger civil action for sustainable and resilient development.

In terms of raising broader societal awareness, the municipality must broaden and structure its communication with society. In this dimension of awareness raising, it is necessary to promote high-level debates about the links between priority issues and the municipality's urban development pattern. This aims to overcome barriers and resistance to new ways of building urban spaces, favouring a more compact city designed for all people, rather than a sprawling city, inconsiderate of future risks, and reliant on unsustainable modes of transportation.

The city hall should also diversify and stimulate an increase in the number of events, seminars, and symposiums on the fundamental aspects for local urban resilience, as well as strengthen the role of the youth in the reflection on public policies, proposing initiatives and communications towards meeting the sustainable development goals.

All these actions must be unified under a narrative that associates the city's unique identity, its cultural traits and relations between humans, nature, and the built space, and the current risks and future challenges that climate change may impose on the city and its inhabitants.

Proposal Overview

Recommended Action	Inputs for Actions			
	Strategic Activities	**Organisational Adjustments**	**Capacity Building**	**Awareness Raising**
1. Mainstream resilience thinking and considerations across local policies, decisions making, projects and activities.	**1.1** Set up a comprehensive strategy for International municipal action.	**1.2** Institutionalise the role of the resilience commission to foster cross-departmental and cross-sectoral efforts around resilience building and RAR-S implementation.	**1.3** Continuous training and capacity development programmes for private entities and stakeholders to enhance their technical skills, operations, and resource management towards more sustainable outcomes.	**1.4** Strengthen the role of youth in innovation and advocacy for resilience and climate change adaptation. **1.5** Promote high-level debates for discussing economic development, mobility, and environmental nexus. **1.6** Public awareness raising through campaigns, conferences, symposia, etc.

Recommended Action 1:
Mainstream resilience thinking and considerations across local policies, decisions making, projects and activities

Capacity building for urban resilience in Teresina builds on pre-existing public policies, as the city has already taken important steps towards institutionalising urban resilience for sustainable development. This action then proposes to complement a policy that is already under implementation, incorporating activities identified as opportunities to improve it.

In late 2015, the city enacted its local Agenda 2030, a multi-sectoral programme that points out priority axes and actions agreed upon with society for a more prosperous, inclusive, fair, and sustainable future. Continuing this process, the municipality has structured a strategy to institutionalise the Agenda 2030 from Global to Local, and Local to Global, through the Department of Agenda 2030. This Department is responsible for localising global development and sustainability agendas such as the 2030 Agenda and its SDGs, the Paris Agreement, the Sendai Framework, the New Urban Agenda, among others, and strengthening them in a transversal manner across various sectors within the local government. It is also responsible for the expansion of partnerships and cooperation for sustainable development, to overcome technical and financial capacity barriers.

Nonetheless, to strengthen the implementation of the wider framework of recommendations proposed in this RAR-S, a systematic approach is crucial. The role of the Municipal Resilience Commission, coordinated by the Department of Agenda 2030, needs to be organised, strengthened, and widely promoted through dialogues, workshops, events and innovative forms of collaboration with diverse actors, and with special attention to those in vulnerable groups and the youth.

Inputs for Action

Activity 1.1

Set up a Comprehensive Strategy for International Municipal Action

Dimension: Strategic Activities

International municipal action has grown and strengthened as a means of connecting local governments to additional capacities to better develop and implement policies, provide technical assistance, expand investment possibilities, and increase the attractiveness and competitiveness of their cities. For this reason, in contexts of scarce resources such as the city of Teresina, international action cannot be considered a luxury. It should be seen as a mechanism to increase urban resilience by leveraging spaces of learning and opportunities, and creating robustness for local capacities.

To reap the benefits of international cooperation, and to include it in the city's development framework, it is necessary for the international relations of the local government to have an adequate perspective of impact and sustainability, defined in a strategic plan. The city of Teresina has recently started its engagement in transnational municipal networks and international cooperation, however, international activity should shift from being solely isolated and pilot projects to a strategic public policy connected to local strategic planning. Hence, this process should be organised in a single strategy, which guides and organises these activities towards agreed outcomes for urban resilience, sustainability, and increased resource efficiency.

What	Set up a comprehensive strategy for international municipal action that streamlines the city's international cooperation efforts towards common development goals.
Why	Municipal international action can be a mechanism to increase urban resilience by leveraging spaces of learning and opportunities, and creating robustness for local capacities. In order to take full advantage of international cooperation and to institutionalise it in the city's development framework, it is necessary to define a strategic plan, which will establish an expected perspective of impact and sustainability.
How	1. Elaborate an internal diagnosis, including mapping of internal actions, affiliations to networks and focus groups, current internationalisation initiatives, international partners, ongoing cooperation, areas of demand and opportunity.
	2. Analyse the external context, mapping possible partners, accessible areas of cooperation, axes of opportunity, cooperation, and funding.
	3. Identify local priorities and define a strategic vision for the future.
	4. Instrumentalise the international strategy by adapting institutional frameworks and processes, observing regulatory frameworks and allocating resources.
	5. Showcase the city's strategy inside and outside the city administration, raise awareness among key players and the population, and report the results of international action.
Who	**Lead stakeholder:**
	• SEMPLAN/EMARI.
	Supporting actor:
	• SEMPLAN/SECREM.
	• SEMPLAN/Agenda 2030.
	• SEMCOM.
Deliverables	**Short-term:** A developed and integrated municipality-wide strategy for enhancing international cooperation.
	Medium-term: Reduced duplication of efforts and channelling of different resources and strategies to deliver a more robust impact for the localisation of global agendas. Enhanced North-South, South-South and triangular regional and international cooperation on (access to) science, technology and innovation, and enhanced knowledge sharing. Improved access to cooperation and financing mechanisms for resilient and sustainable development.
	Long term: Secured additional resources both financial and technical to implement the city's strategy for urban resilience and sustainability.

Insights from CRGP Partner Cities

Department of International Relations, Barcelona City Council, Barcelona, ES

The Barcelona City Council has a specific department to promote the city's participation in international actions, the Department of International Relations, in order to build knowledge related to the municipal government's operational priorities such as social and global justice, diversity, the plural economy, environmental transition and active citizenship. Among other contributions, the Department of International Relations developed the International Relations Master Plan 2020-2023, which aims to advance the city as a global player by underlining a series of strategic goals that combine local demands with the principles that sustain the 2030 Agenda (Fives Ps), and how they can be achieved through different international actions.[41]

Figure 51: Barcelona, global city" International Relations Master Plan 2020 -2023. Source: Ajuntament de Barcelona (2021).

Activity 1.2

Institutionalise the role of the resilience commission to foster cross-departmental and cross-sectoral efforts around resilience building and RAR-S implementation

Dimension: Organisational Adjustments

The resilience commission played a key role in the resilience diagnosis and the development of actions in terms of providing sector-specific expertise as well as in connecting a broad variety of stakeholders together around the priority matters. These efforts and the enhanced capacity that the commission gained during this project should be harnessed by formalising its role as an inter-departmental body for dialogue and decision making around resilience.

This formalisation should pave the way for the establishment of a permanent body or council for urban resilience with a bi-annual plan of activities focusing on new and emerging priority issues to be addressed, and following up with the RAR-S through monitoring and evaluation.

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[41] Ajuntament de Barcelona (2021).

What	Institutionalise the role of the Resilience Commission to foster cross-sectoral work around resilience building and RAR-S implementation.
Why	Institutionalising urban resilience demands a holistic approach, considering all urban systems and their interdependencies. In order to institutionalise resilience thinking inside the local government it is important to consolidate the Resilience Commission as a permanent Council for Urban Resilience.
How	1. Discuss with the Resilience Commission the role it is expected to play in the future, the best frequency of meetings so it remains relevant, the types of activities that will be relevant for institutionalising climate and urban resilience thinking, the roles that its members will play in these activities and in the implementation of the Recommended Actions for Resilience and Sustainability. 2. Develop a proposal for a bi-annual calendar that organises the Resilience Commission's agenda, activities, frequency of meetings, themes, events, and monitoring systems for activities. 3. Designate officers responsible for the different activities and monitor, from the commission's coordinator, the follow-up of these activities.
Who	**Lead stakeholders:** ● Resilience Commission. ● SEMPLAN/Agenda 2030.
Deliverables	**Short-term:** Formalisation of the role of the resilience commission in the municipality, including its bi-annual programme. **Medium-term:** Implementation of the Recommended Actions for Resilience and Sustainability in Teresina. **Long-term:** Institutionalised long-term resilience thinking inside local Government, the integration of resilience thinking and resilience considerations and concerns into municipal departments' policies and decision making. Increase policy alignment across all sectors with the principles of urban resilience and sustainable development.

Activity 1.3

Continuous training and capacity development programmes for private entities and stakeholders to enhance their technical skills, operations, and resource management towards more sustainable outcomes

Dimension: Capacity Building Activities

One of the key issues raised during the workshops is the local private sector's reduced capacities to deliver sustainable alternatives in construction works and projects. It is also necessary to increase the degree of sensitivity, knowledge of the subject, and capacity of the companies and their workers who collaborate with the administration.

The local government should play a leading role to leverage skills through its urban laboratory to foster the technical improvement of the local private sector towards a green economy. Given that the result of these actions and the economic benefits are not immediately perceived, it is necessary for the administration to promote and lead continuous training programmes that increase the degree of general training in environmental matters in the private sector.

What	Continuous training and capacity development programmes for private entities and stakeholders to enhance their technical skills, operations, and resource management towards more sustainable outcomes.
Why	There is a need to increase the degree of sensitivity, knowledge of the subject, and capacity of the companies and their workers who interact with urban development. The administration collaborates and contracts private companies to execute various programmes and actions constantly and these companies and their workers must have the best training available to improve the results of the services they offer. Given that the result of these actions and the economic benefits are not immediately perceived, it is necessary for the administration to promote and lead continuous training programmes that increase the degree of general training in environmental matters in the private sector.

How

1. Organise and coordinate a unit or appoint a coordinator within the Municipal Department of Human Resources.
2. Organise a dialogue with the private sector and companies, such as a forum or advisory group on training.
3. Analyse and define the lacking capacities, based on surveys and accumulated experience in relation to the contracted services and works.
4. Develop the programme in collaboration with the private sector, identify and contact the participants and jointly establish the training actions.
5. Develop the programme in collaboration with external entities and experts, identify and contact the experts and external entities, jointly prepare the training actions methodologies, development, and objectives.
6. Launch the Training and Continuous Improvement Programme.
7. Assess the results of each training programme and action, internally and in collaboration with third parties.
8. Promote an annual global evaluation of the programme results.
9. Define new annual collaboration and training programmes.

Who

Lead stakeholders:

- SEMPLAN/SECREM;
- SEMPLAN/ Agenda 2030.

Supporting actors:

- Lagoas do Norte;
- SAADs;
- SEMA;
- SEMDEC;
- SEMDUH.

A unit or coordinator must be established from the Municipality of Teresina, but each training action must be coordinated and consulted with the corresponding municipal department.

Deliverables	**Short-term:**
	Launch of the Training and Continuous Improvement Programme.
	Medium-term:
	Increased capacity and improved technical skills of partner private entities and companies, as well as of their executives, professionals, workers, and technicians, on environmental matters. Enhanced support for ecosystem approach.
	Long-Term:
	Improved delivery of adequate municipal public services, as well as of their concessionaires, permission holders, and private sector agents, aligned with a resilient and sustainable envisioned future. Increased delivery of adequate green infrastructure in the city.

Activity 1.4

Strengthen the role of the youth in innovation and advocacy for resilience and climate change adaptation

Dimension: Awareness Raising Activities

Major global challenges, such as climate change, cybersecurity, and the post-COVID-19 economic recovery will, above all, affect the prospects of the next generations. However, the youth still have a limited role in the formulation of public policies within the government sector. According to the OECD[46], in more than half of the organisation countries where data is available, young people are less likely to have a say on what the government does than older people.

On the other hand, this same group has great capacity for agency and innovation, and enhanced skills to operate in networks and incorporate new technologies in their daily activities. Enhancing youth participation in decision-making processes and in communicating with their peers in society is key to building urban resilience, long-term effectiveness, and legitimisation of public policies, and responding to local and global shocks and transformations. Moreover, mainstreaming resilience thinking across society, and bringing it forward to the general public's attention, can ensure increasing demand by the public for more resilient and sustainable urban development, supporting the government to sustain initiatives and efforts in this regard, while legitimising new ones.

Hence, the local government should provide a platform to institutionalise and enhance the role of youth leadership for urban resilience inside public administration, designing programmes to support young people thrive in the public sector workforce, including inter-generational learning between older and younger generations. The city must raise the voices of the local youth to mainstream resilience in policymaking by redesigning the internship programme in local government as a youth leadership programme for urban and climate resilience in all policy sector areas.

What	Strengthen the role of the youth in innovation and advocacy for resilience and climate change adaptation
Why	Integrating resilience thinking should be a cross-sectoral and, at the same time, inclusive process, incorporating the voice of the youth to promote innovation and a new vision of public administration efforts towards a sustainable future.

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[42] OECD (2020), Governance for Youth, Trust and Intergenerational Justice: Fit for All Generations?, OECD Public Governance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/c3e5cb8a-en.

How	1. Propose a meeting with the Secretariat of Administration (SEMA) and the human resources team to check the long-term internships and the profile of interns from all secretariats; 2. Research best practices in youth leadership in the public sector; 3. Design a prototype internship for a youth leadership network for a resilient future.
Who	**Lead stakeholders:** • SEMPLAN/Agenda 2030; • SEMJUV. **Supporting Actor:** • SEMA; • Local Universities.
Deliverables	**Short-term:** The establishment of the youth leadership internship programme. **Medium-term:** Increased capillarity of the Agenda 2030 in different municipal departments to integrate urban resilience from and for a youth perspective. Increased youth leadership capacity for sustainable development in the city. Enhanced support for sustainable development policy adoption among the youth. Enhanced support for the ecosystem approach. **Long-term:** Strengthened community resilience. Strengthened innovation capacity for a resilient and sustainable future.

Activity 1.5

Promote high-level debates for discussions on economic development, mobility, and environmental nexus

Dimension: Awareness Raising Activities

The diagnosis in Teresina indicates that valuable opportunities to strengthen resilience lie at the nexus of environment, local economic development, and mobility. Therefore, it is essential to adopt a multi-sectoral and multi-stakeholder approach through which technical expertise, funds and resources are joined up, and duplication of actions and inconsistencies among these three different areas are avoided. Nevertheless, despite this strong connection and its potential impacts to enhance resilience, these three areas continue to be disconnected, and working in silos is quite common.

Although institutionalising the resilience commission represents a great opportunity to facilitate more links between these three areas, this also needs to be accompanied by forms of vertical integration within each of the respective policy areas, without which horizontal inter-sectoral and inter-departmental collaboration will prove highly challenging. This is partly due to difficulties in the use of resources and budgets beyond designated sector-specific or department-specific projects and activities.

It was widely agreed that promoting dialogue and policy debates at higher levels of the municipality, particularly at the political level, is crucial to enable collaboration and integrated approaches between these areas at technical levels, but also in planning and implementing projects.

It was also found that the civil society and the private sector have little engagement around, and thus less sense of ownership over, the benefits of mobility, land use and environmental policies in reducing disaster risks and enhancing economic development. Without a comprehensive understanding of the implications of these realities and how to address them, proper societal adherence to specific urban policies will prove extremely challenging. Hence, this high political debate should engage relevant stakeholders, as well as opinion-shapers, from civil society, private sector, and academia in setting the policy agenda and overcoming potential barriers to implementation.

What	Promote high-level debates to discuss economic development, mobility and environmental nexus.
Why	In order to achieve proper societal adherence to specific urban policies, it is necessary to integrate different stakeholders, such as civil society and the private sector, in discussions on the role of mobility, land use and environmental policies in building urban resilience.
How	1. Organise, along with the Resilience Commission, an agenda of topics for debate that include the nexus between economic development, the environment and mobility; 2. Seek out relevant third sector partners to integrate this debate network and facilitate the organisation of the sessions and contact with civil society; 3. Define a continuous and regular calendar of debates and for each thematic debate select relevant local projects to be discussed with society, stakeholders and opinion makers.
Who	**Lead stakeholders:** ● SEMPLAN/ Agenda 2030; ● Resilience Commission. **Supporting actors:** ● Local NGOs; ● Local Universities; ● Civil society.
Deliverables	**Short-term:** High-level dialogues, events and debates are held and adopted on an ongoing basis by long-term planning departments and respective councils. **Mid-Term:** Increased public understanding of the importance of mobility and land use regulations and projects, as well as environmental governance, for economic recovery and disaster risk reduction. Responsive, inclusive, participatory and representative decision-making at local level. Enhanced support for the ecosystem approach. **Long-Term:** Enhanced policy coherence for sustainable development.

Activity 1.6

Public Awareness Raising for Urban Resilience

Dimension: Awareness Raising Activities

Unpacking the complex relationship between environment and urban ecosystem, and the severity of extreme natural events and disasters to the general public is highly important in enabling cooperation between the government and society in resilience building and adapting to climate change. An adequate and continuous communication strategy can strengthen this holistic view of urban systems and the importance of maintaining ecosystem services for urban resilience, as well as increasing the sense of ownership and support for the implementation of nature-based solutions.

This action is focused on incorporating environmental sensitivity as a key element in public discourse at all levels, reaching a more general audience and trying to awaken their interest and commitment to environmental protection and conservation. In this sense, segmented messages according to the target audience can be useful while making sure that technical information is accessible for the public. To this end, press and radio campaigns, conferences and events that are open to the general public, etc. can be effective in achieving greater degrees of awareness around systemic links between the environment and resilience.

It is key that the local government works hand-in-hand with civil society and local cultural groups, and jointly formulate spaces to promote cultural activities, valuing the identity of the city, its relationship with nature, the river, as well as built spaces. Connecting awareness-raising strategies with the city's cultural identity is key to the protection of its natural and built assets, as well as intangible cultural assets. For example, traditional practices such as pottery in the North Zone are threatened by a warming climate. Incorporating these lived experiences into awareness raising campaigns by the municipality can ensure that the local government is close to and aware of the everyday difficulties of many local communities, while highlighting the extent to which climate change impacts and environmental protection are relevant in many places of the city, and for the livelihood of many communities.

What	Public Awareness Raising for Urban Resilience, including Campaigns, Conferences, Symposia, Cultural Events, etc.
Why	A resilient system ensures the preservation of life, the limitation of injury, and the enhancement of its inhabitants' "prosperity"; promoting inclusiveness and fostering not only comprehensive but also meaningful participation by all, particularly those in vulnerable situations. This approach can ensure a sense of ownership and support implementation of plans and actions.
How	1. Organise a group or unit of social communication on relevant environmental aspects; 2. Define the general and specific objectives of the programme, its campaigns and its final objective. The ultimate purpose of the programme and of each campaign will be the change (who and what needs to change) and the impact (what the change will entail) that is being sought. The end goal should be compelling, inspiring, impact-focused; 3. Identify the problem drivers and their effects (what needs to change) and how that change can be implemented; 4. Prepare an annual programme, with evaluation methodologies (i.e. surveys, assessments, indicators), including its general schedule and materials;
Who	**Lead stakeholders:** • SEMPLAN/Agenda 2030; • SEMCOM.

Deliverables	**Short-term:** An annual calendar of awareness-raising campaigns and policies is established, with a secured budget.
	Mid-term: Enhanced Support for Urban and Climate Resilience Policy Adoption.
	Long-term: Social level of environmental awareness and environmental issues placed as a key element in public debate and communication.

5.2. Improving Urban Management Mechanisms for a Sustainable Urban Development

The Rationale

Two priority matters have been identified to address the environmental challenges of Teresina. The first group is related to water cycle management: Insufficient sewage and wastewater channelling and treatment systems, driven by inadequate funds– by both public and private, and the lack of quality control systems and their application. The disruption of natural hydrological dynamics is mainly caused by urban sprawl, deforestation and soil sealing in the city.

In addressing the issue of disruption to the natural hydrological system in Teresina, the city has embarked on an important journey through the recently approved Urban Development Master Plan, which envisages a more compact Teresina, directing development around key infrastructure, conditioning development in transition regions and safeguarding crucial areas for nature-based disaster risk reduction strategies. However, taking into account the forecasts associated with the effects of climate change, it is urgently necessary to further improve the city's hydrological cycle and drainage system. Indeed, the most crucial and urgent issue to be resolved is the lack of adequate sewerage systems in most of the city. The municipality has made considerable efforts in recent years to increase the coverage rate of the municipal sanitation system from 6% to 31% of the city's total in the last decade. Nevertheless, the 31% coverage is still significantly below the global standards for sustainable, safe and healthy cities.

The second priority matter is related to vegetation loss and urban waste management – ecosystem imbalance. Vegetation loss is a consequence of the expansion, development and formal configuration of the city, its public realm, and buildings. The urban sprawl combined with the sealing of soils and the elimination of vegetation due to poorly focused urbanisation projects causes the disruption of hydrological dynamics. Furthermore, it also causes other effects such as loss of biodiversity, infestation of insects and plants, poor environmental quality of urban spaces and the increase in temperatures in the city, known as the Heat Island Effect.

It should also be noted that there are some cultural and social factors that have contributed to the progressive reduction of vegetation in the city, such as the perception of insecurity in the streets that prompts residents to request the felling of trees to reduce shady spots and dark areas.

With regards to waste management, apart from the shortcomings in the waste collection and recycling system, the environmental damage caused by landfills, the economic loss from the disposal of valuable materials must be considered. In this sense, a relevant percentage of the population still lacks the necessary awareness about the importance of the correct treatment and management of waste in all its forms. The current waste collection and recycling network lacks collection points and recycling centres. There is also a lack of general and public information on how to separate, store and deposit household waste. This results in a low percentage of recycling and recovered materials in relation to the total waste generated.

During the workshops an important issue was highlighted, which related to weak coordination between different departments, secretariats, and the different levels of government. Furthermore, the City, the State and the National Government also have different competences on the same matters. These issues have negative effects on the governance and the implementation of plans, environmental programmes, and projects.

The above priority matters are closely interrelated and therefore the response approach must be holistic and integrative. Although the city of Teresina is already implementing measures and carrying out different plans and programmes to address and solve the priority matters outlined, these efforts are often undermined and hampered by the lack of specificity in the objectives and goals, lack of general awareness, lack or insufficient professional skills of the agents involved, insufficient funds or financing, or weak administrative coordination, control, and monitoring procedures.

For example, with regard to the management of the water cycle, which includes sanitation and drainage, the competences and responsibilities are distributed among departments of different jurisdictions – from the national Government to State and City – creating complicated management circuits and structures and making coordination and decision-making difficult and slow. This administrative structure and distribution of powers has negative effects on the design, implementation, and execution of plans.

Similarly, within the municipal administration itself, planning, design, execution and monitoring of projects and plans pass through different departments and secretariats without effective coordination. At times, low awareness of the issues and problems to be solved, and existing financial and economic constraints result in cost reductions via the elimination of works, elements or aspects scheduled for implementation, the consequence is a decrease in the materialisation and execution of plans and programmes, and ultimately not meeting the objectives and expected results.

A crucial point for the implementation of policies and programmes towards urban sustainability is related to the lack of resources and financing. As mentioned previously, insufficiency or shortage of economic and financial resources often implies difficulties, delays or even cuts in the deployment and execution of plans. For this reason, it is necessary to provide and implement adequate, consistent, and sustainable funding sources and financing instruments for the implementation and execution of the proposed policies and plans.

Low awareness is also detected among various sectors, agents and stakeholders engaged with the environmental issues and challenges facing the city. Where awareness exists, some difficulties persist in relation to operationalising principles into effective measures and actions. In order to address these constraints, a number of actions and activities are crucial, namely perception and awareness; organisational coordination improvement; professional skills enhancement and training for both public and private actors; financing; monitoring the execution of plans, projects, and programmes of the city and private agents.

Line of Action 2
Improving Urban Management Mechanisms for a Sustainable Urban Development

Inputs →	Short Term Outputs →	Med-Term Outputs →	Mid-Term Outcomes →	Long-Term Outcomes →	Impact Goals →
Technical and Financial Capacities for improving of Urban Metabolism	Continous Improvement Programme for City Officers and Practioners	Integrated Ecosystem and Biodiversity in Governmental Planning	Enhanced local support for the ecosystem approach	Increased social level of environmental awareness	Strengthened community resilience
Awareness Raising for reducing Anthropogenic Factors of Ecosystem Imbalance	Production of Technical Manuals	Improved end-to end mechanisms for project design and implementation of urban plans, policies and projects	Improved Adequate Municipal Services	Adequate Green Infrastructure and Policies	Improved Water Cycle Management and Reduced Associated Risks
Capacity Bullding& Organisational Restructuring for Coherent Planning Implementation Ecosystem Approach	Constitute Fund mechanisms for Land Value Gains	Improving standards of local public services and urban metabolism management	Increased adoption of sustainable urban construction practices	Improved management of Urban Metabolism	Climate Resilient Urban Environment
Strategic Actions towards a Compact and Sustainable Urban Form	Designed joint mechanisms for urban planning, implementation and management	Limited urban sprawl and development over environmental hotspols	Increased adequate green and blue infrastructure	Conservation, restoration and sustainable use of freshwater ecosystems and their services	Sustainable use of city's ecosystems
	Proposed organisational planning framework with ecosystem and water cycle approach	Implementar planos de DOT, NBS e Estratégias de Economia Circular	Reduced Urban Vegetation Loss and Wild Fires	Mitigated impacts from Heat Islands	A more balanced local ecosystem

Inputs →	Short Term Outputs →	Med-Term Outputs →	Mid-Term Outcomes →	Long-Term Outcomes →	Impact Goals →
	Waste Recycling and Circular Economy Strategy		Reduced Disruption of Natural Hydrological processes	Reduced the environmental impact of the city	
	Development of TOD Plans and BS Strategies				

For a successful implementation of the recommended actions, it is necessary to integrate a broad array of stakeholders, mainly:

- The public sector: municipality, both at the level of officials and the organisation as a whole. This must include the other administrations with competences in different matters of the city, such as the State and the National Government, which should be integrated and invited to collaborate.

- Civil society is an indispensable element of any process of social change. Fortunately, the level of general environmental awareness is increasing. The increasingly visible effects of phenomena such as climate change, pollution, environmental deterioration, etc. are boosting awareness.

- Companies and the private sector must also incorporate environmental sensitivity into their organisations and processes. This is in their own interest given that the damages of disruptive events resulting from environmental imbalances are increasingly costly and less affordable.

- Universities and academia contribute the knowledge developed on a given subject, hereby overcoming the gap that still exists between research and the application of available knowledge.

Proposal Overview

Recommended Action	Inputs for Actions			
	Strategic Activities	Organisational Adjustments	Capacity Building	Awareness Raising
1. Shifting Towards a Compact and Sustainable Urban Form.	**1.1** Establishment of a Transit Oriented Development programme.	**1.2** Creation of the fund for the capture and management of land value gains.	**1.3** Training and continuous improvement programme for City Officers and Practitioners.	**1.4** Establish partnerships with professional associations and academia for promoting the city's master plan and innovative practises for its implementation.
2. Improving urban metabolism through green and blue infrastructure.	**2.1** Refining Teresina's urban revegetation strategy. **2.2** Development of a permeabilization and soil de-sealing strategy. **2.3** Improvement and expansion of Teresina's recycling system to reduce water and soil contamination.	**2.4** Creation of a single agency or a municipal unit for the management of the water cycle in the city.		**2.5** Establish a guided visits and tours programme to key infrastructures, sites of interest, and pilot initiatives for sustainable and resilient developments.
3. Enhanced Intra governmental coordination for coherent and integrated urban planning and implementation.		**3.1** Increase inter and intra-departmental coordination throughout the policy cycle and decision making.	**3.2** Development of urban planning and Implementation guidebook, checklist and technical manuals.	

Recommended Action 1:
Shifting Towards a Compact and Sustainable Urban Form

A compact city is dense and diverse, with a mix of uses that promote economic activity and short-distance incentives for the development of citizens' daily lives, with high dependence on public transport. There is evidence to prove that the city, insofar as it is less dispersed, contributes less to greenhouse gas emissions; lower land use reduces the warming effect (heat island effect) inside cities and allows for the protection of agricultural and environmental reserve areas for the future, in addition to obtaining other economic benefits.

Urban sprawl increases pollution and environmental risks because it encourages the use of cars and greater energy consumption in transport, construction, and extension of infrastructures. Consequently, efforts made to control the excessive occupation of land will make cities and the planet more sustainable. Teresina, after experiencing the effects of the aforementioned phenomena, legally limited the extension of the city. This decision favoured containing the extension of the city while maintaining in some of the city's already developed areas to reverse the existing effects.

A high level of urban development plays a decisive role in the existence of an advanced and accessible sustainable public transport network, easy and quick access to all kinds of basic services, workplaces, and opportunities - shops, health centres etc. There are environmental benefits to this model as well as economic effects such as the concentration of resources, capacities and knowledge, and sufficient critical mass and network effects.

Within this line of action, the following activities are proposed below.

Inputs for Action

Activity 1.1

Establishment of Transit Oriented Development Programme

Dimension: Strategic Activities

In urban planning, a transit-oriented development (TOD) is a type of urban development that maximises the amount of residential, commercial and leisure spaces within walking distance of public transport. In doing so, TOD programmes intend to increase the number of passengers on public transport, concentrate developments and urban activities along the transit corridor, thus reducing land consumption, urban sprawl, and the use of private cars and promoting sustainable urban growth. In addition, the greater attractiveness of these areas results in an increase in the value of the land that can be captured by the city to improve the quality of urban spaces. TOD programmes also imply an increase in the urban density of the areas in which they are applied. Urban compact forms save significant public spending on new infrastructure such as roads, water, drainage, and electricity, which result from urban sprawl.

The recently approved strategic master plan of Teresina, as highlighted repeatedly across this document, offers strong opportunities to prevent the unsustainable practices of urban sprawl, and reduce unnecessary alteration of natural terrain and hydrological systems, by limiting urban extensions and discarding previous laws and regulations that facilitated such expansion.

Nonetheless, innovative strategies are essential to meet the demand for new affordable housing developments and adequate urban services, which typically drive sprawl. Otherwise, implementing the recent restrictions in land consumption may fail due to high demand for affordable housing. To this end, TOD was viewed by most of the stakeholders participating in the workshops as crucial.

Teresina has already conducted a previous study for the implementation of TOD programmes in different areas of the city. They should be launched through the creation of autonomous bodies to manage their development, following the comprehensive model applied in Lagoas do Norte, which has yielded good results.

Recently the IDB presented a pre-feasibility study of the potential of TOD strategies in Teresina by analysing 3 pilot areas. They found that this model would benefit the transport sector by increasing public transportation demand, promoting the model of a compact and dense city, tackling public infrastructure challenges such as security, benefiting residents regardless of their buying power with new public spaces (parks, plazas), and promoting densification and mixed land use.

What	Establish a Transit Oriented Development Programme.
Why	Reduce the risks of disasters and enhance the city's resilience by limiting land consumption that result in altering natural terrains, and destruction of natural water systems, which in turn raise the risks of flash and fluvial floods in the city. Contribute to building a more sustainable urban form by maximising urban density, and residential, commercial, and leisure spaces near public transport corridors, consequently, reducing the use of private cars, and strengthening economic viability through the concentration of commercial land, and activities and services Greater attractiveness of these areas results in an increase in the value of the land that can be captured by the city to improve the quality of urban spaces. Saving significant public spending on providing new infrastructure for low density developments.
How	1. Create a Study Unit within SEMPLAN to define the areas of implementation of TOD programmes; 2. Create a specific administrative body for the implementation of TOD programmes in the identified areas in the aforementioned analysis. 3. Devise feasible financial instruments to be adopted to fund the TOD.
Who	**Lead stakeholders:** ● SEMPLAN/SEPLUR; ● SEMDUH; ● STRANS. For each TOD programme implementation, the department in charge will be the specific administrative body designated or created for this purpose.
Deliverables	**Short term:** A comprehensive TOD plan with identified zones, funding strategy, and designated body for the management and implementation of the plan. **Medium term:** The implementation of the ToD plans. **Long term:** Reduced urban sprawl, increased urban form compactness and densification in strategic zones and urban centres.

Activity 1.2

Creation of the Fund for the Capture and Management of Land Value Gains

Dimension: Organisational Adjustments

As highlighted in the previous activity, one of the advantages of a compact urban form and TODs is the increase in land and property values thanks to the density of urban activities, better connectivity, and ease of access to public transport. As this increase in value is the result of public investments in a particular area, land value capture policies allow a fairer distribution of benefits by capturing the increased value through levies or property taxes, land lease, among other financial instruments. The captured value is then used for the provision of urban public service, infrastructure as well as affordable housing.

In Brazil, the national legislation already stipulates the creation of a Management Fund for economic resources collected through the Outorga Onerosa (land value capture of additional building rights programmes). However, despite the fact that the Outorga Onerosa has already been implemented in some areas of Teresina, this Fund has not yet been created by the Municipality, and the economic resources raised through the application of the Outorga Onerosa have been entered into the General Accounting Fund of the Municipality. Considering the fact that the creation of this Fund is already contemplated, foreseen, and protected by the national and local legislation, the Legal Services must proceed to drafting of the legal specifications necessary for the approval and constitution of this Fund by the Municipality.

It is proposed that this Fund should be managed jointly by the following secretariats of the Municipality: SEMGOV, SEMPLAN and SEMF. Nonetheless, recognizing that Teresina, an intermediary city, is faced with many economic constraints due to its peripheral location and limited economic investments, the returns from land value capture will not be significant compared to other major cities in Brazil, and perhaps not sufficient for large-scale urban development projects. Therefore, it is proposed that at least part of the funds raised can be allocated to the communication, awareness and continuous training programmes in sustainability and urban resilience issues.

What	Creation of the Fund for the Capture and Management of Land Value Gains.
Why	This fund can be used to finance several activities that can facilitate the strengthening sustainable urban development, namely: • Training programmes for municipal staff. • Awareness-raising campaigns on sustainability and resilience.
How	1. SEMPLAN/ SEPLUR to draft the legal specifications for the constitution of the Fund for the Management of the land value gains captured through the application of the Outorga Onerosa (land value capture of additional building rights programme); 2. Seek approval by the Municipality of Teresina of the legal specifications for the constitution and implementation of the Fund for the Capture and Management of Land Value Gains, in accordance with current national legislation.
Who	**Lead stakeholders:** • SEMPLAN/SEPLUR; • SEMPLAN/Assessoria Jurídica (Legal Advisory); • SEMF. **Supporting actors:** • SEMGOV.

Deliverables	**Short term:**
	Fund for the Capture and Management of Land Value.
	Medium term:
	Secured funds for sustainable urban development strategies.
	Long-term:
	Improved skills and resources for sustainable urban management mechanisms.

Activity 1.3

Training and continuous improvement programme for City Officers and Practitioners

Dimension: Capacity Building Activities

It is essential to continually conduct awareness raising activities and campaigns to achieve optimal results. Awareness must be accompanied by a progressive and continuous improvement of the technical capacities of the different stakeholders, especially city officers and practitioners, who are in charge of either advising at the political level of the administration, planning and implementation, or evaluating and validating urban plans, programmes, and projects in collaboration with third parties (the private and third sector).

It is, therefore, necessary to establish a training and continuous improvement programme for the methodological and technical capacities of municipal staff to ensure they are up to date with latest and innovative approaches in urban planning and managing urban development. In addition, in a changing scenario like the one currently driven by the global COVID-19 pandemic, it is essential to proceed with the continuous improvement of skills and capacities. Furthermore, training is usually highly valued by employees and serves as a professional incentive and motivation.

Nevertheless, embarking on such programmes requires additional resources. Municipal departments' funds are usually linked to their respective projects and programmes. Allocating funds for activities that fall outside these projects are often difficult due to accountability concerns. For this purpose, the previous activity – the creation of the LVC fund - seeks to secure such resources. In doing so, different municipal departments will be incentivized to establish such training initiatives for their own staff and partners.

What	Training and continuous improvement programme for City Officers and Practitioners.
Why	A major bottleneck in the implementation of sustainable urban planning policies, plans and initiatives lies in the technical qualification and implementation chain from planning to execution. The municipality needs continuous staff training for optimal, up to date and innovative ways of implementation of legal frameworks from start to end.
How	1. Organise a Training and Continuous Improvement Unit within the Municipal Department of Human Resources; 2. Identify and map existing capacities and skills already within the organisation, create a map of skills within the organisation and a city officials' skills chart. Skills mapping and validation can be done through various methods: academic and professional certifications, practical tests, etc;

Como	**3.** Cross data with a map of existing skills within the organisation and prepare a training programme, with two sections: internal training actions and training actions in collaboration with external entities and professionals;
	4. Assessment of the results of each training programme and action - internal and in collaboration with third parties;
	5. Promote an annual global evaluation of the programme;
	6. Define new annual collaboration and training programmes.

Who	**Lead stakeholders:**
	● SEMA;
	● SEMPLAN/SEPLAG.
	For each training action, it must coordinate and consult the corresponding municipal department.

Deliverables	**Short-term:**
	Established continuous improvement programme for municipal Officers and Practitioners.
	Medium-term:
	Improved municipal staff's technical capacities; developed standards of local public services and their implementation.
	Long-term:
	Improved effectiveness and efficiency of planning, implementation and evaluation of urban development projects and programmes by the municipality.

Insights from CRGP Partner Cities

Guia de Valoració de Criteris de Sostenibilitat en Urbanisme, Barcelona, ES

In order to establish a set of criteria and standards for sustainability in urban planning, the Barcelona City Council held the 1er Taller d'urbanisme sostenible (1st Workshop on Sustainable Urbanism), with the participation of technicians and managers from different departments involved in the urban process. As a product of this workshop, a list of sustainability criteria was developed, in collaboration with different international certification organisations, which led to the first version of the Guia de Valoració de Criteris de Sostenibilitat en Urbanisme.[43]

Figure 52: Guia de Valoració de Criteris de Sostenibilitat en Urbanisme. Source: Ajuntament de Barcelona (2020).

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[43] Ajuntament de Barcelona (2020).

Activity 1.4

Establish partnerships with professional associations and academia to promote the city's master plan and innovative practises for its implementation

Dimension: Awareness Raising Activities

Enhancing urban resilience requires new ways of managing and addressing risks, a shift from business as usual, to adopting advanced and innovative ways of urban planning and governance. Oftentimes, local governments face public opposition in rolling out new plans, policies, or initiatives, despite anticipated benefits of such plans for the general public. To secure public buy-in toward effective implementation and optimal outcomes, local governments need to work closely with the civil society, academia, think tanks as well as the private sector, to disseminate the environmental and economic implications of inaction or business as usual. They should also highlight ways to address risks, the difficult trade-offs to be made, and the anticipated outcomes for the city as a whole and its inhabitants.

Furthermore, new urban plans and policies, and their implementation approaches can sometimes be extremely complex, and very difficult for the general public to grasp or understand the benefits, which may not be straight forward. The aforementioned partners can play a critical role in communicating new projects in more accessible language or easy to understand ways. For example, despite the great benefits of having a transport-oriented development master plan in Teresina, which will contribute towards limiting urban expansions and avoid further destruction of the natural hydrological system, the framework is markedly complex. For better knowledge dissemination of these new plans and ensuring broader support and engagement from the society, Teresina municipality will need to build strong partnerships with the third sector, NGOs, and academia, among others. Therefore, this activity proposes and details how such partnerships should be sought, initiated and enhanced, and who should be involved (see the table below).

What	Establish partnerships with professional associations and academia to promote the city's master plan and innovative practices for implementation towards an urban and climate resilient city.
Why	To ensure effective and efficient implementation, it is important to gain public support, and enable adjustments whereby public concerns are heard and addressed properly and timely.
How	1. Define the main areas of development and knowledge to be improved 2. Map possible collaborating entities representing professional associations, firms, universities, think tanks or NGOs; 3. Elaborate a proposal for a partnership, cooperation, or coordination of events in collaboration with the relevant entities.
Who	**Lead stakeholders:** ● Resilience Commission; ● SEMPLAN/Agenda 2030; ● SEMPLAN/SEPLUR. **Supporting actors:** ● SAADS.

Deliverables	**Short term:**
	Established platforms and spaces of debate, knowledge share and cooperation between the municipality and the relevant entities.
	Medium term:
	Better public understanding of Teresina's new master plan and its objectives; Refined elements of the master plan thanks to continuous feedback from the above-mentioned entities.
	Long term:
	Reduced barriers for the implementation of the master plan and enhanced sustainable urban development and resilience.

Recommended Action 2:
Improving urban metabolism through green and blue infrastructure

Managing urban metabolism is one of the most pressing issues for today's urban areas, most notably water management, among other important aspects. In Teresina, this issue has been identified as one of the priority matters.

Indeed, the management of stormwater in urban areas is increasingly challenging as our cities grow and weather events become more intense and frequent. The conventional response has historically focused on managing the volume of stormwater with drainage systems responsible for collecting and transporting it faster and for greater distances outside of urban centres. The problem with this infrastructure is that not only does it not seem to cope with the intense meteorological manifestations, but it also presents multiple challenges in its construction, maintenance and in the treatment of the waters that end up being contaminated and affecting the aquifers.

In recent decades, a paradigm shift has been evident, and an approach has emerged that seeks to capture, retain and reuse rainwater at the site of origin instead of building massive grey infrastructures. This approach is often termed as Blue-green infrastructure and refers to the recognition of green spaces and the innate capacities of water to produce environmental benefits.

This approach is based on the existing ecosystem and natural processes rather than engineered structures. Through biophysical processes such as the retention, storage, infiltration of water, as well as the absorption of pollutants, the BGI contributes to improving biodiversity, purifying water and improving air quality. By including blue and green components, the interconnections between aquatic and terrestrial ecosystems are explicitly emphasised.

The main advantage over traditional grey infrastructure (urban drainage) is its multi-functionality to address a variety of factors, beyond solely stormwater retention and transport, such as:

- Improving the quality of water through retention and filtration of toxic agents and components;
- Reducing the potential for flooding, as well as allowing the deceleration of rainwater by filtering it into the ground;
- Reducing the heat island effect since it helps to cool the air temperature through evaporation, the shade produced by the vegetation and the humidity that emanates from the ground;
- Contributing to the protection of biodiversity in urban areas as it enriches the quality of the ecosystems and connects the landscapes fragmented by the infrastructures of the city;
- Providing more spaces for recreation and enjoyment for citizens, as well as urging them to care for and protect the environment.

Inputs for Action

Activity 2.1

Refining Teresina's Urban Revegetation Strategy

Dimension: Strategic Activities

Teresina, traditionally known as "a Cidade Verde" [the Green City] has nevertheless lost a considerable part of its vegetation cover in recent decades due to urban sprawl, unsustainable urban practices and projects that did not integrate vegetation as an essential consideration, and also socio-cultural and safety perceptions of some elements of this emerging approach. For instance, trees are widely considered as an element of insecurity or annoyance, rather than an essential element to improve the environmental and urban quality of the city.

The city needs to urgently recover vegetation on the streets and promote the green coverage of roofs and walls of buildings. The beneficial results of this action are multiple: from improving air quality and reducing temperature in the city, to increasing urban biodiversity and resilience and improving the well-being of citizens. Green infrastructure also contributes to a great extent to improving the urban metabolism, including the city's drainage system, discharging it with water that can be diverted and infiltrated into the subsoil.

The municipality already has some laws in place to promote tree planting (for instance, Lei n ° 4555 de 2014) but the revegetation measures for the city must be strengthened. The criteria and procedure for granting permits for felling trees in public and private spaces must be rethought and revised. Generally related to a perception of urban insecurity, tree plantation must be approached from various points of action: improvement of urban security, awareness campaigns, etc.

What	Refining Teresina's Urban Revegetation Strategy.
Why	The city must improve its revegetation strategy through proper tree planting on the streets and greening of building surfaces, through techniques such as green walls and green roofs, which will improve environmental quality and the population's quality of life as well as contribute to the function of the urban metabolism.
How	1. Organise a steering committee that establishes the objectives of revegetation and creation of new green areas. This committee will be coordinated by SEMPLAN/SEMAM and will incorporate and collaborate with the Agenda 2030 Observatory and its members; 2. Organise a working group to produce methodological materials and documents, to establish criteria and parameters, commissioned and in collaboration with the management committee. This working group, in addition to municipal officials and experts, may incorporate external experts; 3. Draft strategic and methodological documents and an annual plan of objectives through the working group and taking into account the urban and development projects and actions of the city, commissioned by the management committee. The annual plan of objectives must be discussed and agreed with the urban planning department; 4. Regularly monitor the compliance with the annual plan of objectives through the working group and the steering committee; 5. Promote an annual report on the fulfilment of the plan of objectives through the working group and proposal of a new plan of objectives for the following year.
Who	**Lead stakeholders:** ● SEMAM; ● SEMPLAN/SEPLUR.

Deliverables	**Short-term:**
	Developed strategy for promoting and increasing trees and vegetation in the city.
	Medium-term:
	Increased areas of vegetation coverage and enhanced fauna and flora biodiversity.
	Long-term:
	Reduced city's environmental impacts and pollution levels. Mitigated Heat Islands effects.

Activity 2.2

Development of a permeabilization and soil de-sealing strategy

Dimension: Strategic Activities

The sealing and impermeabilisation of soils and surfaces is one of the most difficult problems cities face, a problem that will worsen with the effects associated with climate change. Among other adverse effects, impermeabilisation of soils harms the natural hydrological dynamics, increases the stormwater runoff that must be conducted and managed, and aggravates the effect of heat islands on the city.

According to forecasts, an increase in torrential rainfall is expected in Teresina. The city will not be able to cope adequately with these events without powerful green and blue infrastructure. Green infrastructure and the de-sealing and permeabilisation of soils contribute greatly to improving the city's drainage system by diverting and infiltrating rainwater into the subsoil. For this same reason, many cities around the world have already undertaken soil de-sealing programmes.

A programme for permeabilisation and de-sealing of soils should be designed and implemented. This should work in conjunction with the urban greening and revegetation strategy as both strategies strengthen and reinforce each other, generating positive synergies for the city and enhancing outcomes.

What	Development of a permeabilization and soil de-sealing strategy.
Why	The implementation of green infrastructure strategies and the de-sealing and permeabilisation improves the city's drainage system, reducing the occurrence of floods and landslides, as well as the pollution of water streams due to stormwater runoff.
How	1. Organise a steering committee to establish objectives on de-sealing and permeabilisation of soils in the city. This committee will be coordinated by SEMPLAN/SEMAM and will incorporate and collaborate with the Agenda 2030 Observatory and its members;
	2. Organise a working group to produce methodological materials and documents, to establish criteria and parameters, commissioned and in collaboration with the management committee. This working group, in addition to municipal officials and experts, may incorporate external experts;
	3. Draft strategic and methodological documents and the annual plan of objectives through the working group, taking into account urban and development projects and actions in the city, commissioned by the management committee;
	4. Promote an annual report on the fulfilment of the plan of objectives through the working group, and propose a new plan of objectives for the following year.

Who	**Lead stakeholders:**
	- SEMAM;
	- SEMPLAN/SEPLUR;
	- SAADs.
	Supporting actors:
	- SEMPLAN/ Agenda 2030.
Impact	**Short-term:**
	A developed strategy and plan for de-sealing soils and permeabilisation in Teresina.
	Medium term:
	Increased coverage of permeable pavements and public spaces in flood-risk zones.
	Long-term:
	Improved urban drainage system. Reduced flooding occurrence.

Activity 2.3

Improvement and expansion of Teresina's recycling system to reduce water and soil contamination

Dimension: Strategic Activities

In a context of global scarcity of materials and rising prices of raw materials and energy, an efficient municipal waste collection and recycling system can provide, among others, various benefits beyond environmental protection, such as energy saving possibilities, saving natural resources, decrease waste disposal volume, reducing air and soil pollution, reducing greenhouse gas emissions, and boosting the circular economy.

A well designed and implemented approach to recycling and material recovery can have positive economic effects, such as generating a recycling industry. Beyond these, it can also have positive social effects since it is one of the areas of action in which social inclusion and integration initiatives and projects are often developed, in collaboration with third sector entities.

Teresina has a waste collection and recycling system that can be extended and improved. Local programmes such as Women for Climate Teresina already aim to work on this cross-cutting area involving waste recycling, climate adaptation and gender. However, these are still pilot projects, which need to be scaled up in a comprehensive and ambitious way, a goal that this proposed activity aims to achieve.

What	Improvement and expansion of Teresina's recycling system to reduce water and soil contamination.
Why	Beyond environmental protection and public health benefits, an efficient municipal waste collection and recycling system can help in energy and natural resources saving, reducing waste disposal volume, decreasing air and soil pollution, mitigating greenhouse gas emissions, and boosting the circular economy.

How	1. Organise a steering committee that establishes the objectives of waste management and recycling improvement. This committee will be coordinated by SEMDUH and will incorporate and collaborate with the Agenda 2030 Observatory and its members;
	2. Organise a working group to produce methodological materials and documents, to establish criteria and parameters, commissioned and in collaboration with the management committee. This working group, in addition to municipal officials and experts, may incorporate external experts;
	3. Draft strategic and methodological documents and the annual plan of objectives through the working group, taking into account urban and development projects and actions of the city, commissioned by the management committee;
	4. Discuss and agree on the annual plan of objectives with the urban planning department;
	5. Regularly monitor the compliance with the annual plan of objectives through the working group and the steering committee.

Quem	**Lead stakeholders:**
	• ARSETE;
	• SEMAM;
	• SEMDUH.
	Supporting actors:
	• SEMPLAN/ Agenda 2030.

Deliverables	**Short-term:**
	Develop the city's integrated strategy for waste recycling and promotion of a circular economy.
	Medium-term:
	Strategy implementation and executed pilot projects.
	Long-term:
	Extended and improved waste recycling system, protected natural resources, increased environmental quality, and reduced energy consumption.

Activity 2.4

Creation of a Municipal Unit for the Management of the Water Cycle in the City

Dimension: Organisational Adjustments

Wastewater management is the main basic urban service problem to be solved in Teresina. Beside this, drainage works in the most vulnerable and flood-prone parts of the city are also a priority. Thus, it is imperative to tackle this priority matter decisively by continuing the wastewater network extension programme that the municipality has been developing in recent years. The insufficient coverage of the sanitation network leads to misuses of the drainage system with illegal connections whereby wastewater disposal is made through the drainage network. This issue must be addressed and corrected immediately and effectively as it seriously impairs the performance of both systems and inflicts serious environmental and economic consequences on Teresina.

Looking at the governance around this issue, it appears that the competences and responsibilities concerning the management of the water cycle are distributed among departments belonging to different levels of administration (for instance, drainage is the responsibility of the city, but rivers and riparian margins are responsibility of the State and the basic legislation of the national government). This causes malfunction, slow and complicated decision-making, and execution processes.

Finally, the current underperformance of the water management systems – sanitation network and drainage System – will be worsened because of the effects related to climate change, especially in relation to the management of rainwater, due to the fact that the rainfall will be more intense and concentrated. Hence, it is proposed that the municipality of Teresina should promote a collaboration agreement between all the administrations involved for the creation of a municipal unit for the Management of the Water Cycle in the City.

Given the organisational structure of the municipality, and the multiplicity of departments and actors at other levels of the government involved in the planning and management of water cycle-related policies, projects, and initiative, it was agreed that clustering all water cycle management competencies and jurisdictions under one single department or unit was not a feasible action at this stage. Longer term organisational adjustments and strategic agreements are required among several actors at the local, state, and national level. Nevertheless, establishing a single water cycle management body inside the municipality could pave the way for more ambitious organisational and procedural transformation in water cycle management in Teresina.

The aim of this activity is therefore to set up a new unit inside the municipality, specifically within the department of planning (SEMPLAN), that can take on the responsibility of overseeing the plans, projects and actions of the various bodies involved in water cycle in Teresina, facilitating information and knowledge sharing among all actors, ensuring consistency and coherence of plans and actions, and avoiding mal-functioning. In the long run, this unit will be instrumental in bringing together and merging the competencies of several public bodies and departments and enable a more effective and efficient management of the water cycle system in Teresina.

What	Creation of a municipal unit for the management of the water cycle in the city.
Why	Water cycle mismanagement has been identified as a priority matter in the city, driven by a multitude of factors explained in detail in chapter 3. Addressing this mulit-faceted issue requires bringing many actors and levels of government together and reducing multiple and overlapping work streams which in many cases lead to inaction or counteracting impacts.
	This new unit inside the municipality, specifically within the department of planning (SEMPLAN) can take on the responsibility of overseeing the plans, projects and actions of the various bodies involved in water cycle in Teresina; facilitating information and knowledge sharing among all actors, ensuring consistency and coherence of plans and actions, and avoiding mal functioning.
How	1. Establish the water-cycle management coordination unit inside the department of planning - SEMPLAN, and legalise the mandate of this unit 2. This unit will have to define and map the competences of the various administrations on the city's water cycle; and engage in direct communications with all actors. 3. This unit has to produce regular reporting mechanisms to enable up-to-date reporting from all relevant actors and departments and ensure knowledge and information sharing. 4. The unit should start engaging in coordination activities within a time plan set up and agreed on by all actors and apartments. 5. In doing so, the unit will gradually engage in decision making processes regarding the water-cycle management throughout the whole policy cycle, starting from agenda setting through actions setting, implementation, and monitoring and evaluation. The unit will be better placed to ensure that all policies and projects are coherent, duplication efforts are minimised, and better resource efficiency is achieved.

Who	**Lead stakeholders:**
	- ARSETE;
	- SEMAM;
	- SEMDUH;
	- SEMPLAN/Assessoria Técnica (Technical Advisory).
	Supporting actors:
	- SEMAR;
	- ANA.

Deliverables	**Short-term:**
	Established a unit of water management in Teresina.
	Medium-term:
	Enabled municipality-wide knowledge sharing and communication with regards to water cycle management; Strengthened coordination and alignment among all actors within the municipality, as well as state and national level.
	Long-term:
	Effective and efficient integrated urban water management in Teresina, reduced urban floods, and soil and water contamination.

Activity 2.5

Establish a guided visits and tours programme to key infrastructures, sites of interest, and pilot initiatives for sustainable and resilient developments

Dimension: Awareness Raising Activities

Nature-based solutions such as green and blue infrastructure have undeniable advantages, both at the level of maintenance and environmental impact, and other cross-cutting beneficial effects. However, they often encounter difficulties of various kinds for their implementation. One of them is the general lack of knowledge about their operation, implementation, and benefits in terms of the sustainable management of the city. Another difficulty stems from social, technical, political, and professional habits and inertia that prioritise discrete solutions focused on solving a specific problem with 'visible works or operations', instead of proposing strategies and actions in natural processes. The latter are more difficult to visualise, evaluate and account for, and often produce deferred and scattered beneficial effects in the long term that may go unnoticed by citizens, politicians and even the technicians involved.

It is therefore necessary to take a determined and courageous stance. It is also necessary to specify that the commitment to nature-based solutions and green and blue infrastructure does not imply, much less, an absolute renouncement of the need to implement grey support infrastructure for the functioning of the city, since the urban phenomenon implies an alteration of natural processes that cannot be redirected with nature-based solutions alone. But it does imply that when faced with an urban problem of completion, priority should be given to this type of solution before deferring to solutions based on pure engineering only when they cannot provide the level of response or coverage required.

Given the implementation advantages, collateral effects, benefits, maintenance and costs, durability, and scope of nature-based solutions, it is necessary to carry out specific awareness-raising actions on these aspects both for the general public, as well as for the technicians of the administration and the private sector. One of the most powerful and effective actions that can be carried out is the presentation and dissemination of existing projects, initiatives and experiences that use nature-based solutions and can serve as a model and inspiration for new initiatives. Visits and guided tours are, in this sense, powerful ways to achieve this objective. The visits must be accompanied by extensive

information that is understandable and adapted to the target group to whom it is directed. The city of Teresina has, in fact, various public and private initiatives that could and should be incorporated into this public outreach programme.

What	Establish a guided visits and tours programme to key infrastructures, sites of interest, and pilot initiatives for sustainable and resilient developments.
Why	In a city under the constant threat of flashfloods, it is essential to increase awareness and knowledge about nature-based solutions, such as green and blue infrastructure, as well as infrastructure and the functioning of the city in general, both for the general public, for administration technicians and for private companies. One of the most powerful and effective actions that can be carried out is the presentation and dissemination of existing projects, initiatives and experiences that use nature-based solutions and can serve as a model and inspiration for new initiatives. Visits and guided tours are, in this sense, powerful ways to achieve this objective.
How	1. Identify and list entities and groups conducting initiatives that can be classified as 'nature-based solutions' and infrastructure of the Municipality that can be classified as green and blue; 2. Prepare a programme of guided visits, focused on each audience. The programme should include the calendar of activities and the people in charge of presenting and directing the visits; 3. Prepare explanatory materials; 4. Perform the scheduled guided visits and tours. 5. Promote an annual evaluation of the programme results and activities.
Who	**Lead stakeholders:** ● SEMPLAN/Agenda 2030. **Supporting actor:** ● SEMAM; ● SEMDUH; ● ARSETE; ● SEMCOM. For each guided visit, the action and exchange of information with the corresponding departments must be coordinated.
Deliverables	**Short to medium term:** An established intensive awareness raising programme including guided tours of infrastructure projects and ongoing projects. **Long-term:** Increased awareness and knowledge about nature-based solutions, such as the Lagos Norte project, as well as infrastructure and the functioning of the city in general, both for the general public and for administration technicians and the private companies.

Insights from CRGP Partner Cities

Semana de la Naturaleza, Barcelona, Spain

Barcelona City Council organises a yearly event called Semana de la Naturaleza[44] (Nature Week), in order to raise awareness among the population about the importance of caring for the environment and its natural resources. The event includes multiple activities such as excursions, workshops, guided tours, family activities, exhibitions, children's activities, or field trips related to green and blue infrastructure, city parks, sustainable buildings and urban vegetable gardens.

Figure 53: Natue Week activities in Barcelona, Spain. Source: Ajuntament de Barcelona (2021).

Recommended Action 3:
Enhanced Intra-governmental coordination for coherent and integrated urban planning and implementation

Successful implementation of strategies, policies and programmes will usually enact certain changes in organisation. Careful planning of changes is therefore important. During the study and analysis process in Teresina, dysfunctionalities were detected in the implementation of policies, plans and projects due to lack of inter and intra-departmental coordination and untimely communication channels. The following actions are proposed with the aim of addressing these detected issues and enabling better and efficient policy implementation.

With specific regard to the environmental challenges that Teresina is facing, there is a great dispersion of agents and competent authorities working on these issues, especially the management of the cycle and water courses. This generates many dysfunctionalities, difficulties, and delays in decision-making.

The expected outcomes of this recommended action are greater speed and precision in decision-making, greater agility in processes and better results from the actions undertaken.

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[44] Ajuntament de Barcelona (2020).

Inputs for Action

Activity 3.1

Increase inter and intra-departmental coordination throughout the policy cycle

Dimension: Organisational Adjustments

Working in silos is a common problem in public administrations and local governments. Its implications range from inconsistent policies and projects, effort duplication and resource inefficiency, to poor implementation, to name but a few.
Furthermore, a marked disconnectedness is observed in Teresina between policy and projects planning on one hand, and implementation on the other. Absence of municipal departments (such as public works) and partners that are responsible for implementation, at early stages of policy planning has led to multiple problems, most prominently that execution results do not correspond to the intended results and outcomes set out in the original plans and policies.

While devising careful and strict project monitoring and evaluation frameworks can limit such mal-implementation cases, it may fail in addressing the root causes. Therefore, the adoption of monitoring and evaluation frameworks has to be accompanied by changes in the ways policy and decisions are made in Teresina. Particularly, policy makers and planners need to be familiar with implementation realities on the ground, the extent to which their future plans and projects are executable and feasible given the capacities available to those in charge. On the other hand, departments, and partners in charge of implementation need to be present throughout the decision-making cycle in order to be well familiarised with the goals and objectives of new plans and projects, and accordingly understand what is expected from them at their respective roles and stage of involvement.

This proposed activity suggests that the municipality needs to enact changes in the way decision making is conducted and who should be present at each stage of the process. Moreover, the municipality has to generate motives and incentives for the different departments to follow these new ways of collaborative and integrated decision making by providing resources as well as adherence enforcement.

What	Increase inter and intra-departmental coordination throughout the policy cycle.
Why	To reduce inconsistency between policy and project planning goals and implementation outcomes, thus avoiding inefficiency and ensuring best delivery of goals and objectives.
How	1. The Municipality needs to mandate a new working approach across all municipal departments. This new approach will require all planning departments to engage all relevant implementation and operation departments in the early stage of policy and actions setting. 2. The resilience commission is a well-placed actor to initiate the discussion and design of this new approach since it encompasses departments from both planning and operations. 3. A longer-term organisational adjustment step that the municipality should start considering is bringing all planning departments closer, towards clustering all departments under a macro planning area. Bringing these departments closer will prove highly useful in facilitating vertical and diagonal integration between tightly related services and departments.

Who	**Lead stakeholders:**
	● Resilience Commission;
	● SEMPLAN.
	Supporting stakeholders:
	● STRANS;
	● SEMDUH;
	● SEMAM;
	● SAADs.

Deliverables	**Short-term:**
	The adoption of new mechanisms for planning, implementation, and management in Teresina where all actors (as needed) are engaged in the policy making from the early stages until the execution phase.
	Medium-term:
	Reduced inconsistency between municipal plans and projects, and implementation results.
	Long-term:
	Improved delivery of the goals and objectives set out in the municipality's plans and projects. Efficiency in municipal resource spending.

Insights from CRGP Partner Cities

Gerència d'Habitàt Urbà, Barcelona, ESP

In 2013, Barcelona City Council underwent an organisational restructuring process, which connected different departments related to urban projects, urban planning and management control, environment and urban services, infrastructure and urban coordination, urban planning, and housing under the coordination of the Gerència d'Habitàt Urbà[45] (Urban Habitat Management). The restructuring sought to promote improvements in administration and, consequently, in the definition of policies, decision-making and coherent execution of actions related to the urban environment.
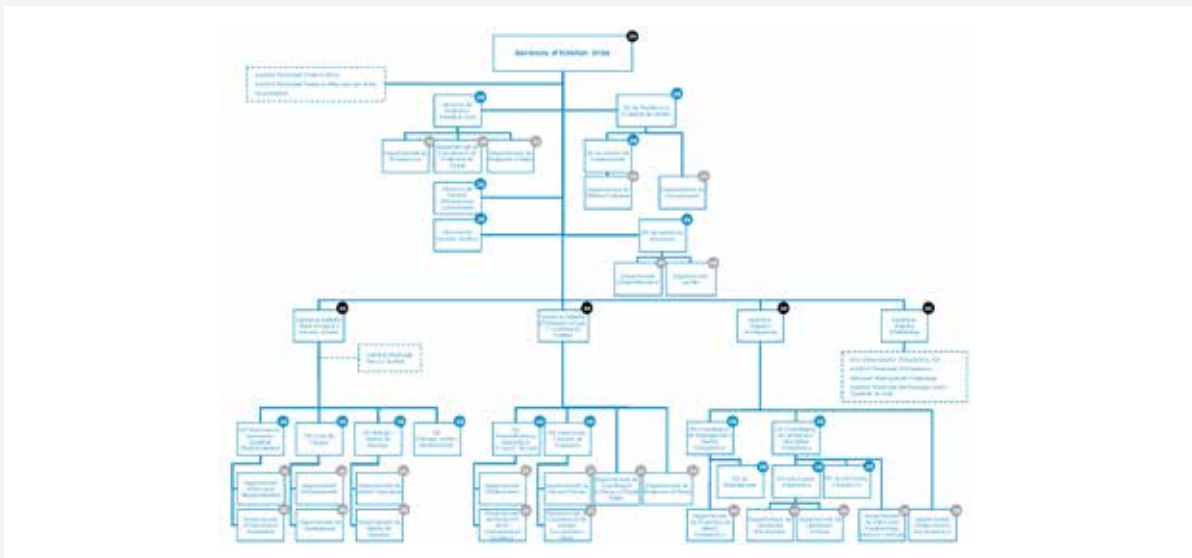
Figure 54: Gerència d'Habitàt Urbà, Barcelona, ESP. Source: Ajuntament de Barcelona (2013).

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[45] Ajuntament de Barcelona (2020).

Activity 3.2

Development of Urban Planning and Implementation Guidebook, Checklist and Technical Manuals

Dimension: Capacity Building Activities

In extensive administrative bodies organised along sectoral lines, it is necessary to establish common and general interpretation and implementation criteria. The criteria should be configured in such a way that the objectives and criteria set from the beginning in plans, programmes, and projects, are not misinterpreted, distorted, or blurred in the process of their implementation.

Teresina is a city of more than 800,000 people. Therefore, it has an extensive municipal administrative organisation. In addition to enabling the changes proposed in the previous activity, it is necessary to establish clear, general, and common criteria - aligned with the general objectives of the city and its master plan - and translate them into documents for the proper monitoring and implementation of plans, projects, and programmes of the city.

These documents can be in a first phase: guidebooks, checklists, technical manuals on paper. However, with the progressive development of the Recommended Action, the use or upgrade to other formats and supports should also be considered: computer applications and programmes, audio-visual materials, etc.

What	Development of urban planning and implementation guidebook, checklist and technical manuals.
Why	Teresina has an extensive municipal administrative organisation; thus, it is necessary to standardise a set of common criteria aligned with the general objectives of the city among the different administrative bodies. These guidelines will be officialised through documents such as guidebooks, checklists, and technical manuals, which will allow the proper implementation of municipal policies and plans.
How	1. Establish a group for the definition and coordination of documents to be created. The group must be made up of a main coordination group and will incorporate competent technicians and practitioners from the municipal areas involved in each project; 2. Collect information and list needs from Municipal Secretariats and Departments; 3. Establish a list of issues and work schedule for the creation of the materials to be developed. The list of issues should identify the departments involved in order to contact them and request the appointment of the municipal officials and practitioners who will participate in the development of the materials. The work schedule shall prioritise projects based on needs and available resources. The suitability of incorporating external expert facilitators or consultants should be assessed; 4. Incorporate municipal officials and practitioners and, where appropriate, incorporate external specialised advisers to the working group. Define the final format of the work to be developed. Define the project development modality: panel of experts and practitioners, participatory workshops, technical working groups, etc. Start-up of the projects defined according to the work schedule; 5. Deliver and validate the product developed. Layout the result document and materials; 6. Disseminate result document and materials. The most appropriate and effective dissemination and implementation methodology should be established: face-to-face presentations, online, practical workshops, websites, etc.

Who	**Lead stakeholders:**
	● SEMPLAN/SEPLAG;
	● SEMPLAN/Agenda 2030.
	Supporting actors:
	● SEMCOM;
	● SAADs.
	For each material to be developed, they must incorporate and coordinate the corresponding responsible departments.

Deliverables	**Short-term:**
	Developed guideline documents.
	Medium-term:
	Widely disseminated guidelines and standards across the municipality and among relevant stakeholders ensuring that staff and practitioners are well informed and trained in the implementation and monitoring of these established guidelines and standards.
	Long-term:
	Clear and coherent interpretation and implementation criteria for the city's urban and environmental actions ensuring results are aligned with the intended vision and objectives of the city.

Insights from CRGP Partner Cities

Technical Prescriptions for the Urban Space, Barcelona, Spain

Barcelona City Council is promoting the development of Project Protocols in order to achieve a better management of resources and to coordinate the information of all architectural, urban or infrastructure projects that are developed in the city, with the guiding principles for projects commissioned by Barcelona City Council.

Therefore, in the ongoing transformation of the city, the municipality established a series of general criteria, which should be applied to all projects promoted by the City Council that will be agreed upon by all agents involved.

These technical guides are intended for all those professionals engaged in the development of basic and executive projects of urbanisation, infrastructures, infrastructures with urbanisation elements; who design, modify and/or improve the public space of the city of Barcelona. These documents aim to facilitate the professionals' task, which should allow them to continue building a public space with reference quality standards that include everything from design excellence to the rationality and simplification of subsequent maintenance.

Figure 55: Technical Prescriptions for the Urban Space, Barcelona, Spain. Source: Ajuntament de Barcelona.

5.3. Building a Strong and Resilient Local Economy

The Rationale

As part of the diagnosis, several issues were identified as drivers of the city's main challenges in terms of economic development, mainly unemployment. The financial crisis of 2015 and most recently the pandemic increased the unemployment rate, especially among the youngest and in the informal sectors. Also, the COVID-19 pandemic exacerbated the need to rethink the future of work and the urgent need to accelerate the transformation of the labour market to increase productivity and match technological transformations. This will require capacity building and greater support for start-ups and entrepreneurship in the city.

A second driver is related to low productivity due to inefficient public transportation systems, and vulnerability to external shocks. This has a direct effect on people's jobs and on the overall economy of the city. Productivity is also affected by weak metropolitan governance frameworks which leads to less economic integration, leading to further negative impacts on local economic development. Low productivity is a disincentive for private sector investment which is another key driver identified. The city is affected by the lack of adequate regional infrastructure to facilitate intra-national and international flows, such as safe dual carriageways, a high-capacity airport, and an efficient railway network. The connectivity issues both internally and externally lead to a third key issue, which has to do with weak attractiveness for business. Municipal finances have been impacted by COVID-19, therefore it is critical that the city embarks on actions conducive to attracting the private sector, which can serve to leverage urban investments such as public transportation.

Finally, diversifying the city's economy was also considered key to the resilience and sustainability of local economic development. The city needs to find multiple sources of income from primary, secondary, and tertiary sectors, and involve all the population instead of relying on few sources. The city has a strong health and education sector; however it has not been fully optimised. Additionally, these problems are all permeated by contextual challenges of governance, impacted by weak intergovernmental coordination - federal, state, and municipal, all of which need more effective systems for intra-organisational management among the various secretariat for the implementation of projects and programmes that are key to the development of the city.

In short, Teresina is a city with a poorly developed market and limited economic diversification that has led to incipient access to external markets and low direct investment with great impact on the creation of formal jobs. The increasingly high levels of informality are worsened by the reliance on particular economic sectors as well as the lack of qualified workers causing further impacts on job creation. For an economy to be strong and resilient, it must have a diverse economic structure which will provide greater regional resistance to shocks such as the COVID-19, which exacerbated the vulnerability of the economy in Teresina.

Line of Action 3
Building a Strong and Resilient Local Economy

Inputs →	Short Term Outputs →	Med-Term Outputs →	Mid-Term Outcomes →	Long-Term Outcomes →	Impact Goals →
Technical Capacities for more efficient public services and increased local revenues	Staff training for Tax Modernisation	Implementation of Tax Modernisation Programmes	Increased tax collection and local revenues	Better quality municipal public services, with effectiveness and diligence in its delivery	Strengthened community resilience
Awareness-raising to facilitate people's access to opportunities	Pilot Implementation of Municipal Public Services Monitoring & Evaluation	Promoted institutional adjustments to improve municipal public services delivery	Improved Adequate Municipal Public Services	Strengthening municipal finance resilience in the face of economic crises	Sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Capacity Building to strengthen institutions to support informal, self-employed and small businesses	Designed an integrated package of service delivery to SMEs and informal sectors under the umbrella of Banco Popular	Develooment of an institutional redesign for Banco Popular	Increased access of small-scale business to financial services and informal sector integration	Improved connectivity and urban mobility; therefore, improved local economy	Enhanced access to safe, affordable, accessible and sustainable transport systems for all
Organisational improvements to boost local productivity, market connectivity, and business attractiveness	Setting up municipal agencies for better Urban Mobility and Local Economic Development (LEDA)	Implementation of urban logistics plans and projects	Proper operation of Public Transportation Systems and Urban Logistics	Robust and resilient local labour force; prepared local economy for digitalisation and future of work	Enhanced access to adequate basic services for all

Inputs →	Short Term Outputs →	Med-Term Outputs →	Mid-Term Outcomes →	Long-Term Outcomes →	Impact Goals →
Strategic Actions to promote innovation and intersectoral collaboration	Promoted development-oriented policies that support productive activities, decent job creation. entrepreneurship creativity and innovation	Development of Teresina re. branding strategy by the LEDA	Increased digital literacy and tech skills, specially among the most vulnerables	Higher levels of economic productivity through diversification, technological upgrading and innovation	
		Increased participation in city-to-city and international cooperation for local economic develooment	Enhanced city's attractiveness for new businesses, and increased employment opportunities		

Nonetheless, Teresina has well-developed regional educational and health institutions that could be an opportunity not only to generate employment, but also to promote both local entrepreneurship and foreign investment. Therefore, the actions that the city takes must be strong and resilient in order to diversify the city's economic sectors, secure investment in infrastructure, create a business-friendly environment that attract firms, support the creation of start-ups, improve connectivity, provide technical training and retraining of the labour market, but most importantly, ensure stronger coordination between key stakeholders to ensure programs are implemented.

The public sector, private sector, academia, and civil society require strengthened mechanisms to integrate and coordinate work and advance in the implementation of programmes and projects, which often fail to get off the ground. Economic development will not happen through discrete projects or programmes, instead it will require interactive, dynamically adaptive, and integrated ecosystems. In this respect, strong governance in the city will be a key step towards development. The actions that the city takes must be both people-based and place-based and framed within strategies that target improving the framework conditions for human creativity, good governance, and greater openness.

Proposal Overview

Recommended Action	Inputs for Actions			
	Strategic Activities	Organisational Adjustments	Capacity Building	Awareness Raising
1. Enhanced Efficiency of Municipal Management and the Financial Sustainability of the Local Government.	**1.1.** Update and enhance municipal mechanisms of monitoring and evaluation of services effectiveness and efficiency.		**1.2.** Enhance municipal staff's skills for improved and efficient municipal tax collection.	
2. Enhanced urban mobility management for higher productivity and social-spatial inclusion.		**2.1.** Create a Local Mobility Agency to oversee operations and integrate mobility planning into the macro-area of planning and environment. **2.2.** Creation of an intersectoral committee for coordinated management of urban mobility and logistics.		
3. City Rebranding for Enhanced Investment Attraction and Innovation.	**3.1.** Future of work.	**3.2.** Set up a Local economic development agency for territorial marketing (LEDA).	**3.3.** Set up City-to-City local economic development cooperation for knowledge transfer.	
4. Enhanced Access to Markets & Employment Opportunities for the Informal Sector.	**4.1.** Commission a comprehensive study, in collaboration with academia and non-profit organisations, to understand and characterise the informal sector.		**4.2.** Position the Popular Bank (Banco Popular) as the anchor for providing support to SMEs and informal sector integration.	**4.3.** Awareness-raising campaign for access to credits, grants, and skills through civil society engagement.

Recommended Action 1:
Enhanced Efficiency of Municipal Management and the Financial Sustainability of the Local Government

Currently, there is a clear tendency towards digitalising municipal administrative services at different levels of the government which has the potential to massively facilitate business operations, especially at the local level such as Teresina Open Data Plan. The city is also implementing a programme with Banco de Desarrollo de América Latina (CAF) called the Municipal Governance Programme, which trains civil servants in the fields of public innovation, open government, and urban resilience. In terms of optimising expenses, the city is developing the "Gestao Cidadã" and "Colab Teresina", an app for citizen collaboration and monitoring of municipal services and public works.

At the national level, there are two main programmes aimed at providing funds for local governments to improve tax modernisation, namely the Tax Modernisation Programme (PMAT), and the National Programme to Support Administrative and Fiscal Modernization of Municipalities (PNAFM). These programmes are aimed at expanding the institutional capacities of the municipalities to increase their tax revenues and improve the administration of public spending. The programme will provide municipal teams with training and technical assistance for the preparation, execution and supervision of projects developed using the System for Development, Execution, Monitoring and Supervision of Projects and approved by the Programme Coordination Unit. The project will also strengthen planning and a results-based management model.

Although the city has some well-established programmes, it faces various challenges including a lack of technical capacities for programme implementation and coordination, which prevent these programmes from being properly implemented. Increasing municipal revenue is key for the development of the city and securing a higher provision of services and urban infrastructure to improve the quality of life in Teresina. The following activities are aimed at increasing municipal revenues and municipal resources to fund economic development in Teresina:

Inputs for Action

Activity 1.1

Update and enhance municipal mechanisms for the monitoring and evaluation of service effectiveness and efficiency

Dimension: Strategic Activities

Systematic and proper monitoring and evaluation was highlighted by many municipal staff and local partners as absent from municipal projects, plans and initiatives. While project monitoring is carried out more often than evaluations, the municipality still does not have standard frameworks, procedures, and metrics on how such processes should be carried out and managed. Evaluation, on the other hand, was seen by most stakeholders as the most challenging. Despite several attempts by multiple municipal departments to devise project evaluation tools, none of these attempts have been successful. The reasons are diverse; some are technically driven by the difficulty of developing accurate indicators and metrics, others are related to coordination difficulties between different municipal departments (especially for multi-jurisdictional projects) and the challenging nature of building consensus on what should be evaluated, how and according to which criteria.

Public administration must continue to improve mechanisms for project and programme monitoring and evaluation, including the definition of performance indicators for public services with a designated time frame. Undertaking proper monitoring ensures that municipal projects, programmes and services are implemented according to plans and project specifications and delivered on time. Thus, monitoring is a powerful instrument for local governments to ensure the effectiveness and efficiency of their services and project delivery. It also allows for adjustments and changes to be made to plans when segments of a project are not suitable or cause bottlenecks or diseconomies for the local government. Monitoring is not limited to newly executed or under-implementation projects only, but can extend to the provision of public services, such as maintenance of infrastructure, public facilities, and others.

In addition to monitoring, evaluation is at the core of resilience-building activities. Being agile, reflective, and proactive implies continuous monitoring of urban services, programmes and projects, and regular evaluation of what works or does not work, and what needs to be done differently. Moreover, evaluation is a crucial tool for ensuring accountability and proper use of public resources.

In this sense, the CRGP offers a complex set of indicators to assess some municipal public services, thereby providing a baseline for monitoring. The following set of activities suggest improvements to the municipality's monitoring and evaluation mechanism and frameworks, through training and learning activities, and building on the CRGP's diagnostic tool.

What	Update and enhance municipal mechanisms for the monitoring and evaluation of services effectiveness and efficiency.
Why	The Urban Resilience Diagnostic showed deficiencies in monitoring data from municipal public services. This lack of data also coincides with relevant points raised by the Resilience Commission, such as difficulties in implementing urban projects and incompatibilities of technical capacity and demand for public services. This monitoring is critical to generate a baseline and respond to problems such as the lack of technical capacity for adequate municipal services.
How	1. Convene sub-group of the Resilience Commission, including the Superintendencies of Administrative Actions (SAADs, Portuguese acronym) managers, the Executive Secretariat for Fundraising and Monitoring Coordination (SECREM, Portuguese acronym), and the Executive Secretariat of Planning and Management for Assessment and Monitoring (SEPLAG, Portuguese acronym) for inception meetings and setting objectives; 2. Map monitoring and evaluation initiatives, understand implementation bottlenecks and produce a diagnostic; 3. Define main services for monitoring and evaluation, research basic indicators for the services (CRPT indicators for municipal public services are recommended) and monitoring methodologies; 4. Agree on a simplified monitoring and evaluation of municipal public services prototype for trial implementation, with scalability plan.
Who	**Lead stakeholders:** • SEMPLAN/SEPLAG. **Supporting stakeholders:** • Resilience Commission; • SAADs; • SEMPLAN/SECREM.

Deliverables	**Short-term:** Understand the bottlenecks in the provision of municipal public services. Established municipal public services efficiency baseline. Developed prototype for public services monitoring and evaluation strategy. **Mid-term:** Successful implementation of the monitoring and evaluation strategy for municipal public services. Promoted institutional adjustments to improve the supply of municipal public services based on continuous evaluation and monitoring. **Long-term:** Better quality municipal public services, with effectiveness and diligence in the delivery of public works; licensing, monitoring and inspection processes; community welfare; emergency services; and law enforcement. Improved efficiency of public spending and reduced burdens on the municipal budget.

Activity 1.2

Enhance municipal staff's skills for improved and efficient municipal tax collection

Dimension: Capacity Building Activities

One of the key challenges in terms of increasing municipal revenue is related to the inadequate technical capacities to properly implement tax collection technologies. Currently, the unit in charge is located within the Secretaria Municipal de Finanças, which the diagnosis identified as lacking technical skills, suffering from information deficits and overburdened staff, and a lack of clear staff roles and responsibilities which result in overlapping/duplicated work streams. Capacity building is key to successfully running the ongoing municipality programmes, but it is also important that city staff is on the lookout for ways to increase municipal revenue as there are various tax collection opportunities that can increase economic development funding.

In Brazil, property taxes are an important source of revenue for cities. A study on the urban property tax (IPTU) in Brazil by the Inter-American Development Bank, compared the collection of municipal current revenue of all Brazilian capitals and found that Teresina has a potential loss of collection of 61%. Also, when comparing the IPTU collection with the municipal wage bill, the study found that the loss of collection was 37%. Averaging these two forms of collection, the study also found that Teresina has the potential to double its IPTU and maintain the average collection, compared to other capitals.[46] Other studies suggest that there is a significant potential to raise IPTU in even the poorest regions of Brazil by modernising tax administration and by introducing some legal changes.[47] Nonetheless, these studies suggest that property appraisal processes should be non-political, ensuring that the value is determined by technical criteria.

As Teresina moves forward with its plans and programmes to improve property tax collection, actions are required to enable the institution of a dedicated team for the projects (PMAT and PNAFM), since the benefits significantly outweigh the implementation costs. This team should receive initial and ongoing training. City-to-city cooperation is highly recommended for the respective municipal staff to learn from cities with best practices in developing mechanisms to resolve implementation problems.

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[46] Baima, Carolina; Hobbs, Jason; Seabra, Renata; Oliveira, Isabela (2021).

[47] Rodrigues, Afonso; Amorim, Erika; and Rios da Nóbrega Marcos (2012).

What	Enhance municipal staff's skills for improved and more efficient municipal tax collection.
Why	The Resilience Commission consultation process clarified that the municipality already has projects for tax management modernisation, as well as secured resources. However, the administrative capacity to implement these resources and follow up on the programmes is still lacking. Modernising tax management responds to the need to increase own revenue sources to finance sustainable development and mitigate fiscal crises.
How	1. Reshape the task force in the Municipal Secretariat of Finances to implement tax collection modernisation programmes (PMAT and PNAFM), including assigning dedicated staff for this task; 2. Request direct support from programme funding entities (PMAT and PNAFM) to improve the implementation strategy and training. Promote the participation of the city in knowledge sharing activities such as interest networks, stimulate cooperation with exemplar cities, or participate in pilot projects in partnership with development aid institutions (such as multilateral banks); 3. Prepare a training framework for the designated staff as well as support stakeholders, including study tours, classroom training in Teresina, training workshops abroad, and by receiving training during the programme's implementation by capacitated staff. Hire an advisor to guide, train, and control local teams, and propose innovative solutions is recommended; 4. Ensure the training of civil servants includes the fields of public innovation, open government, and urban resilience.
Who	**Lead stakeholder:** ● SEMF. **Supporting Stakeholders:** ● SECREM/SEMPLAN.
Deliverables	**Short-term:** Reshaping of the task force for the implementation of the Tax Modernization Programmes. Dedicated and trained staff for the implementation of the programmes. **Medium-term:** Proper implementation of tax modernisation programmes. **Long-term:** Increased municipal revenue and more local capacities for addressing the economic challenges Teresina is facing.

Recommended Action 2:
Enhanced Urban Mobility Management for Higher Productivity and Socio-Spatial Inclusion

The set of activities under this recommended action responds to the diagnosed need to improve the urban mobility management system and reduce inefficiencies in transport networks and logistics chains, which influence market connectivity, limit business attractiveness, and lower productivity, ultimately impacting negatively on the city's economic performance.

It is imperative for the city of Teresina to update urban mobility management models, since the public transport system is facing a severe crisis, and problems concerning the network's sustainability in the short, medium and long term. The municipal transport sector needs agility and quick-response capacity to promote a quality service that is a genuine alternative to private modes of transport. Inadequate urban mobility problems exacerbate poverty and social inequality, reducing accessibility to job opportunities and over-consuming the time of system users, thus also affecting the city's productivity as a whole.

Better economic performance presupposes an adequate logistics base with resilient supply chains. City integration with surrounding municipalities needs to be improved, with better metropolitan mobility and connectivity to regional supply and services. It is necessary to resume the discussion on the city's logistics planning as well as the integration of initiatives in this scope with urban and mobility aspects. Economic development planning and mobility and sustainable urban and environmental development should be integrated, and if possible contemplated, through the effectiveness of TOD initiatives.

Inputs for Action

Activity 2.1

Create a Local Mobility Agency to oversee Operations and integrate Mobility Planning into the Macro-Area of Planning and Environment

Dimension: Organisational Adjustments

Teresina's public transport system is highly vulnerable to shocks and the COVID-19 pandemic has illustrated this vulnerability, with the exacerbation of internal system stresses which, at some points, have led to the occurrence of additional shocks. The response to vulnerabilities demands greater intra-governmental coordination, which should be properly addressed in the Sustainable Urban Mobility Plan under development. While the plan is being constructed to deliver on several axes, seeking to improve the economic, social, and environmental development, there is room for the city to do more and have an integrated transport system that supports economic development. Even though the city is already working on an integrated plan, it still needs an integrated coordination mechanism and vision to build capacity for efficient transport operation.

For this reason, the city needs more agile mechanisms and management models to deal with a sector in constant technological development, such as public transport. The current management model is not able to respond to this need and is outdated in relation to the management models of most large Brazilian cities and capitals. In order to increase agility, local governments have been operating with mixed-economy schemes, such as public agencies or public companies, which facilitate contracting, audits, equipment acquisition and fare collection. The current model of public transport operation management, through a fully public-economy department, hinders the rapid response to transport management. The department in charge is overwhelmed with day-to-day service provision. In addition, both its human and technical capacities are limited, rendering long-term planning, and updating operations very challenging.

By addressing the above issues, this recommended action proposes the establishment of clearer roles and responsibilities in terms of planning and management of urban mobility in Teresina. Specifically, it was agreed by a majority of actors involved in the development of actions that more integration was necessary between urban development planning, and urban mobility - the planning-mobility macro area/department. Managing public transportation modes and their operations should be carried out by a dedicated agency with capacities and skills to execute plans set up by the mobility-planning macro area. Moreover, this agency can also be in charge of attracting funds and investments for public transportation as well as TOD-related projects.

Indeed, this recommended action is aligned with a proposal recently made by the IDB on prospective successful TOD areas in Teresina, in which it suggests the creation of a public transport agency responsible for managing an integrated public transportation system.

What	Replace the current transport management model, transforming STRANS into a Municipal Public Transport Agency, with a mixed economy model; and integrating the transport and traffic planning sectors in the Secretariat of Planning.
Why	STRANS' current management model does not meet the need for agility in the coordination and supervision of municipal transport, be it traffic or public transport. It is thus recommended to update the model following the successful example of other cities, with a Local Transportation Agency, and integrating the mobility planning units with the other urban planning sectors under the Secretariat of Planning.
How	1. Create a study group composed of civil servants to evaluate different alternative solutions for a new management model; 2. Conduct field visits to other cities to understand possible organisational structures and engage with national and international institutions to exchange knowledge and experiences; 3. Meet with Teresina's Regulatory Agency (ARSETE) to understand its creation process and sustainability to formulate the path for the creation of the Transport Agency of Teresina; 4. Meet with leaders of the Municipal Secretariats and the Mayor's Office to present and propose viable alternatives for the implementation of the Agency; 5. Create a draft law for administrative reform of the urban mobility management structure and transport operations to be discussed with society, making sure governance structures are multidisciplinary and making sure urban-related professionals are included.
Who	**Lead stakeholders:** • SEMGOV; • SEMPLAN/SEPLUR; • STRANS. **Supporting actors:** • ARSETE; • ETURB.

Deliverables	**Short-term:**
	The creation of the municipal public transport agency, and integration of the transport and traffic planning sectors in the Secretariat of Planning.
	Medium-term:
	Enable separation between public transport operations, and the urban mobility planning roles, and ensure roles and responsibility are not duplicated or overlapped. Ensured the proper operation of the public transport system.
	Long-term:
	Efficient, sustainable and resilient public transport system; improved connectivity and urban mobility; therefore, improved local economy.

Insights from CRGP Partner Cities

Metro de Medellín, Medellín, Colombia

Empresa de Transporte Masivo del Valle de Aburrá Ltda. (Aburrá Valley Massive Transport Company Ltda.) is a public sector company responsible for the metropolitan transit system in the city of Medellín.[48] Among the company's functions is the management of the Metro de Medellín, which has become an icon of the Aburrá Valley due to its ability to integrate citizens who were previously isolated by geographical barriers into the territory through the implementation of a cable car system, in 2004.

Besides the cable car system, urban infrastructure was built in the surroundings of the train stations by Metro de Medellín through the urban renewal model Proyecto Urbano Integral (Integral Urban Project), such as public housing, shared road system, parks, plazas, and others.

The company also had a positive impact on the quality of life of Aburrá Valley citizens through research, development and innovation in collaboration with local companies and universities, which contributed to its excellence in administrative management and social responsibility.

Most recently, the Metro de Medellin is constructing a tram in three phases. The proposed tram line will run along a 14 km corridor and will transform the mixed-use urban corridor along the western edge of the city. This is a TOD strategy that will bring urban development to the city as well as improve the quality of life of its residents. The company has also managed to use innovative financial mechanisms such as Tax Increase Financing (TIF).

Figure 56: Metro de Medellín, Medellín, Clombia. Source: ACI Medellín.

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[48] Metro de Medellín, Medellín, Colombia (2021).

Activity 2.2

Creation of an intersectoral committee for coordinated management of urban mobility and logistics

Dimension: Organisational Adjustments

Regional interconnectivity challenges were identified as limiting factors for local economic growth, mainly due to inefficient regional transport and supply chain networks. The poor state of intergovernmental coordination between the national and local level has posed obstacles to the proper functioning of metropolitan governance (RIDE Grande Teresina) and improvement of the regional transportation and logistics network. To enhance the city's connectivity with the wider region and the country, and thus improve the productivity and accessibility of the population to jobs, education, leisure, public services, and reduce hours lost in travel times, it is fundamental to advance not only in intra-city travel planning, but throughout the city's direct area of influence.

The city of Teresina is currently developing its Sustainable Urban Mobility Plan, but it requires additional efforts to improve metropolitan transport governance, urban logistics and the promotion of specific projects based on Transport-Oriented Development (TOD). Although it has previously conducted discussions on an urban logistics proposal, the city has not developed a logistics plan to guide the development and fundraising for the improvement of such proposals. Therefore, it is recommended to establish an intersectoral committee led by the planning department (SEMPLAN) to resume discussions on the creation of a municipal strategy to improve logistics and inter-regional connectivity. In addition to this strategy, this proposed body should also take on roles of promoting investments in the city and attracting businesses. Recognizing the clear interlinkages between mobility, economy and the environment, this committee should also work closely with the macro area of mobility and planning as well as the proposed public agency to manage transport operations with the aim of ensuring integrated planning for urban mobility, inter-regional connectivity, and logistics management.

What	Creation of an intersectoral committee for coordinated management of urban mobility and logistics.
Why	The challenges of local and regional interconnectivity are key drivers of low local economic performance. It is necessary to create a local agenda that resumes the discussions on a Logistics Plan for the RIDE Grande Teresina, and advances projects that improve regional mobility.
How	1. Set up a sub-group of the Resilience Commission to work on discussions for Urban Logistics led by the Local Transport Authority; 2. Revisit previous documents, meetings and plans on the issue of Urban Logistics; 3. Identify local and regional actors to be engaged in a forum to resume the debate on the Urban Logistics Plan; 4. Coordinate with the Fund-Raising Department to prioritise this activity and identify possible funding sources for the plan.
Who	**Lead stakeholders:** • STRANS. **Supporting Stakeholders:** • Resilience Commission; • SEMPLAN/SECREM; • SEMDEC; • STRANS.

Deliverables	**Short-Term:**
Creation of an intersectoral committee to discuss objectives and goals for local urban mobility and regional logistics policies. Identify possible sources of funding for an urban logistics plan and bring the topic onto the fundraising department's agenda;

Mid-term:
Successful fundraising for urban and regional logistics improvement plans and projects. Development of such plans and projects;

Long-term:
Improvement of regional interconnectivity, urban logistics, and therefore, of the city's productivity and attractiveness to new businesses, and enhance the local economy performance. |

Recommended Action 3:
City Rebranding for Enhanced Investment Attraction and Innovation

Teresina has tried to adopt an economic development strategy through its different levels of government; however, it is confronted with a lack of a comprehensive strategy to reinforce its own identities and the potential of its inhabitants. At the local level, the Teresina Competitiva programme aims to invest in potential sectors such as health, education, and the fashion industry. At the state level, the Piaui 2050 state-level economic development plan identified opportunity areas of investment for tourism, non-metal mining, and infrastructure. This plan was aligned with the Integrated Development Plan for Sustainable Development in Teresina. Yet, despite these efforts, a key ingredient is missing: a territorial development perspective and a city-rebranding strategy.

The idea behind city rebranding is, beyond creating territorial added value, to provide a common purpose, to draw on the city's unique trajectory to reshape local development. All cities have their own DNA and therefore have different traits including those that are endowed such as location, topography, neighbours, etc.; inherited such as infrastructure, land use, trade, etc.; and acquired such as institutions & governance, innovation, people and cultures, and innovation. A territorial approach for local development provides incentives for local industries to harness local techniques and raw materials in a sustainable way; to strengthen economic activities grounded in local culture and environment, especially by organising and implementing comprehensive value chains involving small and medium-sized businesses, cooperatives, financial and non-financial services, academia, and education and training structures.

This recommended action aims at using the DNA of Teresina to distil its uniqueness in order to guide the city to use branding in order to: i) promote the city; ii) create and inspire a sense of identity, place, and belonging; iii) unite the city with increased common purpose and social capital by producing new ideas and a vision of the future; iv) help the future of the city by designing new infrastructure building, projects, and develop them around the new discovered DNA; and v) position the city in relation to other domains. The action will allow it to operate within an organised territorial environment that enables the development of infrastructure, services, labour markets, finance, and innovation.

To construct the bases of this action, it is first necessary to generate inputs for the development of local capacities, through cooperation and learning between cities, an appropriate administrative organisation to allow for necessary skills to undertake this action, and the strengthening of discussion spaces and territory-based innovation ecosystems.

Inputs for Action

Activity 3.1

Prepare for the Future of Work

Dimension: Strategic Activities

Teresina had already begun the journey of digitalisation, open government, and several tech-accelerator initiatives. For instance, Teresina's Centre for Efficiency and Urban Sustainability (Centro de Eficiência e Sustentabilidade Urbana - CESU) has been exploring ways of making municipal services more efficient and facilitating an environment that is attractive for businesses and start-ups, as well as bringing many other benefits. Teresina's Tech Hub is another initiative by the municipality to promote tech industries and businesses in the city by supporting local start-ups and attracting external entrepreneurs. Nonetheless, it was pointed out by many actors involved in the workshops that the impacts of these initiatives have been quite limited, and meeting the anticipated aims and objectives of such initiative prove to be challenging due to multiple factors; digital illiteracy, poverty, lack of access to training and skills, and inadequate incentives for digitalisation by the government.

Therefore, this activity proposes a set of steps for the municipality to embrace ongoing global trends and prepare for the future of work while ensuring just and inclusive opportunities for all, and reducing inequality in access to work, opportunities and resources. Namely, the activity proposes to update teaching curricula from early stages of education through higher education, especially vocational courses. In addition, the city needs to provide capacity building services for the public, especially for vulnerable labour forces, in terms of alleviating digital illiteracy and reducing the digital divide. Devising incentives, especially financial ones, is also highly recommended to encourage more businesses to make the digital shift while linking these incentives to the extent possible to businesses and start-ups, which can help skills building and offer equal opportunities.

What	Prepare for the future of work.
Why	To cope with ongoing global trends of digitalisation and the consequent shifts in work, industries, and business, and prepare for the future of work while ensuring just and inclusive opportunities for all, and reducing inequality in access to work, opportunities and resources.
How	1. Set up a strategy for preparing for future of work in Teresina 2. Reduce digital illiteracy through updating education curriculum, and the integration of more ICT subjects and courses across all levels of education. 3. The municipality needs to provide publicly available courses and digital skills building initiatives accessible for everyone. 4. The municipality needs to promote more tech hubs and specialise accelerators, and expand existing initiatives. 5. Provide funding as incentives for tech businesses and start-ups. 6. Organise regular events, workshops, and hackathons in the city.

Who	**Lead stakeholders:**
	• Local Universities;
	• SEMDEC.
	Supporting actors:
	• SEMEC;
	• SEBRAE;
	• SEMPLAN/Agenda 2030;
	• SEMCOM;
	• Private Sector Representatives.
Deliverables	**Short-term:**
	Developed strategy on future of work in Teresina and priority actions by the municipality.
	Medium-term:
	Reduced digital illiteracy and digital divide; Increased tech businesses and industries in the city; Increased tech skills in the city.
	Long-term:
	Robust and resilient local labour force; prepared local economy for digitalisation and future of work; Fairer and more Inclusive access to work and opportunities.

Insights from CRGP Partner Cities

Comité Universidad Empresa Estado (CUEE), Medellín, Colombia

Medellin has worked hard on strengthening its university research system. To further strengthen the work by Universidad de Antioquia, in 2001, they held the first public sector, private, university meeting that focused on building a strategic alliance for development that aimed at raising awareness about innovation and the exchange of best practices in scientific-technological development. This event was successful and led to a second meeting in 2002 called Towards an Entrepreneurial and Innovative University.[49]

Parallel to these meetings, there were small gatherings between the Universidad de Antioquia and the private sector to discuss the implementation of research and development projects created by students at the university. The meetings continued and it soon became a committee led by the Universidad de Antioquia, the private sector (the current president of the committee is from well-known company Bancolombia), and the public sector (led by the Secretary of Economic Development).

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[49] Alcaldía de Medellín (2018).

Some of its achievements include:

- Contribution to increase in productivity and competitiveness of companies through R&D projects. First university spin offs and first royalty payments for knowledge transfer;
- Creation of institutions: Tecnnova Corporation for the commercialisation of university technologies. Entrepreneurship Park, for the promotion and incubation of technology-based companies;
- Business Roundtables, to make university research capabilities visible to entrepreneurs.

Figure 57: Committee – University, Business, and State (CUEE), Medellín, Colombia. Source: Alcaldía de Medellín (2018).

Activity 3.2

Set up a Local Economic Development Agency for Territorial Marketing (LEDA)

Dimension: Organisational Adjustments

Territorial marketing strategies seek to increase local attractiveness, especially in areas with scarce resources marked by micro, small business, informal and rural economies. This strategy is implemented through interventions that strengthen the territorial value while seeking to attract populations and activities to these territories to enhance the development of local resources. Thus, territorial marketing values productive, natural, cultural, social, and spiritual assets and communicates the territory's attractive elements, promotes its supply and thus improves the livelihoods of the local population, inserting them into the labour market in an integrated approach leveraging their knowledge and environment.

An effective communication strategy can stimulate new forms of demand based on the knowledge and appreciation of what the city has to offer, as well as contribute to the pride of its citizens by valuing their identity and local knowledge.

It is essential for the city to have a medium to long term strategy that is competitive in its environment and contributes to sustainable development leaving no one behind. Without a common strategy, the actions that are currently carried out in a fragmented way do not produce a transformative impact and do not reverberate the city's identity. However, the formulation of plans and programmes without building implementation capacity also becomes ineffective. Thus, it is necessary for the municipality to have a dedicated and empowered Local Economic Development Agency. The ILS-LEDA defines a LEDA to be, "a legal, non-profit structure, generally owned by public and private entities of the territory,

which acts as a mechanism through which local actors plan and activate, in a shared manner, initiatives for territorial economic development; identify the most convenient instruments for their realisation; implement a coherent system for their technical and financial support.[50]

Local economic development agencies are often better placed than municipalities to pursue economic development goals. In the case of Teresina, a LEDA could serve to leverage assets and private capital towards economic development goals and help with the branding of the city. A LEDA in Teresina can serve as an organising vehicle for territorial development activities, giving visibility to economic development work programmes, and distinguishing it from other activities. They are independent which gives them more flexibility in relation to strategy-making, partnerships, and coordinating a diverse range of public and private partners.

Beyond the goal of re-branding the city, a LEDA has a promotional role in order to attract external investment. An important reason for placing economic development activities in a LEDA rather than a municipal structure is the ability of the development agency to offer a business-like environment and service offering, and the scope to manage customer relationships in a business-to-business model.

What	Set up a Local Economic Development Agency for Territorial Marketing (LEDA).
Why	The municipality has struggled to implement its strategic economic development actions due to limitations in its organisational structure. The economic development department lacks the necessary resources and competencies to enable projects and coordinate the various actors required to leverage economic development strategies. Thus, the creation of a LEDA (Local Economic Development Agency) is proposed to overcome administrative limitations, facilitate knowledge exchange, conduct studies and coordinate multiple actors for context-specific economic development strategies.
How	1. Promote stakeholder buy-in through, for instance, consultation events, formal and informal networking and meetings, public events, as well as produce and disseminate publicity materials.
	2. Establish the LEDA, consolidate its mandate, and core tasks. The establishment of a clear mission for the LEDA is key to guiding its work and keeping it focused on the core tasks for which it was created. Making the scale and scope of the mission clear at the start is essential.
	3. Create a forward momentum by the proactive participation in the local development system as well as relevant institutional networks both domestically and internationally.
Who	**Lead stakeholders**
	● SEMDEC.
	● SEMPLAN.

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[50] www.ilsleda.org/en/services/implementing-strategies.html

Deliverables	**Short-term:**
	Established Local Economic Development Agency in Teresina.

Medium-term:

The development of Teresina re-branding strategy by the LEDA, and the identification of priority projects and initiatives.

Long-term:

Enhanced local market connectivity, improved local economic diversity by supporting local entrepreneurs, enhanced city's attractiveness for new businesses, and increased employment opportunities.

Insights from CRGP Partner Cities

Agencia de Cooperación y Inversión de Medellín - ACI Medellín, Medellín, Colombia

ACI Medellín is the entity responsible for the internationalisation process of the city-region of Medellín through the construction of strategic international relations, management of cooperation supply and demand, attraction of national and foreign direct investment and political advocacy as a local government, also known as city diplomacy.

Together with other actors in Medellín, such as Chambers of Commerce, trade unions and other entities of the public conglomerate of the Mayor's Office of Medellín, such as Ruta N, Greater Bureau Medellín and Plaza Mayor, the city's incursion into the international context is made possible. The agency strategic objectives are:

Cooperation

Articulate the international cooperation ecosystem of the city-region to generate value to actions that contribute to sustainable development (Agenda 2030).

Investment

Attract and retain national and foreign investment in the territory to strengthen local production chains to contribute to the generation of employment, competitiveness and sustainable development.

Positioning

Position the city-region as a strategic actor in the global agenda by managing international cooperation and attracting investment.

Knowledge

Add value through knowledge to innovate and make management more efficient.

Internal Management

To create an institutional management system that enhances the achievement of the entity's purpose.

Activity 3.3

Set up City-to-City local economic development cooperation for knowledge transfer

Dimension: Capacity Building Activities

Promoting the development of a territorial marketing strategy involves building local capacities and institutional arrangements that enable a sustained programme. The city should learn from initiatives of cities that have already satisfactorily developed their local development agencies and carried out inclusive and sustainable city rebranding models.

The city of Teresina must take opportunities offered by participating in LEDA networks and city to city cooperation. Being part of a city's network will generate opportunities for the mayor and other decision-makers to interact and exchange knowledge and practices for the city to develop tailor-made solutions. Often, by providing successful examples of urban interventions from other cities, decision-makers can envision the same achievements in their own cities and gain the confidence to implement them. Creating new administrative mechanisms is challenging for a city when officials do not know in depth how to implement these changes. Cooperation with cities that have already implemented similar actions facilitates the anticipation and resolution of problems and offers possible paths for their feasibility.

What	Set up City-to-City local economic development cooperation for knowledge transfer.
Why	Cooperation with cities that have been dealing with similar issues and already established their LEDA-like agencies can prove very useful in finding new and innovative ways in addressing issues related to local economic development, and knowledge and skills exchange. Such corporations also allow cities to learn from each other's' experiences - what works and does not work for a LEDA agency, whereby cities can avoid experimenting with new policies and projects that have proved unsuccessful in similar contexts, thus saving significant resources.
How	1. As it has been already recommended in Line of Action 1, Teresina needs to devise an international cooperation strategy, whereby the city maps existing cooperation agreements, and identifies new opportunity areas. Building on this, this activity proposes that the municipality has to identify LEDA networks, as well as city-to-city agreements through which the city can gain more knowledge and experience on how to establish its own Local Economic Development Agency (LEDA) and resources and skills it needs. 2. Teresina can offer, when possible, host one of the city's network events. 3. Participation in global events on urban development and planning are also valuable venues for the city to access such networks and initiate new city-to-city corporations in the field of local economic development.
Who	**Lead stakeholders:** • SEMPLAN/Agenda 2030. **Supporting actors:** • EMARI.

Deliverables	**Short-term:** Identified areas of cooperation in terms of local economic development, and potential related partners or networks to cooperate with. **Medium-term:** Developed necessary skills for a robust LEDA agency. **Long-term:** Highly skilled agency and staff capable of attracting notable business investments; improved market connectivity; Adoption of innovative policies and initiatives that support the diversification of the economy, preparing the city for the future of work, and better and just methods of integrating the informal sector.

Recommended Action 4:
Enhancing Access to Markets & Employment Opportunities for the Informal Sector

The economic and social costs of the pandemic exacerbated the vulnerability of employment in Teresina and the urgent need to accelerate the transformation of the labour market to raise productivity and match technological transformations. Teresina has been promoting capacity building through programmes such as Professional Training Programmes at FWF and Professionalise Women where they offer skills development courses in different areas such as ICT, Construction, Fashion and Beauty, and Event Organisation. It has also started Commercial and Creative Technology aimed at training, financing, and monitoring small entrepreneurs to use technological and communication resources to adapt to the new normal brought upon by the pandemic.

As mentioned before, the Popular Bank of Teresina, managed by the SEMEST, had an essential role in supporting the micro entrepreneurs, formal and informal autonomous workers by providing microcredit and training for business integration to the formal market and access to e-commerce.

Additionally, to have a more welcoming business environment, the National Government has been implementing policies and initiatives aimed at tackling administrative inefficiency and skills building. Some of the highlighted initiatives are Efficient Brazil and REDESIM, a services portal platform that brings together many public services with the aim of eliminating queues and reducing costs. The city of Teresina is following up with the national strategy and developing its e-government strategy. The COVID-19 pandemic accelerated this digital transition, and a vast majority of services are now available through online mode. Another step towards achieving an enhanced business environment is Teresina Competitiva; a strategy developed hand by hand with the World Bank and focusing on the biggest value chains in the city: healthcare, construction, and education.

The proposed activities under the previous recommended actions aim at creating jobs by diversifying the economy and increasing productivity through innovation. Activities under this recommended action aim at achieving a positive impact on the informal sector. The following activities seek to better integrate the informal sector in the local economy, protect labour rights in this sector, and gradually reduce socio-economic inequalities.

Inputs for Action

Activity 4.1

Commission a comprehensive study, in collaboration with academia and non-profit organisations, to understand and characterise the informal sector

Dimension: Strategic Activities

Informality is a challenging issue for the country, and, on its own scale, for the city as well. The city must work in coordination with other relevant stakeholders and take actions that can generate employment for the informal sector. To do this, it is necessary to know this sector better, with adequate research into its characteristics, needs and areas of opportunity.

The workshops held during the discussion phase for Actions for Resilience highlighted the need for research and studies focusing on the local informal sector, the last of which was conducted more than a decade ago. According to the last national survey, the state of Piauí has the 4th highest informality rate in the country, at about 56.9%, while the national rate was 40.6% (IBGE, 2021). There is also a lack of research conducted by the national research and statistics institute that understands the particularities of the sector beyond the big numbers.

The city of Teresina should examine trends and expected developments in the economy and job market such as consumption, hiring, and work patterns. The city must develop its ability to adapt to changing conditions in the economy and job market. The required strategy must therefore transfer the weight of the local economy to growth areas and offer technical and vocational training and retraining. The city can also encourage academic institutions and NGOs to work with underprivileged neighbourhoods and areas and serve as an anchor for local economic activity.

What	Commission a comprehensive study, in collaboration with academia and non-profit organisations, to understand and characterise the informal sector.
Why	The Brazilian informality rate is around 40%, while the state rate was almost 60% for the second half of 2021, the 4th highest in the country. Thus, in the Brazilian context, no sustainable economic development is possible without a special focus on this sector. To develop better projects and with the appropriate target audience, it is necessary to conduct specific research that understands the particularities of this sector.
How	1. Hire or partner with research institutions to develop a comprehensive survey of the informal sector in the city.
Who	**Lead stakeholders:** • SEMDEC. **Supporting actors:** • SEMEST; • Local universities.

Deliverables	**Short-term:**
	Commissioning the comprehensive study of the informal sector in Teresina.

Medium-term:

Comprehensive understanding of the informal economic sector, identified issues, drivers of informality, and areas of opportunities for intervention.

Long-term:

Better tailored actions to reduce vulnerability, reduced informality levels, and increased local economic resilience.

Activity 4.2

Position the Popular Bank (Banco Popular) as the anchor for providing support to SMEs and informal sector integration

Dimension: Strategic and Capacity Building Activities

The Popular Bank is a key provider of granting credits and grants to low-income populations. The provision of micro-credits and grants was fundamental during the COVID-19 crisis and helped rescue the city's self-employed population, and micro and small businesses. Supporting this economic sector, as well as the informal sector, is essential for a just and inclusive post-COVID-19 economic recovery and a more resilient future.

However, the Banco Popular, as many stakeholders pointed out, faces serious challenges that limit its role in supporting micro and small businesses as well as the integration of the informal sector. Mainly, the funding capacity of the bank does not match the level of demand for credits. The bank relies on credits defined in the municipal budget, which has limited resources. In addition, the bank lacks skilled professionals with capacities to make the bank's operations more effective and efficient, and skills to attract investments and new funding resources.

The existence and the role of Banco Popular represents a valuable opportunity to expand financial support to a fundamental sector of the local economy. Therefore, it is recommended that additional efforts by the municipality be made to improve the bank's structure and build skills that are crucial for maintaining and improving the role of this entity. It is recommended to expand the bank's total annual credit amount. Moreover, in order to position the bank as a main actor and a reference point for lending and offering grants, services offered by different departments within the municipality to similar clients – micro and small businesses and the informal sector - need to be integrated to the bank's competencies and services.

In doing so, higher degrees of resource efficiency can be achieved, and duplication avoided, supporting a reduction in bureaucratic burdens for citizens and making the process of navigating through available publicly offered grants and credits more user-friendly.

In addition, the municipality and the bank need to engage in closer cooperation with fundraising sectors to expand the bank's capacities to foster the local economy, becoming a reference place for supporting informal workers, encouraging formalisation and modernisation of small and micro-businesses. Simultaneously, the municipality should seek partnerships and cooperation for staff training as well as investments to improve facilities and efficiency of methods, service delivery and programme evaluation.

Other departments working with the same target public, such as SEMEST, SEMCASPI, SEMJUV, and SEMDEC must work in close collaboration with the bank to make sure that there is a designated task force working in creating programmes tackled at reducing the informal sector.

What	Position the Popular Bank (Banco Popular) as the anchor for providing support to SMEs and informal sector integration through enhanced human, technical, and financial capacities.
Why	The Popular Bank has been identified as a key institution, the gateway to strengthening vulnerable economic sectors. It had and continues to have an essential role during the economic crisis caused by the COVID-19 pandemic, proving to be a powerful policy to strengthen economic resilience. Its strengthening offers an area of opportunity to integrate this group into training programs, improve access to credit, professionalisation, formalisation, and facilitate access to rights and benefits. However, it has a limited credit supply, which needs to be re-evaluated especially after the post-financial crisis period. Moreover, the diagnosis showed that its operational capacity is limited, requiring more technical capacity to increase the supply of microcredit, which is also associated with better management mechanisms. A resilient city must be inclusive, and thus accommodate vulnerable sectors with properly adapted programs.

How

Enhanced Technical Capacities:

1. Define a task team that will coordinate the action including supporting stakeholders;
2. Elaborate a mapping of all municipal services and those of partner entities dedicated to SMEs and informal sector integration to be structured within a service package to be offered in an integrated manner under the Bank" umbrella;
3. Include, in the study proposed in the previous activity, an assessment of needs and gaps for enhancing service provision, indicating both areas for technical, technological and organisational improvement for the Popular Bank;Prepare, in collaboration with training i
4. Institutions as FWF, National/State-level School of Government, or local Universities, a training programme for enhancing technical skills and service provision;
5. If necessary, prepare a proposal for organisational improvement, recruitment of professionals from key areas and technology acquisition.

Enhanced Financial Capacities:

1. Create a task force to analyse the results of the studies conducted in the previous activities and re-dimension the credit offer and benefits granted by the bank, adjusting its budget allocation;
2. Research other sources of government funding that could expand the bank's credit offer;
3. Apply for national and international funds and grants for the improvement and upgrading of the bank's services, as well as its physical facilities and equipment.

Who

Lead stakeholders:

- SEMEST;
- Banco Popular (Popular Bank).

Supporting actors:

- SEMA;
- SEMGOV;
- SEMPLAN/SECREM;
- SEMPLAN/SEPLAG;
- Local universities;
- Financing Institutions;
- Development Aid Institutions.

Deliverables

Short-term:

Designed an integrated package of service delivery to SMEs and informal sectors under the umbrella of Banco Popular. Commissioned a study to assess the technical, technological and human resource bottlenecks of Banco Popular. Identification of possible funding sources for the expansion of Banco Popular's credit offer.

Medium-Term:

Development of an institutional redesign for Banco Popular, contemplating the expansion of the credit offer, the integration of services, improvement of the technical staff, of technology and physical space, and the communication strategy with the target public.

Long-Term:

Strengthening the local economy through the support of local micro and small businesses, informal sector integration, stimulating local economic diversification and improving the city's economic performance.

Activity 4.3

Awareness-raising campaign for access to credits, grants, and skills through civil society engagement

Dimension: Awareness Raising Activities

The local government of Teresina provides public services to offer microcredit and grants to formal and informal self-employed entrepreneurs through the Banco Popular de Teresina (BP). By August 2019, an amount of R$1,863,172.98 has been provided through microloans (DRPT diagnosis findings). These loans are accompanied by training actions, business formalisation, and introduction to e-commerce.

Nevertheless, the diagnosis identified opportunities to expand this strategy, especially in the post-COVID-19 economic recovery and the need to assist micro-entrepreneurs and workers in the informal economy. This scaling-up requires a better targeting and awareness-raising strategy to engage the target profile. In addition, it is an opportunity to identify services that can be offered as a package and thus enhance the supply of microcredit associated with other benefits that could be useful to the most vulnerable economic sectors facilitating access to information and benefits. Therefore, a bold, continuous, and integrated action is proposed to offer integrated packages to micro-entrepreneurs in order to increase local entrepreneurship and more formal job opportunities.

What	Run awareness-raising campaigns, in collaboration with the civil society, on access to credits, grants and skills.
Why	Although the municipality offers specific services aimed at the micro and small entrepreneurs, as well as support for formalisation and assistance to informal workers, their awareness and access to the service is still limited. The service does not have an adequate targeting and outreach strategy, which is necessary for efficient service delivery. It is also convenient to unify several services offered separately, to facilitate public's adherence.
How	1. Conduct a study mapping the services offered, the profile of users and trends in access to services; 2. Conduct surveys among the target audience to understand main bottlenecks in awareness and access to the services, including the key communication channels with target audiences and their service interests; 3. Prepare a strategy to offer service packages to different profiles of potential users, identifying and solving access problems identified in surveys and studies; 4. Prepare a communication strategy compatible with the target audience and its main communication channels.
Who	**Principais partes interessadas:** • SEMEST; • Banco Popular; • SEMCOM. **Outros atores envolvidos:** • FWF; • Universidades locais.
Deliverables	**Short-term:** Design and implementation of an annual calendar of campaigns for the target audience of Banco Popular. **Medium-term:** Increased target users' access to the Popular Bank products and services. **Long-term:** Strengthened local micro and small businesses sector, as well as enhanced assistance for formalisation of the informal sector, which will lead to local economic diversification and improved city's economic performance.

Considerations
& Next Steps
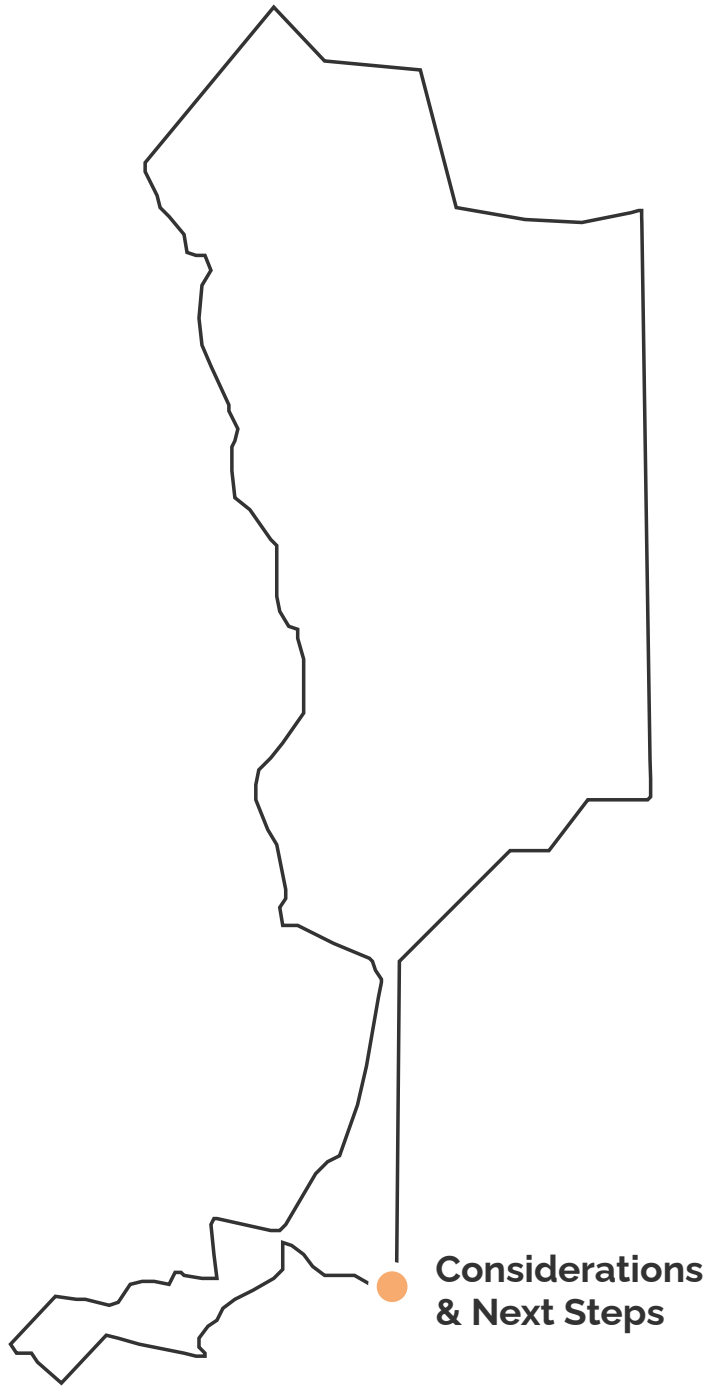
Considerations
& Next Steps

Considerations & Next Steps

This document brought forward Teresina's urban resilience project that was implemented with the support of UN-Habitat City Resilience Global Programme (CRGP). The project aimed to construct a road map of actions and activities through which the municipality can address issues and matters that render the city and its inhabitants vulnerable to various forms of risks, hence enhancing and boosting Teresina's capacities for resilience. To that end, the project started with a resilience baseline assessment, bringing together local knowledge through stakeholders' workshops with tailored indicators-based data gathering. The outcome was a set of matters identified as priorities for the city to resolve. Building up on the assessment analysis and diagnosis, the project then developed a roadmap of actions and activities to enhance resilient and sustainable urban development. This roadmap was the fruit of a close collaboration among a broad array of related actors and stakeholders coordinated closely by UN-Habitat CRGP and Teresina's municipality.

The urban resilience diagnosis shed light on three key matters at which multiple drivers of hazards interplay, reinforcing each other and generating new sources of risks and vulnerability for the city. These priority matters are mismanagement of the water cycle, ecosystem imbalance, and economic underperformance. In addressing these priority matters, three lines of actions were laid out by the project's partners and participants. While two lines of actions focused mainly on the interlinked issues of water cycle mismanagement and ecosystem imbalance, a third line of action was composed of a set of integrative and transversal actions that can further institutionalise resilience planning and consideration in policy and decision making at the local government level.

Despite the city's limited resources and the multiple challenges and constraints encountering the municipality, Teresina has already initiated several ambitious plans and projects to boost resilience and sustainability. Therefore, the proposed actions in this report, build upon the ongoing initiatives and seek to improve and enhance their impacts through more integrated governance and well-coordinated efforts.

However, a marked observation throughout this project's different phases has been the misalignments between plans and projects implementation in the city. More specifically, while the municipality has advanced policies and plans in place to resolve some of the key matters for resilience and sustainability, these initiatives in many cases fail to be implemented as planned, thus undermining their expected outcomes. Therefore, the actions recommended in this document are an attempt to fill this observed gap between policy and implementation in Teresina.

The next step along this path is the formulation of an implementation strategy, including a monitoring framework. Such a strategy should provide a guide for all municipal departments and local stakeholders on how Teresina's urban resilience project should be implemented, ensuring that its policy goals are met in an effective, efficient and inclusive way. The monitoring framework will serve as a means for the stakeholders, in charge of leading each part of the strategy, to ensure proper execution of actions and activities according to an agreed upon time plan. This will require another round of inter-departmental and cross-sectoral dialogue and agreements in the city, set to be led by Teresina's Agenda 2030, the Resilience Commission, and in collaboration with CRGP, on an implementation strategy, and targeted monitoring framework.

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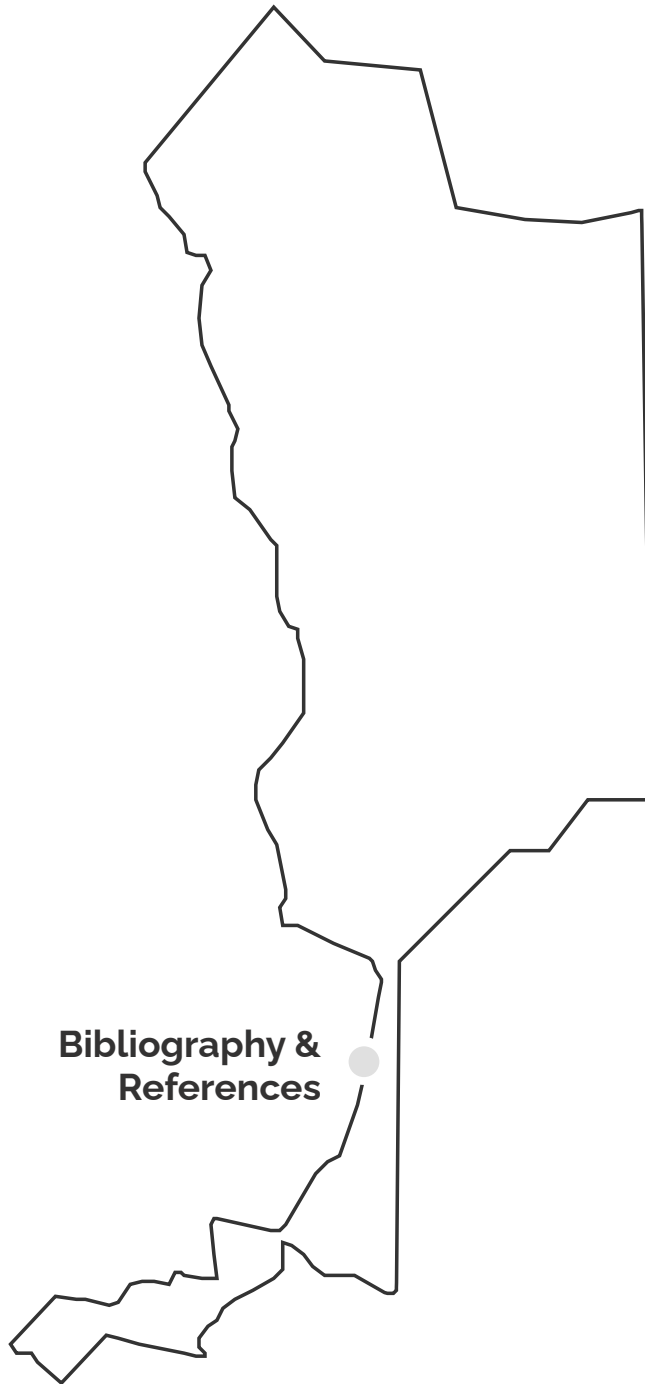
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Risks and Priority Matters Workshop in Teresina

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Annex I
Risks and Priority Matters Workshop in Teresina

Introduction

This annex explains the approach, methods and techniques adopted by CRGP for the purpose of identifying the various types of present and projected risk in Teresina. It, further, displays the outcomes and findings of this approach and related activities in terms of shocks and stresses identification, and mapping priority matters for enhancing urban resilience in the city.

1. CRPT conceptualization of risks

As explained in the introduction part of this report - CRPT methodological framework -, the Why Lens: Shocks, Stresses and Challenges, provides analysis regarding the existence of, and interactions between shocks and stresses in the presence of existing challenges and constraints in the city. The outcome of this analysis is provided in detail in Chapter 2 - The Current State of Urban Resilience in Teresina.

CRGP defines shocks as Uncertain, abrupt, or long-onset events that have the potential to impact upon the purpose or objective of an urban system.

Stresses are Chronic and ongoing dynamic pressures originated within an urban system with potential for cumulative impacts on the ability and capacity of the system to achieve its objectives.

Challenges, while not considered entirely as risks, are Long-term contextual changes and pressures originating outside the urban system that also undermine the city's capacity for sustainability and resilience.
The relationship between stresses, shocks, and challenges, can be expressed as follows:

- Stresses increase the vulnerability of the city to potential shocks
- Shocks see their impacts compounded by the stresses that the city suffers and they have the potential to generate new stresses if they were not properly responded to.
- Challenges limit or constraint the potentials and options available to the city and local authorities to adequately address stresses and manage the risks of shocks .

As it could be seen, these different forms of risks and threats do not operate in isolation in the urban system. It is important to recognize these relationships when building resilience as proposed actions should reduce vulnerability and help mitigate the impact of an external event. Consequently, the city's ability to regain its pace of performance must be improved. Through exposing the risks that Teresina faces, interactions among risks and the components of the urban system can be drawn – the understanding of which are essential for designing actions seeking to build the city's resilience. A resilient city is one that considers how these various risks affect each other and therefore highlight priority matters to be addressed in order to achieve maximum impact.

To this end, CRGP in close coordination with the Municipality of Teresina adopted an approach for identifying the different types of present and anticipated risks in Teresina, and exploring their underlying drivers and consequent effects. This approach relied mainly on a series of consultation workshops with the different municipal departments in Teresina. This was preceded by the formation of a Monitoring Committee for the Urban Resilience Program of the Municipality of Teresina, instituted through the Municipal Ordinance in December 2018. Composed of 21 civil servants from 14 secretariats, executive secretaries and foundations of the Municipal Administration, the Monitoring Committee, also called the Resilience Committee, was instrumental in building a local panorama of risks, by obtaining data needed for subsequent analysis.

The following sections will describe these consultative activities in detail, and display their findings on which Chapter 2 – the Current State of Urban Resilience is based. The design and organization of these workshops was as follows:

- 3 workshops aimed at identifying and characterizing shocks, mapping their impacts on the urban system, and existing risk reduction measures in Teresina.
- 2 workshops aimed at mapping funding and financial capacities by the local government for emergency response and recovery.
- 2 workshops for identifying and characterizing ongoing stresses, mapping their effects across the urban system, and their role in aggravating the impacts of shocks on the city.
- 1 workshop for the final mapping of the interrelations between shocks, stresses and the urban system in the presence of enduring and emerging challenges in Teresina, towards defining Priority Matters for resilience building in Teresina.

	Theme	Date	Nº of participants
Workshop 1	Program Presentation and Shock Identification	June 16, 2020	14
Workshop 2	Following up – the H.A.R.D platform progress on shock Identification	June 23, 2020	11
Workshop 3	Following up – the H.A.R.D platform progress on shock Identification.	June 30, 2020	10
Workshop 4	Finance for DRR	July 7, 2020	11
Workshop 5	Finance for DRR	July 22, 2020	12
Workshop 6	Stress Identification	August 5, 2020	15
Workshop 7	Stress Identification	August 11, 2020	11
Workshop 8	Consensus building on Priority Matters	August 18, 2020	19

2. Shocks in Teresina: Workshops 1-5

Workshop 1	
Date:	16/6/2020
Participation mode:	online

It should be noted that due to COVID-19 restrictive measures imposed by the municipality, in-person workshops were not possible. Therefore CRGP carried out online workshops using Google Meet.

The first workshop was dedicated to presenting the Teresina Resilience Program and the Program Implementation timeline, followed by an introduction to the City Resilience Profiling Tool (CRPT) and its systems thinking based approach to risks and resilience. This workshop represented a training opportunity for the different representatives with the purpose of comprehending the different types of risks CRPT considers in its analysis and how this is utilized in order to draw urban resilience diagnosis.

In addition, the first workshop introduced the means and tools to be used for populating data on shocks in Teresina. Specifically, the participants of the workshop (Teresina Resilience Committee members) were trained on how to use the H.A.R.D platform, an online tool through which data and information on the different types of shocks are input as an alternative for in-person data collection.

Participants were asked to provide data on location, frequency and intensity of events, as well as their impacts on people (e.g. life loss and injuries), assets (e.g. properties and economic losses) and processes (e.g. disruption of urban services). Further, participants were asked to provide information on measures in place per each shock identified, such measures were risk reduction related and existing policies plans and initiatives for addressing the plausible threats and their impacts.
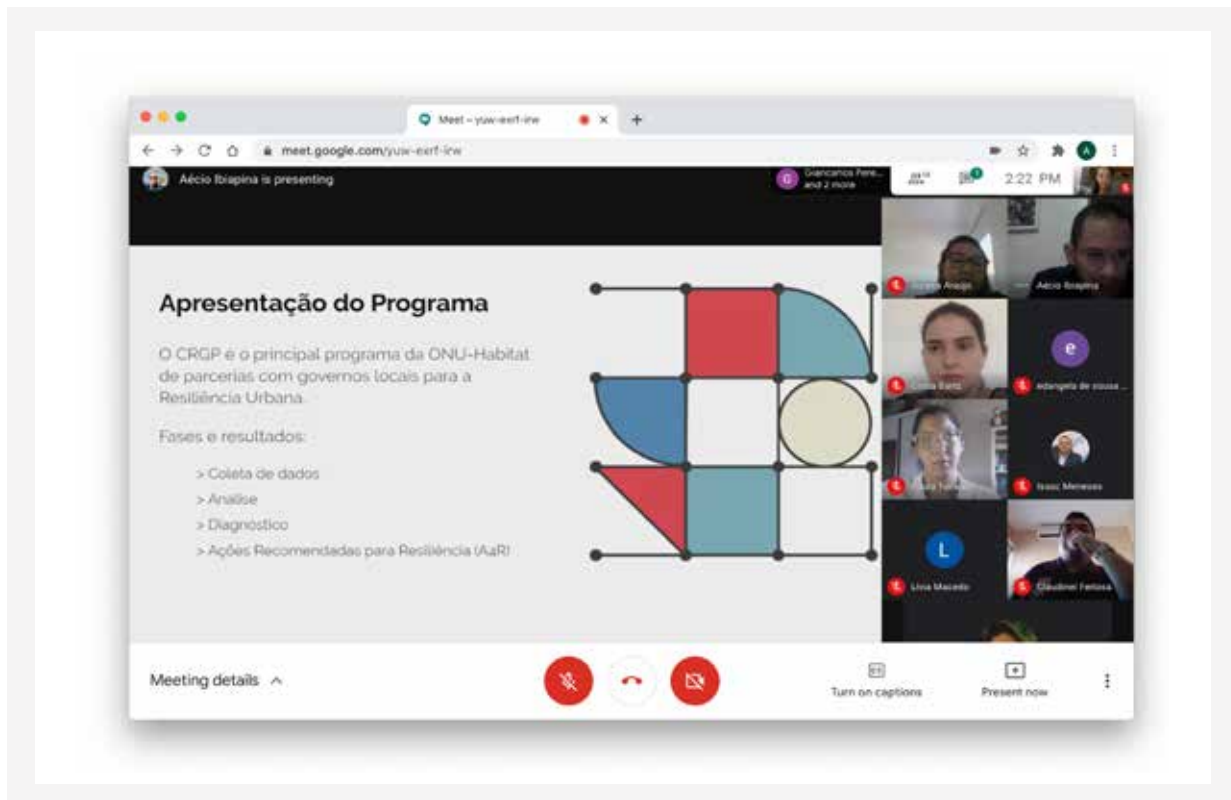
Figure 1: Snapshot of workshop 1.
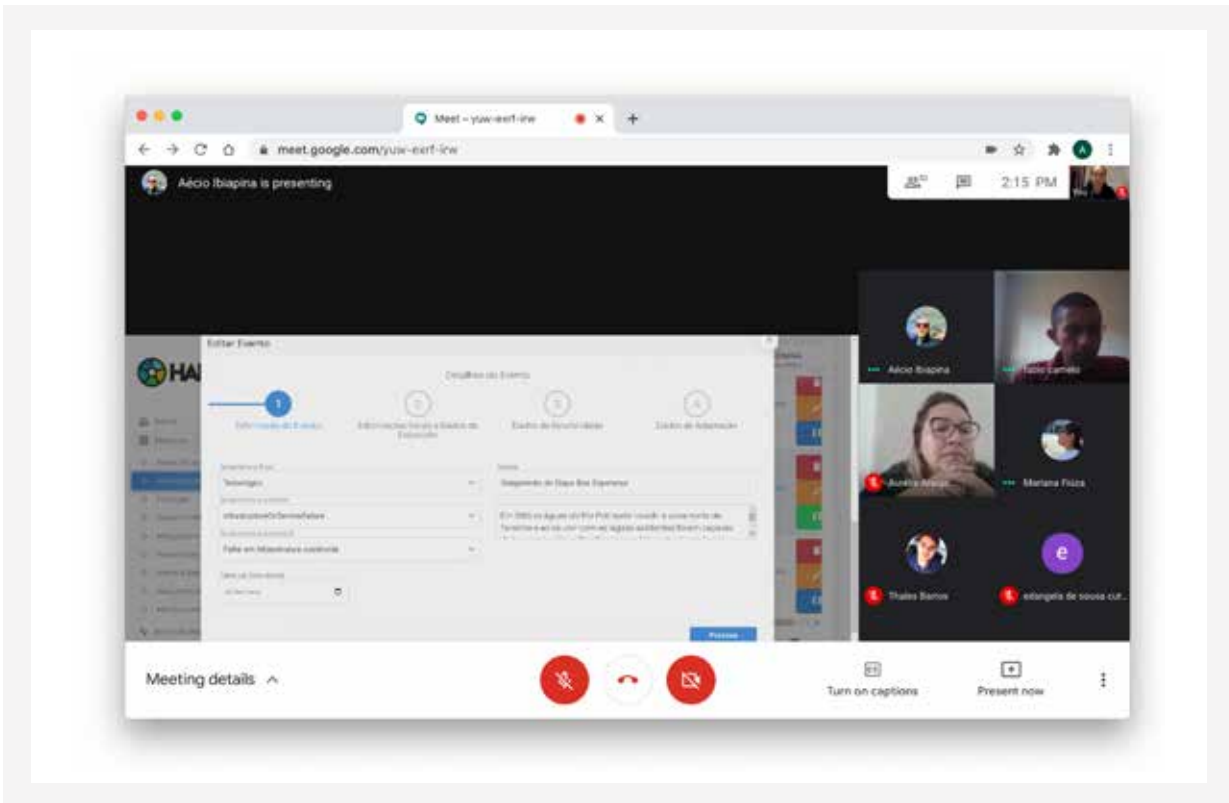
Figure 2: Snapshot of workshop 1.
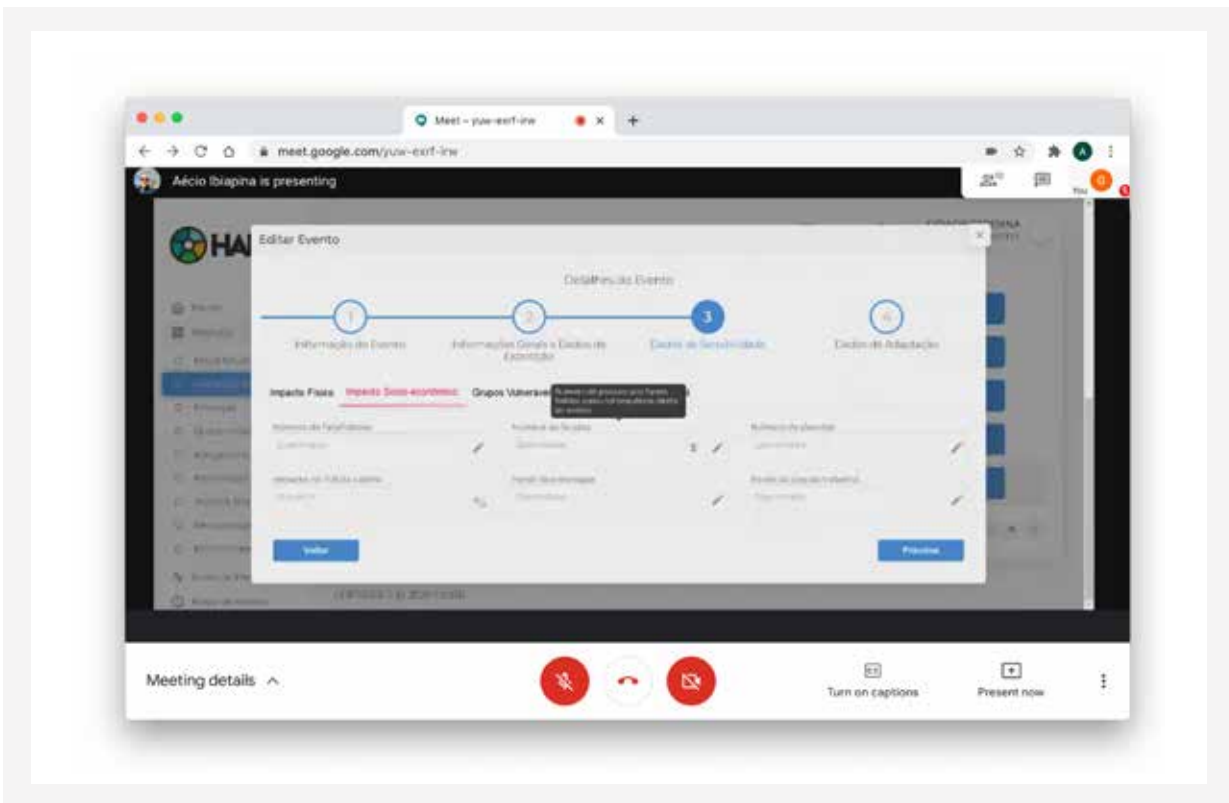
Figure 3: Snapshot of workshop 1.

Workshop 2 and 3

Date:	23/6/2020 and 30/6/2020
Participation mode:	online

Over the course of two weeks, the members of the Committee filled in information regarding events characterized as shocks, which occurs in Teresina, using as reference a non-exhaustive list of shocks provided by CRGP.

Building off of UNDRR's 2017 terminology and taxonomy on hazards, CRPT considers six main groups of shocks, of which four (Natural, Biological, Environmental and Technological/Man-made) are consistent with UNIDRR's taxonomy. In addition to these four groups, CRPT's non-exhaustive list includes complex shocks as well as societal shocks that seek to capture a range of potential socio-economic, socio-spatial, or socio-cultural shocks to which a city may be prone. Figure 02 below graphically represents the organization of potential shocks evaluated as a part of the CRPT implementation.

Two workshops took place on June 23 and June 30 for following up the process of data populating and clarifying the different doubts participants had as well as technical issues they encountered.
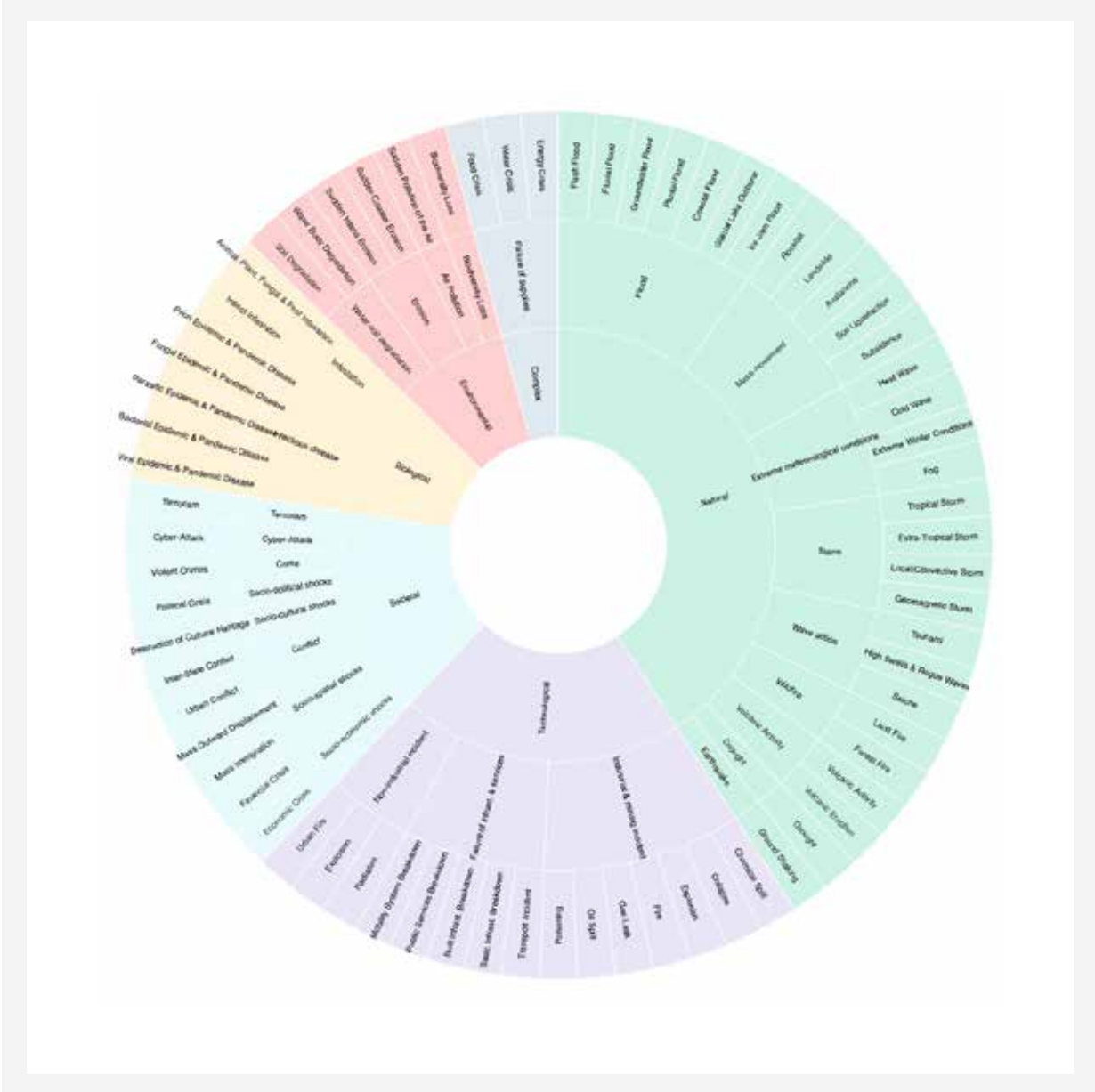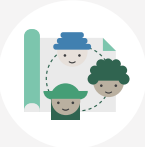
Figure 4: CRPT wheel of potential shocks affecting urban areas.

Workshop 4 and 5
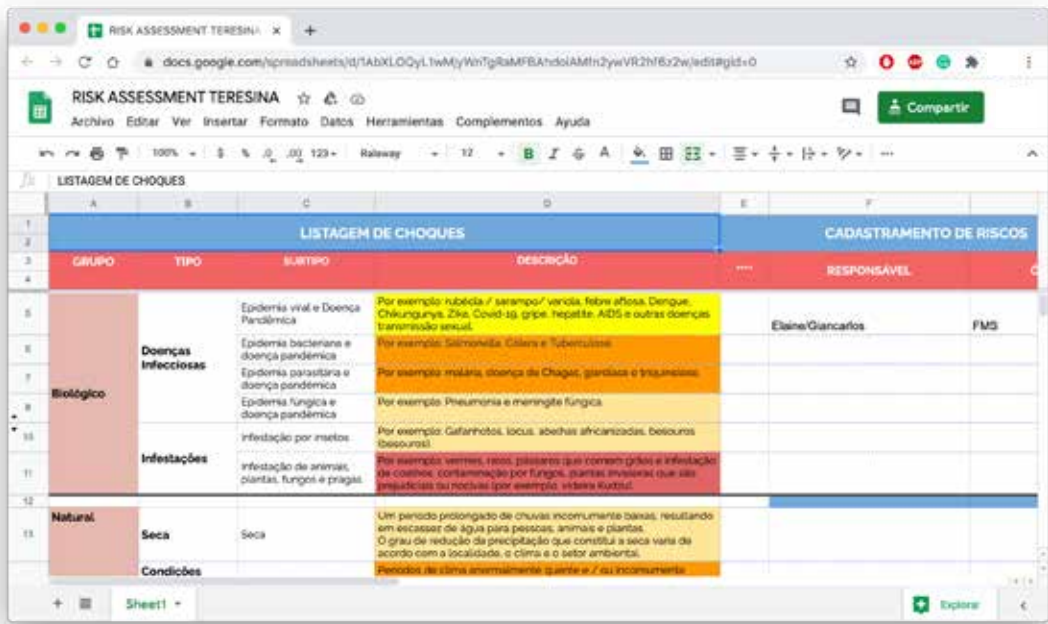
Date:	7/7/2020 and 22/7/2020
Participation mode:	online

In the first week of July, another function of the platform was introduced to the Committee, to initiate a financial evaluation of the registered events, divided into historical events, current data and forecasted data. Two weeks were dedicated to searching and filling out financial information related to shocks, before proceeding with the introduction of a new type of risk: stresses.

Through weekly meetings, the team was able to assess progress in registering risks and events, and clarify any possible doubts. After two weeks, 82 shocks had been registered on the platform, ranging from natural to health and financial shocks. Drawing on the impacts of each shock identified on people, processes and assets, and considering the climate change projection and its implications for each shock identified, participants were asked to qualitatively characterize the seriousness of each shock in the list on a scale from low to high (low risk/yellow, medium risk/ orange, high risk/ red).

While the aim of these categorization was to prioritize those shocks with higher risks on the urban system, less significant ones have been also considered in understanding how multiple threats can interplay in the presence of stresses and challenges. Nevertheless, this categorization proved useful in making the subsequent workshops and discussions very focused.

Figure 5: Snapshots of the list of Identified shocks in Teresina. The full table is accessible through the following link: www.docs. google.com/spreadsheets/d/1AbXLOQyL1wMjyWnTgRaMFBAhdoiAMfn2ywVR2hf6z2w/edit#gid=0

Based on this characterization, the most serious shocks given their current and anticipated effects are illustrated in figure 3.
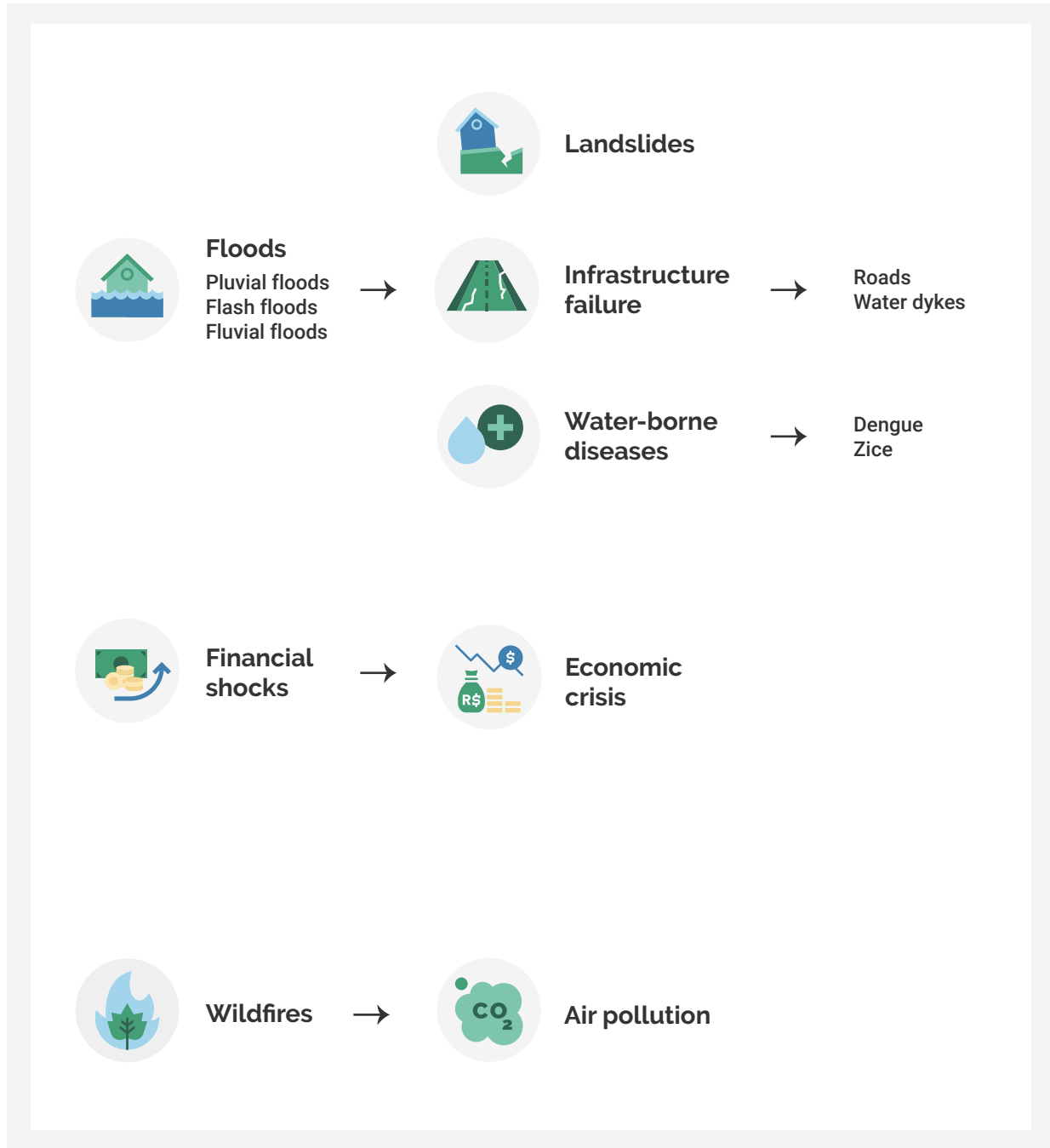
Figure 6: Priority shocks in Teresina and secondary shocks – events triggered by the occurrence of the priority shocks.

3. Stresses in Teresina – Workshops 5 and 6

Workshop 6	
Date:	5/8/2020
Participation mode:	online

In this workshop, participants were introduced to stresses and how they differ from shocks with which most of attendees were already familiar, the interlinks between shocks, stresses and the urban system, and CRPT's approach to identifying stresses, as well as their role in the analysis process and diagnosis. To enhance participants' comprehension of these different concepts and ensure that everyone distinguishes between the different types of threats, attendees were invited to participate in an online activity using the Menti tool.

Stresses identification

Using Menti, participants started to list down different stresses they viewed relevant to the context of Teresina building on their knowledge and experience in their respective fields within the municipality. As a result, 34 stresses were identified as to be present in Teresina and causing major pressure on the urban system (see table 3 – the initial list of identified stresses in Teresina).
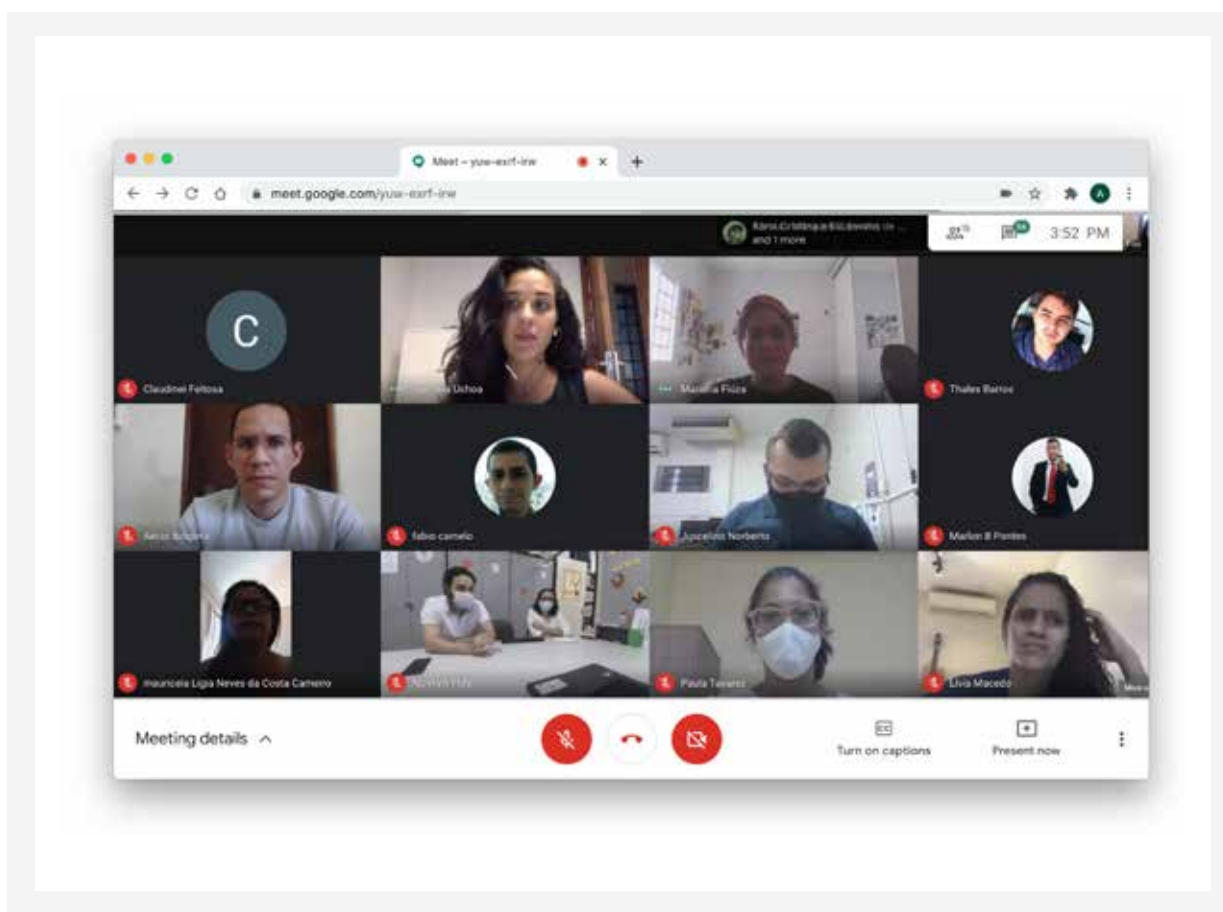
Figure 7: Snapshots of Menti tool during the workshop.

Despite the extensive introduction to the concept of stresses and how they differ from shocks, many conflated some shock events with stresses. Moreover, some participants got confused when they were asked to separate between stresses and stressors (Factors, processes, activities or interactions that individually or conjointly lead to the generation of a stress in the urban system).

Stresses in Teresina (Portuguese)	Stresses in Teresina (English)
Perda de cobertura vegetal do município de Teresina	Loss of vegetation cover in the municipality of Teresina
Gestão ineficiente do transporte público	Inefficient public transport management
Sistema de Drenagem Ineficiente	Inefficient Drainage System
Pouca cobertura da rede de saneamento básico	Poor coverage of the basic sanitation network
Despejo de Esgoto nos Rios	Untreated Sewage Disposal in Rivers
Greve de Operadores do Sistema de Transporte Coletivo	Public Transport System Operators Strike
Ilhas de Calor agravadas pela baixa cobertura vegetal	Heat Islands aggravated by sparse vegetation cover
alta ocupação hospitalar por vítimas de acidentes de trânsito	high hospital occupation by traffic accident victims
Uso irregular das calçadas	Irregular use of sidewalks
Formação de ilhas de calor superficiais	Formation of surface heat islands
Falta de acessibilidade nos passeios públicos	Lack of accessibility on public sidewalks
Falta de arborização em passeios e ciclovias	Poor afforestation on sidewalks and cycle paths
Dificuldade de monitoramento e cumprimento de prazos de execução de serviços públicos	Difficulty in monitoring and meeting deadlines for public services
Aumento da área de solo exposto	Increase of exposed soil area
Ineficiência nos processos de gestão e proteção do patrimônio construído e natural	Inefficiency in the management and protection of built and natural heritage
Crescimento econômico não-saudável e desemprego	Unhealthy economic growth and unemployment
Alta ocorrência de crimes urbanos como assaltos, furtos e agressões	High occurrence of urban crimes such as assaults, thefts and harassment
Distribuição irregular de cobertura vegetal	Irregular distribution of vegetation cover
Baixa capacidade de manutenção de espaços públicos	Low public spaces maintenance capacity
Casos frequentes de tentativas de suicídio	Frequent cases of suicide attempts
Pobreza Concentrada	Concentrated Poverty
Segregação Espacial	Spatial Segregation
Cobertura inadequada dos serviços de saneamento básico	Inadequate coverage of basic sanitation services
Discriminação de gênero	Gender discrimination
Má gestão do metabolismo urbano	Poor management of urban metabolism
Diversificação econômica inadequada	Inadequate economic diversification

Baixa diversidade em indústrias e manufaturas	Low diversity in industries and manufactures
Economia informal	Informal economy
Urbanização rápida e irregular	Rapid and irregular urbanization
Incêndios Florestais Recorrentes	Recurring Forest Fires
Altas taxas de crimes	High crime rates
Falta de políticas urbanas integradas e coesão institucional	Lack of integrated urban policies and institutional cohesion
Focos de incêndios urbanos	Urban fires
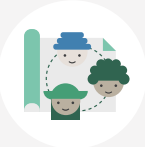
The last part of the workshop was dedicated to filling up a questionnaire regarding each stress identified. The aim of having this questionnaire was to allow participants to provide in-depth information on the stresses they deemed serious in Teresina. The findings of this questionnaire were used as a basis for extensive desk research by the CRGP team aimed at enriching the discussion and debate in the subsequent workshop (workshop 7). Figure 5 illustrates snaps of the online questionnaire attendees filled up. For each stress listed, each of the civil servants had to answer the following questions:

- Enter the name of the stress

- In your opinion, what are the causes or drivers of this stress?

- Has this stress led to any shocks in the past? if so, specify the type of shocks caused.

- Does this stress have the potential to cause shocks in the future? If so, specify which shocks.

- If possible, specify the approximate number of people affected daily / monthly / annually.

- Which areas / neighborhoods are most affected by this stress?

- If possible, specify what the estimated economic losses caused by stress daily / monthly / annually are?

- Has the municipality (or any other levels of government) taken any actions to deal with this stress so far? If so, briefly describe these actions.

- What are the challenges the municipality faces that limit effective actions in relation to this stress?

Figure 8: Snapshots of the online Stresses questionnaire.

Workshop 7

Date:	11/8/2020
Participation mode:	online

Prior to this workshop, the CRGP team carried out a process of bringing together the findings of workshop 6. To that end, the 34 stresses identified were reviewed. Duplications and overlaps were eliminated. The list was split into those considered stresses according to CRGP, and to those considered their respective stressors or drivers. Combining the outcomes of the discussion, the surveys and the desk research, the list of stresses was reduced to 9 stresses. The links between each stress and its drivers/stressors were mapped.

The initial nine stresses identified are:

- Biodiversity loss
- Poverty and inequality
- Mismanagement of urban metabolism
- Inadequate management of urban mobility system
- Inadequate municipal public services
- Safety and crime
- Rapid unregulated urbanization
- Unemployment and Inadequate economic diversification
- Inadequate coverage of sanitation networks
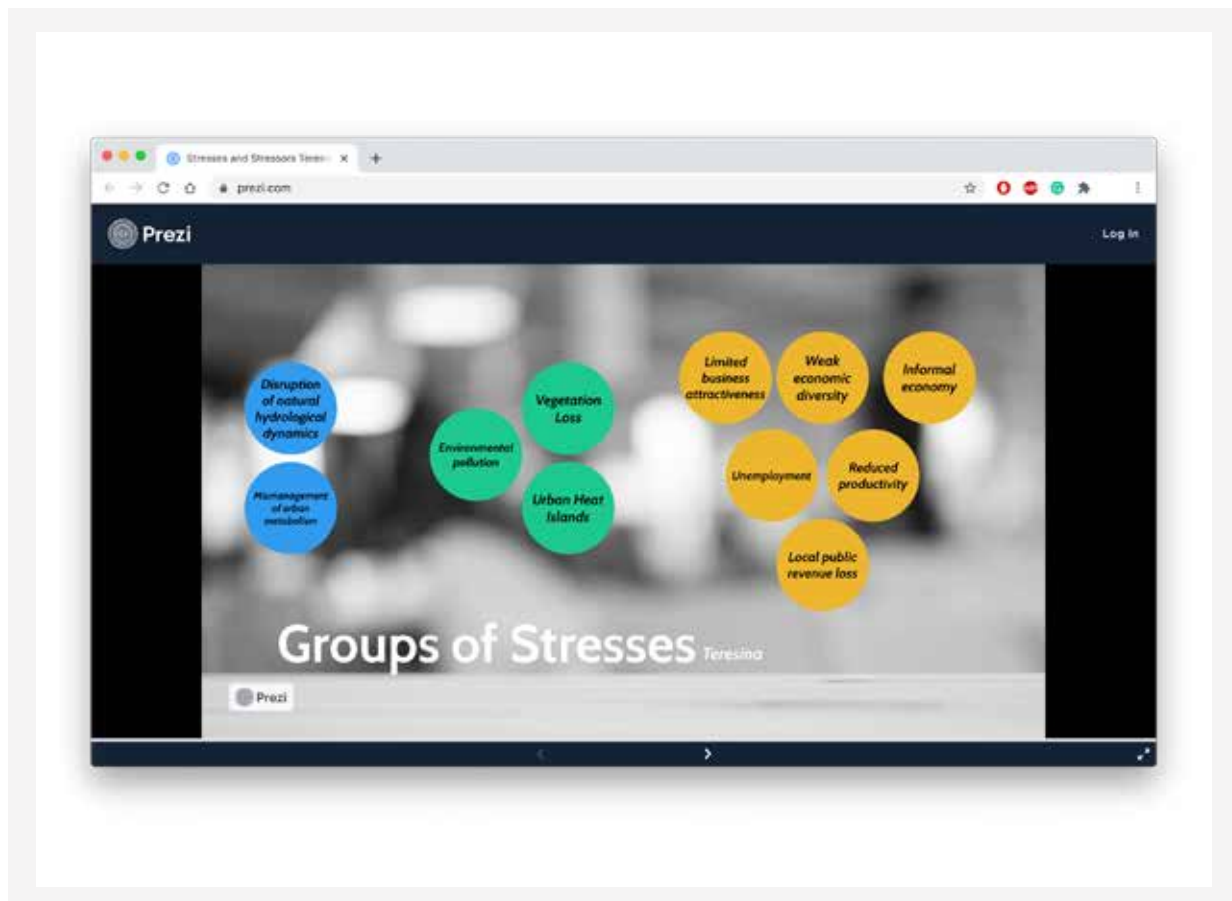
Figure 9: Stresses and stressors in Teresina (snapshots).
To access the mapping, use the following link: www.prezi.com/view/cl0aI515jXOsLheGbNNI
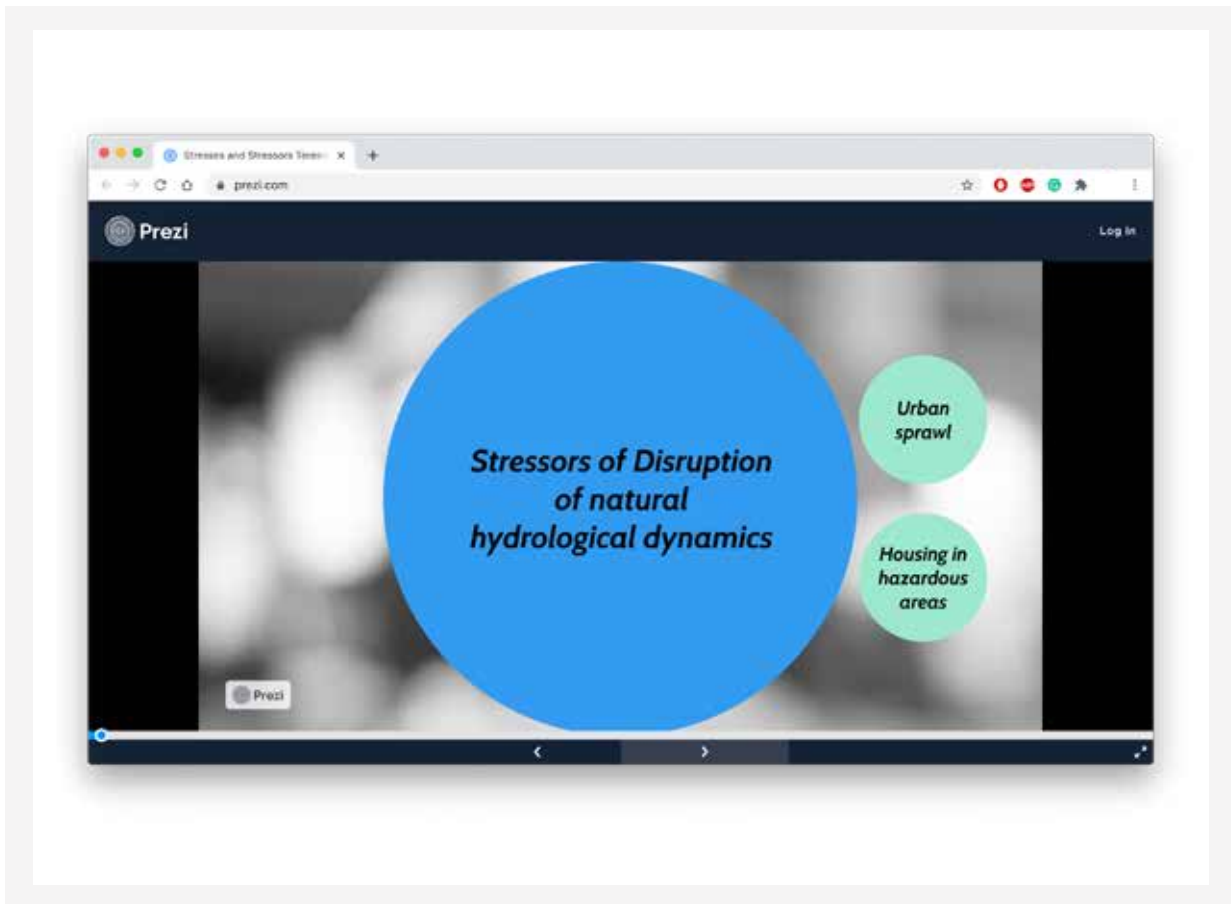
Figure 10: Stresses and stressors in Teresina (snapshots).
To access the mapping, use the following link: www.prezi.com/view/cl0aI515jXOsLheGbNNI
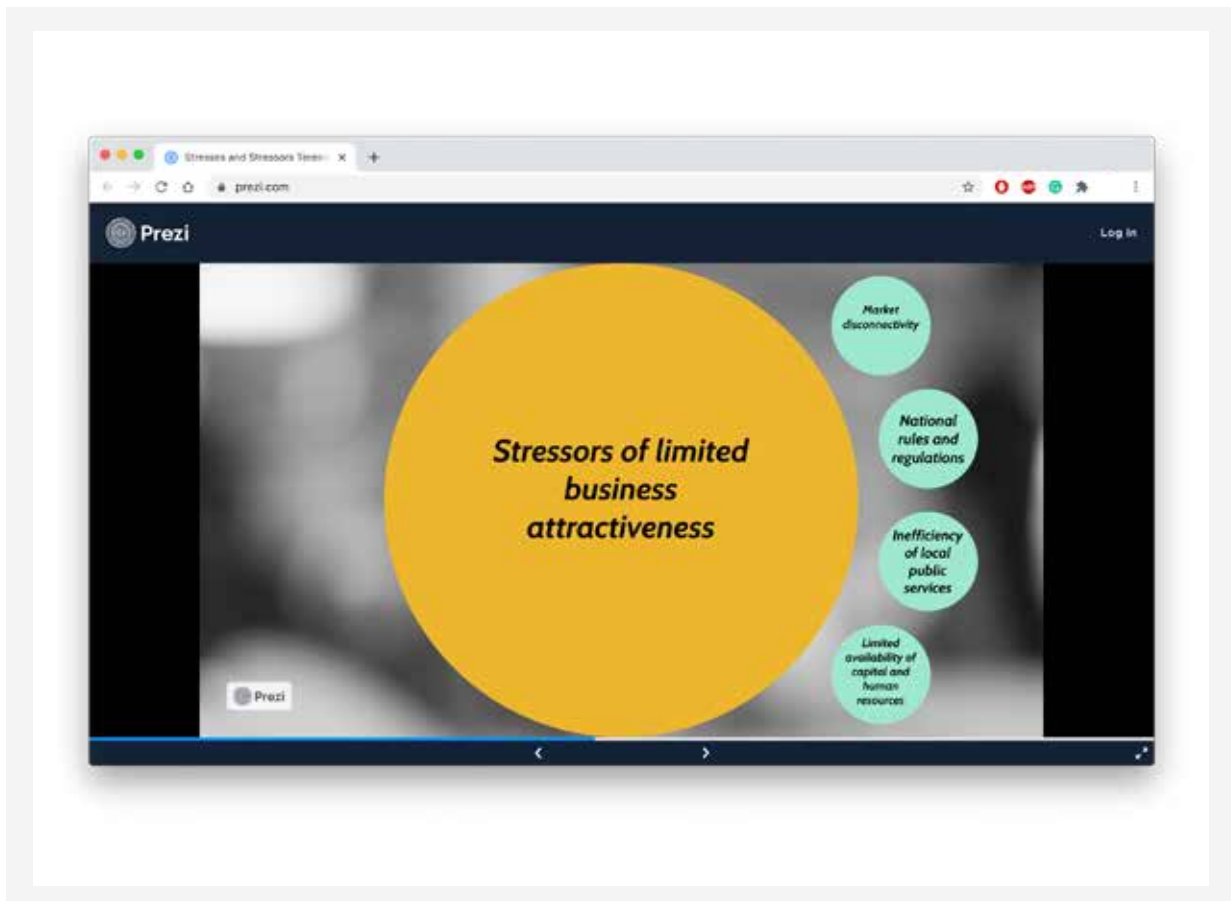
Figure 11: Stresses and stressors in Teresina (snapshots).
To access the mapping, use the following link: www.prezi.com/view/cl0aI515jXOsLheGbNNI

These new results were then presented to the Teresina Resilience Committee during workshop 6 for review, comments and debating. While overall the mapping was verified as accurate by most of the workshop's participants, some links were re-drawn and re-characterized. As a result, the list of stresses was reduced to only 8 main stresses (illustrated in table 4). A more extensive discussion on each stress and its underlying drivers took place. These discussions proved quite informative for the analysis and diagnosis in Chapters 02 and 3.

Stress	Stressors
Disruption of natural hydrological dynamics	● Urban sprawl ● Housing in hazardous areas
Mismanagement of urban metabolism	● Solid waste management ● Wastewater management ● Inefficient stormwater solutions
Environmental pollution	● Water contamination ● Soil degradation
Vegetation Loss	● Deforestation ● Urban vegetation loss ● Inadequate green infrastructures and nature-based solutions
Urban Heat Islands	● Inadequate green cover ● Impermeable surfaces ● Thermal mass
Limited business attractiveness	● Market disconnectivity ● National rules and regulations ● Inefficiency of local public services ● Limited availability of capital and human resources
Weak economic diversity	● Market disconnectivity ● Limited availability of capital and human resources
Informal economy	● Reduced formal jobs opportunities ● National rules and regulations
Reduced productivity	● Labour market dynamics ● Mismanagement of urban mobility ● Inefficient transport networks and supply chains
Unemployment	● Labour market dynamics
Local public revenue loss	● Labour market dynamics

4. Priority Matters - Workshop 8

Priority matters are where the majority of risks to the urban system converge and concentrate in the presence of certain challenges or constraints/conditioning factors, but are also where opportunities for maximizing the outcome of targeted actions lie.

The determination of priority areas in Teresina was the result of workshop 8 which built upon the outcomes of the preceding 7 workshops of identifying and characterizing shocks and stresses held by CRGP together with the Teresina Resilience Commission. Taking stock of local knowledge and expertise, and similar to previous workshops, this workshop served to discuss the multiplicity of risks including shocks and stresses in Teresina and their interdependencies, and how these are shaped by present challenges and constraints leading to the emergence of certain issues seen as priority matters crucial to be addressed for building and strengthening urban resilience in Teresina (See Chapter 02 for detailed display of the analysis findings).

As an introduction to the workshops, participants were presented by the outcomes of the H.A.R.D platform data collections on shocks. Also, the results of the 2 workshops on stresses – 8 stresses and their underlying stressors– were displayed. Participants were then asked to start mapping the links between shocks and stresses, using Jamboard (an online tool) drawing on their knowledge and experience in their respective fields of expertise. Specifically, members were asked to differentiate between the causes/drivers and effects of each risk when drawing those links. In addition, while making these links participants were required to justify these connections. This allowed for a very informative debate to take place through which the network and comprising links connecting the different types of risks were optimized.

The result of this mapping unveiled the existence of 4 main clusters in which multiple shocks and stresses are concentrated and their effects are intersecting. These four clusters which are now called priority matters were:

- Water cycle mismanagement
- Ecosystem imbalance
- Economic underperformance
- Poverty and inequality
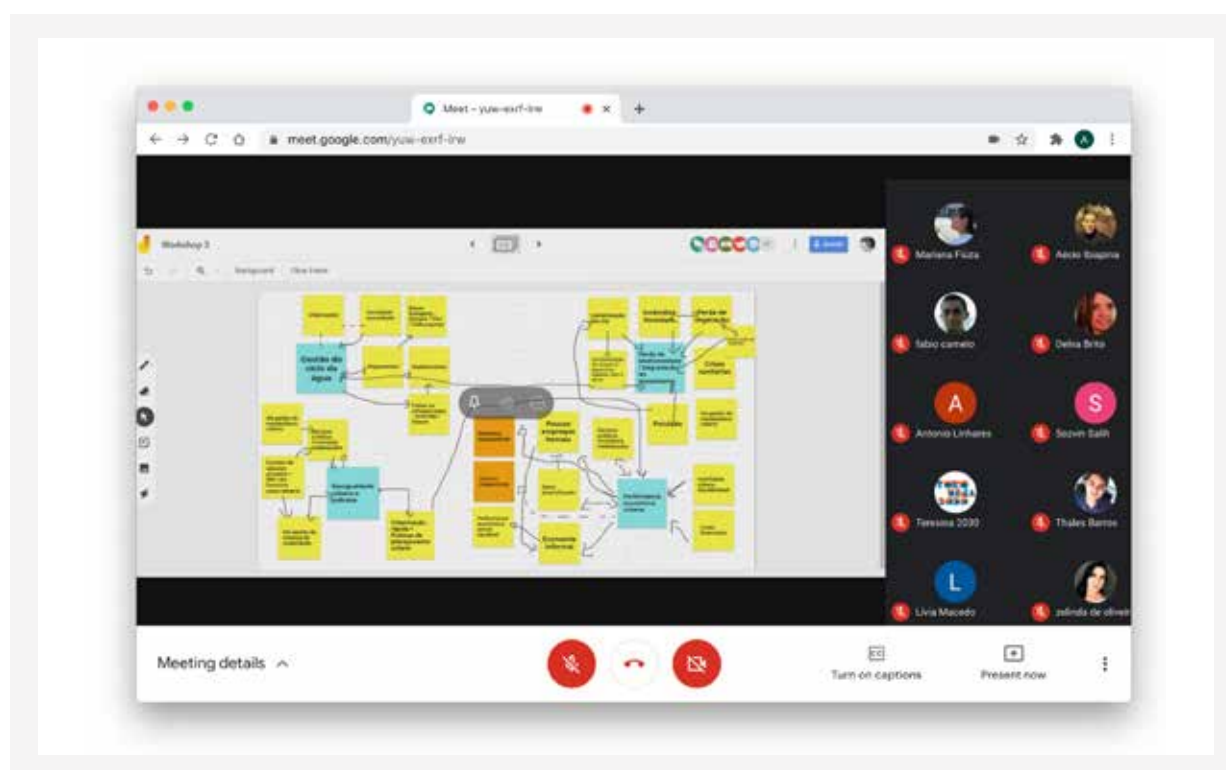
Figure 12: Snapshots of workshop 8 on priority matters.

Figure 13: Snapshots of workshop 8 on priority matters.

However, given the transversal effects of poverty and inequality which means that it is a major driver and a consequence of each of the three other clusters, participants agreed on keeping poverty and inequality as a cross-cutting challenge that shapes how different risks are interrelated under each priority matter. Additionally, this was viewed as a way of promoting actions in later stages of the process which will contribute towards addressing poverty and inequality as part of each priority matter.

In summary, the outcome of this debate was the prioritization of three main priority matters:

• Water cycle mismanagement

• Ecosystem imbalance

• Economic underperformance

The mapping was then redrafted by the CRGP team to clarify the difference between the various links. These maps can be viewed under Chapter 2 – The Current State of Urban Resilience, specifically figures 41, 44 and 46.

5. Actions for Resilience and Sustainability Workshops

Workshop 9	
Date:	20/12/2020
Participation mode:	online

At the end of the diagnosis phase, Workshop 9 aimed to present the Urban Resilience Diagnosis product to the Resilience Commission, as well as to initiate the first steps for the next stage, Recommended Actions for Resilience and Sustainability.

This workshop proposed an initial mapping activity of relevant stakeholders for each defined priority theme of the urban resilience diagnosis. The final outcome of the activity was the preliminary mapping of relevant stakeholders as well as an evaluation of the Resilience Commission's activity during the Year 2021.
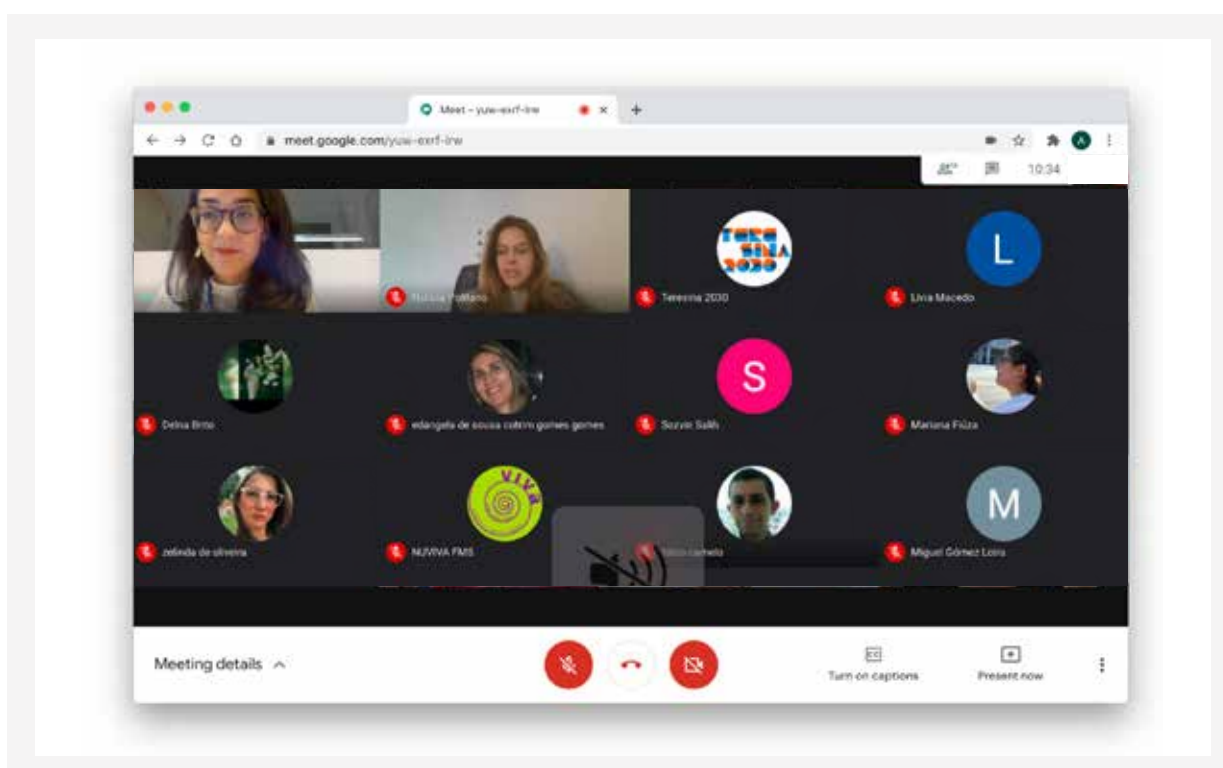
Figure 14: Workshop 9 on Actions for Resilience and Sustainability - Preliminar Stakeholders Mapping.

Workshop 10

Date:	26/05/2021
Participation mode:	online

The year 2021, following the Brazilian municipal elections, brought changes in municipal public administration and with it the need to revise the composition of the Resilience Commission, carry out a levelling up session and proceed with the necessary training for phase 3 - Actions for Resilience and Sustainability.

In this sense, the first part of the workshop was dedicated to present the background of programme activities and to introduce key concepts, so that all members - both from previous composition and newcomers - are prepared for the next activities. During the second part of the workshop, the committee was divided into two groups. The first group for activities related to Inefficient Water Cycle Management and Ecosystem Imbalance, while the second was dedicated to Poor Economic Performance. Each group was responsible for mapping relevant stakeholders guided according to the drivers and risks associated with the priority matters, as illustrated in the diagram below.

Figure 15: Conceptual scheme for mapping stakeholders according to drivers and risks associated with priority issues.

The outcome of this second part of the workshop was the preparation of a comprehensive list of stakeholders, who were invited by the Resilience Commission to participate in the Stakeholder Workshop in discussing the Priority Matters and delineating goals for a resilient urban future.

Workshop 11

Date:	26/06/2021
Participation mode:	online

The UN Habitat team and the Municipality of Teresina hosted an online workshop to discuss the vision of the city from the perspective of the civil society, private, public, and academic sector. It was a place for brainstorming opportunities to understand each stakeholder's objective and vision of the priority matters already delineated in the previous project phase. The workshop was the first step to start building the theory of change framework and co-design the A4R with the city stakeholders.

The workshop began with an opening and introduction for all participants, with an explanation of the programme, and the purposes of this activity. It was then divided into two parallel sessions for each axis to be discussed - Inefficient Water Cycle Management and Ecosystem Imbalance, while the second was dedicated to Poor Economic Performance.

The sessions with the stakeholders were designed as an opportunity to contrast the views and insights of the respondents from the city in order to identify priorities, barriers and levers for the implementation of measures towards urban sustainability and resilience. Each session was organised using the theory of change framework approach. The theory of change method helps to identify solutions to effectively address the causes of problems through consultations with key stakeholders by learning what works and what doesn't.

Each session was divided into 5 key discussion points following the theory of change framework:

1. Vision of the city and possible roads to address economic development challenges
2. Expected outcomes of the actions discussed
3. Viability of the results (social, technical, and financial)
4. Challenges and Opportunities (possible implementation issues and opportunities including legal, social, technical, and financial)
5. Risks
6. Participants were selected from each of the sectors to share their views. The moderator was a representative of the Municipality of Teresina and was supported by the local economic development expert and the UN Habitat team.

The main outcomes of the workshop included:

Economic Underperformance Session:

- Getting to know more about programs and initiatives in Teresina. One key initiative identified was the work that the private sector is doing to create an innovative ecosystem.
- One key challenge identified is the lack of infrastructure in the rural areas and the potential to become a touristic destination.
- Understanding the vision of the city from different sector perspectives.
- Identification of key challenges such as lack of coordination between all sectors, weak metropolitan governance, vulnerability of the public transportation, urban violence, and need to take care of public spaces.

Water Cycle and Ecosystems Session:

- Much emphasis was placed on the need to develop awareness-raising campaigns at all levels in order for the measures taken by the city to be truly effective. Measures alone are inefficient if the citizens do not see their usefulness and integrate them as principles of action.
- In relation to the sewerage system, mention was made of the need to continue its extension, making it serve each area of the city in an efficient manner and establishing a monitoring system to evaluate its performance.

- The negative effects of deforestation and tree felling within the city were also highlighted. The municipality, in addition to awareness-raising campaigns, should have stricter control of logging permits and a more severe penalty system. Special attention needs to be paid to specific areas such as riparian forests and vacant plots within the city. The latter host interesting use initiatives such as urban agricultural use by associations and citizens, but this is still not enough and should be encouraged.

- The drainage system must also be improved in different areas of the city.

- In relation to urban densification, it is considered that this should be carried out with an adequate infrastructure plan. It is also mentioned that national legislation allows for land value capture ("outorga onerosa") which should feed an urban development fund that has not yet been created.

Figure 16: Economic Underperformance Session.

Figure 17: Water Cycle and Ecosystems Session.

Workshops 12 and 13

Date:	26/8/2021 and 27/8/2021
Participation mode:	Participation mode: hybrid (online and in-person)

Workshops 12 and 13 presented the actions proposed by the CRGP, in partnership with experts on the priority matters in question, for discussion and validation with members of different secretariats of the Municipality of Teresina and for the co-creation of the A4R-S. Initially, in both workshops, a review of the implementation of the CRGP in Teresina was conducted, pointing out the activities carried out and the products developed so far, as well as the priority matters to be addressed through the proposed A4R-S.
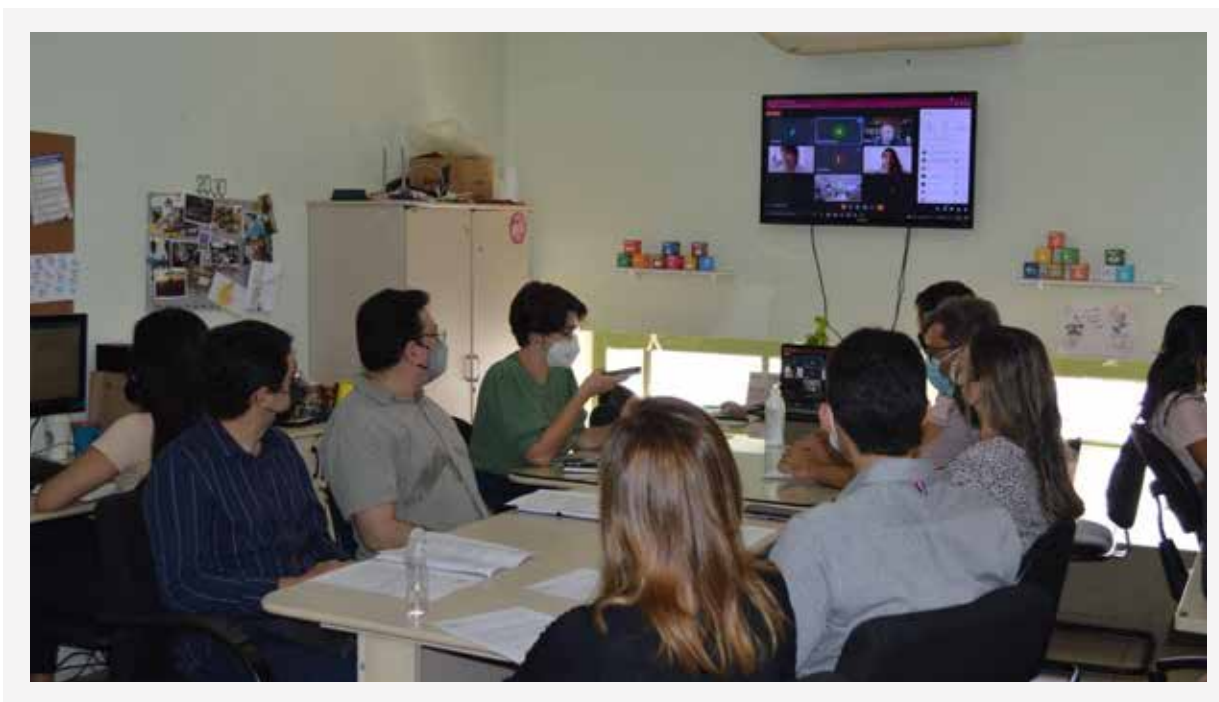
Figure 18: Photo Workshop 12 on Actions for Resilience and Sustainability.

Figure 19: Photo Workshop 13 on Actions for Resilience and Sustainability.

On the first day, the proposals related to the priority matters of Mismanagement of the Water Cycle and Ecosystem Imbalance were discussed and jointly addressed in order to promote sustainable urban development in Teresina. Initially, the proposals were presented by the expert Héctor Rodal and then discussed by members of the secretariats present, including Agenda 2030, ARSETE, SECREM, SEMAM, SEMCASPI and the Lagoas do Norte Program.

Lines of Action Dimensions	1. Compact and sustainable urban form	2. Sustainable green and blue infrastructure	3. Coherent urban planning and implementation
1. Awareness raising actions	**1.1** Participation in international knowledge exchange groups and programs	**2.1** Awareness program through guided visits and tours to key infrastructures, sites of interest and pilot initiatives and experiences	
2. Capacity building actions	**1.2** Training and continuous improvement program for City Officers and Practitioners	**2.2** Program for collaboration on information exchange and research with the Academy, Universities, Organisations and Research Centres	**3.2** Guide books, checklists and technical manuals
3. Organisational enhancement actions	**1.3** Creation of the fund for the capture and management of land value gains	**2.3** Creation of a single Agency or at least a Municipal Unit for the management of the water cycle in the city	**3.3** Organisational restructuring and coordination
4. Strategic and deployment actions	**1.4** Transit Oriented Development (TOD) programmes	**2.4.a** Urban revegetation strategy **2.4.b** Strategy for permeabilization and de-sealing of soils **2.4.c** Improvement and extension of recycling system to prevent water and soil contamination	

Then, on the second day, the proposals related to the priority theme of Economic Underperformance were discussed, with the aim of building a strong and resilient local economy. The proposals were presented by the expert Maria Camila Quintero and then discussed by the members of the secretariats present, including Agenda 2030, FWF, SECREM, SEMDEC, SEMEST, SEMF, SEMJUV, SEMPLAN, SEPLAG and STRANS.

Lines of Action / Dimensions	1. Increasing local government capacity for municipal service modernisation	2. Improving Urban Mobility Management for Higher Productivity	3. City Rebranding for Investment Attraction and Innovation	4. Enhancing Access to Markets & Employment Opportunities for the Informal Sector
1. Awareness raising actions				**4.1** Awareness raising campaign for access to credits, grants and skills through civil society engagement
2. Capacity building actions	**1.1** Staff Capacity Building for Increased Municipal Revenue		**3.1** Establish city-to-city cooperation for knowledge transfer	**4.2** Strengthen Popular Bank's technical capacity through capacity building
3. Organisational enhancement actions	**1.2** Municipal strategy and mechanisms to improve the monitoring and evaluation of service efficiency	**2.1** Creation of a Local Mobility Agency for Operations and integration of urban mobility planning into a macro-area of urban planning **2.2** Creation of a joint committee between the Local Mobility Agency and Local Agency for Development to ensure Transport Oriented Development (TOD) and relive the discussion of the city's Logistic Plan	**3.2** Create a Local Economy Development Agency (LEDA) for territorial marketing **3.3** Reformulate the private, public and academic council to formulate a work agenda around science, technology, innovation, education and health - including a Youth Chapterthe city's Logistic Plan	**4.3** Strengthen collaboration with fundraising sectors to increase Popular Bank's microcredit fund
4. Strategic and deployment actions			**3.4** Promote innovation in the city for and by the youth	**4.4** Develop a study to identify and characterise the informal sector in Teresina through collaborations with academia and non-profit organisations

After the discussion, validation and review of the proposals, the A4R-S report was prepared, taking into account the observations regarding the feasibility and effectiveness of these proposals, made by the participants during the workshops.

Annex II

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CRPT Indicators

List of Acronyms and Abbreviations

A4R	Actions for Resilience (Ações para a Resiliência)
Aneel	Agência Nacional de Energia Elétrica
BACEN	Banco Central do Brasil
BNH	Brazil's National Housing Bank
CAU PI	Conselho de Arquitetura e Urbanismo do Piauí
CEPRO PI	Superintendência de Estudos Econômicos e Sociais - Piauí
CONFEN	Conselho Federal de Enfermagem
CRECI PI	Conselho Regional de Corretores de Imóveis
CRGP	City Resilience Global Programme (Programa Global de Cidades Resilientes)
CRPT	City Resilience Profiling Tool (Ferramenta de Perfis de Cidades Resilientes)
DNPM	Departamento Nacional de Produção Mineral
FCMC	Fundação Cultural Monsenhor Chaves
FMS	Fundação Municipal de Saúde de Teresina
IBGE	Instituto Brasileiro de Geografia e Estatística
INEP	Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira
IPHAN	Instituto do Patrimônio Histórico e Artístico Nacional
IUCN	International Union for Conservation of Nature
PDTMU	Plano Diretor de Transportes e Mobilidade Urbana de Teresina
PIEMTUR	Empresa de Turismo do Piauí S/A, extinct in 2010
PMT	Prefeitura Municipal de Teresina
PNAD	Pesquisa Nacional por Amostra de Domicílios
RAIS	Relação anual de informações sociais
RAR-S	Recommendations Actions for Resilience and Sustainability (Recomendações de Ações para Resiliência e Sustentabilidade)
RIDE	Região Integrada de Desenvolvimento (Integrated Development Region)
SAMU	Serviço de Atendimento Móvel de Urgência
SDR	Superintendência Desenvolvimento Rural
SDU	Superintendência Desenvolvimento Urbano
SECREM	Secretaria Executiva de Captação de Recursos e Monitoramento
SEFAZ	Secretaria do Estado da Fazenda

SEMAM	Secretaria do Meio Ambiente de Teresina
SEMCASPI	Secretaria Municipal de Cidadania, Assistência Social e Políticas Integradas
SEMCOP	Secretaria Municipal de Concessão e Parcerias
SEMDUH	Secretaria Municipal de Desenvolvimento Urbano e Habitação
SEMEC	Secretaria Municipal de Educação
SEMF	Secretaria Municipal de Finanças de Teresina
SEMPLAN	Secretaria Municipal de Planejamento e Coordenação
SEMTCAS	Secretaria Municipal do Trabalho, Cidadania e Assistência Social
SIS/IBGE	Síntese de Indicadores Sociais
SMPM	Secretaria Municipal de Políticas Públicas
SNIS	Sistema Nacional de Informações sobre Saneamento
SSP-PI	Secretaria de Segurança Pública do Estado do Piauí
STRANS	Superintendência Municipal de Transportes e Trânsito
UN-Habitat	The United Nations Human Settlements Programme

List of Figures

Annex II
CRPT Indicators

This section provides an overview of the data collected, analysed, and distilled into key findings for each of the eight Urban Elements that comprise the urban system's performance. In addition, key information that is not directly collected through indicators and related questions but provides critical information for better understanding certain complex urban dynamics, is presented herein primarily as a means to further contextualize data findings for the city.
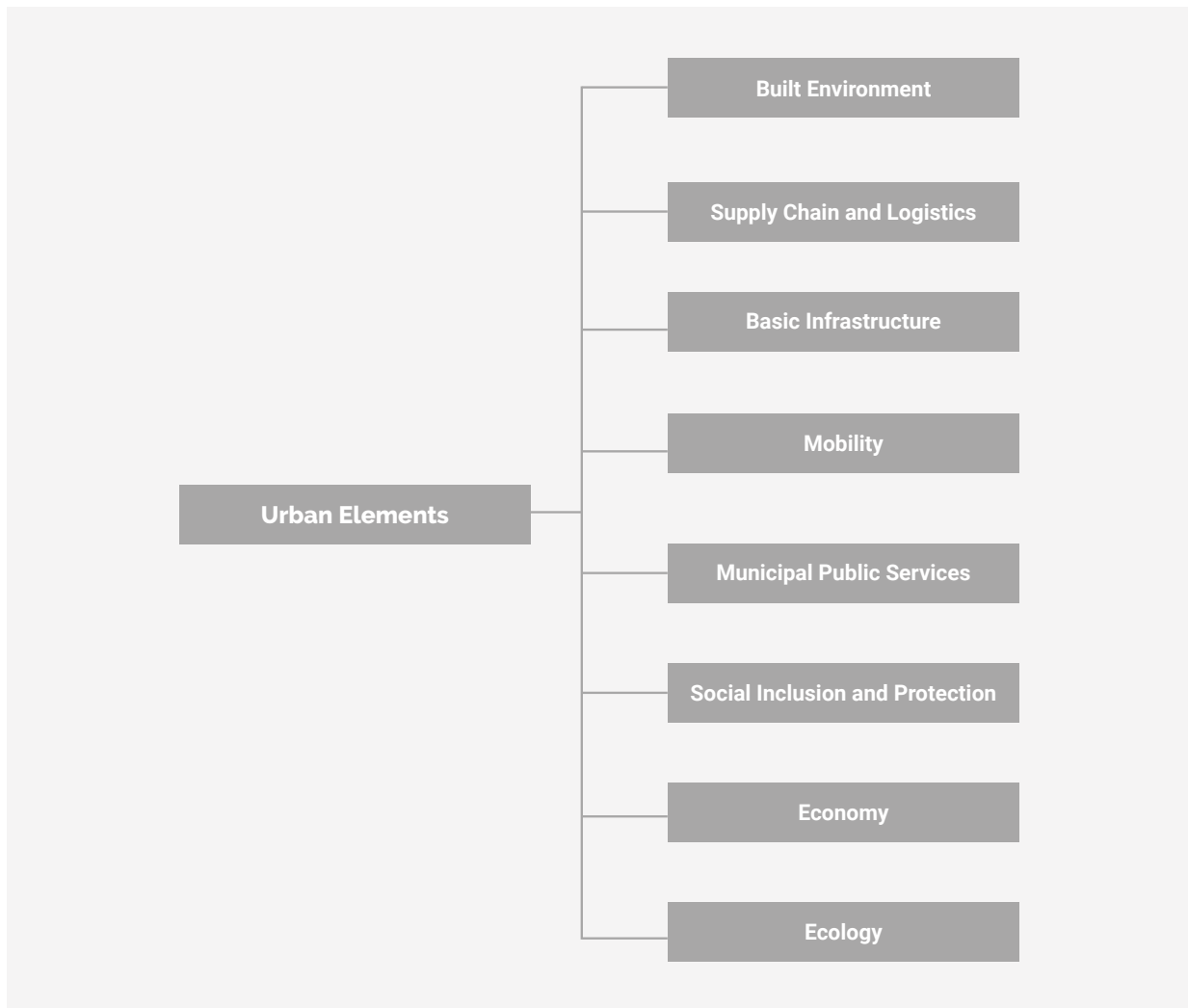
Element overviews are intended to provide a high-level snapshot, not comprehensive analyses. Consequently, all identified vulnerabilities, capacities, and data-related complications are not presented in these overviews. Key findings should therefore be understood as data-borne highlights that have been extracted because they are indicative of common trends identified in more exhaustive data analyses.

Each element overview is comprised of 3 sections:

Data Collection: Summation of data collection completion results, overview of data completion by component, and key findings suggested by data completion. Completion is calculated using three categories: complete, incomplete, alternative, pending, and not available. Complete refers to data sufficient for calculating a benchmark; alternative refers to data insufficient for calculating a benchmark but nonetheless beneficial for the analysis; incomplete refers to composite indicators that only partial data was available and hence insufficient to generate the full indicator; pending

are data that are feasible/available but still under processing or collect; and not available refers to data that was not collected or not available for the city.

Key findings: Executive summary of key takeaways related to all available data. Findings may relate to data collection, performance, contextual factors, or some combination.

Selected Indicators: this section presents the set of indicators selected for analysis and benchmarking, with a summary of collected results, sources and additional information that are relevant to the diagnosis.

Indicators Selection Methodology and Process

The indicator selection process derives from the mapping of stresses, shocks and risks for each priority matters. From this definition, a process flow is followed to filter, from the set of total indicators of the CRPT tool, those that inform the diagnosis and or the monitoring of issues relevant to the city.

In this workflow, as shown in the graph below, each urban element is analysed, and one by one all its components, if its indicators answer key questions in relation to the priority matters. First, it is analyzed whether the indicator offers contextual information that directly characterizes any of the drivers (shocks or stresses) or associated risk in each of the priority issues. Those indicators refer to our WHAT question.

Secondly, if the indicator provides insights on the causes of the drivers (shocks or stresses) of each priority issue. These indicators offer information on our WHY questions, as well as qualifying the relationships within the each priority matter problem tree.

Finally, it is analysed if the indicator gives information on existing capacities and how the city is responding to associated risks (shocks and stresses) for each priority matter. Here, the indicators will help to clarify HOW the city's resilience capabilities are in a specific subject of analysis. The flow chart below summarizes the indicator selection methodology.
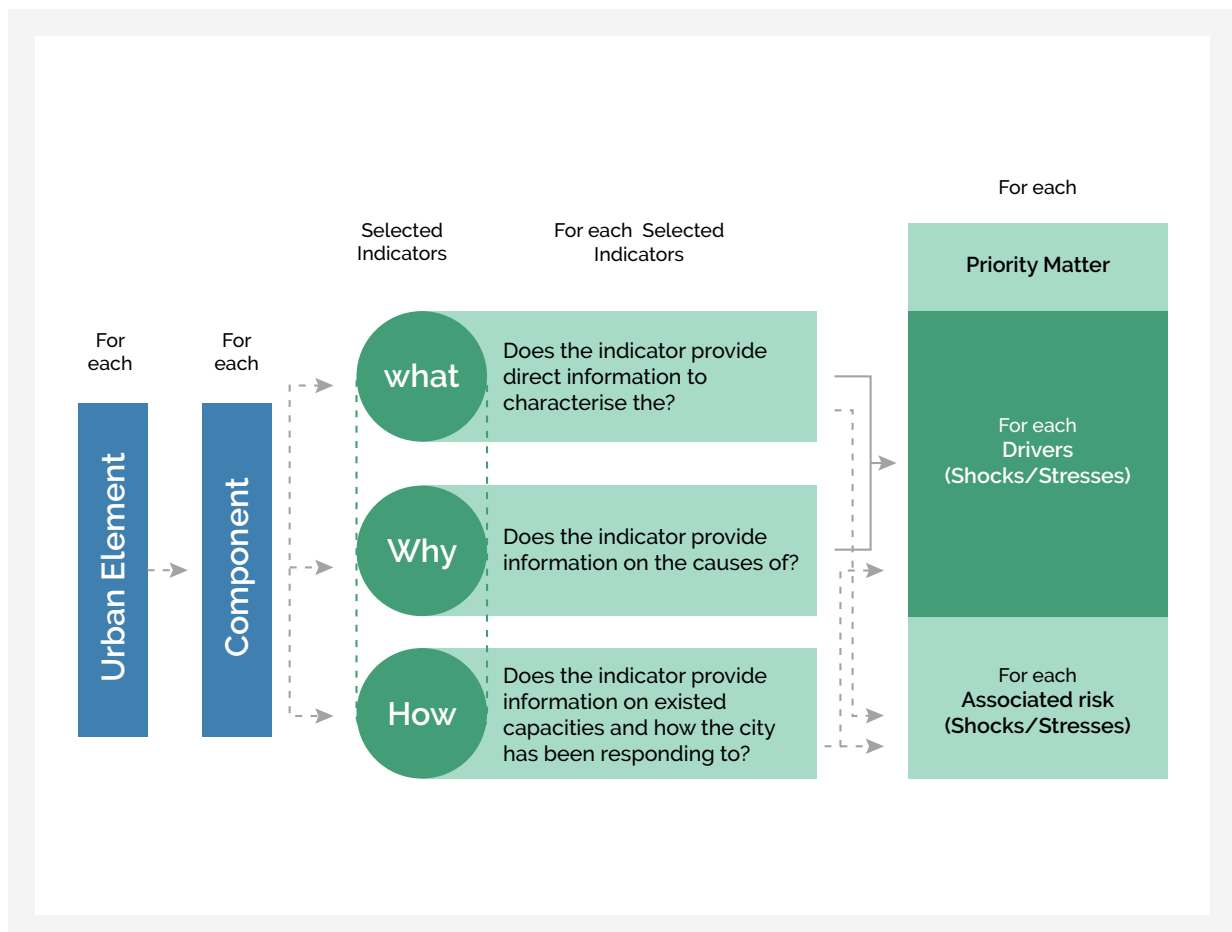
In total, considering all priority issues, 88 indicators were selected, conformed by 229 supporting indicators and other several related questions. The total number of indicators per urban element is shown in the table below. This distribution doesn't characterise the weight of the urban elements for data collection since indicators may vary in complexity and information, hence selecting fewer indicators in an element cannot be implied as fewer information.

Urban Element	Total Indicators Selected	Total Supporting Indicators Selected
Built Environment	8	18
Supply Chain & Logistics	11	22
Basic Infrastructure	25	42
Mobility	7	25
Municipal Public Services	12	43
Social Inclusion & Protection	6	11
Economy	9	33
Ecology	10	35
Total	**88**	**229**

In the scheme below, the relations between the priority matter plus inequality and poverty transversal issues and the several components that constitute the urban elements are drawn, according to how many indicators on these components were selected for analysis. Note that indicators and components may provide information on several issues at once.
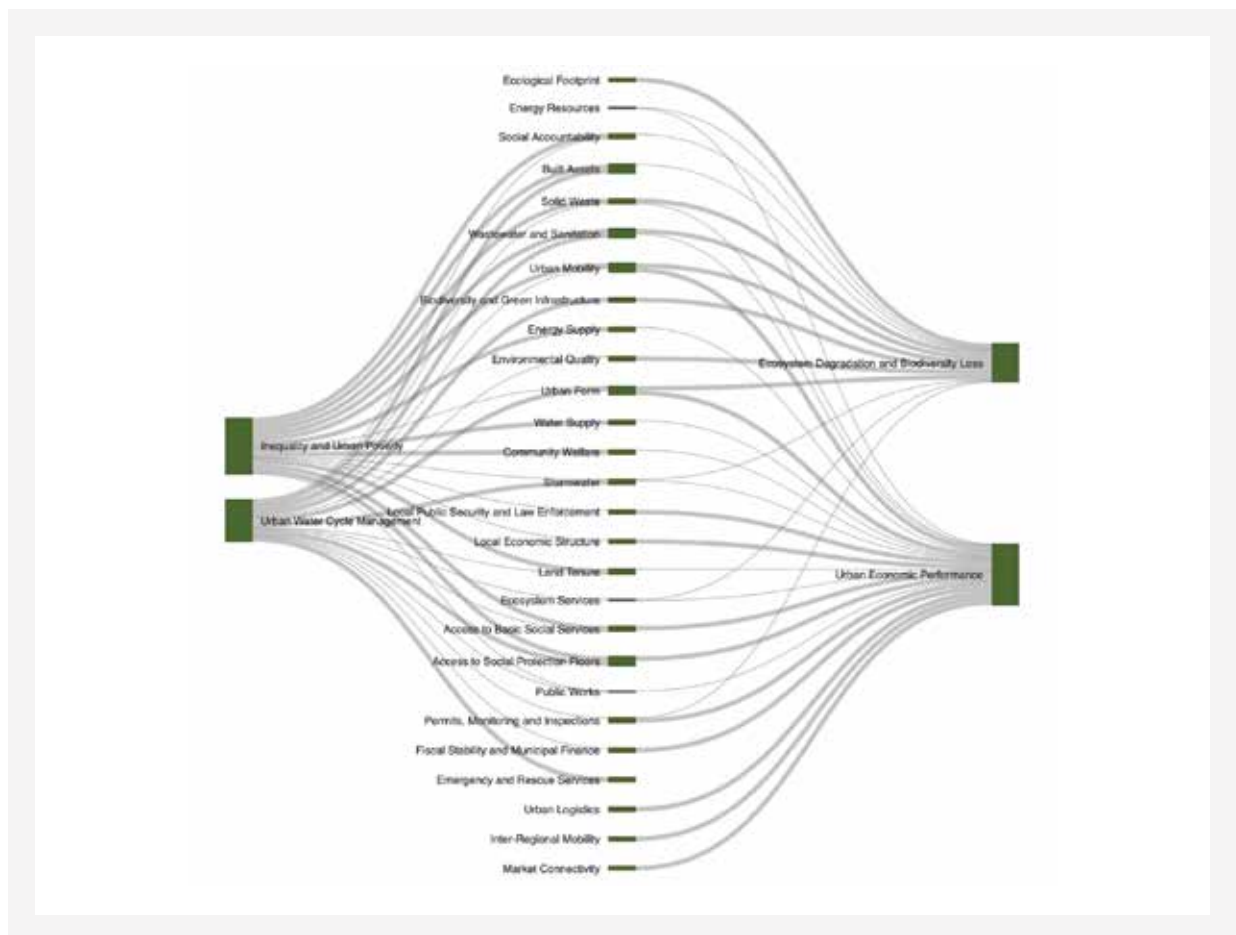
1. Built Environment

The Built Environment Element analyses information that spans the urban footprint and its growth and composition, then proceeds to delve deeper into the aspects of land tenure, housing and built assets.

Data Collection

The total completion rate for data collection is 73%, also 9% of the data considered not available and 18% not applicable. Considering only the selected indicators, the completion rate was 100% for this element (including completed and alternative data).

Built Environment Element Data Completion (%)	Supporting Indicators (SI) %

18%

9%

73%

100%

- ● Complete
- ● Not Available
- ● Not Applicable

- ● Complete + Alternative
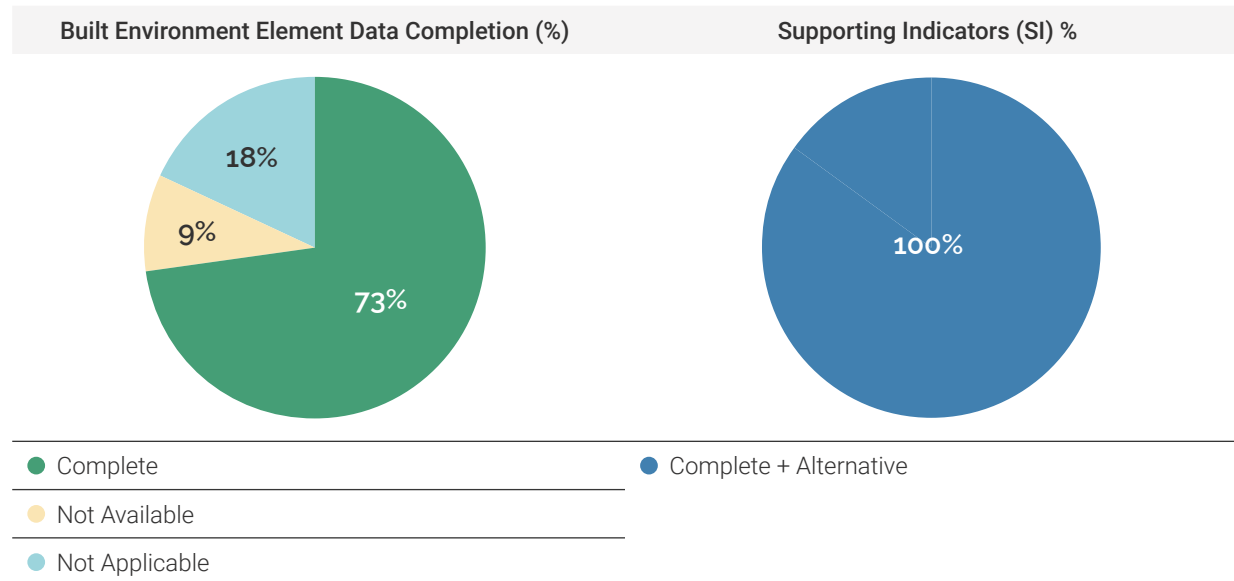
Key Findings

The urban area has a low population density, however land consumption rate has been more stable in the last 10 years.

Percentage of streets within the urban footprint and street intersection density is considerably lower than CRPT benchmarks.

There is a considerable percentage of urban space in hazardous areas. High percentage of homes with inadequate structure, more than 44.000 are uncoated masonry and uncoated cob walls.

Relatively few areas of the city are considered informal as a percentage of the urban area, but figures are high if considering the percentage of households. Poor disaggregated data on the population of areas considered informal.

The city has a broad legal framework to regulate urban space and guarantee citizens' rights.

Selected Indicators

1.1	Urban Form				
1.1.1	**Urban Growth Model**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
1.1.1.1	(Net) Urban population density	3.091 hab/km²	621,72 people/km² (Total Area)	Teresina - Panorama Municipal - agosto 2020	2020
1.1.1.2	Land consumption to population growth rate	1,05		PMT; IBGE	2010; 2020
1.1.2	**Open Areas Provision**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
1.1.2.1	Percentage of open areas within the urban footprint	46%		PMT	2020
1.1.2.2	Public open space per 100 000 population	57 ha/pop		PMT	2020
1.1.3	**Street Network Connectivity**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
1.1.3.1	Percentage of streets within the urban footprint	20,64%		PMT	2020
1.1.3.2	Street density	17,98 km/km²		PMT	2020
1.1.3.3	Street intersection density	87,82 intersections/km²		PMT	2020
1.2	**Built Assets**				
1.2.1	**Risk Exposure of Built Up Areas**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
1.2.1.1	Percentage of urban footprint located in hazardous areas	7,745%		Municipality and HARD with CRGP developed Shapefile	2019
1.2.1.1.1	Percentage of built assets located in hazardous areas	3,81%	Trânsito (Critical Infrastructure)	Municipality and HARD with CRGP developed Shapefile	2019
1.2.1.1.2	Trend of urban growth towards hazardous areas in the past 10 years	Sharp increase		HARD Platform	2020
1.2.1.1.3.	Are hazardous areas physically marked?	Yes		HARD Platform	2020
1.2.1.2	Trend of urban growth towards hazardous areas in the past 10 years	Sharp Increase		HARD Platform	2020
1.2.1.2.1	Level of dependency of the city on hazard protection systems	High Dependency		Defesa Civil - SEMCASPI	2020
1.2.1.2.2	Level of reliability of hazard protection systems	Moderate reliability		Defesa Civil - SEMCASPI	2020
1.2.2	**Durability of Built Assets**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
1.2.2.1	Percentage of homes with inadequate structure	Greater than 20%		Sidra IBGE	2019
1.2.2.2	Percentage of critical infrastructures with inadequate structure	Less than 10%		PNAD IBGE	2019

1.3	Land and Housing Tenure				
1.3.1	**Status of Land and Housing**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
1.3.1.1	Percentage of city area considered informal	2%		SEMDUH/PMT	2020
1.3.1.2	Quantitative housing shortage	29%	Join data from 3 articles. Due the impossibility of finding the total amount of houses built in Teresina.	ADH-PI; LOPES, W. ; ANDRADE	
1.3.2	**Access to Secure Tenure**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
1.3.2.1	Percentage of households with secure tenure				
1.3.2.2	Percentage of population considered landless, homeless and/or displaced	0,03%	The previous report quantified 270 homeless, landless or displaced people. Most recent data needed to be checked. In 2020, a regional law was established to focus on homeless people.	Plano de Reordenamento do Serviço de Acolhimento para Pessoas em Situação de Rua. SEMTCAS/PMT.	2013
1.3.3	**Land and Property Administration**				
	Indicator Description	**Main Value**	**Sec. Values (if. any)**	**Source**	**Date**
1.3.3.1	Percentage of city area with complete land administration data				
1.2.3.1.1	Is there baseline data that proves who owns what piece of vacant land in the city?	Yes		SEMDUH/PMT	2020
1.2.3.1.2	Is the data protected, backed-up and processable in an emergency situation?				
1.3.3.2	Does the authority in charge of land in the city recognise continuum of land rights and practice pro-poor land administration?	Both recognizes and practices	PLHIS- LOCAL HOUSING AND SOCIAL INTEREST PLAN - 2018-2021	SEMTCAS/PMT	2012
1.3.3.3	Are there awareness-raising campaigns and projects regarding the use and ownership of land and property conducted in the city?	Yes, general public	PDOT - Master Plan for Territorial Planning	SEMPLAN/PMT	2020

TERESINA | URBAN FORM

Indicator 1.1 - Urban Growth Model; Open Areas Provision; Street Network Connectivity

Urban Perimeter

Urban Perimeter in 2010

Streets Intersection within the Urban Limit

Municipal Public Spaces and Institutional Green Areas

Parks

Tree Cover

Road Network

— trunk

— primary

secondary

tertiary

Water streams

Source: CRGP with SEMPLAN, 2020

0   2,5   5 km
△ N

Annex II: CRPT Indicators

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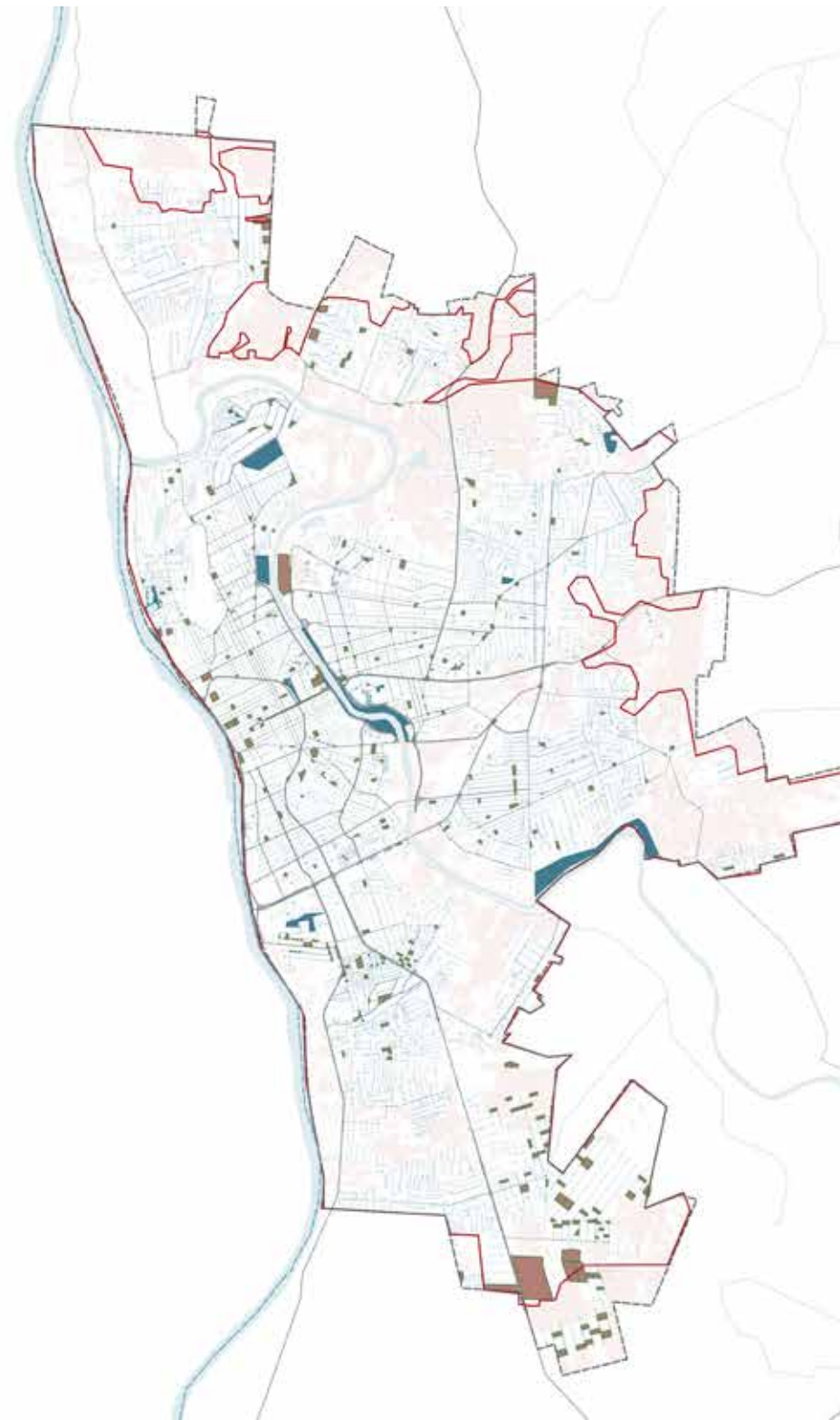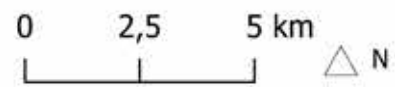
Figure 2: Indicator 1.2 and 1.3. Source: CRGP with SEMPLAN (2020).

TERESINA | BUILDINGS, SHOCKS and INFORMAL SETTLEMENTS

Indicator 1.2 and 1.3

Urban Perimeter

Informal Settlements

Buildings of Informal Settlements in Harzardous areas

Buildings in Hazardous Areas

Hazardous Areas

Teresina's Perimeter

Water Streams

CIty Buildings

Timon

TIMON

Source: CRGP with SEMPLAN, 2020

0   2,5   5 km   △ N

2. Supply Chain & Logistics

The Supply Chain & Logistics Element is composed of four components: Water Resources, Energy Sources, Food Supply and Urban Logistics. It assesses the access, distribution and management of non-human resources such as supply of food and water, energy and logistics, especially the reliability of access during emergencies.

Data Collection

The total completion rate for data collection is 65%, also 3% of the data considered pending, 33% not applicable and 12% incomplete. Considering only the selected indicators, the completion rate was 85% for this element (including completed and alternative data).

Supply Chain & Logistics Element Data Completion (%)

Supporting Indicators (SI) %

- ● Complete
- ● Pending
- ● No Applicable
- ● Incomplete

- ● Complete + Alternative
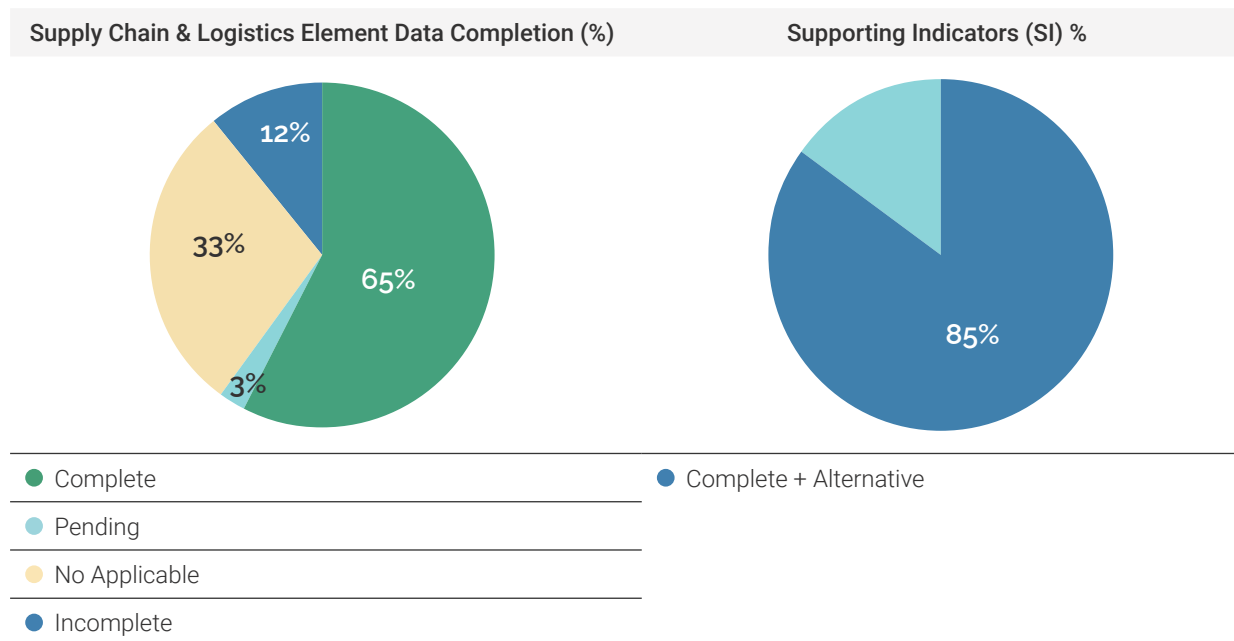
Key Findings

There is a higher dependence on one water source kind, inland surface waters, but there are 3 different withdrawal points for 2 different water sources, this increases resilience to possible shocks due to droughts or water contamination. However, the city must consider put in place strategies for alternative sources in case of shocks.

Domestic usage is the main sector for water consumption in the city. Low proportion of water consumed by the industrial and commercial sectors. No data was available on water consumption by the agricultural sector.

There is a high consumption of non-renewable energy by the transport sector, mainly dependent on liquid fuels. The electricity supply is 100% from renewable sources (hydroelectric power). High dependence on a single energy source for electricity supply, that also has high supply instability.

Local food production value is low, and most of the food consumed comes from outside the city. No local measures were reported to prevent food waste.

Urban logistics has a high dependence on land transport (Trucks/LCV/HCV), representing 77,88% of goods, followed by cargo airplanes, both in stable increase. Land and air transport are overloaded due to high demand. According to the State Treasury Office, the primary entry points are Ponte Engenheiro Antônio Noronha, Rodovia BR-343/226/222, and Rodovia BR-316.

No existence of integrated coordination body/ system for managing urban logistics operation.

Selected Indicators

2.1	Water Resources					
2.1.1	**Water Resource Diversity**					
	Indicator Description	**Main Value**	**%**	**Sec. Values (if any) Number of sources**	**Source**	**Date**
2.1.1.1	Proportion of water supplied from each source	Inland surface water	93,9	3	CRGP/PMT	2018
		Sub basin Parnaiba	19,5			
		Sub basin Poti Direita	59,95			
		Sub basin Poti Esquerda	14,44			
		Reservoir/Dams	-			
		Shallow aquifers/ Groundwater	6,1	2		
		Deep aquifers/ Groundwater	_			
		Others, please specify	_			
2.1.1.1.1	Seasonal variability	Medium variability			ARSETE	2020
2.1.1.1.2	Inter-annual variability	Low variability			ARSETE	2020
2.1.1.3	Does the city have strategies in place for alternative resources in times of unavailability of primary water sources?	No			ARSETE	2020
2.1.1.3.1	Frequency the city needs extra support from alternative sources.	Never			ARSETE	2020
2.1.2	**Water Balance**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.1.2.1	Water consumption per capita (liters/day)	163 liters/day		170 liters/day (avg. jan – aug 2020)	ARSETE	2020
2.1.2.1.1	Proportion of water consumed by sector	Domestic/Municipal	88 %		ARSETE	2020
		Agricultural	-		ARSETE	2020
		Industrial	1 %		ARSETE	2020
		Commercial	7 %		ARSETE	2020
		Public Sector	4 %		ARSETE	2020
2.1.2.1.2	Trends in water consumption in the past 10 years	Stable Increase			ARSETE	2020
2.1.2.1.3	Please describe the periods of occurance and reasons for any spikes in consumption	Consumption peaks occur from September to December (B-R-O-BRÓ) due to high temperatures. (around 11.6%)			ARSETE	2020

2.1.3	Water Resource Management					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.1.3.1	Existence of Integrated Water Resource Management (IWRM) toolbox components in place (please specify degree of implementation, if possible)	Enabling environment	x	20/200	SEMAM/PMT	2019
		Institutions and participation	x	220/600	SEMAM/PMT	2019
		Management Instruments	x	280/800	SEMAM/PMT	2019
		Financing	x	40/200	SEMAM/PMT	2019
2.1.3.1.1	Are advocacy groups representing women and groups in vulnerable situations involved in the IWRM process?	No			SEMAM/PMT	2019
2.1.3.2	If the city belongs to a transboundary basin area, is there an operational arrangement for water cooperation among relevant authorities?	No		Maybe with the implementation of the GEF an action will be taken in this direction	SEMPLAN/PMT	2020
2.1.3.3	Does the city have established and operational policies and procedures for participation of local communities in water management?	Yes, exists and operational		ARSETE performs election with representatives of residents' associations to compose to its sanitation advisory council	ARSETE	2020
2.1.3.4	Is the city implementing water demand management strategies?	Yes, please specify		MUNICIPAL PLAN FOR WATER SUPPLY AND SANITARY SEWAGE IN TERESINA - PMAE / THE - Program and actions to achieve the goals	ARSETE	2019

2.2	Energy Resources					
2.2.1	**Energy Resource Diversity**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.2.1.1	Proportion of energy consumed from each source, based on shares in total final consumption	Electricity (from electricity grid)	Non-renewable	Renewable	Equatorial	2020
			0%	100%		
		Off-Grid Renewable Sources	Non-combustible	Combustible	Equatorial	2020
			100%	0%		

2.2.2	Energy Efficiency and Clean Consumption					
	Indicator Description	Main Value		Sec. Values (if any)	Source	Date
2.2.2.1	Proportion of Total Final Consumption by sector.	Buildings (inc. services and public spaces)	35%		Global Covenant of Mayors for Climate and Energy	2015
		Transport/Mobility	65%		Global Covenant of Mayors for Climate and Energy	2015
	Energy Consumption disaggregation by Energy Typ	Liquid Fuels	65%		Global Covenant of Mayors for Climate and Energy	2015
		Gaseous Fuels	7%		Global Covenant of Mayors for Climate and Energy	2015
		Electricity	27%		Global Covenant of Mayors for Climate and Energy	2015
2.2.2.1.3	Trend in energy intensity in the past 10 years					
	Buildings Electricity Consumption disaggregation *	Residential	86,2%	Trend +112%	Equatorial	2020
	*Considering only Electricity Supply	Industrial	5,5%	Trend -31%	Equatorial	2020
		Agricultural	4,7%	Trend +122%	Equatorial	2020
		Others, please specify	.	Trend +76%		2020
2.2.2.2	Renewable energy share in the total final energy consumption (%)	27%*		*Considering Electricity Supply as 100% Renewable according to Equatorial.	Equatorial	2020
2.2.2.2.1	Trend in renewable energy share in the past 10 years.	-				

2.2.3	Energy Resource Management					
	Indicator Description	Main Value		Sec. Values (if any)	Source	Date
2.2.3.1	Existence of energy efficiency regulations or incentives in place	Energy efficient building standards	x		Empresa de Pesquisa Energética	2019
		Efficient public lighting regulation	x		SEMCOP	2019
		Regulations for municipal energy management	x		Aneel	2020
		Promotion of renewable sources for heating/cooling	x	Equatorial promotes since 2018 efficient equipments with lower prices to the city of Teresina	Equatorial	2020
		Promotion of renewable sources for transportation				
		Regulations for efficiency in corporate procurement	x		Ministry of Mines and Energy	2019
		Price signals for permit fees for low-energy/zero-energy activities				
		Partnerships, networks or alliances for energy efficiency	x		SEMCOP/PMT	2019
		Other, please specify.				
2.2.3.1.1	Are advocacy groups representing women and groups in vulnerable situations involved in the energy efficiency process?	No, but the measures particularly consider the interests of groups in vulnerable situations				

2.2.3.2	Does the local government finance clean/renewable energy transition and energy efficiency initiatives?	Yes			PMT	2020

2.3	**Food supply**					
2.3.1	**Availability Of Food Supply**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.3.1.2	Average value of food production per capita (disaggregated by basic food commodity groups, if possible)	National Scale	1102,45 R$/capita	Low variability	IBGE	2018
		Regional Scale	889,35 R$/capita	Low variability		
2.3.1.2.1	Food production variability. (Sec. Value column)	Functional Scale	22,23 R$/capita	Low variability		
2.3.1.4	Cereal import dependency ratio	National Scale	-22%		FAO	2017
2.3.1.4.1	Trend in cereal import dependency in the past 10 years	Sharp decrease	2008-2010	-0.3%	FAO	2017
			2009-2011	-2.9%		
			2010-2012	-9.1%		
			2011-2013	-15.3%		
			2012-2014	-18.8%		
			2013-2015	-23.3%		
			2014-2016	-20%		
			2015-2017	-22.2%		

2.3.2	**Availability Of Food Supply**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.3.2.1	Are there existing measures in the local level to prevent food loss and waste?	No			CRGP	2020
2.3.2.2	Farm to market price differential	Farm price	-			
		Market price	R$ 348,67		CEPRO PI	2018
2.3.2.2.1	Please specify the food types comprising the typical food basket	Crystal sugar, rice, banana, powdered coffee, meat, manioc flour, beans, pasteurized milk, margarine, vegetable oil, bread, tomatoes			CEPRO PI	2018

2.3.3	**Food Supply Chain Continuity**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.3.3.1	What level of disruptions does the food supply chain face? (per stage, if possible)	No disruptions			Public Knowledge	2020

2.4	Urban Logistics					
2.4.1	**Goods Transport Modal Share And Diversity**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.4.1.1	Proportion of goods (tonnes) hauled by different transport modes.		To/From the city's functional area		SEFAZ/PI	2020
			Percentage %	Trend		
		"Trucks/LCV/ HCV"	77,88 (1.548,501 t)	Stable Increase		
		Freight train	N.A.			
		Non-motorised modes	irrelevant			
		Light vessels	irrelevant			
2.4.1.1.1	Trends in dependence on each mode used within the functional area in the past 10 years. (Check Sec. Value Column)	Heavy vessels	irrelevant			
2.4.1.1.2	Trend in dependence on each mode used from or to the functional area in the past 10 years.(Check Sec. Value Column)	Cargo airplanes	22,11 (439,782 t)	Stable Increase		
2.4.2	**Capacity Of Logistics Infrastructures**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
2.4.2.1	Entry point significance in overall movement of goods, per critical entry point	Ponte Engenheiro Antônio Noronha	Primary		SEFAZ - PI	2020
		Ponte da Amizade	Tertiary			
		Ponte Metálica	Tertiary			
		Aeroporto Senador Petrônio Portela	Secondary			
		Rodovia PI-112	Secondary			
		Rodovia PI-115	Tertiary			
		Rodovia PI-113	Secondary			
		Rodovia BR-343/226/222	Primary			
		Rodovia BR-316	Primary			
		Rodovia PI-130	Secondary			
		Ferrovia Transnordestina	-			
2.4.2.1.1	Is the entry point located in a hazardous area?	On the periphery of the airport is located a hazardous area			PMT and CRGP GIS analysis	2020
2.4.2.2	Logistics facility capacity and complexity, per key logistics facility	Type	Modes Supported		CAU-PI	2019
		Multi-modal logistic platform	Trucks	x		
			Freight rail	x		
			Non-motorised land	x		
			Light vessels			
			Heavy vessels			
			Cargo planes	x		
2.4.2.2.1	Is the key logistics facility located in a hazardous area?		On the periphery of the airport is located a hazardous area		PMT and CRGP GIS analysis	2020

2.4.3	Logistics Management And Continuity Of Operations				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
2.4.3.1	Existence of public policies at the local level aimed at encouraging more sustainable practices in urban logistics systems?	Yes	SPECIAL ZONES FOR SPECIFIC URBANIZATION PLAN areas designated to receive Specific Urbanization Plans, such as the current airport area and the areas benefited by the structuring projects, foreseen in the Territorial Planning Master Plan.	SEPLUR/PMT	2019
2.4.3.1.1	Are advocacy groups representing women and groups in vulnerable situations involved in setting logistics-related public policies?	Yes		SEPLUR/PMT	2019
2.4.3.2	What level of disruptions does the urban logistics network face? (per goods transport mode, if possible)	No disruptions		SEFAZ - PI	2019
2.4.3.2.1	If significant, please indicate reason(s)		There are occasional interruptions, usually political, related to strike movements.	SEFAZ - PI	2019
2.4.3.5	Existence of integrated coordination body/ system for managing urban logistics operation?	No		CRGP	2020

Figure 3: Indicator 2.1. Source: CRGP with SEMPLAN and HARD (2020).

TERESINA | WATER RESOURCE DIVERSITY

Shallow aquifers

0 5 10 km

◻ Teresina's Perimeter

Sub Basins
◻ Sub basin Poti Esquerda
◻ Sub basin Parnaiba
◻ Sub basin Poti Direita

Health Facilities within the urban area of the city

◻ Teresina's Perimeter
■ Shocks Areas
◻ Urban Perimeter
  Water Streams

Sub Basins
▨ Sub basins Susceptible to Flooding

Source: CRGP with SEMPLAN and HARD, 2020

0   2,5   5 km   △ N

TERESINA | REGIONAL CONNECTIVITY

Largest cities located between 200 and 500 km that have greater than 150,000 inhabitants

CAXIAS

TIMON

0   25   50 km

☐ Teresina's Perimeter
☐ Urban Perimeter

Road Junctions Significance
— Primary
— Secondary
— Tertiary
⊢ Transnordestina Railway - São Luis, Teresina, Fortaleza

Main Entry Points
✈ Aeroporto Senador Petrônio Portella (Primary)
● Ponte Engenheiro Antonio Noronha (Primary)
● Terminal Rodoviário Governador Lucídio Portella (Secondary)
■ Ponte da Amizade (Tertiary)
● Ponte Metalica (Tertiary)

Source: Municipality of Teresina, IBGE Brazil, Open Street Maps

0   5   10 km   △N   △N

Main railways, highways and entry points in the Municipality
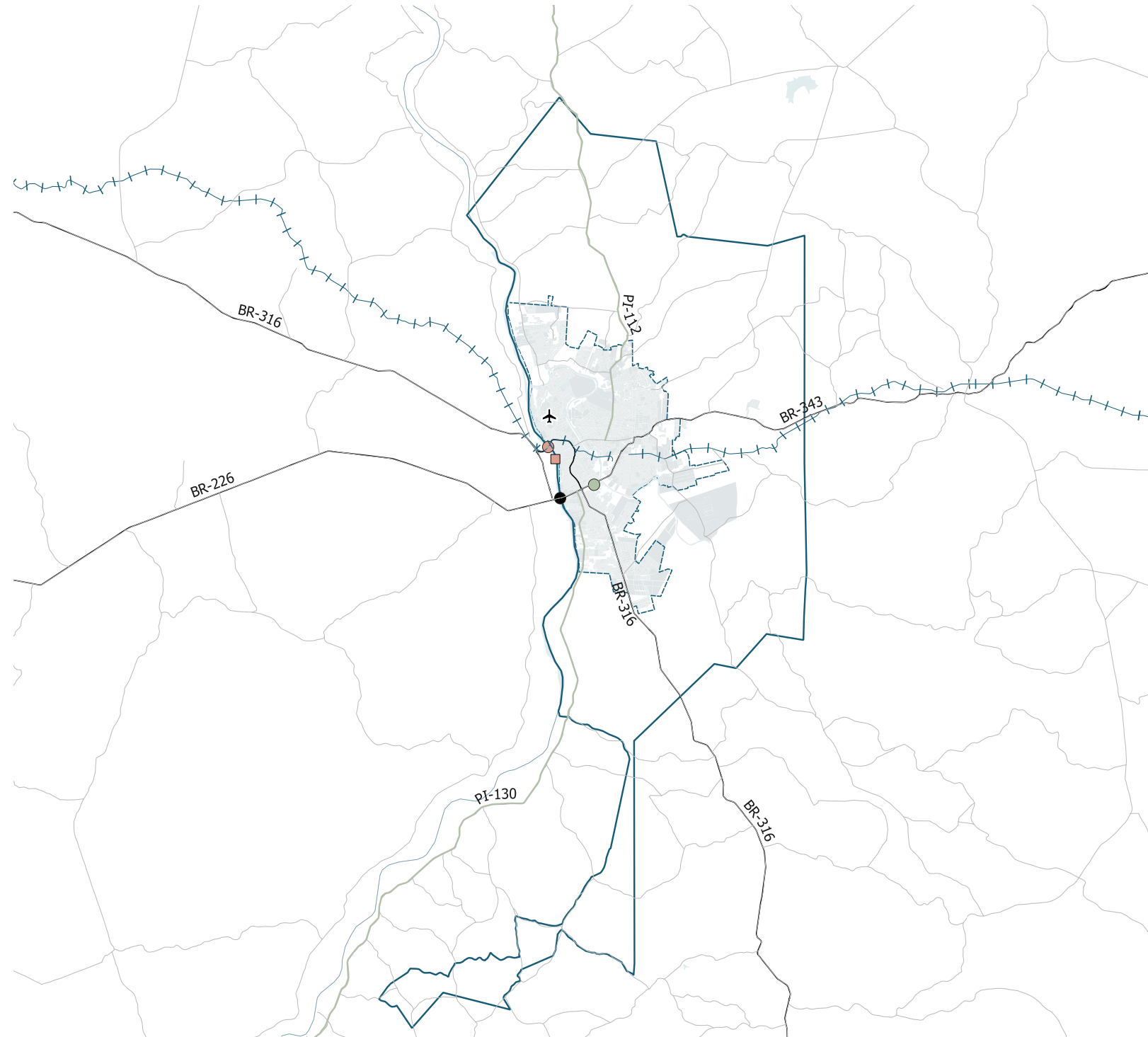
BR-316
PI-112
BR-343
BR-226
BR-316
PI-130
BR-316

3. Basic Infrastructure

The Basic Infrastructure Element is composed of six components grouped under three thematic groups. It analyses information related to energy supply in buildings and for mobility, water from its supply to sanitation and networks of wastewater and stormwater, and solid waste management in the city.

Data Collection

The total completion rate for data collection is 56%, also not applicable indicators represented 36%, incomplete 6%, not available 3%. Considering only the selected indicators, the completion rate was 94% for this element (including completed and alternative data).

Basic Infrastructure Element Data Completion (%)

Supporting Indicators (SI) %

- ● Complete — 56%
- ● No Applicable — 36%
- ● Incomplete — 6%
- ● Not Available — 3%
- ● Complete + Alternative — 94%
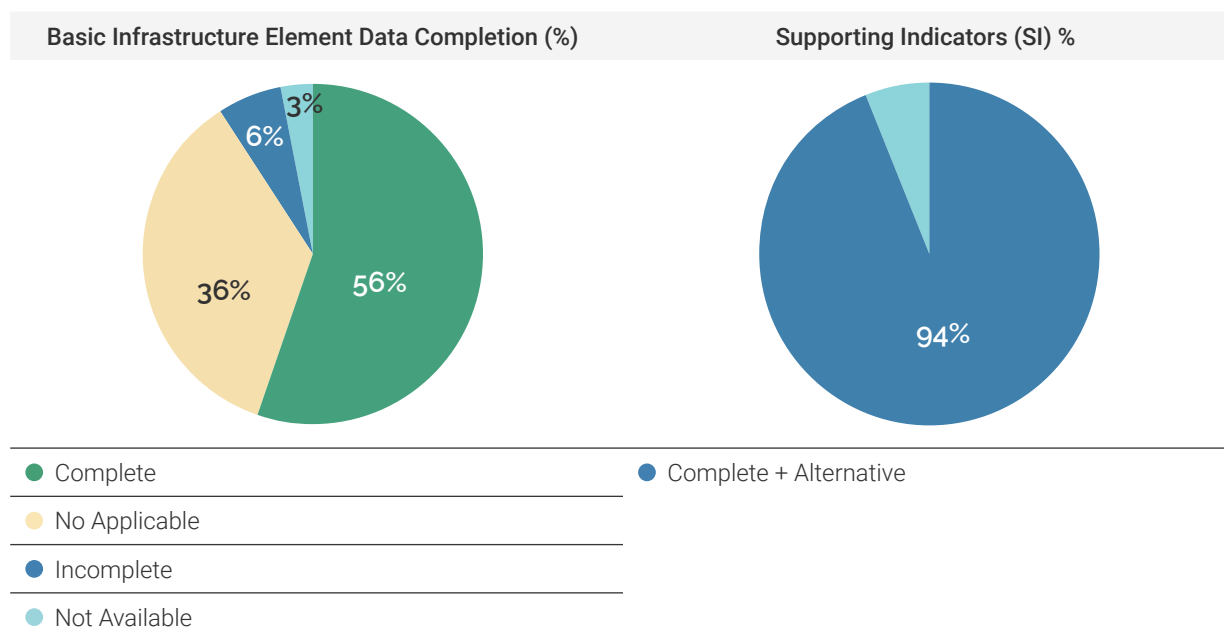
Key Findings

Although reaching 99,7% of the population, the electricity supply network does not yet have full coverage. The city is highly dependent on a single energy source, which faces significant disruptions. The network is also not able to cope with seasonal increase on demand.

The general consumption/capita of buildings sector have a good benchmark in the CRPT tool analysis. Public buildings have high energy consumption, and it is growing steadily, representing a considerable expense in the local budget (R$20.000.000,00/month). A public-private partnership was signed to improve the energy efficiency of municipal public buildings and public lighting. The energy consumption by the transport sector is under stable decrease, with a total of 0,405 ToE/capita, however alternative low/non-carbon fuel share is only 4%.

In 2020, the city achieved the universalisation of water supply services, as 100% of the population has access to water services. However, water distribution has a high percentage of unaccounted for water - water losses - (44%). According to the water and wastewater concessionair there are external disruptions in the service mainly caused by breakage of water mains by paving works.

Regarding sewage networks coverage, a low percentage of the households are connected to wastewater sewes. According to the water and wastewater concessionaire, the main barriers for coverage were from normative and institutional framework.

The city has insufficient data for accurate calculation of the drainage system coverage area, showing a data gap for the city' 'urban planning activities. However, recurrent disruptions on road traffic due to waterlogging are reported. Regarding protective structures, infrastructure has some deficiencies relative to 25-year flood scenario but designed to deal with 10-year flood scenario.

Teresina has a good coverage of the waste collection system and services are stable, but there are no pre-treatment methods and landfill remaining useful life is limited. Despite having a recycling collection system, there is low adherence among the population to the selective collection system and the municipality also has a low rate of recycled waste, but the recovery trend is under stable increase.

Selected Indicators

3.1.1	Energy - Energy Supply For Buildings				
3.1.1.1	**Access to energy supply**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.1.1.1.1	Proportion of population with access to any means of electricity supply	99,7%	Male: 99.7% Female: 100%	PNAD/IBGE	2019
3.1.1.1.1.1	Reasons for access being less than 100%	Socio-economic capacity, hydrological risks			
3.1.1.1.1.2	Proportion of population with alternative sources of electricity other than the public network	0,3%		PNAD/IBGE	2019
3.1.1.1.2	Proportion of population with primary reliance on clean fuels and technology for heating/cooling, lighting and/or cooking	81,2%		PNAD/IBGE for the State of Piaui	2015
3.1.1.1.2.1	Reasons for access being less than 100%	Socio-economic capacity		PMT	2015
3.1.1.2	**Coverage of energy supply services**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.1.1.2.2	Is the network able to cope with seasonal increase in demand?	No		https://g1.globo.com/pi/piaui/noticia/2019/10/08/procon-instaura-procedimento-contra-equatorial-por-conta-de-quedas-de-energia-em-teresina.ghtml	2019
3.1.1.2.3	Is the network able to cope with the city tendencial growth scenario?	Yes		ELETROBRAS Piauí-2017 Relatório de Administração e Demonstrações Financeiras de 2017	2020
3.1.1.3	**Efficiency in energy consumption**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.1.1.3.1	Buildings Sector (Residential + Services/Commercial) energy consumption per capita (ToE/cap)	0,25 ToE/cap		Equatorial	2019
3.1.1.3.1.1	Trend in Consumption	Stable Increase	0,19 (Decrease in the number of consumers from 2016 to 2019. The building sector energy consumption per capita were 0,19)	Equatorial	2016
3.1.1.3.3	Energy consumption of public buildings	94.861.968 kwh/ per year (AVG)	Municipal administration consumes, on average, 7.905.164 kwh in 1.494 consumer units, totaling a monthly expense of approximately R$ 20.000.000,00 (twenty million reais). There is no information about public buildings sqm in Teresina.	SEMCOP/PMT	2019
3.1.1.3.3.1	Trend in Consumption	Stable Increase		SEMCOP/PMT	2019
3.1.1.4	**Continuity of energy supply operations for building sector**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.1.1.4.1	Level of interruptions that the service faces, by source	Significant disruptions, Recurrent/Seasonal disruptions		Equatorial	2019

3.1.1.5	Maintenance and monitoring of supply network				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.1.1.5.1	Maintenance and monitoring measures are applied	Asset database for supply system network, operation and maintenance plan for supply management, regular monitoring of illicit connections.		Equatorial Website	2020

3.1.2	Energy - Energy Supply for Mobility				
3.1.2.2	**Efficiency in fuel consumption**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.1.2.2.1	Transport energy consumption (ToE/capita).	Diesel	0,17 ToE/capita	Data Portal for Cities	2015
		Gasoline	0,23 ToE/capita		
		Total	0,405 ToE/capita		
3.1.2.2.1.1	Trend in Consumption	Stable decrease		SEFAZ/PI	2019
3.1.2.2.2	Alternative low/non-carbon fuels share (%)	4%		Data Portal for Cities	2015

3.2.1	Water - Water Supply				
3.2.1.1	**Access to drinking water**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.1.1.1	Percentage of population with access to water services	Safely Managed Services = 100%		SNIS	2019
3.2.1.1.1.1	Barriers to accessing improved water services	No barriers			
3.2.1.2	**Water supply network coverage**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.1.2.3	Is the capacity of the network able to cope with seasonal increases in water demand?	Yes		Águas de Teresina	2020
3.2.1.2.4	Is the network able to cope with the city tendencial growth scenario?	Yes	Interventions are in accordance with the Water Supply System Master Plan.	Águas de Teresina	2020
3.2.1.3	**Efficiency of water supply operations**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.1.3.1	Percentage of unaccounted for water (water loss)	44%		Águas de Teresina	2020
3.2.1.3.4	What level of unplanned disruptions does the service face?	No major disruptions		Águas de Teresina	2020
3.2.1.3.4.1	Are majority of the disruption internal or external?	External	Breakage of water mains by paving works.	Águas de Teresina	2020

3.2.1.4	Monitoring and maintenance of water supply				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
3.2.1.4.1	What maintenance and monitoring measures are applied?	Asset database for water supply system, Operation and maintenance plan for water supply management, Regular maintenance of water supply network, Regular monitoring and replacing of ageing infrastructure, Regular monitoring of illicit connections		Águas de Teresina	2020
3.2.1.4.2	Is regular sampling of water in the supply network for compliance with water quality standards being conducted in the city?	Yes, regular sampling		Águas de Teresina	2020

3.2.2	**Water - Wastewater and Sanitation**				
3.2.2.1	**Access to sanitation**				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
3.2.2.1.1	Percentage of population with access to sanitation facilities	Safely Managed Services/ Transported through a sewer with wastewater and then treated off-site	14,8%*	Censo 2010 *The data for Safely Managed services is outdated, as it comes from the 2010 Census, and it is the only resource found for combined disaggregated data. However, data from the SNIS informs that Transported through a sewer with wastewater and then treated off-site is 33% in 2020.	2010
		Safely Managed Services/Treated and disposed in situ	74%*		
3.2.1.1.1.1	Barriers to access	-			
3.2.1.1.1.2	Please select and specify prohibitive costs associated with sanitation	-			
3.2.2.1.2	Percentage of population with access to handwashing facilities	Basic facility	99,3%	SIDRA IBGE	2019
		Limited facility	0,7%		
3.2.2.1.2.1	Barriers to access	No barriers		PMT	2020
3.2.2.1.2.2	Prohibitive costs associated with hygiene	No prohibitive costs		PMT	2020
3.2.2.2	**Wastewater network coverage**				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
3.2.2.2.1	Percentage of households connected to a wastewater network	35%	This number considers the inhabitants (287,521) with sewage collection and treatment.	Águas de Teresina	2020
3.2.2.2.1.1	If percentage is considered inadequate (or less than 60%), please indicate reason(s)	Normative and institutional frameworks		Águas de Teresina	2020
3.2.2.2.2	Is the network able to cope with seasonal increase in wastewater?	Yes		Águas de Teresina	2020
3.2.2.3	**Wastewater treatment and discharge**				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
3.2.2.3.1	Proportion of wastewater that is safely treated	34%		Águas de Teresina	2020
3.2.2.3.1.1	If percentage is considered inadequate (or less than 40%), please indicate reason(s)	Normative and institutional frameworks		Águas de Teresina	2020

3.2.2.3.2	Methods of treatment for hazardous wastewater				
3.2.2.5	**Maintenance and monitoring of wastewater system**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.2.5.2	Is regular sampling of wastewater discharge for compliance with water quality standards being conducted in the city?	Yes, regular sampling		Águas de Teresina	2020
3.2.3	**Water - Stormwater**				
3.2.3.1	**Stormwater collection**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.3.1.1	Percentage of urban area covered by stormwater collection system	Not covered	24,5%	CRGP/SEMPLAN/SEPLUR/PMT	2019
3.2.3.1.1.1	If percentage is considered inadequate, please indicate reason(s)	Street network with curb/gutter system connected to wastewater system.	75,5%	CRGP/SEMPLAN/SEPLUR/PMT	2019
3.2.3.1.2	Is the city's drainage system currently able to cope with seasonal increase in rain/stormwater?	Yes, for a 25-year recurrence interval.		SECREM/PMT	2020
3.2.3.1.3	Is the city reusing rainwater collected stormwater and?or reclaimed water	No		SECREM/PMT	2020
3.2.3.2	**Stormwater and flood management strategies**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.3.2.1	Is existing protective infrastructure well-designed and well-built based on flood risk information?	Infrastructure has some deficiencies relative to 25-year flood scenario but designed to deal with 10-year flood scenario.		SECREM/PMT	2020
3.2.3.2.2	Is the use of alternative water sensitive urban design solutions regularly and extensively being considered in the city?	No		SECREM/PMT	2020
3.2.3.2.3	Do zoning rules, building codes and standards that address water sensitive urban design and/or onsite stormwater solutions exist, are widely applied, properly enforced and verified?	Yes	Drainage Act/ Lei de Drenagem 4724 de 03/06/2015 LC3610	SECREM/PMT	2020
3.2.3.2	**Stormwater and flood management strategies**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.3.3.1	Percentage of dwellings damaged by intense flooding (10 years)	-			
3.2.3.3.2	What level of disruptions on road traffic due to waterlogging does the service face?	Recurrent/ Seasonal disruptions (specify period of year)	First half of the year	SECREM/PMT	2020
3.2.3.3.3	What level of disruption of access to public services due to waterlogging does the service face?	No major disruptions		SECREM/PMT	2020
3.2.3.4	**Monitoring And Maintenance Of Stormwater System**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.2.3.4.1	What monitoring and maintenance measures are applied?	Regular clearing of storm drains and street sweeping; Regular monitoring of illicit sewer connections and elimination; Regular monitoring and replacing of ageing infrastructure.		SECREM/PMT	2020

3.3	Solid Waste				
3.3.1	**Solid waste collection coverage**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.3.1.1	Proportion of solid waste collected out of total solid waste generated by the city.	Total solid waste generated (all types of waste)	449.148,10 ton	SEMDUH/PMT	2020
		Total solid waste collected formally	74,07%		
		Total solid waste collected informally	25,92%		
		Municipal Solid Waste	90%		
		Non-Municipal Solid Waste	10%		
3.3.1.1.1	If the proportion of solid waste collected is considered inadequate, please indicate reason(s), per category of waste	n.a			
3.3.1.1.2	If informal solid waste collection exists, please characterise the amount collected	116.434,71 ton		SEMDUH/PMT	2020
3.3.2	**Access to collection service**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.3.2.1	Percentage of population with regular municipal solid waste collection service (at least once a week)	99%		SNIS	2020
3.3.2.1.1	If percentage of population with regular municipal solid waste collection service is less than 100%, please indicate reason(s)	Socio-economic capacity, geospatial setting; social and cultural norms.		SEMDUH/PMT	2020
3.3.3T	**Strategies for solid waste reduction**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.3.3.2	Main method(s) used for pre-treatment	No pre-treatment methods exist		SEMDUH/PMT	2020
3.3.4	**Treatment: recovery of solid waste**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.3.4.2	Characterise the recovery trend of solid waste in the last 10 years	Stable increase		SEMDUH/PMT	2020
3.3.5	**Treatment: disposal of solid waste**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.3.5.3	Characterise the trend of solid waste that has been landfilled in the last 10 years	Stable increase		SEMDUH/PMT	2020
3.3.6	**Continuity of operations of solid waste systems**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
3.3.6.1	What is the average number of days the solid waste systems are out of service per year?	For collection	0	SEMDUH/PMT	2020
		For treatment	0		
3.3.6.1.1	For collection and for treatment, what is the level of impact of the disruptions?	No major disruptions		SEMDUH/PMT	2020

3.3.7	Maintenance and monitoring of solid waste systems				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
3.3.7.1	For collection and for treatment, what maintenance and monitoring measures are applied?	Asset databases for solid waste, operations and maintenance plan for waste management, regular cleaning of collection points and drop of facilities (incl. within treatment sites), regular maintenance of vehicles and machineries of solid waste systems, regular monitoring and replacing of ageing infrastructure.		SEMDUH/PMT	2020
3.3.7.2	Remaining useful life of the site where the landfill is located (in years, based on capacity and municipal solid waste generation projections)	5		SEMDUH/PMT	2020

TERESINA | COVERAGE WATER SUPPLY

Indicator 3.2.1 – Water – percentage of Population Coverage

0   2,5   5 km

Covarege Water System

ETA-CODIPI

ETA-SUL
DISTRITO
INDUSTRIAL
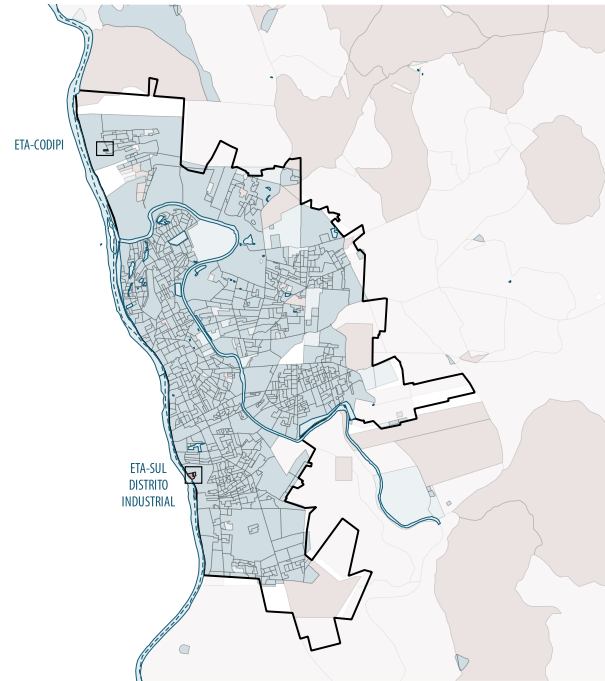
■ Water Treatment Station (ETA - Estação de Tratamento de Água) in Teresina
● Water Well
— Water Mains
— Water System Network
□ Water Streams
□ Teresina's Perimeter
□ Urban Perimeter

Percentage of Population Coverage Water Supply in 2018
□ 0 - 20
□ 20 - 60
□ 60 - 85
□ 85 - 100

Source: CRGP with SNIS, 2018

0   2,5   5 km   △ N

TERESINA | SOLID WASTE AND SEWAGE SYSTEM

Sewage Stations (ETE - Estação de Tratamento de Esgoto) in Teresina

0   2,5   5 km

ETE EDGAR GAYSO

ETE 0 - CONJ VERANA
ETE 0 AFREDO PACHECO
ETE - TERRA DOS PASSAROS

ETE LESTE

ETE MIRANTE DOS LAGOS
ETE PIRAJÁ
ETE BOSQUE RESIDENCIAL

MARGENS DO POTY

ETE FRANCISCO DAS CHAGAS

ETE TORQUATO NETO
ETE WALL FERRAZ
ETE BOSQUE SUL
ETE DO CONJ. ORGULHO DO PIAUÍ
ETE DO CONJ. EDUARDO COSTA
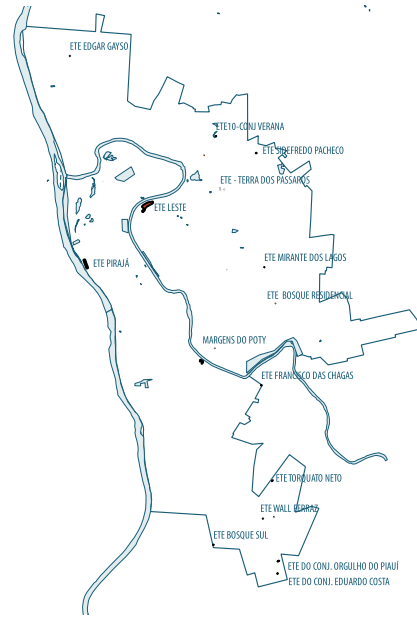
Indicator 3.3: Solid Waste

- ● Sewage Pumping Station
- ● Selective Collection Points
- ■ Sewage Station
- — Outfall Sewage Pipeline
- — Sewege Network
- ▢ TE_naturalwater_osm
- ▢ Sewage System
- ▢ Urban Perimeter

Source: CRGP with SEMPLAN, Open Street Maps, 2020

0   2,5   △ N   5 km   △ N

4. Mobility

The Mobility Element consists of two components: Urban Mobility and Inter-regional/International Mobility. The element analyses information on the diversity of transport modes, coverage of infrastructure including networks and critical interchange facilities as well as potential vulnerabilities hindering the performance of the service and the consequent impacts while highlighting capacities.

Data Collection

The total completion rate for data collection is 45%, also 31% not available, 2% not applicable and 22% incomplete. Considering only the selected indicators, the completion rate was 82% for this element (including complete and alternative data).

Mobility Element Data Completion (%)

22%
2%
45%
31%

- Complete
- Not Available
- No Applicable
- Incomplete

Supporting Indicators (SI) %

82%

- Complete + Alternative
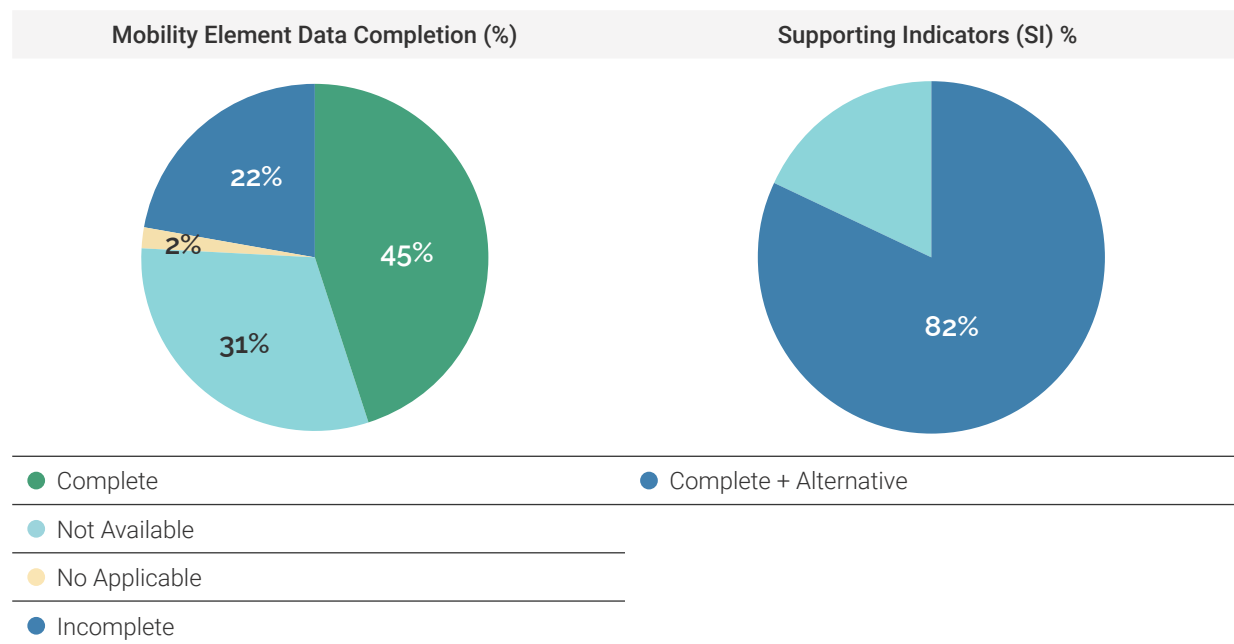
Key Findings

There is a lack of local updated data on origin-destination surveys, since the last available data is from 2008. As the city is conducting the new Sustainable Urban Mobility Plan, it is likely to have this data updated in the incoming year.

According to IBGE data, the main commuting mode is by Walking, representing 33,8%, the second most used mode to commute is by Bus, followed closely by individual cars. Cycling represents 12,2% of the commuting trips, while motorcycles 5,2%. It is relevant to highlight that private modes represents 28%.

Regarding urban mobility network coverage, the road network density is still poor when marked against CRPT benchmarks, also there is a low density of cycle paths. Transit dedicated read density is considered good and 83,63% of the population lives within 500m from a public transport stop. Public transport is partially accessible to people with reduced mobility, but there is a specific system to serve this population (Transporte Eficiente). Low railway density. The public transportation department doesn't have an operation control center, but it is under construction.

The city has great potential for water transportation however demand and accessibility should be evaluated to assess feasibility.

Male population are the main victims of transportation fatalities, representing almost 80% of the seriously injured victims and fatalities.

Regarding inter-urban mobility there is only one bus terminal in the city with regional / international destinations and one airport. However, there are also other smaller inter-city bus terminals serving as boarding/unboarding points.

Selected Indicators

4.1	Urban Mobility				
4.1.1	**Diversity of Transport and Modal Share**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
4.1.1.1	Percentage of commuting trips using each one of the following modes	Private modes: 28%	Car = 22,25% (sharp decrease) Motorcycles = 5,2% (sharp increase) Trucks = 0,16% (stable decrease) Taxi=0,41% (stable increase)	IBGE CIDADES	2010 and 2018
		Public modes: 26%	Bus = 24,7% (stable increase) Metro = 0,04% (stable increase) Van = 0,35% (stable decrease) School transport = 0,66% Freight transport = 0,31%	IBGE CIDADES	2010 and 2018
		Sustainable modes: 46%	Bicycle private = 12,2% (stable increase) Bicycle public = 0% Walking = 33,8%	IBGE CIDADES	2010 and 2018
4.1.1.2	Percentage of population using paratransit modes of transportation		At least 9,23% based on 22% decrease of bus use due the paratransit "ligeirinho" comparing 2015 to 2018.	SETUT/PI	2018
4.1.1.2.1	For each mode of transport, characterise the growth rate				
4.1.2	**Coverage of Urban Mobility Networks**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
4.1.2.1	Road network density (km/100000 population)	414,45 km/100 000 pop		Municipality Shape File and CRGP developed Shape File	2020
4.1.2.2	Road density dedicated for public transport only (km/100000 population)	265,25 km/100 000 pop		Municipality Shape File and CRGP developed Shape File	2020
4.1.2.3	Railway density (km/100000 population)	1,56 km/100 000 pop		CRGP developed Shape File	2020
4.1.2.4	Navigable water network density per population (km/100000 population)	21,45 km/100 000 pop		Municipality Shape file and GRGP developed Shape File	2020
4.1.2.5	Density of sidewalks and pedestrian paths (km / 100 000 population)		Less than two times the length of road network		
4.1.2.6	Bicycle lanes density (km/100000 population)	7,4 km/100 000 pop		CicloMapa Shape File and Local CRGP developed Shape File	2019
4.1.2.6.1	If coverage is less than 15km/100000 population please indicate reasons	Financial capacity		Cycling Master Plan and https://www.mobilize.org.br/noticias/12280/afinal-quantos-quilometros-de-ciclovias-existem-em-teresina.html	2020
4.1.3	**Access to Urban Mobility Systems**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
4.1.3.1	Percentage of city population within 500m distance to nearest public transport stop	Bus stop Metro stop	83,63%	PMT	2017
4.1.3.4	Is public transport accessible to people with reduced-mobility?	Partially		STRANS/PMT	2020

4.1.3.5	Average commuting travel time using various modes of transport	Within the city		PDTMU/PMT	2008
		Public Modes	69 minutes	Plano Diretor de Transportes e Mobilidade Urbana de Teresina - 2008	
		Private Modes	21 minutes		
		Sustainable Modes	17 minutes		
4.1.3.6	Identify barriers to access per public transport mode (with particular attention to sex and groups in vulnerable situations)	Safety on transport vehicles; safety at transport stations, terminals, etc.; socio-cultural norms.		PMT	2020

4.1.4	**Continuity of Urban Mobility Operations**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
4.1.4.0	**Mode of transport**	**Public mode**			
4.1.4.1	What level of disruptions does the service face?	Significant disruptions	Difficulty o car circulation, insecurity and evasion of the middle/higher class at the city center	STRANS/PMT	2020
4.1.4.2.1	What are the other modes of public transport that can be used, temporarily, as alternatives in case of a disruption in operations?	-			
4.1.4.3	What is the average passenger capacity during peak hours?	BUS: 35,15 passengers during peak hours 306,1 PPhPD		STRANS/PMT	2019
4.1.4.4	What is the average travel speed on major thoroughfares during peak hours?	20 km/h		PDTMU/PMT	2008
4.1.4.5	Does this mode have a central control system?	No (Under Construction)	No (Under Construction)	PDTMU/PMT	2008
4.1.4.6	What is the average age of the transport fleet?	5,8 years		STRANS/PMT	2019
4.1.4.0	**Mode of transport**	**Private model**			
4.1.4.1	What level of disruptions does the service face?	Significant disruptions	Difficulty o car circulation, insecurity and evasion of the middle/higher class at the city center.	STRANS/PMT	2020
4.1.4.4	What is the average travel speed on major thoroughfares during peak hours?	35 km/h		PDTMU/PMT	2008
4.1.4.7	Transportation fatalities per 1000 population	fatalities	0,16/1000/pop	STRANS/PMT	2019
		Seriously injured and fatalities	2,93/1000pop		
		Seriously injured and fatalities MALE	2,34/1000/pop		
		Seriously injured and fatalities FEMALE	0,59/1000/pop		

4.2	Inter-Regional Mobility				
4.2.1	Diversity and Modal Share of Inter-Regional Mobility Systems				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
4.2.1.1	Percentage of trips using each one of following modes	Mid-distance inter-regional trips	Coach: 235174,4 trips per weekdays	Gov. Estado do Piauí	2020
			Airplanes: 13823 flights per year	Infraero Statistics	2018
		Long distance international trips	Coach: More than 300 bus services a day	Gov. Estado do Piauí	2020
4.2.1.2	Please select the growth rate of each mode.				
4.2.2	Coverage and Capacity of Entry Points and Inter-Regional transport Facilities				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
4.2.2.1	Number of major coach/bus terminal in city regional/international destinations	1		Gov. Estado do Piauí	2020
4.2.2.1.1	Characterise capacity	City coach station "Terminal Petrônio Portela"	2,000 pax / week 5,000 pax / weekend	Gov. Estado do Piauí	2020
4.2.2.2	Number of major train stations in city with regional/international destinations	0			
4.2.2.2.1	Characterise capacity	0			
4.2.2.3	Number of ports in city	0			
4.2.2.3.1	Characterise capacity	0			
4.2.2.4	Number of airports in city	1			
4.2.2.4.1	Characterise capacity	Petrônio Portela Airport	1.073.570 pax/year	INFRAERO	2018
4.2.4	Continuity of inter-regional mobility operations				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
4.2.4.0	Select mode of transport	-			
4.2.4.1	What level of disruptions does the service face?	-			
4.2.4.2.1	What is the most common cause of disturbance?	-			

TERESINA | PUBLIC TRANSPORTATION

Public Transports Stops, roads, buffer zone.

Legend:

- Teresina`s Perimeter
- Teresina`s Urban Perimeter
- • Bus Stops
- ● VLT Station
- — VLT road
- ● Inthegra Stations
- — Inthegra road

Road System

- — Trunk
- — Primary
- — Secondary
- — Tertiary
- — Residential
- Waterstreams
- Buffer Zone of 500 m distance to nearest public transport stop

Source: CRGP with SEMPLAN, Open Street
Maps, 2020
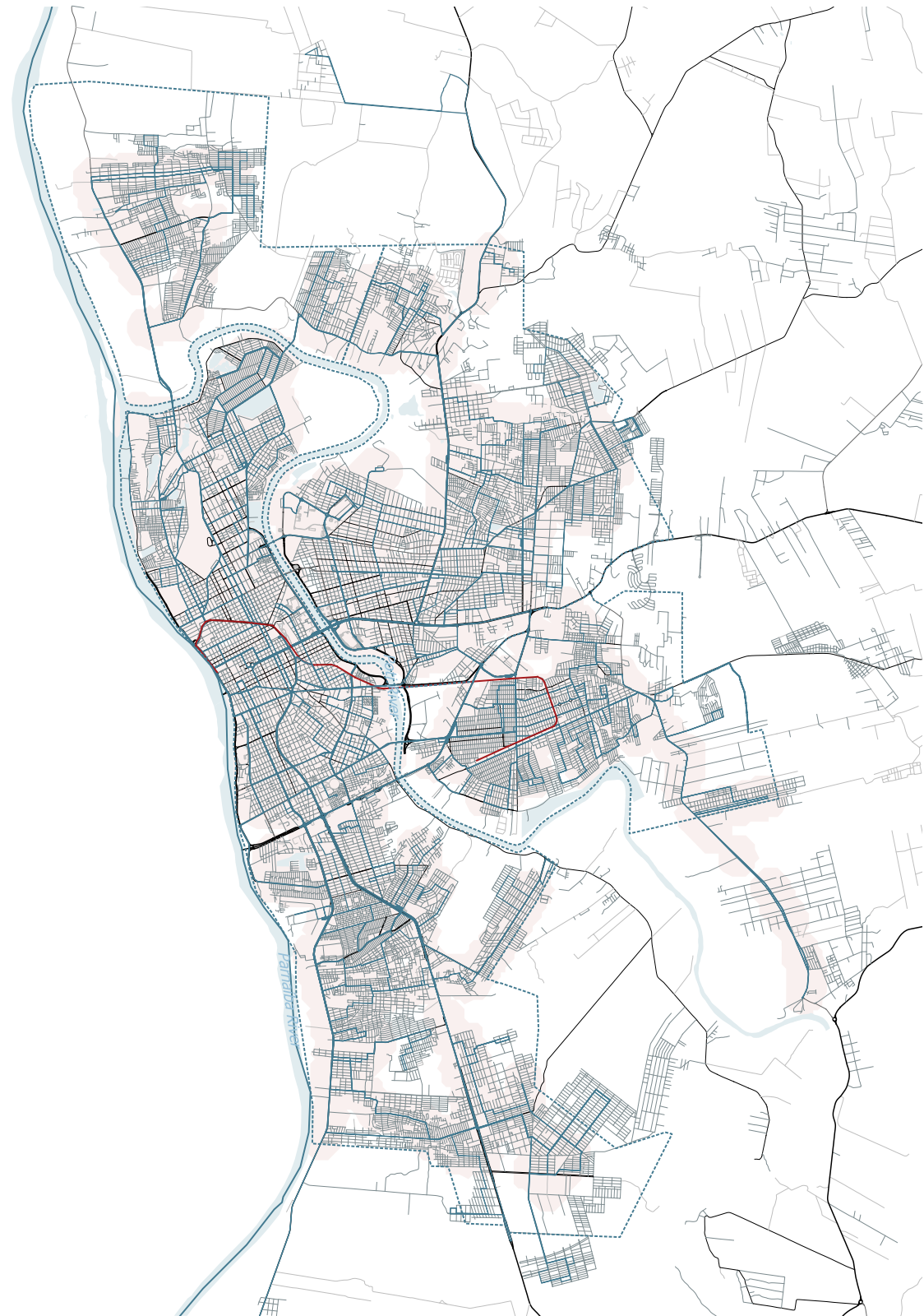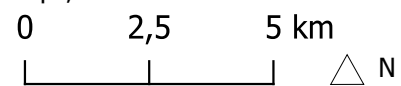
0   2,5   5 km

△ N

5. Municipal Public Services

The Municipal Public Services Element is composed of five components. It analyses information related to obligations commonly deployed by or under the expenses of the local governments as the public works; permits, monitoring and licensing activities; community welfare; local public security and law enforcement; and local emergency and rescue services.

Data Collection

The total completion rate for data collection is 37%, also 37% of the data was considered not applicable, 23% pending, 2% not available and 2% incomplete. Considering only the selected indicators, the completion rate was 66% for this element (including complete and alternative data).

Municipal Public Services Element Data Completion (%)	Supporting Indicators (SI) %

Municipal Public Services Element Data Completion (%):
- 37% Complete
- 37% No Applicable
- 23% Pending
- 2% Not Available
- 2% Incomplete

Supporting Indicators (SI) %:
- 66% Complete + Alternative
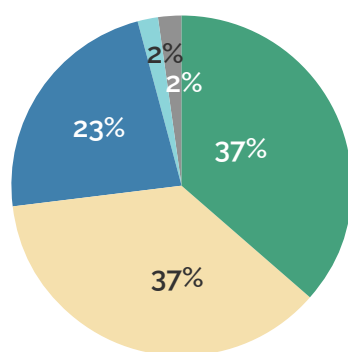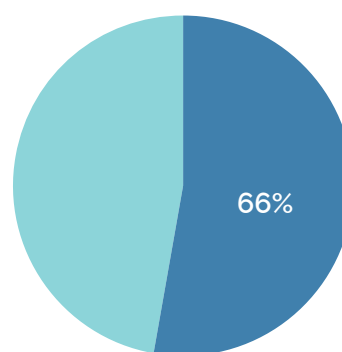
Legend:
- ● Complete
- ● No Applicable
- ● Pending
- ● Not Available
- ● Incomplete

- ● Complete + Alternative

Key Findings

Data for street coverage demands calculations from CRGP and it will be updated soon and the cadaster of lighting fixtures were made available by the municipality. SEMDUH states that pedestrian and cycle paths, bridges and tunnels and transport hubs are 100% covered by public lighting. The majority of the lighting fixtures are High pressure sodium, displaying a large gap for investments in public lighting, 7.2% are LED.

Teresina does not use a night lighting schedule, but in the next 12 months, the lighting fixtures will be changed and telematic network equipment will be implemented so the municipality can dimerize 20% of the lights. Trends in energy consumption from public lighting are in sharp decline. The public lighting service represents 1,93% of local budget expenses, while maintenance 1,9% (in stable increase).

According to the municipality, 100% of public space has a regular cleaning schedule - daily for primary roads, every 3 months for residential roads, and alternative days for public spaces. According to the city" Finance Department, 6.21% of the municipal budget is spent on street cleaning. Despite the good coverage of cleaning and sweeping service, the service faces significant disruptions reported to be caused by the lack of awareness from the population in the maintenance of clean public spaces. Regarding buildings and engineering services, the municipality assesses that between 26-50% of services are completed on schedule, and less than 25% of projects are completed within estimated budget.

There is a local Animal Control and Communicable Disease agency, and its self-evaluating report shows good coverage and efficiency of inspection services. The service also has an early warning and rapid alert systems in case of disease outbreak through the basic health system. The most relevant emergency events occurred are chrome COVID-19, Dengue, Zika, Chikungunya and leishmaniose disease outbreaks.

There is a data gap regarding the activities, development, buildings and engineering works permits and monitoring in the city's data collection. The city also lacks proper mapping of cultural and community welfare facilities. There is a good rate of sport facilities per habitant, but the city lacks a better cultural offer for citizens.

There is a high prevalence of urban crime in the city, being markedly robberies. According to SMPM/PMT, 12,25% of the female population experienced some type of domestic violence in the previous year (2016), and in total 27,11% experienced any type of domestic violence in their lifetime. The city has a Local Security Body - Guarda Municipal, responsible for security and protection of municipal assets, however operational capabilities are inadequate.

No data on Emergency and Rescue Services were available.

Selected Indicators

5.1	Public Works				
5.1.1	**Public Lighting**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.1.1.1	Percentage of public space covered by public lighting.	Public lighting		SEMDUH/PMT and CRGP shapefiles	2020
		General Coverage	74,92%		
		Lighting of primary roads	73,8%		
		Lighting of secondary roads	48,9%		
		Lighting of pedestrian paths and bicycle lanes	99,4%		
		Lighting of public open spaces	100%		
		Lighting of outdoor sports facilities	No data		
		Lighting of cultural heritage sites	No data		
		Lighting of bridges and tunnels	100%		
		Lighting of transport hubs	100%		
5.1.1.2	What level of disruption does the public lighting service face?	Seasonal disruptions	Considering that disturbance is the demand for correcting public lighting problems	SEMDUH/PMT	2020
5.1.1.2.1	Does the municipality use a night lighting schedule?	No	In the next 12 months, the park luminaires will be changed and remote management equipment will be implemented and the city hall will be able to dim 20% of the luminaires installed in Teresina.	SEMDUH/PMT	2020
5.1.1.2.2	Does the municipality switch off lighting for the entire city during the specified	Yes		SEMDUH/PMT	2020
5.1.1.3	Proportion of different lighting types installed from the total public lighting infrastructure in the city	Mercury vapour lighting	0,2%	SEMDUH/PMT	2020
		Metal halide lighting	10,65%		
		High pressure sodium (HPS) lighting	81,65%		
		LED lighting	7,1%		
		Fluorescent and mixed lamps	0,58%		
5.1.1.4	Trends in energy Consumption/capita from public lighting	Sharp decrease	Considering the PPP that come into force in Sep/20, the goal is to reduce the electricity consumption of the public lighting network by 50% in up to 21 months	SEMDUH/PMT	2020
5.1.1.4.1	Percentage of municipal budget spent on public lighting energy consumption last 5 years	2015	-	SEMDUH/PMT	2020
		2016	-		
		2017	-		
		2018	-		
		2019	1,93%		
5.1.1.5	What operation and maintenance measures are applied	Asset database for public lighting system, Operation and maintenance plan for public lighting infrastructure, Regular maintenance of all public lighting infrastructure, Regular monitoring and replacing of ageing infrastructure, Regular monitoring and replacing of non-functional infrastructure		SEMDUH/PMT	2020

		Indicator Description	Main Value	Sec. Values (if any)	Source	Date
5.1.1.5.1		Percentage of municipal equipped with telematic network	0%	Not relevant, 50 points with telematic network still in testing phase .	SEMDUH/PMT	2020
5.1.1.5.2		Percentage of municipal budget spent on public lighting maintenance	2016	1,29%	SEMDUH/PMT	2020
			2017	1,43%		
			2018	1,65%		
			2019	1,92%		
			2020	n.a.		
5.1.2		**Public spaces quality, maintenance and cleaning**				
		Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.1.2.1		Please select the choice that best suits primary space furniture quality assessment	Street & public spaces litter bins coverage	medium	SDU Sudeste/PMT	2020
			Street & public spaces benches coverage	medium		
			Street name signing coverage	good		
			Public lavatories coverage	good		
			Street & public spaces litter bins maintenance	good		
			Street & public spaces benches maintenance	good		
			Street name signing maintenance	good		
			Public lavatories maintenance	good		
5.1.2.2		Percentage of public space with regular cleaning schedule	100%		SDU Sudeste/PMT	2020
5.1.2.2.1		What is the sweeping cycle for arterial and residential streets?	Primary road	daily	SDU Sudeste/PMT	2020
			Residential roads	Every 3 months		
			Public spaces	Alternative days		
5.1.2.2.2		Percentage of municipal budget spent on street cleaning	6,21%		SEMF/PMT	2020
5.1.2.3		What level of disruption does the public spaces cleaning service face?	Significant disruptions	Greater population awareness is needed to maintain the cleanliness of public spaces.	SDU Sudeste/PMT	2020
5.1.2.4		Percentage of public spaces in need of significant repairment	0-25%	Only periodic maintenance done regularly is necessary	SUS Sudeste/PMT	2020
5.1.2.5		What operation and maintenance measures are applied?	Operation and maintenance plan for public spaces and furniture maintenance, Regular maintenance of all public spaces and furniture, Regular monitoring and replacing of ageing infrastructure, Regular monitoring and replacing of non-functional infrastructure.	The plan is applied to squares. There is no plan for the other spaces, as maintenance is carried out on demand.	SDU Sudeste/PMT	2020
5.1.2.2.2		Percentage of municipal budget spent in public spaces maintenance	0,05%		SDU Sudeste/PMT	2020
5.1.3		**Public buildings maintenance and engineering services**				
		Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.1.3.1		Percentage of buildings demanding maintenance that is currently being addressed (under project, bidding, implementation phase)	0-25%		SDU Sudeste/PMT	2020
5.1.3.2		Assessment of Buildings and Engineering Services Operations	Projects completed on schedule	26-50%	SDU Sudeste/PMT	2020
			Projects completed within budget	0-25%		

5.2	**Permits, Monitoring and Inspection**				
5.2.2	**Animal control and communicable diseases**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.2.2.1	Is there any local Animal Control and Communicable Diseases agency to drive the coordination work to ensure public safety?	Animal Control and Communicable Diseases		FMS/PMT	2020
5.2.2.2	If answer to 5.2.2.1 is Yes, please select the choice that best suits Animal Control and Communicable Diseases inspection and monitoring quality assessment	Coverage Routine Inspection	good	FMS/PMT	2020
		Coverage Risk-Based Inspection	good		
		Coverage Complaint-based	good		
		Coverage Acute Events	good		
		Efficiency Routine Inspection	For Leishmaniasis, rabies:good. For animal collection: average		
		Efficiency Risk-Based Inspection	good		
		Efficiency Complaint-based	good		
		Efficiency Acute Event	good		
5.2.2.3	Presence of notification mechanism on communicable disease occurrence or outbreaks	Yes	Colab, sinan, telephone exchange	FMS/PMT	2020
5.2.2.4	Existence of early warning and rapid alert systems in case of diseases outbreak	Yes, general public	Basic health system	FMS/PMT	2020
5.2.2.5	Existence of awareness-raising activities as means of prevention and control of communicable diseases	Yes, general public	Schools and churches	FMS/PMT	2020
5.2.2.5.1	Please specify the five most relevant emergency events occurred in the last five years	2020 - COVID 2019 - Dengue, zika, chikungunya, leishmaniose		FMS/PMT	2020
5.2.2.6	What operation and maintenance measures are applied?	Regular surveillance of communicable diseases, Regular surveillance of immunisation and vaccination programmes, Investigation and control of communicable disease, Epidemiological research, Teaching/training in communicable diseases epidemiology, 24h Animal Shelter to receive sick or injured animals, Immediate response to call in case of aggressive animals endangering human life.		FMS/PMT	2020

5.2.2.7	Frequency of surveillance activities	Type of disease(s):	Raiva, Leishmaniose, Arboviroses (dengue, zika, chikungunya, febre amarela, febre do Nilo), Malária, Leptospirose	FMS/PMT	2020
		Active surveillance	Daily		
		Frequency of data collection:			
		Passive surveillance	Daily		
		Frequency of data collection:			

5.2.3	**Activities, development, buildings and engineering works permits and monitoring**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.2.3.1	Is there any local agency responsible for Buildings and Engineering Works Permits and Monitoring?	Activities, Development, Buildings and Engineering Works Permits	CREA - Conselho Regional de Engenharia e Agronomia do Piaui	CREA-PI	2020
		Activities, Development, Buildings and Engineering Works Inspections and Monitoring	Tribunal de Contas do Estado do Piaui, SEMPLAN, Corpo de Bombeiros	TCE-PI, PMT, Corpo de Bombeiros	2020
5.2.3.2	If answer to 5.2.3.1 is Yes for any, please select the choice that best suits Buildings and Engineering Works Permits and Monitoring quality assessment	Licensing (new development), Licensing (new activity).Routine Inspection, Complaint-based, Emergency Event		CAU-PI	2020
5.2.3.2.1	If coverage/response efficiency is less than "Good:, please identify barriers (for each item)	-			
5.2.3.4	Diversity of submission/following-up/notification mechanism for licensing and inspection services	Digital Service for irregular construction or activity; Digital service to submit and follow-up development licensing; Digital service to submit and follow-up activity licensing		CAU-PI	2020
5.2.3.5	Percentage of Development services delivered on the basic level of service	-			
5.2.3.6	What operations measures are applied?	-			
5.2.4.7	Does the Local Authority dispose of municipal funds for emergency intervention on protected built heritage?	Yes	Lei Orçamentária Anual do Município - Fundação Cultural Monsenhor Chaves	SEMPLAN/PMT	2020

5.3	**Community Welfare**				
5.3.1	**Cultural and community facilities and activities**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.3.1.1	Coverage of Community Facilities. Please inform rate of community facilities per capita				
	Public libraries	10	1,15 facilities per 100 000pop	FMC/PMT	2020
	Museums of all disciplines	7	0,80 facilities per 100 000pop	FMC/PMT	2020
	Archives and documentation centres	2	0,23 facilities per 100 000pop	PMT	2020
	Performing arts centres	3	0,35 facilities per 100 000pop	FMC/PMT	2020
	Community and civic centres	3	0, 35 facilities per 100 000pop	PMT	2020
	Child recreation spaces	12	1,38 facilities per 100 000pop	SEMEL/PMT	2020
	Sports Complex and Facilities	181	20,85 facilities per 100 000pop	SEMEL/PMT	2020
5.3.1.1.1	If number of facilities are considered inadequate, please identify barriers				
5.3.1.1.2	Does the local authority maintain an updated georrefered database of community facilities?	Yes		Teresina Geo/PMT	

5.3.1.4	Does the municipality regularly perform participatory processes to decide on community facility offers and regular activities developed?	Yes	Orçamento participativo	SEMPLAN/PMT	2019

5.4	Local Public Security and Law Enforcement				
5.4.1	**Violence and security**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.4.1.1	Crimes against property per 100 000 inhabitants	Burglaries	2303,64/100000hab	SSP-PI (Secretaria de Segurança Pública Estatísticas Criminais)	2019
		Motor vehicle thefts	380,64/100000hab		
5.4.1.2	Violent crimes per 100000 inhabitants	Total	2336,02/100000hab	SSP-PI,SEMPLAN, Fórum Brasileiro de Segurança Pública	2018-2019
		Robberies	2303,64/100000hab		
		Rapes	29,83/100000hab		
		Aggravated assaults	2,55/100000hab		
5.4.1.3	Homicide per 100 000 inhabitants (Please disaggregate by sex, age and groups in vulnerable situation, if possible)	Intentional Homicide per 100 000 inhabitants	27,63/100000hab	SSP-PI	2019
		Male	26,24/100000hab		
		Female	1,5/100000hab		
5.4.1.6	Percentage of inhabitants who experienced domestic violence. (Please disaggregate by sex, age and groups in vulnerable situation, if possible)Last year	Type	%	SMPM/PMT	2016
	Last year	All types of domestic violence (Female)	12,25%		
		Physical (female)	4,38%		
		Psychological (female)	10,28%		
		Sexual	2,19%		
	Last 5 years	n.a.			
	Lifetime	All types of domestic violence (Female)	27,13%		
		Physical (female)	14,22%		
		Psychological (female)	22,11%		
		Sexual	6,35%		

5.4.2	**Local public security bodies**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
5.4.2.1	Does the city has any Local Public Security Body?	Yes		PMT	2020
5.4.2.2	If answer to 5.4.2.1 is Yes, please select the applicable areas of activity being carried by the authority	Name of unit	Guarda Civil Municipal	PMT	2020
		Area(s) of responsibility	Security and protection of municipal assets		
		Spatial scale(s) of interventions	Local		
		Operational capabilities	Inadequate		
5.4.2.3	Does the Local Public Security Body also implement preventive policies?		Add here: Public Security Secretariat of the State of Piauí (Secretaria de Segurança Pública do Estado do Piauí)		

5.4.3	Traffic control and enforcement				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
5.4.3.1	Does the city have any local authority in charge of traffic control and enforcement?	Yes	STRANS has traffic guards in charge of traffic control	SSP	2020

5.4.4	Law enforcement and justice				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
5.4.4.2	Is any informal crime-watch organisation in place?	-			

5.5	Emergency and Rescue Services				
5.5.1	Diversity and typology of emergency and rescue services				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
5.5.1.1	Fire emergency services operating in the city, with respective capacities	Public Private Charity/ Non-profit	Defesa Civil (Civil Defense) e Corpo de Bombeiros (Firefighters) (not available) (not available)	Defesa Civil e CBM	2020
5.5.1.2	Public works units available in the city, with capacities.	-			
5.5.1.3	Emergency services available in the city, with respective staffing and equipment capacities	-			

5.5.2	Continuity of emergency and response operations				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
5.5.2.1	Operational schedule of emergency and response services	-	Working Hours Specific schedule		2020
	Fire emergency services	Fire Department (Corpo de Bombeiros)	24h/7d On-demand	CBM	
	Public works units	Civil Police (Policia Civil)	24h/7d Field operations	Policia Civil	
	Specialised Emergency Services	Mobile Emergency Service (SAMU)	24h/7d Field operations	SAMU-PI	
	Civil Emergency Services	Civil Defense (Defesa Civil)	24h/7d On-demand	Defesa Civil	
5.5.2.2	Modality that emergency and rescue services can be contacted	-			2020
	Fire emergency services	Fire Department (Corpo de Bombeiros)	Free Number: 193	CBM	
	Public works units	Civil Police (Policia Civil)	Free Number: 197	Policia Civil	
	Specialised Emergency Services	Mobile Emergency Service (SAMU)	Free Number: 192	SAMU-PI	
	Civil Emergency Services	Civil Defense (Defesa Civil)	Free Number: 199	Defesa Civil	
5.5.2.3	Response time of emergency and rescue services	SAMU: 13,6 minutes (urban zone) 32,8 minutes (rural zone)		SILVA, 2012	2012
5.5.2.4	Existence of a public management body that is responsible for inter-agency preparedness and response coordination	-			

TERESINA | PUBLIC LIGHTING
Indicator 5.1: Public Lighting

Primary Road
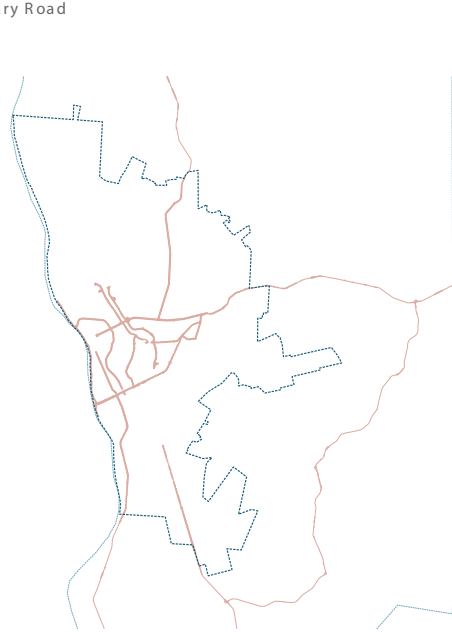
Secondary Road
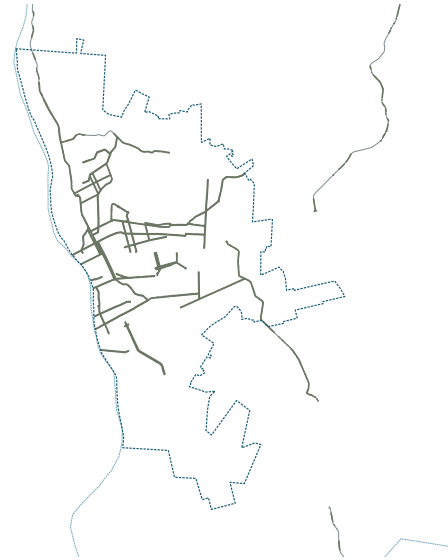
Tertiary Road
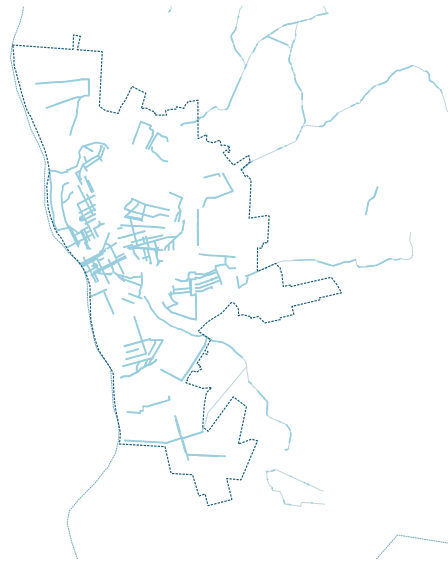
Residential and Others
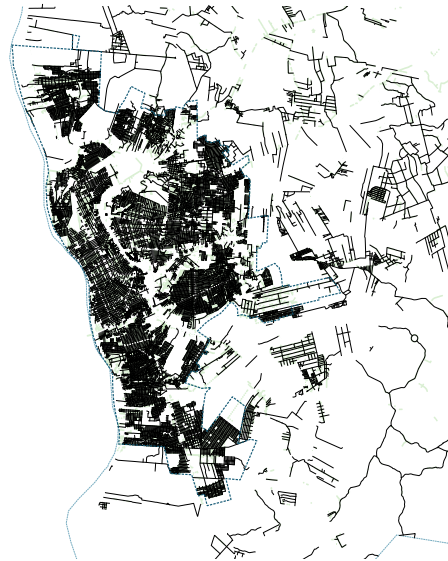
Public Lighting 50m Radious Buffer

- Primary
- Secondary
- Tertiary
- Residental and Others

Road

- Primary
- Secondary
- Tertiary
- Residential and Others

- Teresina's Perimeter
- Urban Perimeter

Source: CRPG and Municipality of Teresina, 2020

0   2,5   5 km   △ N

TERESINA | CULTURAL AND COMMUNITY FACILITIES AND ACTIVITIES

Indicator 5.3: Coverage of Community Facilities

- Esportes
- Library
- Museums
- Theaters
- Open Popular Gyms
- Urban Perimeter
- City Blocks
- Teresina's Perimeter

Source: CRGP with Open Street Maps, 2020

0   2,5   5 km

△ N
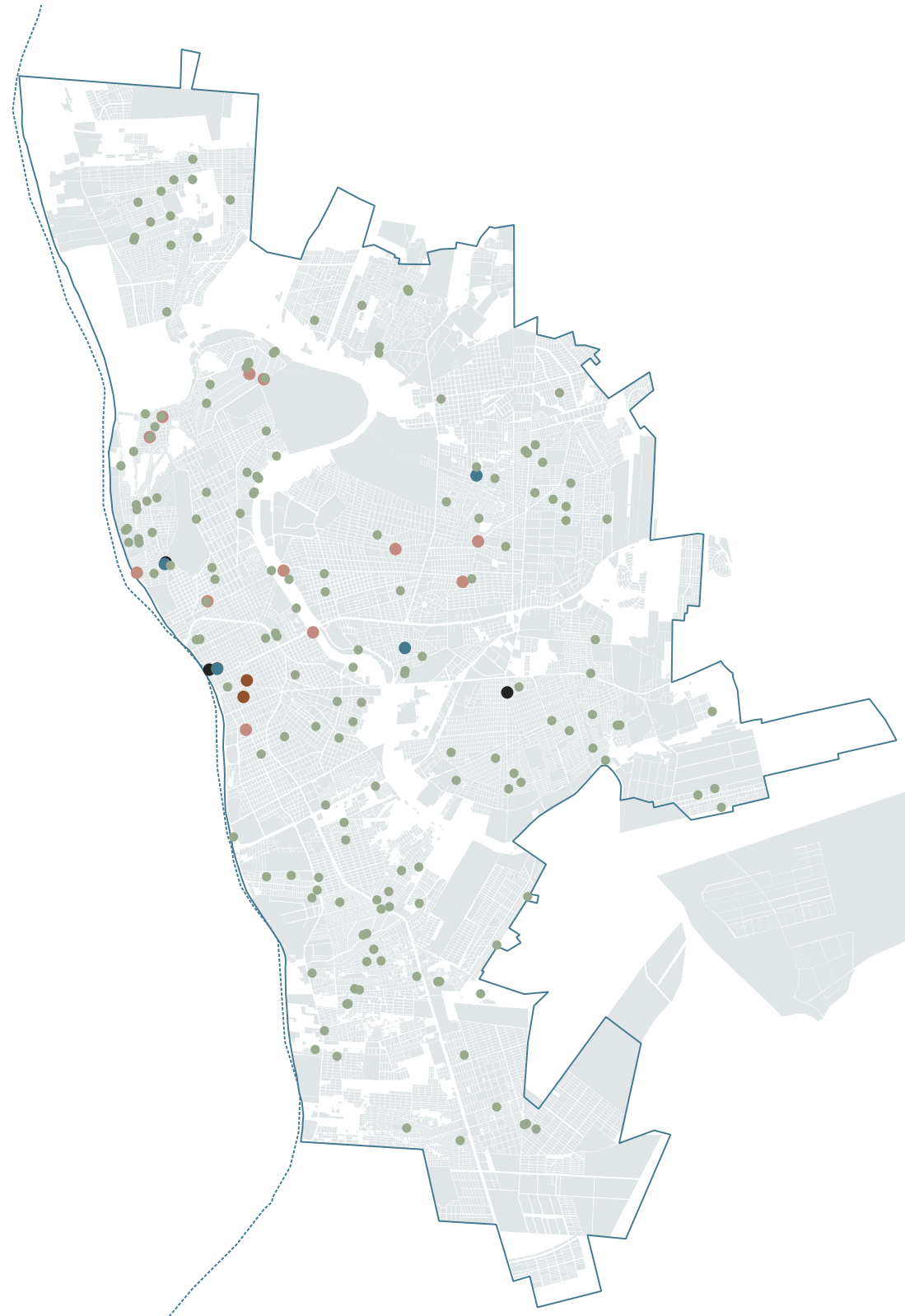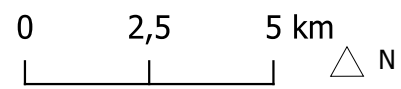
6. Social Inclusion and Protection

The Social Inclusion and Protection Element (SIP) Element is composed of three macro-components, gathering data on Social Accountability, Social Protection Floors and Basic Social Services – such as education, health, social care and food provision. The chapter is designed to assess the availability of the aforementioned services in the city, mapping accessibility barriers that different population groups may face.

Data Collection

The total completion rate for data collection is 21%, 65% not applicable and 13% incomplete. Considering only the selected indicators, the completion rate was 87% for this element (including complete and alternative data).

Social Inclusion And Protection Element Data Completion (%)

Supporting Indicators (SI) %

- Complete
- No Applicable
- Incomplete

- Complete + Alternative
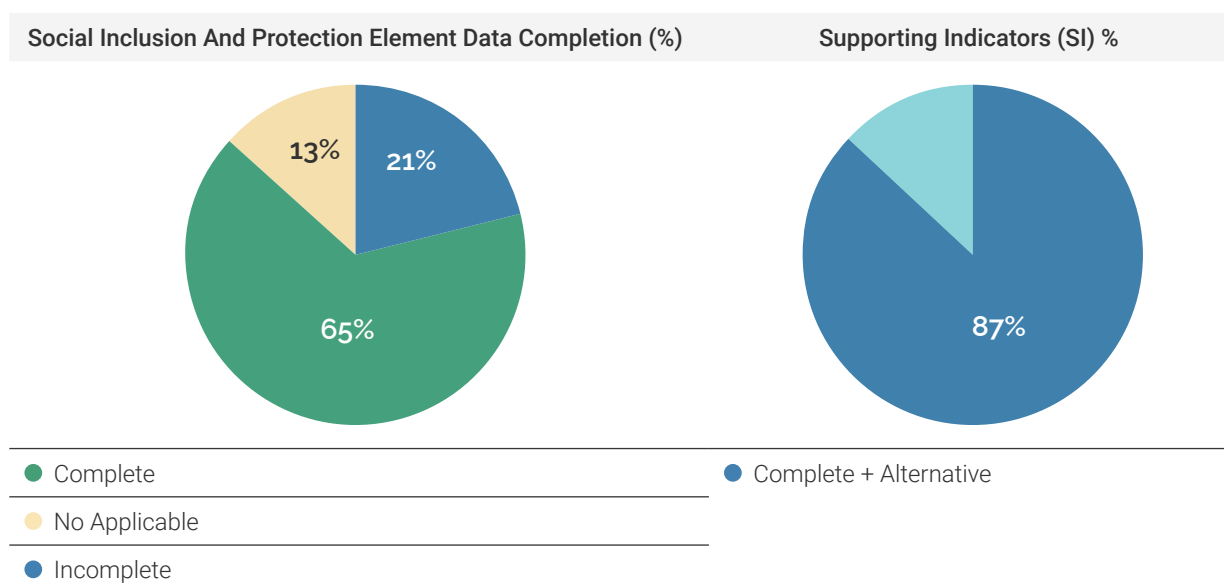
Key Findings

The municipality has several mechanisms of citizen consultation in the development of public interventions, with a diversity of methods as workshops, public meetings, online consultations, and regular mechanisms as a participatory budget.

Regarding social protection floors, there is a 100% universal basic health insurance coverage, offered by the national health insurance system SUS, and more than 17% of the households benefit from a guaranteed minimum income (Bolsa Família).

Regarding the access to social basic services, enrolment rate is 97,3% for early childhood, 98,7% in primary education, and 61% on Secondary education, being this the most concerning sector. Drop-out rate is low in early years, but considerably high in secondary education. The capacity of public education facilities of the services surpass the demand.

Hospital beds per 1.000 inhabitants are double the national values, nursing personnel and physicians are considerably higher than national figures. The operations of healthcare systems are facing significant disruptions. There are protocols in place to monitor infectious diseases.

No data on social care services were provided by the conclusion of the report.

Selected Indicators

6.1	**Social Accountability**				
6.1.1	**Consultation of citizens in development intervention**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
6.1.1.1	Does the local government consult citizens regarding its development interventions?	Yes	Teresina Participativa, Also there are several sectoral councils composed by the public sector + civil society, in areas such as Urban Development, Health, Culture, Women rights, Environment, Public Transportation, Social Services, Employment, etc.	SEMPLAN/PMT	2020
6.1.1.1.1	If yes, does the local government consider the balanced consultation of male and female citizens as well as of citizens in vulnerable situations?	No data available, but this one line of action of the Municipal Plan of Public Policy for Women.	According 'to the Plan: "1.1.1 Implement a policy of equal participation and equal pay for men and women in public and private service. Therefore, a diagnosis of the current situation must be made, with a view to building an adequate and consistent policy".	SEMPLAN/PMT	2020
6.1.1.1.2	Select the topics of interest when organising consultations, and specify the number of citizens reached by the process:	Development of utilities infrastructure	x	SEMPLAN/PMT	2020
		Development of basic social services	x	SEMPLAN/PMT	2020
		Development of land and housing	x	SEMPLAN/PMT	2020
		Development of mobility infrastructure	x	SEMPLAN/PMT	2020
		Development of ecology-related projects	x	SEMPLAN/PMT	2020
6.1.1.1.3	What method is used for public consultation and what is the number of citizens reached by each method?	"Small groups/ roundtables/ workshops"	x	SEMPLAN/PM	2020
		Public call/meeting	x	SEMPLAN/PMT	2020
		Mail/telephone/online questionnaire		SEMPLAN/PMT	2020
		Other(s)	x - Online Consultation; Popular Budget	SEMPLAN/PMT	2020
6.2	**Access to Social Protection Floor for All**				
6.2.2	**Access to health care (primary, secondary and tertiary healthcare) through appropriate insurance**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
6.2.2.1	Coverage of basic universal healthcare insurance, total population, sex disaggregated	Yes	100 %	FMS/PMT	2019
6.2.4.3	Coverage with Guaranteed Minimum Income (GMI) type of benefits	24,17 %		Transparent Portal	2019
6.2.4.3.1	If less than 100%, what are the barriers them prevent them from benefiting from this measures	Financial capacity	x	Public Knowledge	2019
6.3	**Access to Basic Social Services**				
6.3.1	**Access to Basic Social Services - Education**				
6.3.1.1	**Coverage of Public Education Services**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
6.3.1.1.1	Physical Capacity of Public Education Facilities	Early Childhood (age 3-5)	62,18 % of effective coverage	INEP/DataSUS	2019
		Primary (age 6-11)	177,78 % of effective coverage	INEP/DataSUS	2019
		Secondary (age 12-18)	25,51 % of effective coverage	INEP/DataSUS	2019

6.3.1.1	Access to public education					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
6.3.1.2.1	Indicate the enrolment rate (%) (disaggregate by sex when data is available)	Early Childhood (age 3-5)	97,3 %	Kindergarten 27,48% (51,10% M/ 48,90% F) *Municipal schools	INEP/SEMEC	2019
		Primary (ages 6-11)	98,7 %	Elementary School 70,48% (51,50% M/ 48,50% F) *Municipal schools	INEP/SEMEC	2019
		Secondary (ages 12-18)	61 %	Youth and Adult Education 1,93% (46,60% M/ 53,40%F) *Municipal schools	INEP/SEMEC	2019
6.3.1.2.1.1	If enrollment rate is not universal, what factor(s) most contribute(s) to this limitation?	Other, please specify	x	Address change; Family (has no one to leave children with); Job; Pregnancy; Lack of interest; Violence	SEMEC/PMT	2020
6.3.1.2.2	What is the drop-out rate per education level (%) (disaggregate by sex when data is available)?	Early Childhood (age 3-5)	0,2%		INEP	2018
		Primary (ages 6-11)	2%		INEP	2018
		Secondary (ages 12-18)	11%		INEP	2018

6.3.2	Access to Basic Social Services - Health					
6.3.2.1	**Coverage of Basic Health Services**					
	Indicator Description	**Main Value**		**Sec. Values (if any)**	**Source**	**Date**
6.3.2.1.1	Physical Capacity of Health Facilities	Number of Hospitals	123	0,14 per 1.000 pop.	FMS/PMT	2020
Physicians		Hospital beds	3.246	3,74 per 1.000 pop.	Ministério da Saúde	2020
Nursing Personnel		6.127	70,58 per 1.000 pop.	CRM-PI		2020
		23512	71,65 per 1.000 pop.	COFEN		2020
6.3.2.1.2	Capacity of Emergency Response	Emergency responders	252	2,9 per 1.000 pop.	SEMPLAN/PMT	2018
		Emergency response vehicles	15	0,17 per 1.000 pop.	SEMPLAN/PMT	2018
		Facilities for emergency response purposes	3	0,03 per 1.000 pop.	SEMPLAN/PMT	2018
6.3.2.1.3	Do local or national early warning systems for disease control exist (e.g. Ebola outbreak)?	Yes			SEMPLAN /PMT	2018
6.3.2.1.4	Are there protocolos in place for monitoring infectious diseases	Yes			SEMPLAN /PMT	2018

6.3.2.3	Continuity of Operations of Basic Health Services					
	Indicator Description	Main Value		Sec. Values (if any)	Source	Date
6.3.2.3.1	What level of disruption is faced in the healthcare system?	Significant			SEMPLAN /PMT	2018
6.3.2.3.1.2	If disruptions in provision of health service are significant, please describe the cause(s) of the disruption(s)	Unknown			SEMPLAN /PMT	2018
		Seasonal/Environmental Disruption				
		Fiscal/Budgetary Constraints or Mismanagement	x			
		Administrative/Health Provider Disruption	x			
		Other Disruptions				

6.3.3	Access To Basic Social Services - Social Care And Protection					
6.3.3.1	Coverage of Social Care Services					
	Indicator Description	Main Value		Sec. Values (if any)	Source	Date
6.3.3.1.1	Existence of preventive measures per each of the following category and subcategory of people in vulnerable situations, sex disaggregated	Existence of Preventive Measures (Yes/No)	Total	[%] of population covered	SEMPLAN/PMT	2019
6.3.3.1.1.1	Children without parental care	Yes	45 Units of Preventive Measures	41,03%	SEMPLAN/PMT	2019
6.3.3.1.1.2	Poor people	Yes	77 Units of Preventive Measures		SEMPLAN/PMT	2019
6.3.3.1.1.3	Lone and dependent elderly	Yes	8 Units of Preventive Measures	28,13%	SEMPLAN/PMT	2019
6.3.3.1.1.4	Ethnic minorities	Yes			SEMPLAN/PMT	2019
6.3.3.1.1.5	Persons with disabilities	Yes	3 Units of Preventive Measures		SEMPLAN/PMT	2019
6.3.3.1.1.6	People living in marginalised communities	Yes			SEMPLAN/PMT	2019
6.3.3.1.1.7	Other categories of people in vulnerable situations - Facilities for emergency response purposes	Yes	11 Units of Preventive Measures		SEMPLAN/PMT	2019
		Homeless	2			
		LGBTI	4			
		Women	5			
6.3.3.1.2	Existence of protective measures per each of the following category and subcategory of people in vulnerable situations, sex disaggregated	All the protective measures are the same as the preventive measures of people in vulnerable situations			SEMPLAN/PMT	2019

TERESINA | EDUCATION

Indicator 6.3.1 Access to Basic Social Services - Education Facilities

- Education Facilities
- City Blocks
- Teresina`s Perimeter
- Water Streams
- City Zones

NORTH

EAST

SOUTHEAST

SOUTH

Source: CRGP with SEMPLAN, 2020

0   2,5   5 km

N

Annex II: CRPT Indicators
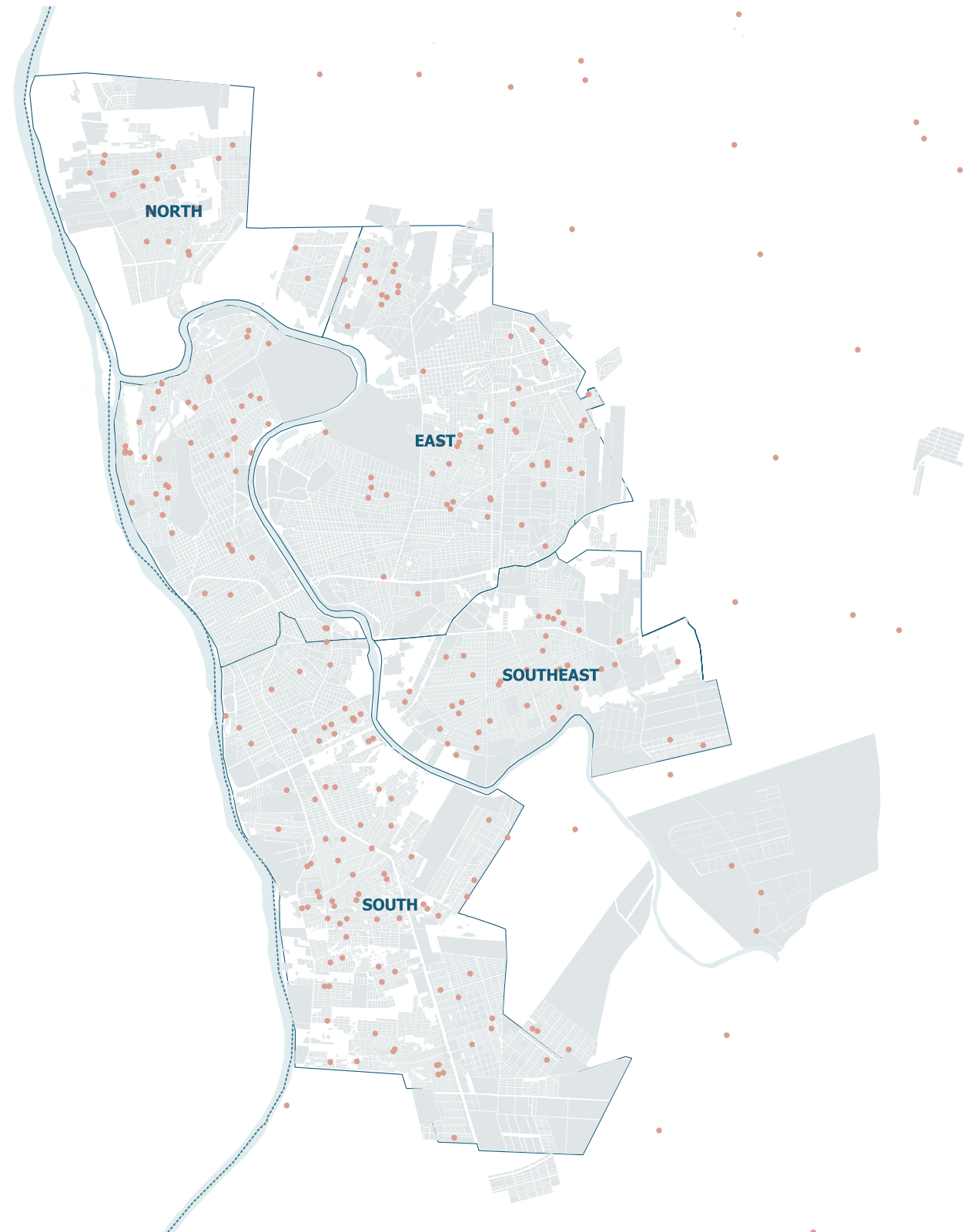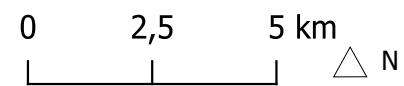
Figure 11: Indicator 6.3.2 - Health. Source: CRGP with Open Street Maps (2020).

TERESINA | HEALTH

Indicator 6.3.2: Access to Bacic Social Services - Health Facilities

NORTH

EAST

SOUTHEAST

SOUTH

- Saúde
- City Main Zones
- Teresina's Perimeter
- City Blocks
- Water Streams

Source: CRGP with Open Street Maps, 2020

0   2,5   5 km

△ N

7. Economy

The Economy Element comprises three components and analyses information related to the local economic structure, municipal fiscal stability and market connectivity. Analysing information related to the economic composition of a city such as its municipal finance and fiscal mechanisms, and the degree to which the local economy is connected to other markets, can provide an understanding of factors that influence economic resilience. While there are many ways to analyse urban economies, the three components have been selected to highlight vulnerabilities and capacities within the economic aspects of a city.

Data Collection

The total completion rate for data collection is 84%, also 3% of the data considered incomplete, 5% not applicable and 8% incomplete. Considering only the selected indicators, the completion rate was 92% for this element (including complete and alternative data).

Economy Element Data Completion (%)	Supporting Indicators (SI) %

- ● Complete
- ● Incomplete
- ● No Applicable
- ● Incomplete

- ● Complete + Alternative
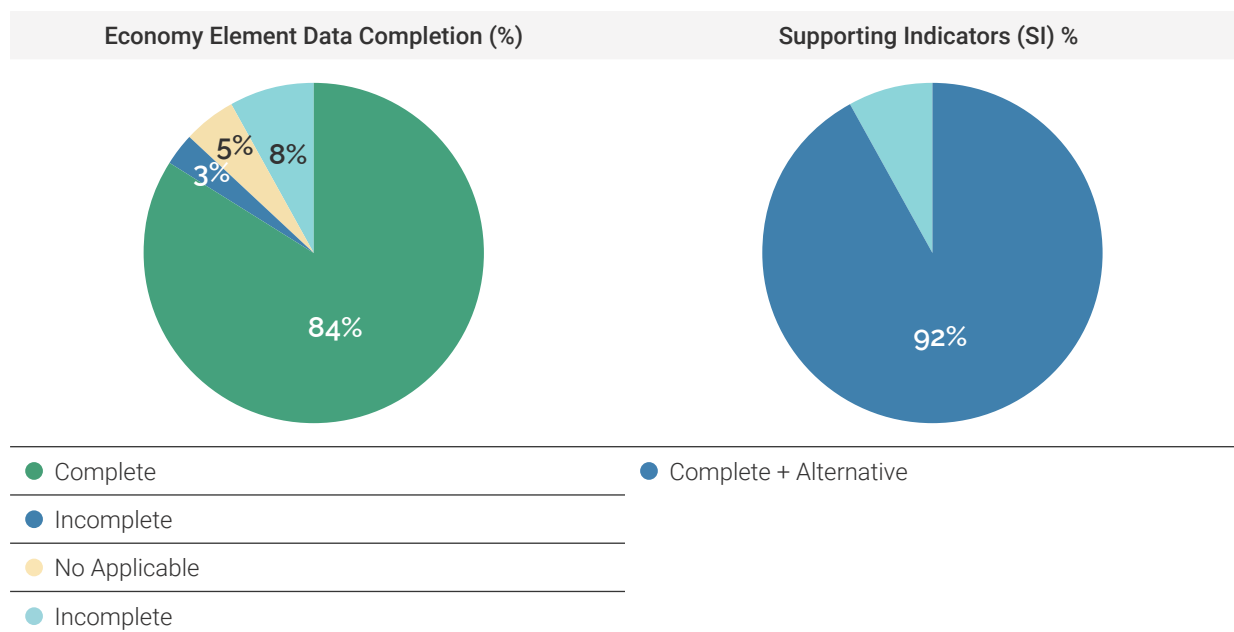
Key Findings

Public Administration is the main industry sector responsible for 37% of city product share. Other relevant industry sectors are Retail (11%), Administrative Activities (8%), Education (8%) and Human Healthcare and Social Services (7%). Manufacturing share of the city's GDP is low (5,7%). City's GCP/capita in local currency (BRL) had a considerable average growth rate in the past decade, but figures are low with values in USD (current prices). Industrial diversity is low.

Business diversity is average. The retail sector represents 41% of total business, the second sector in number of business is Administrative Activities (8%), Processing Industries (8%), and Lodging and Food (8%). However, the informal economy represents around half the economy.

Regarding employment, 26% of jobs are under the Public administration, 17% in Administrative activities, and 13% in the Retail sector. Employment diversity is considered low. Self-employed share was around 31%, and informal employment rate 44,7%. In 2019, the unemployment rate was 13,7%, being 24% among the youth (age under 29 years old).

According to SIS /PNAD data, 29.3% of families below the poverty line. The income gap between women and men was 21% higher for men. There are considerable inequalities in local income distribution.

Regarding fiscal stability, the main revenue sources are current transfers from the national government. The proportion of local government revenues that is won-source is 22,5%, with an increasing trend in the last 5 years. Diversity index in municipal income is considered low. The diversity index in municipal expenses is considered on average. The main expense shares in local government are for Health services (43,66%), followed by education (18%) and Urban Development (18,27%).

Access to financial services is still of concern, 87,10% of the population has a bank account, and there are 6,13 commercial banks per 100 000 inhabitants. Market connectivity is low, there are only 2 large cities located between 200 and 500km. Imports and Exports are low.

Selected Indicators

7.1	Local Economic Structure										
7.1.1	Industrial Composition										
	Indicator Description	Main Value	Sec. Values (if any)							Source	Date
7.1.1.1	Industrial diversity using composition by city product sector shares	Industry sector	Product my sector	Employment by sector	Emp. by sector	Emp. Ratio	City product by sector	City product share by sector	City Product Share ^2	RAIS	2017
		Public administration	1706595,534	9250000	76900	1%	14187,8050	36%	0,1268992		
		Retail sector	808387,3582	9160000	49600	1%	4377,29399	11%	0,01207924		
		Administrative activities	371259,3793	4200000	37800	1%	3341,33441	8%	0,0070383		
		Human healthcare and social services	281438,5617	2290000	22000	1%	2703,77657	7%	0,0046086		
		Education	371259,3793	2040000	17600	1%	3203,02209	8%	0,00646767		
		Processing industries	856291,7942	6750000	15900	0%	2017,04289	5%	0,00256483		
		Construction	131737,1991	1960000	15200	1%	1021,63542	3%	0,00065799		
		Lodging and food	191617,7442	1890000	10200	1%	1034;12750	3%	0,00067418		
		Transport and postal services	275450,5072	2310000	8740	0%	1042,18070	3%	0,00068472		
		Others	107784,9811	740000	19277	3%	2807,79875	7%	0,00497004		
		Specialized services	149701,3626	1020000	4940	0%	725,02246	2%	0,00033138		
		Agriculture	119761,0901	1390000	843	0%	72,6320855	0%	0,00000332		
		Electricity and gas	41916,38154	125000	2330	2%	781,321351	2%	0,00038484		
		Domestic Services	0	3300	3	0%	0	0%	0		
		Extractive industry	59880,54505	212000	204	0%	57,6209018	0%	0,00000209		
		Information and communication	161677,4716	338000	2330	1%	1114,52221	0%	0,00078307		
		Arts, entertainment and recreation	23952,21802	254000	943	0%	88,9249669	3%	0,00000498		
		Real estate activities	11976,10901	143000	1040	1%	87,0989746	0%	0,00000478		
		Financial activities	251498,2892	870000	3340	0%	965,522167	2%	0,00058769		
		Water supply, sewerage, waste management and remediation activities	5389249055	333000	1230	0%	199,062352	0%	0,00002498		
		Total	5976078,396	43000000	290420	1%	39827,7466	100%			
		HHI Diversity Index	0,1687720									
7.1.1.1.1	Manufacturing share of Local City Product	5,7%								RAIS	2017

7.1.1.2	Gross City Product (GCP) and GCP per capita for the past 10 years		GCP (US$ current prices)	GCP/capita (US$ current prices)	GCP (R$)	GCP/capita (R$)	IBGE	2017
		2010	5987261,83	7412,997784	10539377	13049,1		
		2011	6808069,254	8838,191045	11403516	14803,97		
		2012	6296312,289	8225,156042	12306772	16076,89		
		2013	6861158,231	8174,958287	14803635	17638,29		
		2014	7478541,684	8984,945186	17600000	21145,17		
		2015	5294070,854	6270,775927	17637197,05	20891,09		
		2016	5490264,643	6478,722673	19161572,63	22611,39		
		2017	5988054,505	7043,129699	19113869,98	22481,67		
		Average Growth Rate	0,00%	-0,64%	7,73%	7,04%		

7.1.2	**Business Composition**					
	Indicator Description	**Main Value**	**Sec. Values (if any)**		**Source**	**Date**
7.1.2.1	Diversity of businesses based on ICIS industry sector categorisation	Industry sector	Number of businesses	% of total businesses	RAIS	2017
		Public Administration	98	1%		
		Retail sector	5690	41%		
		Administrative activities	1110	8%		
		Human Healthcare and social services	987	7%		
		Education	429	3%		
		Processing industries	1110	8%		
		Construction	685	5%		
		Lodging and food	1130	8%		
		Transport and postal services	366	3%		
		Others services activities	736	5%		
		Specialized services	554	4%		
		Agriculture	95	1%		
		Domestic services	2	0%		
		Electricity and gas	7	0%		
		Extractive industry	29	0%		
		Information and communication	206	2%		
		Arts, entertainment and recreation	178	1%		
		Real estate activities	112	1%		
		Financial activities	158	1%		
		Water supply, sewerage, waste management and remediation activities	36	0%		
		Total	13718	100%		
		HHi Diversity Index	0,2064986837			
7.1.2.2	Total number of business establishments per square kilometre	77,61634506			IBGE	2018
7.1.2.3	Proportion of total businesses that can be classified as informal	58,80% of informal workers in Piauí, in the 1st semester of 2020			Censo IBGE	2020

7.1.2.4	Number of new businesses (by sector if possible)	45311				
7.1.3	**Employment Composition**					
	Indicator Description	**Main Value**	**Sec. Values (if any)**		**Source**	**Date**
7.1.3.1	Diversity index for local employment using local employment composition by sector	Industry Sector	Total Employment	Employment share (%)	RAIS	2017
		Public administration	76900	26%		
		Retail sector	49600	17%		
		Administrative activities	37800	13%		
		Human Healthcare and social services	22000	8%		
		Education	17600	6%		
		Processing industries	15900	5%		
		Construction	15200	5%		
		Lodging and food	10200	4%		
		Transport and postal services	8740	3%		
		Others services activities	19277	7%		
		Specialized activities	4940	2%		
		Specialized services	843	0%		
		Agriculture	2330	1%		
		Domestic services	3	0%		
		Electricity and gas	204	0%		
		Extractive industry	2330	1%		
		Information and communication	943	0%		
		Arts, entertainment and recreation	1040	0%		
		Real estate activities	3340	1%		
		Financial activities	1230	0%		
		Water supply, sewerage, waste management and remediation activities	0	0%		
		All sectors	290420	100%		
		HII Diversity index		0,1385152983		
7.1.3.1.1	Manufacturing job share	5%			RAIS	2017
7.1.3.1.2	Local government job share	40%			RAIS	2017
7.1.3.1.3	Self-employed job share	31%			RAIS	2017

7.1.3.2	Unemployment rate	Category	Unemployment rate			SIS/IBGE	2019
		TOTAL (all groups)	Total	Female	Male		
			13,7	13,8	13,6		
		Education level					
		Without instruction or incomplete elementary					
		Complete elementary school or incomplete high school					
		Complete high school or incomplete higher education					
		Complete higher education					
		Age group					
		<29	24%				
		30-49	10,6%				
		>50	7,2%				
7.1.3.3	Informal employment rate (please desaggregate by sex and vulnerable groups, if possible)	Total	44,7			SIS/IBGE	2018
		Male	50,1				
		Female	49,9				
7.1.3.4	Youth unemployment rate (please desaggregate by sex and vulnerable groups, if possible)	Total	24%			SIS/ PNAD	2018
		Male					
		Female					
7.1.3.5	NEET Rate (please desaggregate by sex and vulnerable groups, if possible)	Total	19,3%			SIS/ PNAD 2018	2018
		Male					
		Female					
7.1.3.6	Are worker training and retraining programs available for city inhabitants?	Yes				SENAC website	2020
7.1.4	**Income and equality**						
	Indicator Description	**Main Value**	**Sec. Values (if any)**			**Source**	**Date**
7.1.4.1	Local income distribution (disaggregate by sex and vulnerable groups, if possible)	Income group	Proportion of population (%)			SIS/ PNAD 2018	2018
			Total	Women	Men		
		Lowest earning 20%	3,5				
		21-40%	7,6				
		41,60%	12,6				
		61-80%	20,4				
		Highest earning 20%	55,9				
		All income groups	100				
7.1.4.2	Proportion of the households below the poverty line	29,3%				IBGE	2018

7.1.4.3	Provide GINI Coefficient at local level the last year available	0,511					SIS/ PNAD	2018
7.1.4.4	Gender pay gap		Median income		Income Gap		SIS/ PNAD	2018
			Women	Men				
			R$ 398	R$ 505	21,2%			

7.1.5	**Housing Affordability**							
	Indicator Description	**Main Value**	**Sec. Values (if any)**				**Source**	**Date**
7.1.5.1	Residential real estate market trends in relation to income	Year	Median home sale price (R$)	% change in home price	Median household income (R$)	% change in income	CRECI PI and IBGE	2020
		2016	253000		1367			
		2017	269000	6,33	1290	-5,63		
		2018	284000	5,58	1781	38		
		2019	290000	2,11	1420	-20,27		
		2020	302000	4,14	1999	40,77		
		5-year chance		19,37		46,23		
7.1.5.3	Average proportion of a household's budget spent on rental housing		36%				IBGE POF - Pesquisa de orçamento familiar	2017-2018
7.1.5.4	Housing tenure composition (rental/mortgage/owed outright)	Item	All housing	Rental	Owned outright	Other	IBGE Censo	2010
		Number of housing units	222154	30013,01	176945,66	2865,79		
		Proportion of total (%)		13,51	79,65	1,29		
7.1.5.5	Existence of taxes, subsidies, and/or regulations targeting access to, and security within, housing for low and middle-income households	Subsidies	Minha casa minha vida				PMT	2020

7.2	Fiscal Stability and Municipal Finance						
7.2.1	Municipal revenue composition						
	Indicator Description	**Main Value**				**Source**	**Date**
			Sec. Values (if any)				
7.2.1.1	Revenue diversity	Revenue category	Total revenue (R$)	% share	% share ^	SEMPLAN /PMT-	2020
		Current transfers	2.245.963.222,00	61%	0,3661320085		
		Land/property tax	99.994.000	3%	0,0007257388735		
		Other local taxes	489.217.000	13%	0,01737143051		
		Grants and subsidies	202.141.000	5%	0,002965796326		
		Patrimonial revenue	88210000	2%	0,0005647654849		
		Services revenue	78.460.000	2%	0,000468164058		
		Other current revenue	101.816.000	3%	0,0007524273362		
		Credit operations	324.520.000	9%	0,007643907761		
		Amortization of loans	3.020.000	0%	0,0000006619823177		
		Capital transfers	144907000	4%	0,001524092177		
		Intra-budgetary contributions	158340000	4%	0,001819758616		
		Revenue patrimonial	400000	0%	0,000000011611321552		
		Services revenue intra-budgetary	27185000	1%	0,0000536402975		
		Current transfers deduction	252380000				
		Total revenue	R$ 3.711793.000,00	100%	1		
		Diversity Index	0,40				
7.2.1.2	Proportion of total local government revenue that is own-source	22,5%				SEMPLAN/PMT	2020
7.2.1.3	Trends in own-source revenue (last 5 years)	Increased		45%		SEMPLAN/PMT	2020
		Increased slightly/remained the same					
		Decreased					
7.2.1.4	Percentage of inhabitants paying land/property tax	0%-50%	*38,04%			PMT *In 2019, Teresina registred 329 .000 proprieties tax with the Property and Urban Property Tax (IPTU)	2019
		51%-70%					
		71%-90%					
		Greater than 90%					
7.2.1.4.1	How is land/property assessed	Assessed by government official based on established criteria					

7.2.2	Municipal expenditure composition						
	Indicator Description	**Main Value**	**Sec. Values (if any)**			**Source**	**Date**
7.2.2.1	Expenditure diversity of the local government	Government division	Total expenditures (R$)	% share	% share ^	SEMPLAN/PMT	2020
		01- Legislative	77.192.000	0,03	0,00		
		02 - Essential to justice	1.206.000	0,00	0,00		
		03 - Administration	422.939.000	0,14	0,02		
		04 - Public security	13.369.000	0,00	0,00		
		05 - Social assistance	67.550.000	0,02	0,00		
		06 - Municipal Pensions	348.524.000	0,12	0,01		
		07 - Health	1.280.859.000	0,44	0,19		
		08 - Work	2.982.000	0,00	0,00		
		09 - Education	649.675.000	0,22	0,05		
		10 - Culture	7.648.000	0,00	0,00		
		11 - Citizenship rights	14.517.000	0,00	0,00		
		12 - Urbanism	535.970.000	0,18	0,03		
		13 - Housing	23.910.000	0,01	0,00		
		14 - Sanitation	45.743.000	0,02	0,00		
		15 - Environmental management	36.597.000	0,01	0,00		
		16 - Science and technology	2.425.000	0,00	0,00		
		17 - Agriculture	3.634.000	0,00	0,00		
		18 - Industry	301.000	0,00	0,00		
		19 - Services and retail	4.311.000	0,00	0,00		
		20 - Transportation	6.040.000	0,00	0,00		
		21 - Leisure	6.905.000	0,00	0,00		
		22 - Special Charges	135.528.000	0,05	0,00		
		23 - Contingency reserve	23.968.000	0,01	0,00		
		Total expenditures	R$2.933.412.000,00	1			
		HHI	0,31		0,19		
7.2.2.2	Percentage of total expenditures that are discretionary or fixed for each Local Government Division	Local Government division	Discretionary Exp.	Fixed Expenditures	Total expenditures	SEMPLAN/PMT	2020
		01 - Social and Personal Charges		44.32%			
		02 - Debts interest and charges		1.37%			
		03 - Other current expenses		33.85%			
		04 - Investments	18%				
		05 - Financial Inversion	0.88%				
		06 - Debt Amortization		1.88%			
		Total expenditures	18.57%	81.43%	100%		

*The Budgetary Law doesn't express the proper discretionary and fixed expenditures it was subdivided as fixed the Social and Personal Charges, Debts interest and charges and Debt Amortization. The Law establishes only the difference of current and capital expenditures.

| 7.2.2.3 | Existence of performance indicators and goals for tracking budget execution | Yes and results from performance indicators and goals are incorporated into the following budget | | SEMPLAN/PMT | 2020 |

7.3 — Market Connectivity

7.3.1 — Access to financial services

	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
7.3.1.1	Proportion of the population with a bank account (%) (Please disaggregate by sex and groups in vulnerable situations, if possible)	87,1%		PMT	2020
7.3.1.2	Commercial banks per 100000 inhabitants	6,13	Total = 53	BACEN	2020
7.3.1.2.1	ATMs per 100000 inhabitants	10,52	Total = 91	Multiple Banks website	2020

7.2.3 — Investment context and market integration

	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
7.3.2.1	National Business Freedom measure according to the Index of Economic Freedom	63.8		Heritage Institute	2020
7.3.2.1.1	Trade Freedom measure	73.9		Heritage Institute	2020
7.3.2.3	Currency volatility over the past decade	Year	Year-over-year inflation % / value of currency	IBGE	2011/2020'
		2011	7,1		
		2012	6,75		
		2013	6,49		
		2014	7,73		
		2015	12,08		
		2016	6,69		
		2017	3,25		
		2018	4,08		
		2019	4,53		
		2020	1,34		
		Total 2011-2020	68,71		
7.3.2.4	Largest cities located between 200 and 500 km that have greater than 150,000 inhabitants	City name	Population and distance	IBGE	2020
		Parnaíba-PI	153.482hab - 340km		
		Sobral-CE	210.711hab - 360km		
		São Luís-MA	958.545hab - 439km		

7.3.2.5	Top 5 import and export partners (domestic and international) by value (cities with from which city receives imports/exports)	Import		DataViva	2018
		Country	Annual Import Value		
		China	46,1M		
		USA	13,6M		
		Ukraine	11,6M		
		Canada	6,57M		
		Russia	3,42M		
		Exports			
		Country	Annual Import Value		
		Venezuela	763 mil		
		China	480 mil		
		Hong Kong	25,7 mil		
		Angola	5,14 mil		
		Egito	2,76 mil		
7.3.2.6	Five largest import and export commodities (by value)	Imports / Industrial sector	Value / % of total imports / product type	DataViva	2018
		1 Produtos laminados de ferro revestidos / metais	21900000 / 02,2013809%		
		2 Produtos laminados a frio de ferro / metais	15100000 / 0,1737629459%		
		3 Produtos laminados a quente de ferro metais	14900000 / 0,1714614499%		
		4 Petróleo refinado / produtos minerais	9030000 / 0,1039125432%		
		5 Trigo / produtos de origem vegetal	6570000 / 0,07560414269%		
		All imports	86900000		
		Exports / Industrial sector	Value / % of total imports / product type		
		1 Fertilizantes mistos minerais ou químicos / Produtos químicos	466000 / 0,03612403101%		
		2 Resíduos de cobre / Metais	480000 / 0,03720930233 %		
		3 Soja / Produtos de origem vegetal	297000 / 0,02302325581 %		
		4 Maquiagens / Produtos químicos	25700 / 0,001992248062 %		
		5 Produtos para cabelo / Produtos químicos	8900 / 0,0006899224806 %		
		All Exports	12900000		

Annex II: CRPT Indicators

Annex II: CRPT Indicators

Figure 12: Indicator 7.1 . Source: CRGP with Open Street Maps (2020).

TERESINA |LOCAL ECONOMIC STRUCTURE

Indicator 7.1

- Public Administration
- Rede Estadual e Federal
- Retails
- Healthcare
- Social Services
- Food
- Agriculture
- Economy Support
- Arts , entertainment and recreation
- Education
- Water supply, sewerage, waste management and remediation activities
- ☐ Neighborhoods
- Water Streams
- City Blocks
- Teresina's Perimeter
- Urban Perimeter
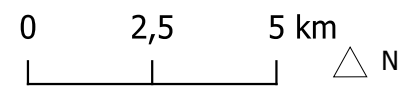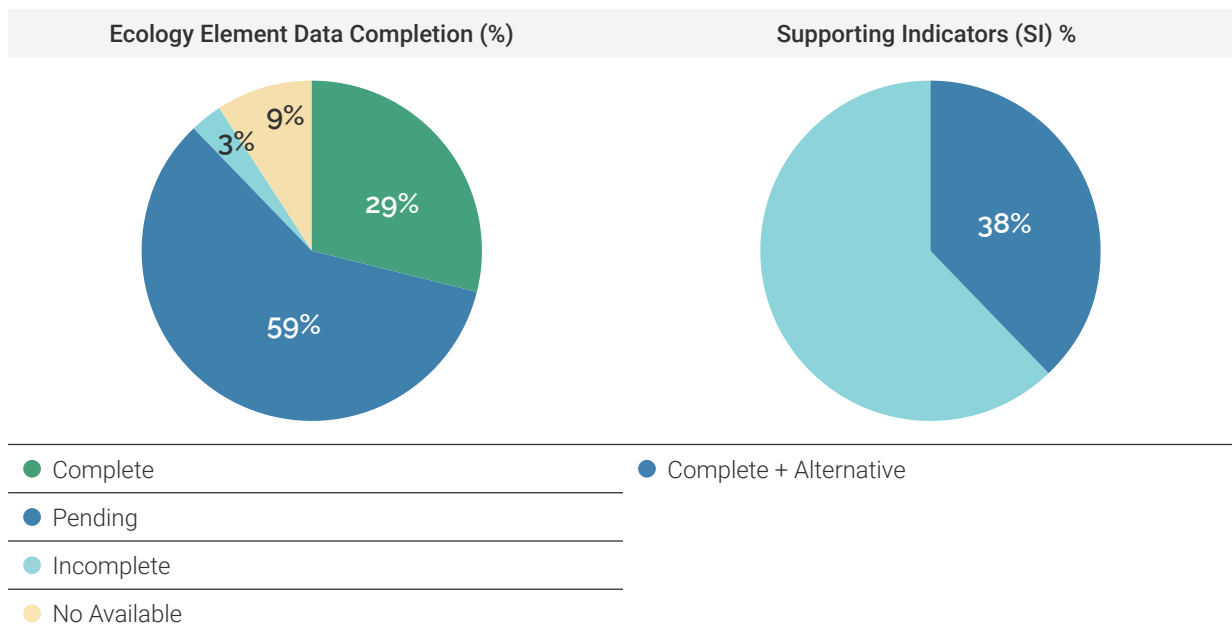
Source: CRGP with SEMPLAN, Open Street
Maps, 2020

0   2,5   5 km

△ N

8. Ecology

The Ecology Element adopts the ecosystem services approach to assess how the city and its surrounding region interact with and impact its ecosystems – essential in providing resources for consumption, regulating the environment, and serving cultural and recreational purposes –, and by further analysing its ecological footprint, its biodiversity and green infrastructure, and its environmental quality.

Data collection

The total completion rate for data collection is 29%, also 59% of the data considered pending, 3% incomplete, 9% not available. Considering only the selected indicators, the completion rate was 38% for this element (including complete and alternative data).

Ecology Element Data Completion (%)

29%

59%

3%

9%

Supporting Indicators (SI) %

38%

- Complete
- Pending
- Incomplete
- No Available

- Complete + Alternative

Key Findings

There is a large data gap in environmental data in the city. The local government doesn't take an ecosystem services approach or a different environmental approach into consideration in local policy and planning. The main services provided by the surrounding ecosystems and taken into account in local policies, plans and initiatives are Fresh Water Provision, Climate Regulation, Water Regulation, Water Purification and Waste Treatment, Disease Regulation and Natural Hazards Regulation.

There is no data for local biocapacity and ecological footprint (national level provided). National figures for ecological footprint of production and consumption were both considered inadequate according to CRPT benchmarks.

There is little data on local green infrastructure and biodiversity. Proportion of natural areas (which are not, no longer, or only slightly influenced by human actions) is low, however it is estimated that 73,94% of these areas are protected under legal instruments.

There are strong environmental regulation mechanisms at the municipal level, but it is reported an overlap of competences over environmental legislation, involving local, state and federal governments.

No data was available to inform local environmental quality. Relevant master plans (open data, greenhouse gas inventory, afforestation) are under development to support the production of quality environmental data.

Selected Indicators

8.1	Ecosystem Services				
8.1.1	**Ecosystem Services Condition & Trends**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
8.1.1.1	Indicate the level of preservation (good, bad) of the provisioning services the inhabitants are obtaining from the ecosystem, as well as the trend (enhanced, stable, degraded) over the past 10 years.				
8.1.1.2	Indicate the level of preservation (good, bad) of the regulating services the inhabitants are obtaining from the ecosystem, as well as the trend (enhanced, stable, degraded) over the past 10 years.				
8.1.1.3	Indicate the level of preservation (good, bad) of the cultural services the inhabitants are obtaining from the ecosystem, as well as the trend (enhanced, stable, degraded) over the past 10 years.				
8.1.2.1/ 8.1.2.2	Please select the services the local government obtains from the surrounding ecosystems and identify the policies or plans that the local government developed to preserve the selected ecosystem services				
			The local government does not produce food, but supports local producers with inputs, equipment and logistics.	SDR/SEMAM	2020
Provisioning of services		Raw materials	x	The National government has done an analysis of raw materials, minerals reserves of each Region in Brazil. It compared prices, production.	DNPM	2014
		Genetic resources	-			
		Biochemical, natural medicines and pharmaceuticals	-			
		Ornamental resources	-			
		Fresh water	x	The production and distribution of treated water in the municipality is carried out by the Águas de Teresina concessionaire.	ARSETE	2020
		Others				

Regulating Services				
	Air quality regulation	-		
	Climate regulation	x	Creation of programs to encourage the public and private sectors to plant trees in the municipality, improving thermal comfort in the most diverse points of the city. Creation of the project "A tree in my life", which planted 192 seedlings between 2019 and 2020. Joint efforts of planting in municipal parks, 210 seedlings in Parque Matias Matos, 200 seedlings in Lagoas do Norte Project, 70 seedlings in Parque Potycabana and 100 seedlings around UFPI. All only in 2019.		
	Water regulation	x	Federal Law No. 9.433-1997 - Institutes the National Water Resources Policy, creates the National Water Resources Management System.	Arsete	2020
	Erosion	-			
	Water purification and Waste treatment	x	Municipal Plan Of Basic Sanitation And Municipal Plan For Integrated Solid Waste Management In Teresina.	SEMPLAN	2018
	Disease Regulation	x	Municipal Health Plan	SEMPLAN	2018
	Pest Regulation	-			
	Pollination	-			
	Natural hazard regulation	x	Risk Plan And Mapping In Teresina	SEMPLAN	2014
	Other(s)				

8.1.2.2.1	Does the local government involve advocacy groups representing women and groups in vulnerable situations in the development of measures to preserve ecosystem services?	Yes	Workshop Women for Climate 2019	SEMPLAN	2019
8.1.2.2.2	Please identify if educational and awareness measures (e.g. global citizenship education, education for sustainable development) exist to encourage a lifestyle in harmony with nature, for all sexes, ages and groups in vulnerable situations	Yes	Municipal Plan For Environmental Education	SEMPLAN	2020
8.1.2.2.3	Existence of educational and awareness measures that consider climate change mitigation, adaptation, impact reduction and early warning	Yes	All the themes found in the SDG indicator 4.7.1 (education for global citizenship and sustainable development) are present in the New Teresina 2018 Curriculum and, consequently, are part of teacher training as well as student assessment.	SEMPLAN	2020
8.1.2.3	Does the local government take the ecosystem services approach or a different environmental approach into consideration in local policy and planning?	No		SEMPLAN	2020
8.1.2.4	Is the local government involved in transboundary agreements or collaborations to enable policy and planning for the implementation of ecosystem services approaches?	No (Under Development)	Sustainable RIDE Great Teresina Project / Funded by the Global Environmental Facility - GEF 7	SEMPLAN	2020

8.2 Ecological Footprints

8.2.1 Biocapacity

	Indicator Description	Main Value	Sec. Values (if any)				Source	Date
8.2.1.1	What is the biocapacity of the region over the last 10 years? Please specify the area size (in hectares) of each land use type present in the region, in order to calculate the area's biocapacity (in global hectares) for 2008 and 2017.	Land use type	Area size in 2008 (in ha)	Biocapacity in 2008 (in gha)	Area size in 2017 (in ha)	Biocapacity in 2017 (in gha)	Data Footprint Network	2020
		Built-up	0,09	6,52	-	5,8		
		Cropland	-					
		Grazing land	-					
		Forest land	-					
		Fishing ground	-					

8.2.2	Ecological Footprint of Consumption				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
8.2.2.1	Ecological Footprint of Production (10 year trend)		EFP [gha]	Data Footprint Network	2019
		2020	-		
		2019	-		
		2018	-		
		2017	-		
		2016	8,7		
		2015	8,88		
		2014	8,93		
		2013	9,02		
		2012	9,04		
		2011	9,17		
		2010	9,2		
8.2.2.2	Ecological Footprint of Consumption (10 year trend)		EFP [gha]	Data Footprint Network	2019
		2020	-		
		2019	-		
		2018	-		
		2017	-		
		2016	2,81		
		2015	2,91		
		2014	3,1		
		2013	3,1		
		2012	3,09		
		2011	3,13		
		2010	2,99		

8.3	**Biodiversity and Green Infrastructure**				
8.3.1	**Native biodiversity in the city**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
8.3.1.1	Specify the change in number of native species over the past ten years. If data is available, please disaggregate further, particularly into those species on the Red List of Threatened Species.		* 586 species on the Red List of Threatened Species, which 2 are classified as Endangered and 8 as Vulnerable. The others are classified as Near Threatened (12), Least Concern (554) and Data Deficient (10)	IUCN	2019
8,3,1,2	Proportion of invasive alien species as percentage of all species				
8.3.1.2.1	Please, provide a full list of invasive alien species and, if available, information regarding areas in the city where these species concentrate				
8.3.1.2.2	Does the local government take measures (regulation, monitoring, enforcement) to prevent or control invasive alien species?	Yes		ICMBio	2019
8.3.1.3	Proportion of natural areas and urban green spaces in the city as a percentage of the urban area	Type %		CRGP & PMT	2020
		Natural areas	1,26%		
		Urban green space	44,19%		

		Main Value	Sec. Values (if any)	Source	Date
8.3.1.4	Specify the urban green space per capita and disaggregate, if possible, by sex, age and groups in vulnerable situation.	13,43 ha/1000pop		CRGP	2020
8.3.1.4.1	Select barriers that may reduce access to the urban green spaces	Socio-economic		PMT	2020
8.3.1.5	Proportion of urban green space cover (including vegetation canopy cover and blue areas), as percentage of the size of the functional area.	76,88%		CRGP	2020
8.3.2	**Protected natural areas in the region and connectivity**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
8.3.2.1	Please, specify the proportion of natural areas in the region that is protected	21,4%		CRGP & PMT	2020
8.3.2.2	Please specify whether expenditure (public and private) per capita spent on the preservation, protection and conservation of natural heritage is increasing, stable, or decreasing.				
8.3.2.3	Please specify the total size of the number of areas (in ha) that connect protected natural areas and urban green spaces in the city, using the Green Infrastructure Index as measure.				
8.3.2.4	Does the city take the biodiversity in these corridors, and in their green spaces and blue areas in general, into consideration?	Yes	Master Plan for Urban Afforestation for Teresina	SEMAM	2020
8.4	**Environmental Quality**				
8.4.1	**Native biodiversity in the city**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
8.4.1.1	CO2 emissions	2.23		Our World in Data	2017
8.4.1.2	CO2 Intensity				
8.4.2	**Air quality**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
8.4.2.1	Particulate matter (PM10) concentration (24-hour average)				
8.4.2.1.1	Exceedance days (above 50μg/m3)				
8.4.2.2	Fine particulate matter (PM2.5) concentration (1-year average)				
8.4.2..2.1	Exceedance days (above 25μg/m3)				
8.4.2.3	Nitrogen dioxide (NO2) concentration (1-hour average)				
8.4.2.3.1	Annual average concentration				
8.4.2.3.2	Exceedance days (above 200μg/m3)				
8.4.3	**Water quality**				
	Indicator Description	**Main Value**	**Sec. Values (if any)**	**Source**	**Date**
8.4.3.1	Select the pollutants present in groundwater that have transgressed the established limit				
8.4.3.1.1	Specify additional pollutants of concern: primary pollutants, their characteristics and other factors that affect groundwater				
8.4.3.1.2	Please describe the source of pollution, if applicable				
8.4.3.2	Select the pollutants present in inland surface water that have transgressed the established limit				
8.4.3.2.1	Specify additional pollutants of concern: primary pollutants, their characteristics and other factors that affect inland surface water bodies				

8.4.3.2.2	Please describe the source of pollution, if applicable.				

8.4.4	Additional pollution				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
8.4.4.1	Are there areas in the city with significant land pollution (e.g. brownfield sites, riverbeds, agricultural sites etc.)?				
8.4.4.1.1	Specify additional pollutants of concern: primary pollutants, their characteristics and other factors that affect inland surface water bodies				
8.4.4.2	Are there currently areas in the city with significant thermal pollution (e.g. heat island effect)?				
8.4.4.2.1	Please describe the source/origin of pollution, if applicable.				
8.4.4.3	Are there currently areas in the city with significant radioactive pollution (e.g. nuclear power plants, industrial sites, hospitals etc.)?				
8.4.4.3.1	Specify additional pollutants of concern: primary pollutants, their characteristics and other factors that affect inland surface water bodies				
8.4.4.4	Are there currently areas in the city with significant noise pollution?				
8.4.4.4.1	Please describe the source/origin of pollution, if applicable.				
8.4.4.5	Are there currently areas in the city with significant light pollution?				
8.4.4.5.1	Please describe the source/origin of pollution, if applicable.				
8.4.4.6	Other types of pollution not included in this report [+]				
8.4.4.6.1	Please describe the source/origin of pollution, if applicable.				

8.4.5	Monitoring of environmental quality				
	Indicator Description	Main Value	Sec. Values (if any)	Source	Date
8.4.5.1	Existence and monitoring of a greenhouse gas inventory	No (Under Development)	The city has already launched a second bidding process (previous one was deserted) for its GHG Inventory within the Climate Action Plan.	Agenda2030/ PMT	2020
8.4.5.2	Existence, monitoring and enforcement of air quality regulations	Ineffective regulations, no monitoring or enforcement		PMT	2020
8.4.5.3	Existence, monitoring and enforcement of water quality regulations	Approved regulations, adequate monitoring, adequate enforcement		SEMAM	2019
8.4.5.4	Existence, monitoring and enforcement of regulations regarding the additional types of pollution identified in Indicator 4.4.4 [+]				

TERESINA | GREEN INFRASTRUCTURE

Indicator 8.3: Native biodiversity in the city

Teresina's Perimeter

Urban Footprint 2019

Tree Cover

Water Streams

Source: CRGP with SEMPLAN and Global Forest Watch, 2020

0   2,5   5 km

△ N

Annex III

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Inventory of Policies, Plans and Initiatives in Teresina

List of Tables

Priority Matter 1: Water Cycle (MIS) Management

Water Cycle Mis Water Cycle Mismanagement management				
		Name	**Status**	**Areas**
National	Policy	[2001] City Statute - National Urban Policy	Approved	Urban Development/Sprawl
		[2012] National Civil Defense and Protection Policy	Approved	DRR
		[2010] National Civil Defense System	Approved	DRR
		[2017] National Policy for the Recovery of Native Vegetation	Approved	Natural Buffers Protection
		[2017] National Policy for Land Regularization	Approved	Housing Tenure/Accessibility
	Plan	[2017] National Plan for the Recovery of Native Vegetation (Planaveg)	Approved	Natural Buffers Protection
		[1997] National Water Resources Plan	Approved	IWRM
	Initiative	[2020] Pro-housing (PRÓ-MORADIA)	Under implementation	Housing Tenure/Accessibility
		[2019] Advancing Cities - Sanitation	Implemented	IWRM, Flood Prevention, DRR
		[xxxx] S2iD (Integrated Disaster Information System)	Implemented	DRR
		[2012] National Civil Defense and Protection System	Approved	DRR
		[2020] National Housing Programme (Minha Casa Verde Amarela)	Under implementation	Housing Tenure/Accessibility
Supra Local	Policy	[2000] State Water Resources Policy	Approved	IWRM
		[2019] Urban Land Regularization Policy in Piauí	Approved	Housing Tenure/Accessibility
	Plan	[2010] State Water Resources Plan	Approved	IWRM
	Initiative	[2020] Minha Casa Legal (Tenure Formalisation). Already finished	Implemented	Housing Tenure/Accessibility
		[2020] Integrated and sustainable Piauí (Inside Piaui PPA)	Approved	Housing Tenure/Accessibility, DRR Natural buffers protection, IWRM
		[2019] Moradia para Todos (Micro Credit for Housing Improvement)	Approved	Housing Tenure/Accessibility

Water Cycle Mis Water Cycle Mismanagement management				
		Name	**Status**	**Areas**
Local	**Policy**	[2019] Teresina Urban Land Regularization Policy	Approved	Housing Tenure/ Accessibility
		[2015] Urban Perimeter Act	Approved	Urban Development/ Sprawl
	Plan	[2013] PLHIS - Local Social Housing Plan	Approved	Housing Tenure/ Accessibility
		[2015] Drainage Act	Approved	Flood Prevention
		[2015] Urban Drainage Plan	Approved	Flood Prevention
		[2016] Municipal Basic Sanitation Plan	Approved	IWRM
		[2019] Land Tenure Regularization Plan		Housing Tenure/ Accessibility
		[2020] Teresina's Urban Development Master Plan	Approved	Urban Development/ Sprawl Natural Buffers Protection
	Initiative	[2020] Teresina Natural Based Solutions Strategies	Under development	Natural Buffers Protection Flood Prevention
		[2019] Advancing Cities - Sanitation - Teresina (Avançar Cidades)	Under development	IWRM, Flood Prevention, DRR
		[OnGoing] Land Regularization Project	Under implementation	Housing Tenure/ Accessibility
		[2019] REURB	Under implementation	Housing Tenure/ Accessibility
		[2013-Ongoing] Teresina Mais Verde Program	Under implementation	Natural Buffers Protection
		[2013-Ongoing] Vila da Paz Urbanisation Project	Under implementation	Natural Buffers Protection Flood Prevention
		[2019] Drainage System at Portal da Alegria (residential Torquato Neto)	Under development	Flood Prevention, DRR
		[2020] PPP Drainage Systems	Under development	Flood Prevention
		[2006-Ongoing] Northern Lagoons Programme	Under implementation	Flood Prevention, DRR, Natural Buffers Protection

Priority Matter 2: Ecosystem Imbalance

Ecosystem Imbalance				
		Name	**Status**	**Areas**
National	Policy	[2010] National Solid Waste Policy	Approved	Solid Waste
		[2015] PAN-Brasil	Approved	Desertification, Droughts
		[2007] National policy for basic sanitation	Approved	Water Contamination
		[2009] National Policy on Climate Change	Approved	Heat waves, Climate Action
	Plan	[1997] National Water Resources Plan	Approved	Water Contamination
		[2015] Contingency plan for public health emergency due to drought	Approved	Droughts
	Initiative			
Supra Local	Policy	[2011] State Policy on Climate Change and Combating Poverty	Approved	Climate Action, Droughts
	Plan			
	Initiative	Ongoing] Ecological ICMS	Implemented	Environmental Action
		[2010] PAE Piauí	Under implementation	Desertification, Droughts

Ecosystem Imbalance			
	Name	**Status**	**Areas**
Local — Policy	[2009] Disposal of technological waste	Approved	Solid Waste
	[2014] Law 4555/2014 Obligation of afforestation in low-density urban developments	Approved	Vegetation Loss
Plan	[2016] Municipal Basic Sanitation Plan	Approved	Solid Waste, Wastewater
	[2018] Municipal Plan for Integrated Solid Waste Management	Approved	Solid Waste
	[2020] Municipal Afforestation Plan	Under development	Vegetation Loss
	[2020]Teresina's Urban Development Masterplan	Approved	Land Consumption
Initiative	[2020] Women for Climate - Recycling	Under development	Solid Waste
	[2013] Zero Waste Programme	Implemented	Solid Waste
	[Ongoing] Teresina Recycling Programme	Implemented	Solid Waste
	[2019] Restructuring and creation of environmental parks	Under development	Green Infrastructure, Heat Waves, Climate Action
	[2020] Teresina Natural Based Solutions Strategies	Under development	Vegetation Loss, Low Emission, Green Infrastructure, Heat Waves, Climate Action
	[2020] GEF RIDE Great Teresina	Under development	Vegetation Loss, Low Emission, Green Infrastructure, Heat Waves, Climate Action
	[2014] Adopt the Green Program	Implemented	Vegetation Loss, Heat Waves
	[2020] Women for Climate - Urban Gardens	Under development	Green Infrastructure, Heat Waves, Climate Action
	[2020] Teresina Climate Action Plan	Under development	Heat Waves, Low Emissions, Green Infrastructure,Climate Action
	[xxxx] Project A Tree in My Life	Implemented	Vegetation Loss, Low Emission, Climate Action

Priority Matter 3: Economic Underperformance

Economic Underperformance		Name	Status	Areas
National	**Policy**	[2012] National Urban Mobility Policy	Approved	Mobility
		[2008] National Microentrepreneurs Act	Approved	Informal Economy
	Plan	[2019] Industry 4.0 Action Plan	Approved	Supply Chain Management, Attractiveness
		[2019] PRDNE (Northeast Regional Development Plan)	Approved	Supply Chain Management, Attractiveness
	Initiative	[2007] REDESIM	Implemented	Public Services Efficiency
		[2017] Efficient Brazil	Implemented	Public Services Efficiency
		[2020] PRONAMPE	Implemented	Business and Employment
		[2020] BNDES Small Business Credit Line	Implemented	Business and Employment
		2017] Advancing Cities - Mobility	Implemented	Mobility
		[2017] REFROTA	Implemented	Mobility
Supra Local	**Policy**			
	Plan	[2016] Piaui 2050 (State-level Economic Development Plan)	Approved	Supply Chain Management, Attractiveness
		[2020] PPA/Piaui 2020-2023	Approved	Supply Chain Management, Attractiveness
	Initiative	[2016] Piauí Digital	Implemented	Public Services Efficiency
Local	**Policy**	[2015] Teresina Municipal Employment Council - COMETE	Approved	Business and Employment
	Plan	[2017] Municipal Plan for Public-Private Partnerships	Approved	Public Services Efficiency
		[2011] Integrated Development Plan for Sustainable Tourism (PDITS)	Approved	Economic Diversification, Business and Employment
		[2015] Cycling Master Plan	Approved	Mobility
		[2020] Sustainable Urban Mobility Plan	Under development	Mobility

Economic Underperformance				
		Name	**Status**	**Areas**
Local	Initiative	[2018-2020] INTHEGRA (BRT System)	Implemented	Mobility
		[2018] Euroclima + Innovation for better Mobility	Under implementation	Mobility
		[2019] IDB/Brazil DOT Technical Cooperation	Under implementation	Mobility, Urban Development/ Sprawl
		[2015-OnGoing] "Gestão Cidadã" Programme	Implemented	Municipal Finance
		[2018-Ongoing] Sustainable Teresina Program	Under implementation	Mobility, Urban Development, Public Services Efficiency
		[Ongoing] Empresa Fácil (Easy Business)	Implemented	Public Services Efficiency
		[2018-Ongoing] Construa Fácil (Easy Building)	Implemented	Public Services Efficiency
		[2020] Teresinense Digital (Digital Teresina)	Implemented	Public Services Efficiency
		[Ongoing] Colab Teresina	Implemented	Public Services Efficiency
		[2018-On Going] Municipal Training Program (CAF)	Under development	Public Services Efficiency
		[2018-On Going] Teresina Open Data Plan	Under development	Public Services Efficiency
		[OnGoing] Popular Bank of Teresina (BP)	Implemented	Economic Diversification, Business and Employment
		[2019] Empreende Bairro Project	Implemented	Economic Diversification, Business and Employment
		[2019-OnGoing] THEch Programme	Under implementation	Economic Diversification
		[2015] Competitive Teresina (Teresina Competitiva)	Under development	Economic Diversification, Business and Employment
		Promotion and Attraction of Private Investments	Implemented	Business and Employment
		[2020] Active Teresina (Covid-19 Economic Recovery)	Under development	Business and Employment
		[2020] Commercial and Creative Technology	Under implementation	Business and Employment
		[On-Going] Professional Training Programs at FWF	Under implementation	Business and Employment

Annex IV

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Covid-19 Municipal Budget Impacts Report

Annex IV
Covid-19 Municipal Budget Impacts Report

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Municipality of Teresina

Report 29/2020 - ASS-TEC-SEMF
Teresina, 27th October 2020

In attention to the request through the Office NO 1355/2020 - GAB-SEMPLAN (1212460) issued in the SEI Case No. 00046.002668/2020-18, and the order 714/2020 - CERM-SEMF (1254824), follow the data regarding the financial impact of the COVID-19 pandemic on the economy of the Municipality of Teresina explaining about the revenue projections for the year 2020.

In the current world situation, the economic crisis related to the pandemic of the new coronavirus (Covid-19) makes revenue projections more uncertain. The SEMF seeks to carry out analysis with the objective of measuring in a technical way the impact on revenue projection at the municipal level by observing the factors that touch the revenue of the municipality of Teresina. This projection aims to establish criteria and rules to give reliability and consistency to the estimates of revenues with Own Resource.

The methodology used for the projection of the revenue involves the use of conjunctural indicators published by the Central Bank, via Focus Bulletin, as well as by other national and international institutions. The Gross Domestic Product (GDP) and the Broad Consumer Price Index (IPCA) are the main makers, besides the analysis of elasticity of each revenue in relation to these indicators. However, the impacts resulting from SEMF actions, regulatory changes, and the peculiarities inherent to each of the revenues are projected.

The current year (2020) also includes some exceptional measures adopted at the municipal, state and federal levels to try to mitigate the negative impact on the economy, such as the delayment of the Property Taxes payment due dates, thus maintaining the taxpayer's opportunity to obtain the discount for the single quota payment. And, at the Federal level, through the Recomposition of the FPM - Municipal Participation Fund - (MP 938/2020) and Financial Aid to Municipalities by the Act no 173/2020, due to the public health emergency. Below, the scenarios projected before and during the pandemic, in the latter, considering more conservative and more optimistic circumstances.

1. **Scenario 1:** The first scenario projected for the 2020 collection, elaborated in July 2019, had as indicators, the GDP growth of 2.3% and the IPCA in 4%, which resulted in a predicted value in the order of R$1,710,185,635.67.
2. **Scenario 2:** The second scenario was elaborated in May 2020, during the pandemic. Taking in consideration the economic conjuncture, in the end of 2020 it would have a retraction of 7% in its production and with an inflation (IPCA) of 1.59 0 0. This would result in an estimated amount of R$1,530,128,092.40 and consequently a reduction of 10.5% in relation to the previously projected.
3. **Scenario 3:** The third scenario, elaborated at the same time as the partial reopening of the economy, shows a situation of recovery, which aims an improvement in the indicators, with the GDP pointing to -4.8% and IPCA with an expectation of 3.4% resulting in a revenue expectation of around R$ 1,568,050,953.63

The table "2020 Revenue Projection" shows each scenario described added to the extra resources, which served to soften the negative effect of the pandemic on the economy of states and municipalities. For the municipality of Teresina in specific, there is an amount of R$ 111,326,219.44 of extraordinary resources. Being R$ 39,610,331 through the Recomposition of the FPM (MP 938/2020) and Financial Aid to Municipalities by national Act.

Revenue Projection 2020			
Scenarios	Projected	Extra Resources	Total in each scenario
Scenario 1	1.710.185.635,67	---	1.710.185.635,67
Scenario 2	1.530.128.092,40	111.326.219,44	1.641.454.311,84
Scenario 3	1.568.050.953,63	111.326.219,44	1.679.377.173,07

* This document has been translated from Portuguese to English by the CRGP.

The original document in Portuguese is annexed and signed in the following pages.

ESTADO DO PIAUÍ
Prefeitura Municipal de Teresina
SEMF - Secretaria Municipal de Finanças

Despacho 29/2020 - ASS-TEC-SEMF

Teresina, 27 de outubro de 2020.

    Ao Gabinete SEMF

    Em atenção ao solicitado através do Ofício Nº 1355/2020 - GAB-SEMPLAN (1212460) proferido no Processo SEI nº 00046.002668/2020-18, e ao despacho 714/2020 - CERM-SEMF (1254824), seguem os dados referente ao impacto financeiro da pandemia de COVID na economia do Município de Teresina explanando sobre as projeções de receita para o ano de 2020.

    Tendo em vista a atual conjuntura mundial, onde se vive uma realidade de crise econômica, relacionada à pandemia do novo coronavírus (Covid-19) tornando mais incerta as projeções de receita, a SEMF busca realizar análise com o objetivo de mensurar de forma técnica o impacto na arrecadação a nível municipal observando os fatores que tangem a receita do Município de Teresina. O trabalho de Projeção, visa estabelecer critérios e regras com o intuito de dar confiabilidade e consistência as estimativas de receitas com Recurso Próprio.

    A metodologia utilizada para a projeção da receita envolve o uso de indicadores conjunturais divulgados pelo Banco Central, via Boletim Focus, bem como por outras instituições nacionais e internacionais, tendo como principais balizadores da projeção, o Produto Interno Bruto (PIB) e o Índice de Preços ao Consumidor Amplo (IPCA), além da análise de elasticidade de cada receita em relação a estes indicadores. Não obstante, são projetados os impactos resultantes de ações desenvolvidas no âmbito da SEMF, alterações normativas, e as peculiaridades inerentes a cada uma das receitas.

    O ano corrente (2020) conta ainda com algumas medidas excepcionais, adotadas tanto pela esfera municipal, como pela esfera estadual e federal para tentar amenizar o impacto negativo na economia, como a prorrogação da data de vencimento do pagamento do IPTU e do IPVA, mantendo assim a oportunidade de o contribuinte obter o desconto do pagamento pela cota única. E, em âmbito Federal, através da Recomposição do FPM (MP 938/2020) e auxílios Financeiro aos Municípios pela LC nº173/2020, em razão da emergência de saúde pública. Abaixo, os cenários projetados antes e durante a pandemia, neste último, considerando circunstancias mais conservadoras e mais otimistas.

1. Cenário 1 - O primeiro cenário projetado para a arrecadação de 2020, elaborado em julho de 2019, tinha como indicadores, o crescimento do PIB 2,3 % e o IPCA em 4% que resultou em um valor previsto na ordem de **R$1.710.185.635,67**.
2. Cenário 2 - O segundo cenário foi elaborado em maio de 2020, já durante a pandemia, considerando que a conjuntura econômica teria ao final do ano, uma retração de 7% na sua produção e com uma inflação (IPCA) de 1,59%, que resultaria no montante previsto em **R$ 1.530.128.092,40**, que resultando numa redução de 10,5% frente ao projetado anteriormente.
3. Cenário 3 - O terceiro cenário, elaborado concomitantemente a reabertura parcial da economia mostra uma situação de recuperação, tendo em vista uma melhoria dos indicadores, com o PIB apontando para -4,8% e IPCA com expectativa de 3,4% resultando uma expectativa de receita na ordem de **R$ 1.568.050.953,63**

    O quadro "Projeção de Receita 2020" mostra cada cenário descrito somado aos recursos extras, que serviram para suavizar o efeito negativo da pandemia na economia dos Estados e Municípios. Para o município de Teresina em especifico, foram repassados até outubro de 2020 o montante de R$

111.326.219,44 de recurso extra. Sendo <u>R$ 39.610.331,32</u> através da Recomposição do FPM (MP 938/2020) e <u>R$ 71.715.888,12</u> de auxílios Financeiro aos Municípios pela LC nº173/2020.

Projeção de Receita 2020			
Cenários	Projetado	Recurso Extra	Total em cada Cenário
Cenário 1	1.710.185.635,67	-	**1.710.185.635,67**
Cenário 2	1.530.128.092,40	111.326.219,44	**1.641.454.311,84**
Cenário 2	1.568.050.953,63	111.326.219,44	**1.679.377.173,07**

Documento assinado eletronicamente por **Taffarel Francisco Oliveira Soares**, **Assessor Técnico**, em 27/10/2020, às 12:44, com fundamento no Decreto nº 18.316/2019 - PMT.

A autenticidade do documento pode ser conferida no site **https://processoeletronico.pmt.pi.gov.br/sei/autenticador** informando o código verificador **1296775** e o código CRC **F0DBAF61**.

Referência: Processo nº 00046.002668/2020-18   SEI nº 1296775

Praça Mal. Deodoro, 860 - Bairro Centro - Palácio da Cidade - CEP 64000-160 - Teresina - PI
- http://semf.teresina.pi.gov.br/

Annex V

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Climate Change Projections for Teresina

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Annex V
Climate Change projections for Teresina

Future climate change and expected impacts and vulnerability in the Teresina city (Brazil) by the end of the 21st century

The Teresina City (the capital of Piauí Province, Brazil), located at 72 m a.s.l., in NE part of South-America, has a tropical climate (AW - according to the Koeppen-Geiger classification), with distinct seasons: a dry season (with sweltering weather) between May and December and a wet season between December and May; a hot season between August and November and a cool season between January and June. The city has multiple stressors derived by anthropic activity related to e.g. land use change or exacerbated by the recent climate variability and change. Overall, the city is located in the northeastern part of South-America, a region which experienced an increasing frequency of warm days, warm nights and heavy precipitation and a decrease in dry spell duration and dryness (e.g. Dai, 2011; Donat et al., 2013). Air temperature is already rising in the city due to both climate change and the urban heat island effect.

Methodology

In order to provide a realistic projected climate change signal for a certain local area (i.e. a city), the selected climate models should be able to reproduce the local climate patterns. This implies that commonly used global circulation models (GCM) used in the IPCC report, with a typical spatial resolution smaller than 1° (>100km) cannot be directly used on impact assessments. Instead, regional circulation models (RCM) simulate the climate for a certain part of the globe, usually a continent, with a much higher spatial resolution. This higher resolution allows a more accurate reproduction of the surface elevation and in turn a more realistic simulation of the small-scale climate patterns of specific locations on Earth. Still, RCMs require GCMs as boundary conditions for their simulations. Thus, each climate projection is generated by a regional model driven by a global model. The combination of different RCMs and GCMs provides a broad ensemble of plausible future projections which in turn allows the computation of robust statistics for the estimation of the climate change signal.

Here, we use a multi-model ensemble of 4 regional climate projections from the South-America CORDEX domain with a spatial resolution of 0.22° (~22km) and a daily temporal resolution (see Table 1). Projected changes describe the possible future evolutions of the local urban climate for the next 80 years, over three time horizons (near future - 2011-2040; mid-future - 2041-2070; and far-future - 2071-2100), relative to the 1980-2000 baseline climate. The projections cover the expected changes in air temperature (mean, maximum and minimum), precipitation and some associated extremes defined below.

The output of any climate model should be always adjusted with observations in order to assure it represents the observed statistics of the past climate and thus gain confidence on the projections for the future climate. In this assessment we have corrected the annual mean bias of each of the climate models before generating the multi-model ensemble. We have used as observational reference the commonly used ERA5 reanalysis from the ECMWF.

Projection	Driving global circulation model	Regional circulation model
1	MOHC-HadGEM2-ES MetOffice Hadley Center, UK	REMO2015 Climate Service Center, Germany
2	NCC-NorESM1-M Norwegian Climate Centre, Norway	REMO2015 Climate Service Center, Germany
3	NCC-NorESM1-M Norwegian Climate Centre, Norway	RegCM4-7 National Center for Atmospheric Research, USA
4	MPI-M-MPI-ESM-LR Max Planck Institute for Meteorology, Germany	REMO2015 Climate Service Center, Germany

Table 1: List of the regional climate models used in this assessment together with the scientific developing institutions. Each climate projection is generated by a specific RCM driven by a specific GCM.

Two different emission scenarios are considered corresponding to the marginal IPCC-AR5 Representation Concentration Pathways (RCPs): On the one hand, the RCP2.5 represents a stringent mitigation scenario which implies a major change in the global socio-economical system in order to reduce net global CO_2 emissions to 0 by year 2050. RCP2.5 aims to maintain mean global warming below 2°C. On the other hand, the business as usual scenario is represented by RCP8.5 accounting for a pathway without additional efforts to constrain emissions.

While average values of temperature and precipitation show a significant change in climate projections, it is the change in the occurrence and intensity of climate extremes (within daily time scales) where the future projections show a more drastic alteration relative from the historic period. Climate extreme indices used in this assessment follow the next definitions.

- Tropical nights (TR): It is the average number of days per season which daily minimum temperature is above 20°C.

- Heat wave (HW): A heat wave is defined for each season as a persisten warm event of consecutive days having maximum temperature above the percentile 90th of the corresponding season from the reference period (here during 1980-2000).

- Heat wave duration (HWD90): It is the average duration in days of heat waves per season - Heat wave number (HWN90): It is the average number of heat waves events per season. - Dry spell duration or Consecutive dry days (CDD): It is the number of consecutive days with daily precipitation below 1mm/day per season.

- Wet spell duration or Consecutive wet days (CWD): It is the number of consecutive days with daily precipitation above 1mm/day per season.

- Heavy precipitation (R10mm): It is the number of days with daily precipitation above 10mm/day per season.

- Very heavy precipitation (R20mm): It is the number of days with daily precipitation above 20mm/day per season.

- Maximum seasonal daily precipitation (Rx1day / Rx5day): It is the maximum ammount of daily precipitation during 1 or 5 consecutive days per season.

Air Temperature and Temperature Extremes

Annual mean temperatures are expected to increase significantly for both scenarios (RCP2.6 and RCP8.5) although with a clear distinction between them (figure 1). In the most favorable scenario (RCP2.6) a consistent temperature increase is observed until mid-century where the maximum positive change around

slightly above 1°C is observed. Note that this maximum in mean temperature matches the moment where the greenhouse emissions are impossed to remain neutral under this scenario. A weak temperature decrease is observed during the second half of the XXI century ending with a mean temperature change just below 1°C. On the contrary, under the RCP8.5 scenario, a constant warming is clearly evident during this whole century. The change in the annual mean temperture by 2100 reaches 4°C with the multi-model ensemble minimum around 3°C.
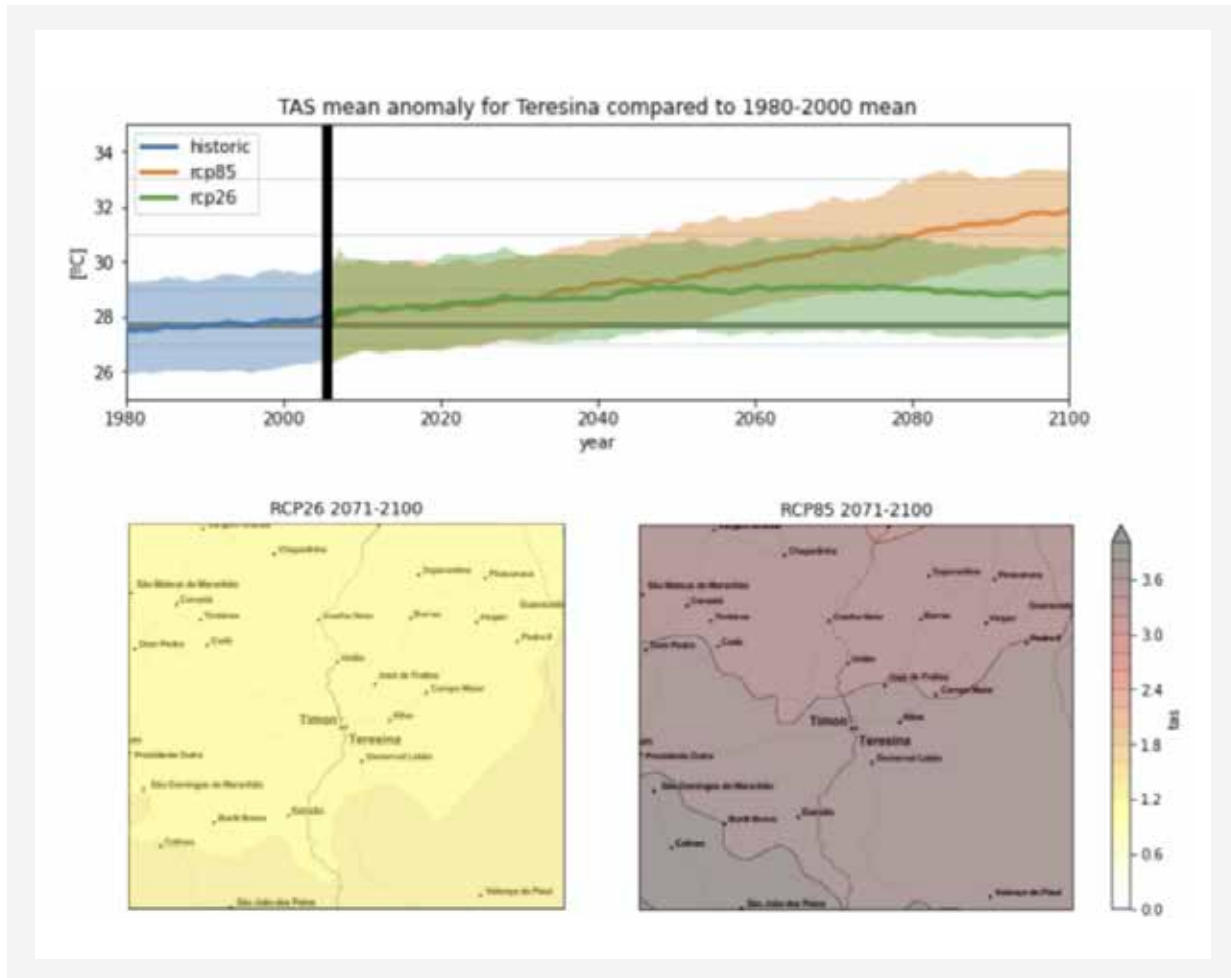
Figure 1: Top panel: Time series of the projected annual mean surface temperature [°C] in Teresina during XXI century for the two scenarios (RCP2.6 and RCP8.5). Shaded coloured area represents the region between the minimum and maximum values within the multi-model ensemble. This interval provides an estimation of the uncertainty related to the natural variability, i.e. the interannual variation for a given year may fall within this shaded area. Horizontal grey line indicates the average annual temperature for the historical period. Bottom panel: Projected annual mean change in surface temperature [°C] for period 2071-2100 with respect to the reference period (1980-2000) for the two scenarios. Positive values indicates an increase in temperature in the future. Source: Lobelia.

Monthly mean temperatures in Teresina are projected to increase slightly throughout the year under the low emission scenario (RCP2.6) by 0.6°C to 1.1°C by the 2040s, 0.9°C to 1.8°C by the 2070s and 0.8°C to 1.4°C by the end of 2100. The climate projections forced by RCP2.6 indicate that the largest warming in the Teresina area is expected in the mid-future (2041-2070). Under the high emission scenario (RCP8.5), mean temperatures are projected to increase dramatically, especially in the mid- (2041-2070) and far-future (2071-2100), by 1.7° to 2.9°C and 2.6° to 4.8°C, respectively. Regardless of the selected scenario, largest warming is projected between June and December in the target area (especially in November and December), making the hot season of the year longer and even hotter than in the present climate (Fig. 2). The days and the nights in the city are expected to become particularly hot exacerbating the heat stress and bioclimatic discomfort. Daytime heat stress is projected to increase considerably at the end of the hot season in the area, due to an estimated increase in the maximum temperatures of up to 2.0°C under RCP2.6 in December (2041-2070) and up to 4.7°C under RCP8.5 in November (2071-2100). Comparatively, during nighttime, the augmentation of future heat stress is also important especially in November, in response to an estimated increase in minimum temperatures of 1.5°C under RCP2.6 (2041-2070) and 4.6°C under RCP8.5 (2071-2100).

An additional indication of heat stress augmentation with climate change is provided by the record maximum monthly temperatures which are projected to increase notably under the high emission scenario (RCP8.5), especially in the far-future time horizon (2071-2100). The interval between June and December (overlapping most of the hot season under present climate conditions) is projected to experience the largest increases, from 4.1°C in June and September to 4.6°C in December, which will determine record daytime temperatures of over 36° (July) or even 40°C (August to December), well-above those in the historical period.
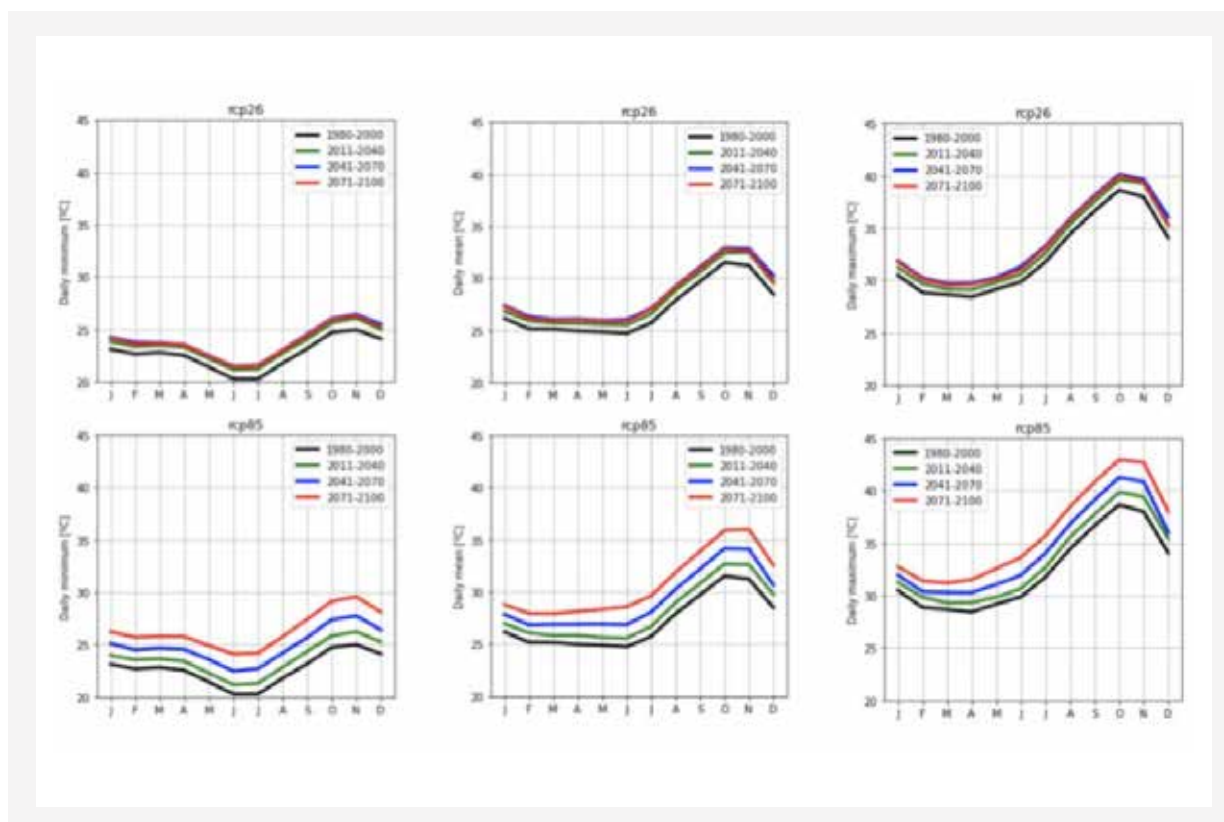
Figure 2: Projected change of the seasonality for the surface temperature daily minimum (left), daily mean (center) and daily maximum (right) for different periods and scenarios. Source: Lobelia.

Over the June-August interval (the best tourist visiting period of the year), mean temperature will rise up to 1.4°C under the low emission scenario and up to 3.8°C under the high emission one and increasing exposure to hotter-humid weather is expected both daytime and nighttime. By the end of the 21st century, mean monthly temperatures of October (the warmest month of the year) are projected to reach values of up to 33°C under RCP2.6 and 36°C under RCP8.5. For the coldest month of the year (February), mean temperature rise is projected to increase moderately, up to values of 26°C under RCP2.6 and about 29°C under RCP8.5.

A dramatic increase in the frequency and duration of hot weather extremes is expected in the area of Teresina city.

The frequency of tropical nights (daily minimum temperatures over 20°C) in Teresina will increase at the beginning of the hot season (between June and August) with 12-13% (corresponding to an average increase of 12-14 tropical nights more during the hot season) under the low-emission scenario and between12 to 18% (corresponding to 12-18 nights) under the high-emission scenario (Fig. 3). This change is expected to contribute to the increase of nighttime heat stress and bioclimatic discomfort across the city already augmented by the heat island effect. Throughout the rest of the year, tropical nights will also become more.

frequent but the change signal is visibly weaker under both emission scenarios: 1.4-1.6% between March and May, about 1.2% from December to February and about 0.1% between September and November over the last two thirds of the century (RCP2.6); 0.8 to 2.2% between March and May, 1.2% between December and February over the same future time horizons (RCP8.5). It worth mentioning, that under both emission scenarios, the frequency of tropical nights in Teresina is projected to increase the least over the March-May interval (0.2% under RCP2.6 and 0.8%, under RCP8.5) or even to decrease slightly in the far-future (with no more than 1.4%) between December and February (at the end of the cool season) and from September to November (at the end of the hot season).
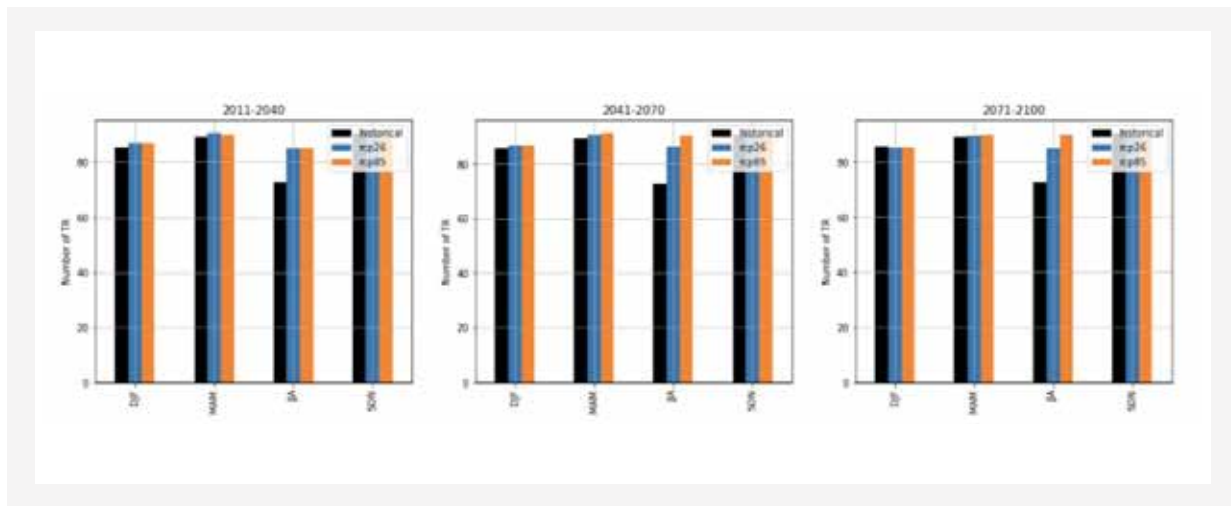
Figure 3: Average number of tropical nights per season for different periods and scenarios. A tropical night is defined as a day with a minimum temperature above 20°C. It can be seems that for Teresina, climate projections show a quasi permanent ocurrence of tropical nights along the whole year. Source: Lobelia.

Heat waves events represent one of the more evident impacts of global warming. As described in the methodology, heat waves are defined as persistent warm episodes that surpass a certain threshold defined from the historical period (1980-2000) climate. In a warmer climate, this constant threshold will be exceeded systematically as clearly shown in figure 4. The occurrence of heat waves during the reference period was below 0.3 events per season with a weak seasonality. For the projected future the huge increase of extreme warm events is alarming. The number of heat waves will grow up to an occurrence of 0.5 to more than 2 events per season. This represents an increase factor between 2 to 10 times with respect to the reference period. Interestingly this increase will happen under the two scenarios. The number of heat waves (persistent time intervals of extreme daytime heat) is on a slight increase by the end of the 21st century, with no evident changes between the two scenarios. The projected change in heat wave frequency is of +1-2 cases per season in both scenarios. Largest increases are expected over the September-November interval (at the end of the hot season), in all the three future time-horizons (RCP2.6), as well as from December to August by 2070s and by the end of 2100 and from September to November by 2041-2070 (RCP8.5).

But the most dramatic change related to heat waves can be seen from the duration of these events. Figure 4 shows that heat waves will last from an average of a few days at the end of the last century to far beyond 10 days during the hot season in the second half of the XXI century. Actually, under the rcp8.5 from 2040 onwards, more than half of the hot season (from June to November) will become a permanent heat wave considering the definition of what a heat wave was in the XX century. Climate projections suggest that heat waves in the city of Teresina will increase considerably in duration. Most visible upwards are expected at the end of the hot season, from September to November, under both scenarios, in the range of 10 to 21 days under RCP2.6 and of 17 to 75 days under RCP8.5 (Fig. 4). As previously shown, the 2041-2070 (RCP2.6) and 2071-2100 (RCP8.5) are the future time-horizons in which the change in heat wave duration is projected the largest. Heat waves will become more persistent throughout the entire year, but the expected change is lower than that estimated for the September-November interval. Under RCP2.6 these changes are generally below 12 days under RCP2.6. The high emission scenario shows a different picture especially for the mid- (2041-2070) and far-future (2071-2100), when the increasing rates of heat wave duration maintain large enough also during the cool season of the year, covering the January-June interval (14 to 28 days in the mid-future and 30 to 62 days in the far-future).
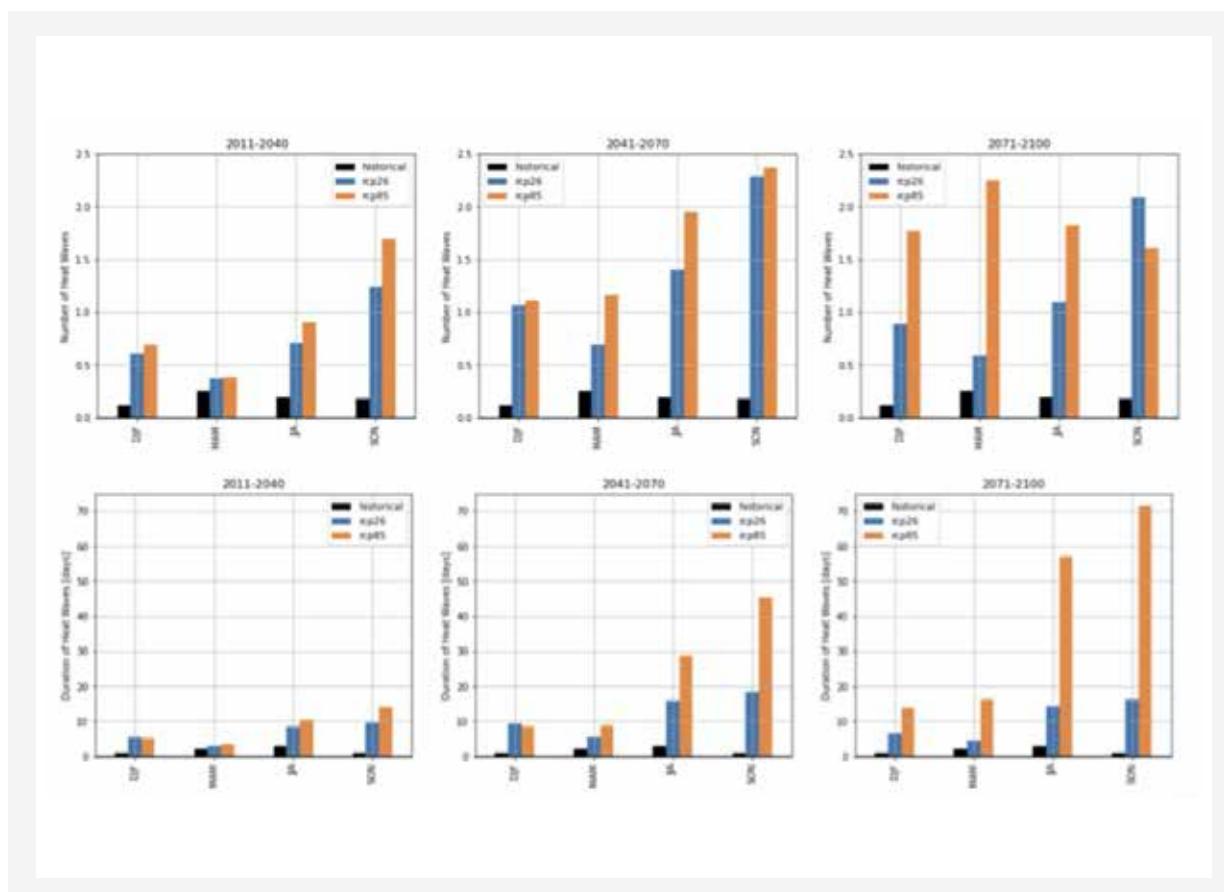
Figure 4: Average number (top) and duration in days (bottom) of heat waves for different periods and scenarios. Source: Lobelia.

Precipitation and Precipitation Extremes

Projected changes for precipitation are not as significant as for temperature in the area of Teresina (figure 5). show in general a reduction on the average daily precipitation in both scenarios. However this reduction mainly occurs during the dry season while the projected change during the wet season especially under the RCP8.5 precipitation shows a positive sign and a larger absolute value (figure 6). By 2100, change in precipitation intensity range between -33.6% to +6.6% under RCP2.6 and between -93.7% and +23.3% under RCP8.5.

In the future, Teresina will face less precipitation throughout most of the year under both emission scenarios. Under RCP2.6, the wet season in the area (December to May) will accumulate less precipitation than in the present-day conditions, especially at its onset with peak decreases over 2041-2070 (December -22.8%). In this scenario, some small increases are also expected, but only in the near-future (2011-2040), which are less than 10%: in March (+6.6%) and January (+2.0%). The dry season of the year (generally lasting from May to December) is expected to grow even drier, particularly in June (with a peak decrease of -30.6% over 2041-2070) and toward its end in September-October (e.g. the peak decrease for September is of -44.3% over 2071-2020, while that of October is of -41.5% over 2041-2070).

The projections under RCP8.5 scenario indicate a different picture of future precipitation evolution in the target area. The dry season is expected to become considerably dry in the mid- and far-future, with peak precipitation decreases in June (44 to 53%) and October (73 to 94%). During the wet half of the year (December to May) precipitation is projected to increase between January and March in the near-future (2.9 to 4.2%) and mid-future (0.9 to 16.4%) and over January-February interval in the far-future (11.8 to 23.3%). In other words, the mid part of the wet season in Teresina is expected to become wetter under RCP8.5, especially over the last two thirds of this century.
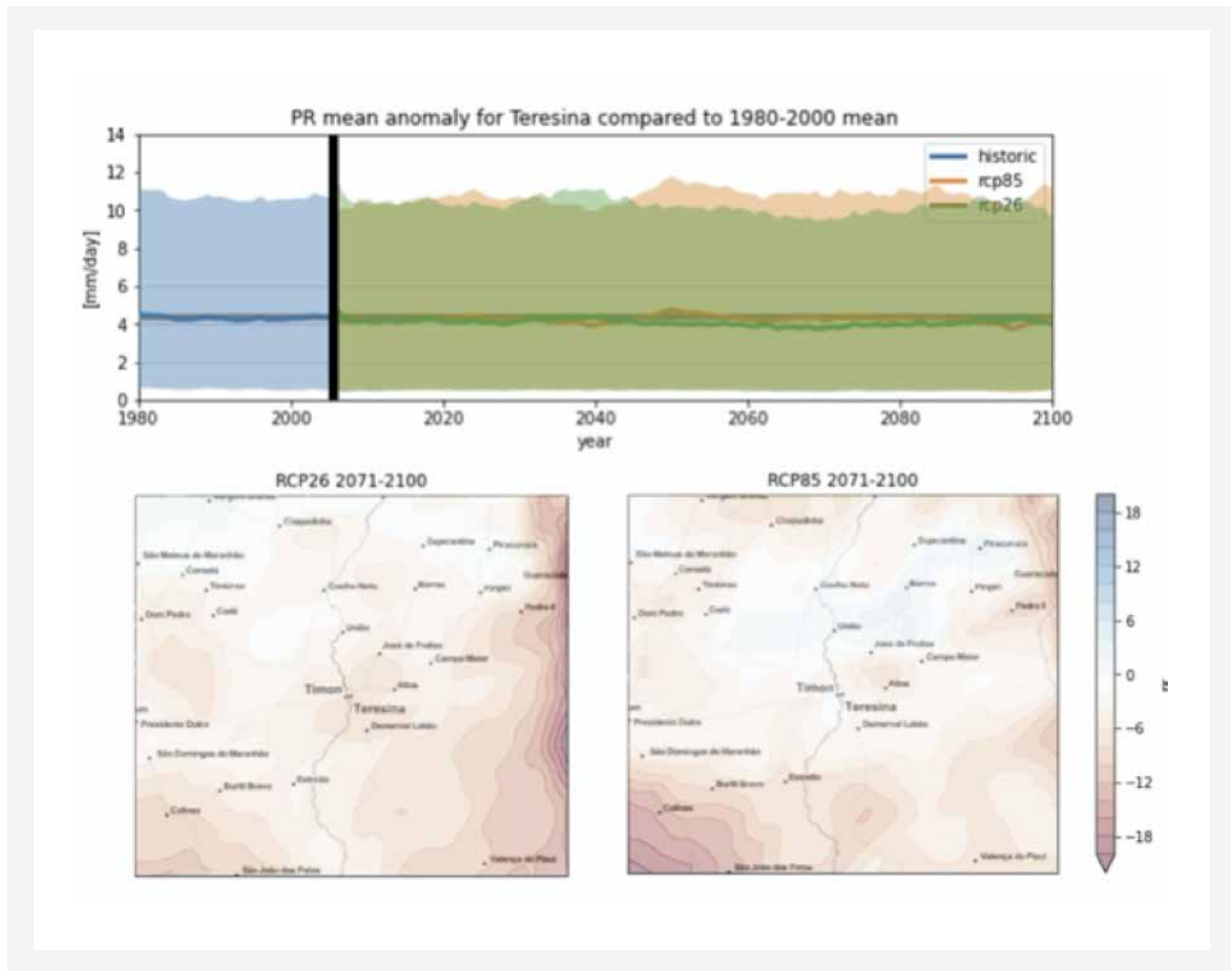
Figure 5: Top panel: Time series of the projected annual mean daily precipitation [mm/day] in Teresina during XXI century for the two scenarios (RCP2.6 and RCP8.5). Shaded coloured area represents the region between the minimum and maximum values within the multi-model ensemble. This interval provides an estimation of the uncertainty related to the natural variability, i.e. the interannual variation for a given year may fall within this shaded area. Horizontal grey line indicates the average annual precipitation for the historical period. Bottom panel: Projected annual mean percentual change in precipitation [%] for period 2071-2100 with respect to the reference period (1980-2000) for the two scenarios. Negative values indicates less precipitation in the future. Source: Lobelia.

Again, the climate average projected changes described for the average daily precipitation (figure 5 and 6) contrast with the significant expected changes for extreme precipitation events.An increase in the duration of dry spells (resulting from time-spans of consecutive days without precipitation) is expected in the area throughout the entire year, under both scenarios (Fig. 7). Largest positive changes are expected from December to May (the dry season) in the mid-future (2041-2070) under RCP2.6 (19 to 26%) and far-future (2071-2100) under RCP8.5 (27 to 30%). A slight increase in dry spells is also projected during the wet season, between September and November, of about 5% under RCP2.6 and in the range of 10 to 12% under RCP8.5. Further indication regarding this future drying climate trend is given by the future evolution of wet spell duration (time-spans of consecutive days with rainfall) by the end of the 21st century (not shown). Teresina will experience a generalized decrease in the maximum number of consecutive wet days over the year, with up to 10-20% in the mid-future (RCP2.6) and 10-46% in the far-future (RCP8.5). Largest changes are expected from September to November under both scenarios.
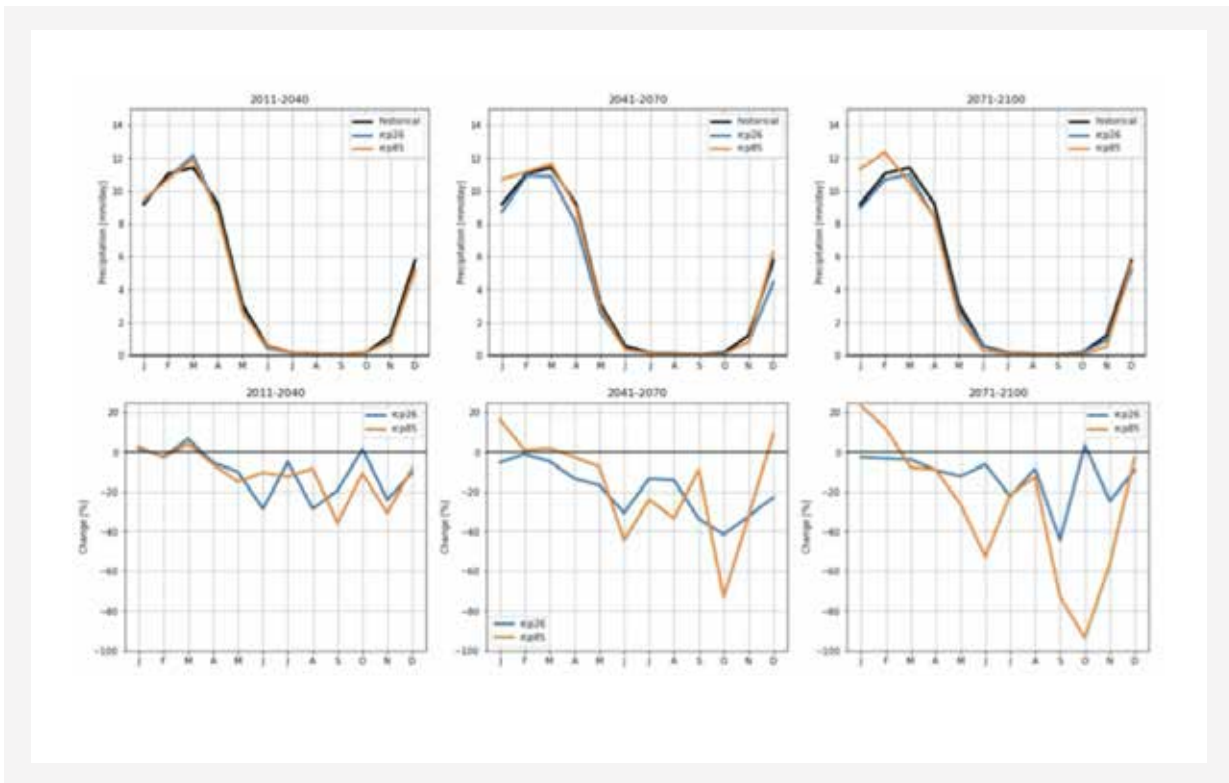
Figure 6: Seasonal cycle of the projected daily precipitation [mm/day] in Teresina (top) and relative change [%] with respect to the historical period [bottom] for the two scenarios (RCP2.6 and RCP8.5) and different periods. Source: Lobelia.
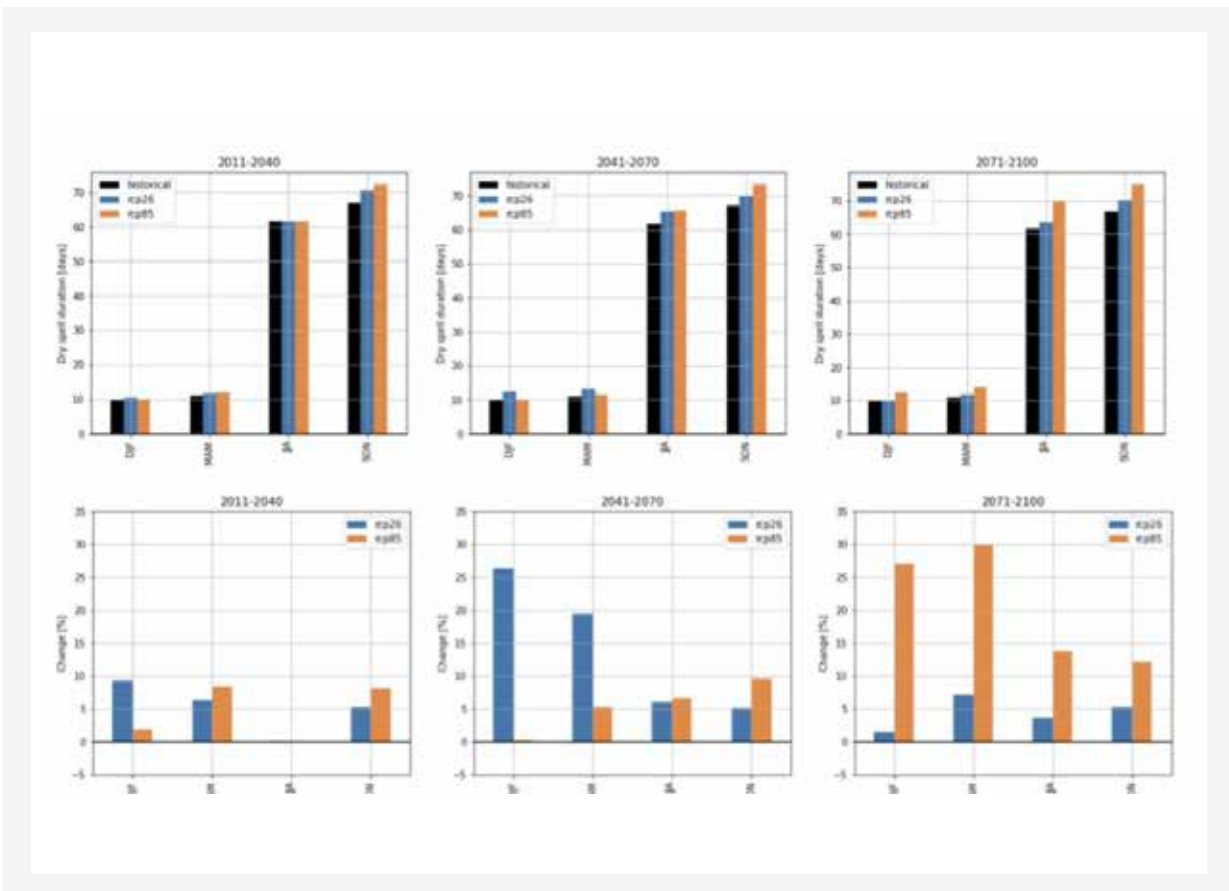

Figure 7: Average duration of dry spells [days] in Teresina (top) and relative change [%] with respect to the historical period [bottom] for the two scenarios (RCP2.6 and RCP8.5) and different periods. Source: Lobelia.

Projected extreme precipitation events show a marked contrast with the general dryer climate expected for Teresina during next decades. In general, Teresina will face less frequent abundant rainfalls (of over 10 mm or 20 mm/day)during the dry season but the contrary during the wet season. It is important to highlight interms of climate risks the impact of this intensity increase in heavy precipitation during the wet season in comparison with the also significant but less sensible reduction of extremes during the dry season.

The decrease will affect especially those months of both hot-dry season (June to November) when heavy rainfall events will become visibly rarer both in the near- (with decreases in the range of 13 to 65%) and mid-future (32 to 44%) under RCP2.6, as well as in the mid- (35 to 71%) and far-future (24 to 64%) under RCP8.5. However, over the December to February interval (the beginning of the wet season), it is projected that Teresina will be affected by an increase in the frequency of heavy precipitation events. The trend towards an increasing torrentiality of rainfalls in this interval was projected in the mid- and far-future of both scenarios, but it is stronger under RCP8.5 (14 to 18% increase in the frequency of heavy rainfall events of at least 20 mm per day) (not shown).

The future trend of increasing rainfall torrentiality over December-February is also suggested by the projections of the maximum 1-day and 5-days precipitation in both scenarios (figure 8). The future trends of these extreme precipitation indices are more pronounced in the mid- and far-future projections with the RCP8.5, ranging between 20-45% for the maximum 1-day precipitation amounts and between 16-34% for the maximum 5-day precipitation. For RCP2.6, the projected upwards are generally below 14%. Outside this time interval of the year, slighter increase (below 10%) in such extreme precipitation amounts are also expected at the end of the wet season (from March to May).
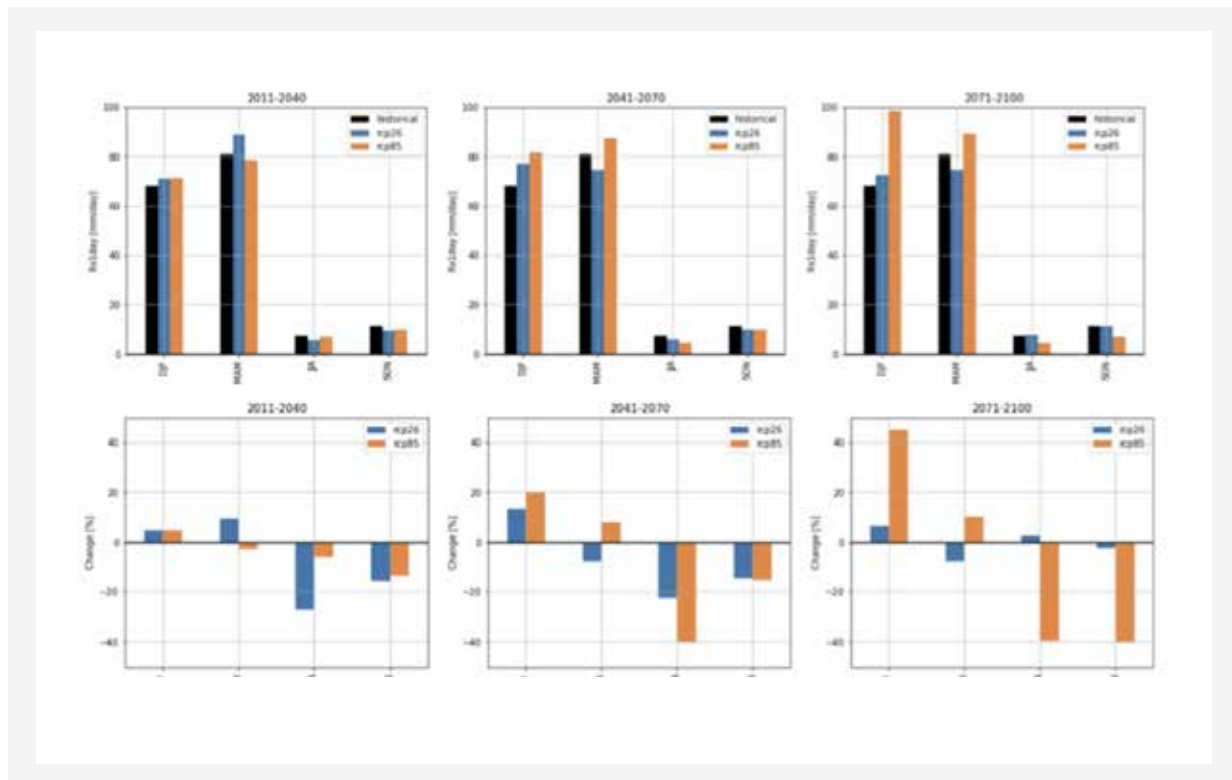

Figure 8: Average maximum daily precipitation for each season [mm/day] (top) and relative change [%] with respect to the historical period [bottom] for the two scenarios (RCP2.6 and RCP8.5) and different periods. Source: Lobelia.

Key Messages

In summary, the key future climate changes in Teresina City indicate that:

- The local climate will grow warmer and drier throughout most of the year;

- Local warming will be significant both during nighttime and daytime;

- Heat waves will become more frequent and much more persistent;

- Warm (tropical) nights will become very frequent in most months of the year, especially at beginning of the hot season (June to August interval);

- The dry season will become drier and hotter;

- The hot season will become hotter, longer and drier (especially in June, September and October); - Precipitation will decrease throughout most of the year under both emission scenarios; - Dry spells will become more persistent favouring the gradual transition towards a drier local climate;

- The frequency of heavy rainfall events and the extreme rainfall amounts in time sequences of 1 and 5 days will significantly increase (20%-40%) over the December to February interval (the beginning of the wet season), especially in the mid- and far-future under RCP8.5; a slight increase in the extreme precipitation amounts is also expected at the end of the wet season (from March to May).

Expected Future Impacts and Vulnerabilities in Teresina Due to Climate Change

Future climate change is expected to aggravate the existing environmental, health and urban problems and to increase risk, especially for communities already living in vulnerable conditions.

- Increasing heat-health risks, due to the augmented heat stress and urban heat island effects, in response to the significant temperature increase both daytime and nighttime; additional risks for residents and tourists is expected to be posed by the increasing frequency of warm (tropical) nights and heat wave duration;

- Climate is one important driver of the current distribution and incidence of dengue fever (Menezes et al., 2014), as well as a significant co-factor for malaria (Githeko et al., 2000). Important epidemics in Teresina were observed in the periods 1983-1985 and 1992-1994, that coincided with major droughts caused by El Niño. As the climate of Teresina will grow generally drier by 2100 and the frequency of heavy precipitation days and extreme precipitation amounts are expected to increase, a likely to increase in the exposure to dengue and malaria disease is possible in the future. However, other factors (e.g. individual behavior, immunity and socioeconomic factors), showing non-linear relationships with the disease incidence, together with the effectiveness of implemented preventive measures such as vaccination campaigns, disease surveillance and vector control might be more relevant in understanding the seasonal timing of outbreaks under the future climate.

- Through its location, at the confluence of the Parnaiba and Poti rivers), Teresina is expected to face an increase of urban (fluvial) flooding in response to the projected increases of torrential rainfalls (e.g. heavy precipitation days with at least 20 mm and extreme rainfall amounts in 1 and 5 consecutive days) projected at the beginning of the wet season (from December to February). The future flooding risk is expected to be high in the areas with high social vulnerability under the present climate conditions. Along with, the contamination level of local water rivers and of soils in their adjacent areas (floodplains) isexpected to maintain high in the light of the projected increase of rainfall torrentiality, if the waste management in Teresina will continue to be deficient.

- On the other hand, the increasing duration of dry spells is likely to hydrological and agricultural implications, through more occurrences of hydrological drought events, deficiencies in water supply and decreased soil moisture.

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Prefeitura de
Teresina

Recommendations of Actions for Resilience and Sustainability

TERESINA

This report presents Recommended Actions for Resilience and Sustainability for the city of **Teresina** to propose a strategic roadmap for building capacity in local government for a more resilient and sustainable urban future.