

Vila Piracicaba and Jardim Helena, on the banks of the Rio Tietê, São Paulo, SP. Photo: Omar de A. Cardoso.

EXECUTIVE SUMMARY

RESULTS OF THE CLIMATE CHANGE ADAPTATION CAPACITY BUILDING IN THE ALTO TIETÊ WATERSHED

Government of the State of São Paulo
SEMIL – Secretariat for Environment, Infrastructure, and Logistics
CETESB – Environmental Company of the State of São Paulo

São Paulo, June, 2025



Secretaria de
Meio Ambiente, Infraestrutura e Logística



SÃO PAULO
GOVERNO DO ESTADO

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FOREWORD

The climate crisis is a reality that imposes growing challenges on public management and society as a whole. Understanding its risks and, above all, promoting urgent transformations has become essential to strengthen the resilience and adaptive capacity of territories and populations.

In urban areas, the adverse effects of extreme climate events are intensifying, exposing the population to increasing risks. In this context, it is imperative to deepen the understanding of territories and to structure adaptation measures based on strategic planning, integrated and guided by local realities.

Reaffirming the State of São Paulo's commitment and leadership in the face of climate change, the Environmental Company of the State of São Paulo (CETESB) has been investing in actions that promote knowledge dissemination and the strengthening of joint efforts between the Public Power and civil society. The goal is to increase response capacity to climate-related vulnerabilities and risks through strategies grounded in science, technical expertise, and cooperation.

The Capacity Building, aimed at municipalities within the Alto Tietê Watershed, was designed to train public agents and civil society representatives in a learning path that ranges from fundamental concepts to the development of fundable projects. This is a region of economic and environmental relevance, but also highly susceptible to climate impacts.

This publication presents the results of this journey, carried out with the support of the State Water Resources Fund (FEHIDRO) and the Alto Tietê Watershed Committee (CBH-AT). More than sharing the progress made, our aim is to inspire new initiatives, engaging managers, technicians, researchers, and citizens in the path toward adaptation and the construction of more resilient territories.

Thomaz Miazaki de Toledo

President Director

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LIST OF ACRONYMS

APP – Permanent Preservation Area
APRM – Watershed Protection and Recovery Area
AR4 – Fourth Assessment Report of the IPCC
AR5 – Fifth Assessment Report of the IPCC
AR6 – Sixth Assessment Report of the IPCC
BAT – Alto Tietê Watershed
CETESB – Environmental Company of the State of São Paulo
CEU – Unified Education Center
CONDEMAT – Consortium for the Development of Alto Tietê Municipalities
COP 30 – 30th Conference of the Parties of the United Nations Framework Convention on Climate Change
CRA – Climate Risk Analysis
FEHIDRO – State Water Resources Fund
GHG – Greenhouse Gases
IBGE – Brazilian Institute of Geography and Statistics
IPCC – Intergovernmental Panel on Climate Change
NBS – Nature-Based Solutions
PEMC – São Paulo State Policy on Climate Change
PMMAC – Plan for the Recovery and Protection of the Atlantic Forest and Cerrado of the Municipality of Mairiporã
PRAMC – Regional Climate Change Adaptation Plan for Alto Tietê-Headwaters
RMSP – São Paulo Metropolitan Region
SDG – Sustainable Development Goals
SEMIL – Secretariat for Environment, Infrastructure, and Logistics
UBS – Basic Health Unit
UGRHI – Water Resources Management Unit
UN – United Nations
WG – Working Group
WMO – World Meteorological Organization
ZEE – Ecological-Economic Zoning

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INTRODUCTION

The State of São Paulo has faced a series of climate challenges that have become more consolidated in recent years, many of which are directly linked to the intensification of global climate change. Among the most notable events, the increasingly frequent occurrence of extreme rainfall events, both in volume and intensity, resulting in floods and landslides, endangering urbanized areas in vulnerable locations, such as hillsides, floodplains, and coastal areas. As an example, the disaster resulting from a series of landslides that occurred at the beginning of 2023 in the municipality of São Sebastião, on the northern coast of the State, after heavy rainfall in the area, which recorded the highest rainfall indexes in a 24-hour period in the country's history. Or the severe drought that struck the State in the period 2014-2015, culminating in an unprecedented water crisis, directly affecting the reservoirs of the Cantareira and Alto Tietê Systems, seriously compromising the water supply for millions of people in the Metropolitan Region. In addition to increasingly intense and frequent heat waves, which only worsen the phenomena of excessive temperature increases in cities and consequently exacerbate their related problems.

In this context, due to this diversity of impacts, and their intensity and frequency, in a region that stands out for hosting the largest population concentration in the country, the Environmental Company of the State of São Paulo (CETESB), supported by the State Water Resources Fund (FEHIDRO), was motivated to implement capacity-building aimed at public managers, technicians, and civil society, seeking the planning and implementation of adaptation strategies to make municipalities more resilient to climate change. The project focused on identifying vulnerabilities and proposing adaptive measures for the 40 municipalities of the Alto Tietê Watershed (BAT), as a fundamental step to prepare the region for future climate challenges. The Capacity Building took place from 2022 to 2024, and its activities included classes, dynamics, exercises, and technical workshops.

This Executive Summary presents a synthesis of the results obtained in the Capacity Building, concisely exposing the documented content and results, along with the applied methodology, the climate adaptation projects selected and developed by the working groups, as well as reflections, lessons learned, and recommendations from the proactive journey to overcome the climate challenges currently faced.

Contemporary challenges in the face of climate change

Since the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988, and the subsequent advances in multilateral climate agreements, societies and governments have strived, in recent decades, to find the best strategies to reduce climate-related risks, especially in an attempt to minimize environmental, social, and economic impacts that, among other consequences, lead to the loss of human lives.^[1]

However, achieving these goals has become an increasingly complex challenge, especially at a time when climate issues are taking on an emergency context, and the resulting events are already affecting all regions of the planet, putting the environment, economy, health, water security, and the well-being of society in general at risk.

^[1] According to the World Meteorological Organization (WMO), between 1970 and 2012, there were 8,835 climate, meteorological, and hydrological disasters worldwide, resulting in 1.9 million lives lost and economic losses of 2.4 trillion dollars (UN BRAZIL, 2021).

In the latest reports of the Intergovernmental Panel on Climate Change (IPCC), AR4, AR5, and AR6 (IPCC, 2007; 2014; 2023), for example, the climate emergency has already been widely addressed, from a perspective that goes beyond simple studies on climate risks and impacts, focusing mainly on research and development of adaptation actions for territories to climate change, aiming to make them more resilient, especially in areas more exposed and potentially susceptible to climate risks, such as those with greater socioeconomic and environmental vulnerability.

In this sense, considering climate risk as a result of the interaction between climate hazard, vulnerability, and exposure of human and natural systems (IPCC, 2014), as well as the various degrees of vulnerability to which the population is exposed, having different capacities to face extreme climate events, it is urgent and necessary to promote and implement proposals for the development of climate adaptation projects and plans.

However, given the multiplicity of observed scenarios, it is not appropriate here to define a one-size-fits-all approach for the best projects, but rather, fundamentally, to acquire knowledge and/or deepen a series of issues, with a view to developing adaptation solutions to climate change, combining a more technical approach and a new way of formulating proposals, projects, and plans.

Based on the international commitments made in climate agreements, it is important to highlight the need to promote the expansion and dissemination of knowledge about climate change, creating models of proactive learning and qualification, especially at this time when Brazil is preparing to host in 2025 the 30th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 30), the main global event to define policies and strategies to address the climate crisis at a global level.

CETESB AND THE CLIMATE AGENDA

Since 1995, CETESB has been supporting the implementation of commitments arising from the international agreements established in the United Nations Framework Convention on Climate Change (UNFCCC) (BRAZIL, 1998), acting in the coordination of state programs, in the preparation of national and state inventories, and in the application of the State Policy on Climate Change (PEMC) (SÃO PAULO, 2009), having been responsible for the technical coordination of the Inventory of Direct and Indirect Anthropogenic Greenhouse Gas Emissions of the State of São Paulo (CETESB, 2011). In addition, CETESB has collaborated in the formulation, implementation, publication, and updating of regional programs that include measures to mitigate the impacts of climate change, as well as establishing criteria for the preparation of corporate greenhouse gas (GHG) emission inventories for specific industry segments in the State of São Paulo, a pioneering initiative in Latin America regarding data collection and storage.

During this period, CETESB has also conducted various courses and capacity building on climate change and related topics, aimed at both external and internal audiences, reinforcing the commitment and leadership of the State of São Paulo on the subject. More recently, after the publication of the latest IPCC reports, when approaches to climate adaptation became more effective and feasible, CETESB also began to address this issue, especially regarding the feasibility, effectiveness, and potential of climate adaptation measures, as well as their co-benefits for human health, the economy, and the environment.

It was precisely in this scenario that the technical capacity building project for climate risk identification and the proposal of adaptive measures emerged, seeking the development of adaptation projects that would not only include the study of climate risk and the development of policies and strategies for the advancement of knowledge and learning, but mainly to prepare the involved municipalities and/or regions for the identification and reduction of risks, contributing to the proper planning and implementation of local and regional adaptive measures.

In this context, CETESB has been developing a technical capacity building project for the identification of vulnerabilities and the proposal of adaptive measures aimed at preventing the effects of climate change on water resources, targeting the State's River watersheds. The objective is to enhance the response capacity not only of the Public Authorities but also of civil society regarding the identification of vulnerabilities and risks associated with climate change. The project, coordinated by CETESB, has received support from the State Water Resources Fund (FEHIDRO) and the relevant watershed committees.

Having already been carried out in the Baixada Santista Region (UGRHI-7) between 2019 and 2021 (CETESB, 2022), the project, now in its second edition, has been directed at the Alto Tietê Watershed (UGRHI-6). This is a region of great economic, social, and environmental importance for the State, notable for its extensive and continuous urban area (the largest in the country) and its high population density (with an approximate population of 21 million inhabitants distributed across its 40 municipalities). It also hosts the largest economic center in the country—almost the entire São Paulo Metropolitan Region (RMSP) is located within the Alto Tietê Watershed, housing the headquarters of the largest industrial, commercial, and financial complexes responsible for managing national economic activities. Therefore, it is one of the most challenging river watersheds in terms of socio-environmental management, due to the intense modifications caused by human occupation and activities in its floodplain areas.

WHY OFFER CAPACITY BUILDING IN THE ALTO TIETÊ WATERSHED?

The Alto Tietê Watershed (BAT) is a crucial region for the water supply of the São Paulo Metropolitan Region (RMSP), the largest urban and economic center in Brazil. Its importance goes beyond providing water for millions of inhabitants, vital for economic activities at both the state and national levels.

Based on the analysis of the causes and consequences of risk and its impacts, considering vulnerability and exposure to threats and extreme weather events, climate studies indicate an increase in the intensity and frequency of droughts and heavy rains in the BAT, impacting the hydrological cycle and the water security of the RMSP.

By applying the concept of Climate Risk Analysis (CRA) to the current situation, it is possible to identify several climate change impacts in the region, including:

1. Increased risk of flooding;
2. Impacts on urban infrastructure and sanitation services;
3. Risks to productive activities;
4. Greater likelihood of mass movements (landslides);
5. Reduced water storage capacity;
6. Negative consequences for local biodiversity.

Considering these challenges, the Alto Tietê Watershed (BAT) was prioritized for the development of climate adaptation policies, aiming to increase the resilience of the territory through measures that improve its adaptive capacity and promote integrated and efficient planning for the entire region.

THE PATH TO THE CLIMATE CHANGE ADAPTATION CAPACITY BUILDING IN THE ALTO TIETÊ WATERSHED

In line with the promotion of climate resilience and the enhancement of planning and action capacity in response to environmental challenges in the Alto Tietê Watershed, the Capacity Building initiative had as its main objectives to provide participants with an understanding of key concepts related to climate change, its causes and its impacts on the hydrological cycle and water systems; to identify climate risks and socio-environmental vulnerabilities at both regional and local levels; and to collaboratively develop climate adaptation measures that can be implemented through facilitated access to financing sources.

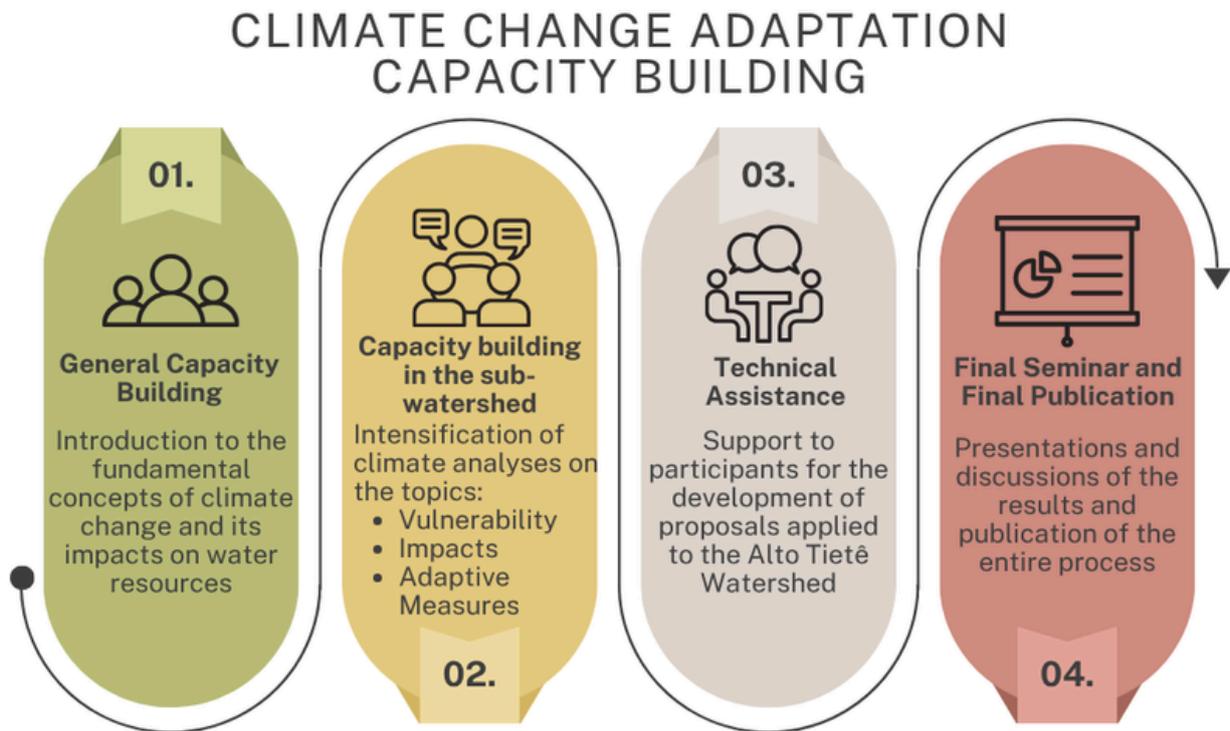
In addition, the Capacity Building promoted knowledge sharing and the exchange of experiences through various activities, including a final seminar for the presentation of plan and project proposals, as well as discussion of the main issues addressed throughout the training journey.

Guiding Principles of the Capacity Building

As listed below, the capacity building was based on a series of fundamental guiding principles, which served as the foundation for the content explored in greater depth. These principles guided the approaches for composing strategies to mitigate climate impacts, promote resilience in vulnerable communities, and integrate public policies focused on sustainability and adaptation to climate risks.

- Sustainable Development Goals (SDGs);
- Regenerative Design;
- Nature-Based Solutions;
- Ecosystem-Based Adaptation;
- Green Infrastructure;
- Effective Co-creation and Facilitation.

The capacity building for climate change adaptation was structured into four main stages (see Figure 1), designed to build knowledge in a progressive manner, starting from theoretical foundations and advancing to practical application through technical assistance in the formulation of plans and projects. The structure of the capacity building was proposed to ensure that participants gained an understanding of the essential concepts and developed the skills necessary to identify and implement adaptive solutions in the context of the Alto Tietê Watershed and sub-watersheds.

Figure 1 - Structure of the Capacity Building

Source: Prepared by the author.

Conducted in a dynamic and interactive manner, the capacity building also included the development of didactic materials specifically focused on the topics addressed in the course. This provided access to relevant and specific content to facilitate the understanding process of climate change and its risks and impacts in the most vulnerable territories of the Alto Tietê Watershed.

Capacity Building Handbook

The preparation of the Technical Handbook (Figure 2) aimed to provide participants at the capacity building with theoretical references on the proposed program content. The handbook is divided into two main parts: the first, broader in scope, covers the identification of climate risks and the proposal of adaptive measures; the second, more specific, addresses local issues in the Alto Tietê region. The document compiles up-to-date content supported by a reference bibliography on climate change, with an emphasis on its implications for water resources. The Technical Handbook was developed with the following content:

- Bibliographical and technical references to support the Capacity Building;
- Theoretical and practical concepts on climate change and adaptation, including recent advances in adaptation actions, climate forecasts, and emerging theories regarding the climate emergency;
- Relevant studies to support theoretical classes and practical exercises, offering comprehensive support to participants;
- Broad and in-depth understanding of the topics covered;
- Content focused on the practical application of acquired knowledge and providing a foundation for the formulation of climate adaptation proposals.

Figure 2 - Capacity Building Handbook

- MODULE I - Climate Change: Concepts and Definitions
- MODULE II - Hydrological Cycle and Climate Changes
- MODULE III - Addressing Climate Change
- MODULE IV - Practical Guide to Financing Climate Projects



Source: Prepared by the author.

General and Subcommittee Capacity Building

During the implementation phase of the climate change adaptation capacity building aimed at the entire watershed, the focus was on presenting broader issues relevant to the entire watershed, in addition to introducing common concepts and conducting exercises and activities designed to explore the essential topics for understanding the problems and challenges associated with climate emergency. This initial approach made it possible to build a shared knowledge base among participants.

In a second stage of the capacity building, by dividing the class into five groups, it was possible to carry out a more specific approach for each of the subcommittees that make up the Alto Tietê Watershed (BAT), addressing their particularities and characteristics. This allowed for a more localized and contextualized analysis of the impacts and climate adaptation strategies.

Technical Assistance

After completing the General and Subcommittee phases, the Technical Assistance phase began with the purpose of supporting participants in selecting, investigating, and developing project proposals focused on climate change adaptation. The main objective of this phase was to enable the practical application of the content explored in the previous stages, offering participants the opportunity to structure a real case based on the knowledge acquired.

With technical support, participants, organized into Working Groups (WGs), were able to deepen the analysis of their ideas, develop contextualized solutions, and begin outlining concrete actions aimed at climate resilience in their respective regions.

Final Seminar

The capacity building cycle concluded with a Final Seminar, during which the Working Groups (WGs) had the opportunity to present the progress achieved in their project proposals for climate change adaptation. During the event, the teams shared the results of their analyses and the strategies they had developed, receiving strategic feedback from a panel of experts in the field. The main purpose of this moment was to provide qualified feedback, encourage the improvement of the proposals, and strengthen the conditions for the continuation of the work, fostering the effective implementation of the initiatives developed throughout the capacity building.

As illustrated below (Figures 3 and 4), the Capacity Building adopted a practical and participatory approach to the topics covered, informing participants about the climate challenges faced and enabling the joint identification of adaptation solutions that are aligned with the complex realities of the Alto Tietê Watershed territory. Guided by the capacity building's core principles, the practical exercises designed for applying theoretical concepts included the sharing of climate adaptation case studies and fieldwork, following a logical sequence to:

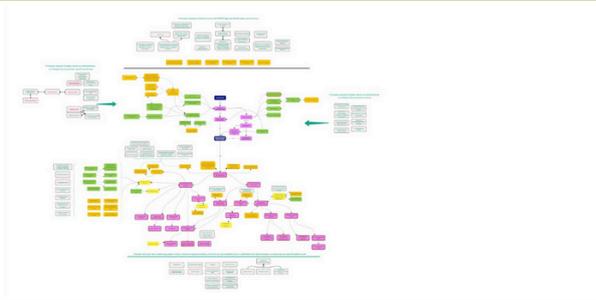
- identify climate change vulnerabilities in the Alto Tietê sub-watersheds;
- analyze the various impacts, especially on the hydrological cycle;
- and identify possible adaptive actions, recognizing the degree of effectiveness of each solution and the elements necessary for their effective implementation.



Figure 3 – Practical exercises applied during the capacity building

Vulnerabilities

- Territorial information and vulnerability indicators viewed through layers of georeferenced data
- Identifying vulnerable areas in the sub-watershed: a participatory exercise



Impacts of Climate Change

- Aspects for a better understanding of the impacts caused by climate change, especially on the hydrological cycle
- Gradual development of a chain of impacts

Adaptive Actions

- Practical and context-specific solutions to address climate challenges
- Selection and prioritization of adaptation measures distributed into solutions with characteristics of project and planning

Índice de Risco	Baixo	Médio	Alto
1. Quota total orçamentária	X		
2. Eficácia Capacidade de gerar maior ou maior efeito positivo sobre a adaptação e redução do risco climático		X Se for período de forma estacional (por bacia hidrográfica)	
3. Viabilidade Capacidade de implementação da medida			X (abrange local)
4. Baixo empacotamento e cobenefícios Capacidade de não gerar efeitos negativos			X (tem que ser bem executado para não gerar áreas de alagamento)

Planejamento	Projeto	Premissas e métodos
Planos de habitação	Renovação de edificações sociais na cidade	Melhoria no cadastro
Regularização fundiária	Moradas sociais	cadastre
Proteção de áreas ambientalmente frágeis via zoneamento	Regularização fundiária	melhoria das políticas habitacionais
Plano de uso das áreas ambientalmente frágeis	Reativação	Realização de áreas ambientalmente frágeis
Educação ambiental	Proteção de áreas via criação de parques	
	Integração Tera	

Source: Prepared by the author.

Figure 4 – Example of case studies shared during the Capacity Building



SANTOS CLIMATE ACTION PLAN e 20 (modelos globais e/ou regionais, para o período histórico (1961-1990) e projeções para o período 2021-2050, sob os cenários de emissões;

Eduardo Kimoto Hosokawa

Índice de Risco Climático e Vulnerabilidade Socioambiental – Mapeamento das Áreas Vulneráveis;

- Mensurados os impactos e riscos relacionados aos eventos de origem geo-hidro-meteorológica mais relevantes para o município;
- Identificou e discutiu parâmetros para a adoção de medidas de adaptação, a curto, médio e longo prazo e que se mantenham eficazes também no futuro;

Diretrizes e Metas para 8 Eixos Estratégicos definidos no PACS

MUNICIPAL PLAN FOR ADAPTATION AND RESILIENCE TO CLIMATE CHANGE OF GUARULHOS

Solange Duarte

Parque Linear Cubas

Eixo 2: Ações de Educação Ambiental e Gestão Participativa

- Palabras e Oficinas
- Criação de Conselho Gestor do Parque
- Sinalização do parque

FINANCIAMENTO???

Source: Prepared by the author.

Figure 5

CAPACITY BUILDING STATISTICS



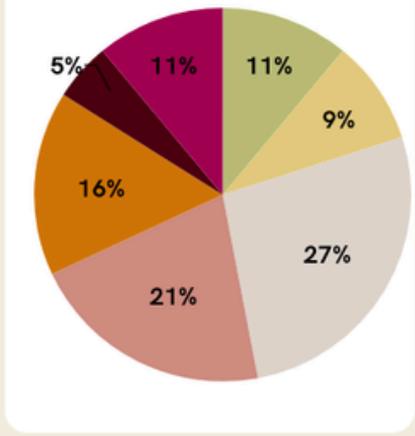
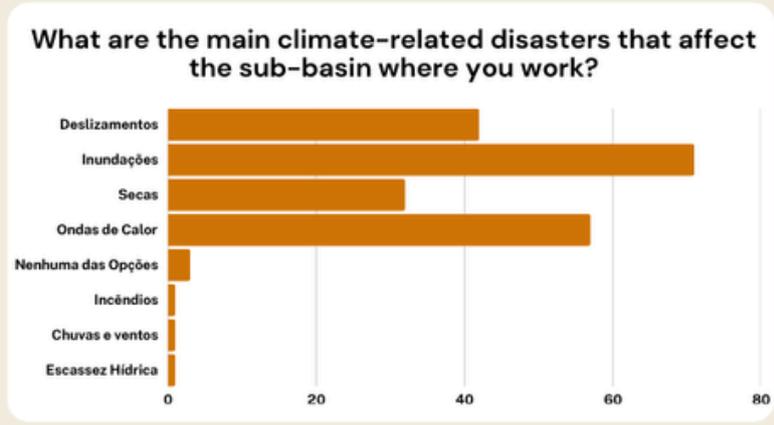
Statistics



Area of Activity



Initial Perceptions



Source: Prepared by the author.

CLIMATE ADAPTATION PROJECTS AND PLANS

Regarding the results achieved, the capacity building resulted in a set of adaptive proposals (projects and plans), based on an understanding of the effects of climate change in each of the sub-watersheds that make up the Alto Tietê Watershed . These proposals took into account the existing territorial characteristics of each municipality and/or sub-region, especially with regard to socio-environmental vulnerabilities.

Each participant formed a Working Group dedicated to developing a concrete project or plan, allowing for the practical application of the knowledge acquired throughout the capacity building. The climate adaptation proposals developed were also aligned with the guidelines and requirements of funding institutions, increasing the chances of successfully securing and efficiently using resources.

Through this integrated approach, the goal was not only to prepare participants for the challenges posed by climate change but also to foster innovative and applicable solutions for the territory.

The methodology and activities applied in the capacity building resulted in the development of project and plan proposals with the following objectives

- Development of proposals adapted to local realities;
- Strengthening technical and institutional capacity;
- Promoting the exchange of experiences among participants;
- Alignment with funding opportunities from different funds and sources.

Below, you will find basic information about the eight proposals developed by the Working Groups, created after technical assistance, field visits, presentations of results to experts, and work meetings, resulting in the plans and projects presented below.



NUMBER OF WORKING
GROUPS

8



EXECUTIVE SUMMARY

RESULTS OF THE CLIMATE CHANGE ADAPTATION CAPACITY BUILDING IN THE ALTO TIETÊ WATERSHED

TRANSGUARULHENSE PROJECT – ADAPTATION AND RESILIENCE MEASURES TO CLIMATE CHANGE IN GUARULHOS

Category: Linear park project and interventions in the watershed.

Location: Ribeirão dos Cubas Watershed , Transguarulhense Linear Park and surroundings, Guarulhos, SP.

Figure 6 – Transguarulhense Project divided into sectors (Phase 1)



Source: Working Group 1.

Climate Events Addressed: Flooding and heat waves

Target Audience: Residents of the project area, including those benefiting from the retention reservoirs; local commerce located in the project area; educational institutions and health units located in the project region; public servants involved in the thematic areas of the project; third sector institutions involved and located in the project area.

Description: This is a pilot project aimed at advancing the implementation of actions foreseen in the Municipal Plan for Adaptation and Resilience to Climate Change of Guarulhos, which has been underway in the municipality since 2021.

It includes the following subprojects: Revitalization of Urban Furniture; Implementation of Green Infrastructure; Recovery and Implementation of Bike Lanes and Walking Paths; Installation of Retention Reservoirs; Recovery of Permanent Preservation Areas (APPs); Awareness Raising with the Involved Population; Educational Signage; Installation of Solar Panels; Implementation of Selective Waste Collection; Creation of the Management Council of Parque Transguarulhense and the Management Council of Bosque Maia.

Expected Results: Increase water security; improve the municipality's green infrastructure; improve air quality and reduce the number of polluting vehicles; promote proper solid waste disposal; minimize the effects of heat waves; and foster scientific, technological, and innovative development for sustainable management.

Justification: The need to manage risks, increase water security, establish conservation units, implement bike lanes and linear parks, and guarantee dignified housing are just some of the guidelines that guide the proposal. The project respects the layout of previous initiatives along the river that accompanies it, such as Parque Transguarulhense and other public or private facilities nearby: Basic Health Unit (UBS), Unified Education Center (CEU), Ecological Sawmill, squares, and streets that may receive increased urban tree planting.

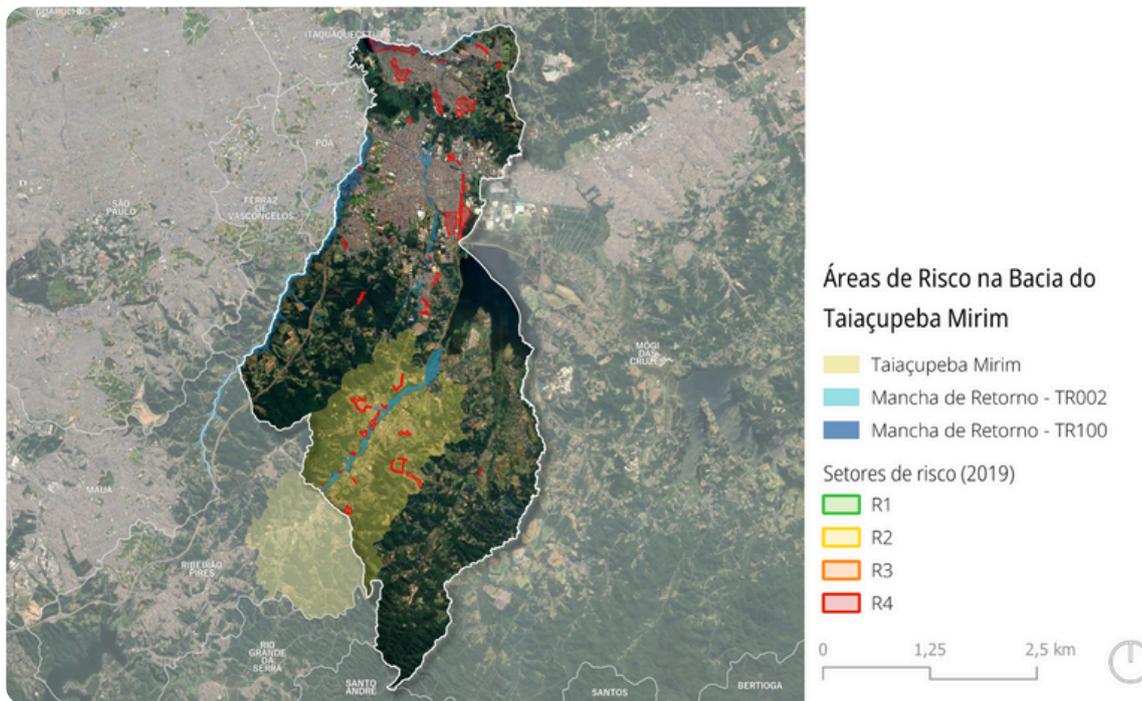


ADAPTATION AND RECOVERY OF FLOOD RISK AREAS IN THE TAIACUPEBA-MIRIM WATERSHED - SUZANO, SP

Category: Adaptation and risk area recovery project.

Location: Taiaçupeba-Mirim watershed, Suzano, SP.

Figure 7: Risk Areas in the Municipality of Suzano, SP



Source: Working Group 2.

Climate Event Addressed: Flooding

Target Audience: Resident communities – 3,316 people living in 829 buildings located in the 8 risk areas of the Taiaçupeba-Mirim watershed

Description: The municipality of Suzano presents conflict points when territorial occupation expands in the face of environmental vulnerabilities. This is expressed in the physical characteristics of the territory, with the extensive floodable areas of the Tietê River, the presence of an extensive hydrographic network and slopes in the southern region of the municipality, areas protected by environmental legislation, mostly represented by the Water Source Protection and Recovery Areas (APRM), which cover about 73% of the territory, in addition to the history of informal settlements over time.

The proposal aims to develop an intervention project in the Taiaçupeba-Mirim watershed, with the implementation of green and gray infrastructure and adaptation and recovery measures for flood risk areas, mapped in the Municipal Drainage and Stormwater Plan of Suzano, which reduce peak flow and flood extent.

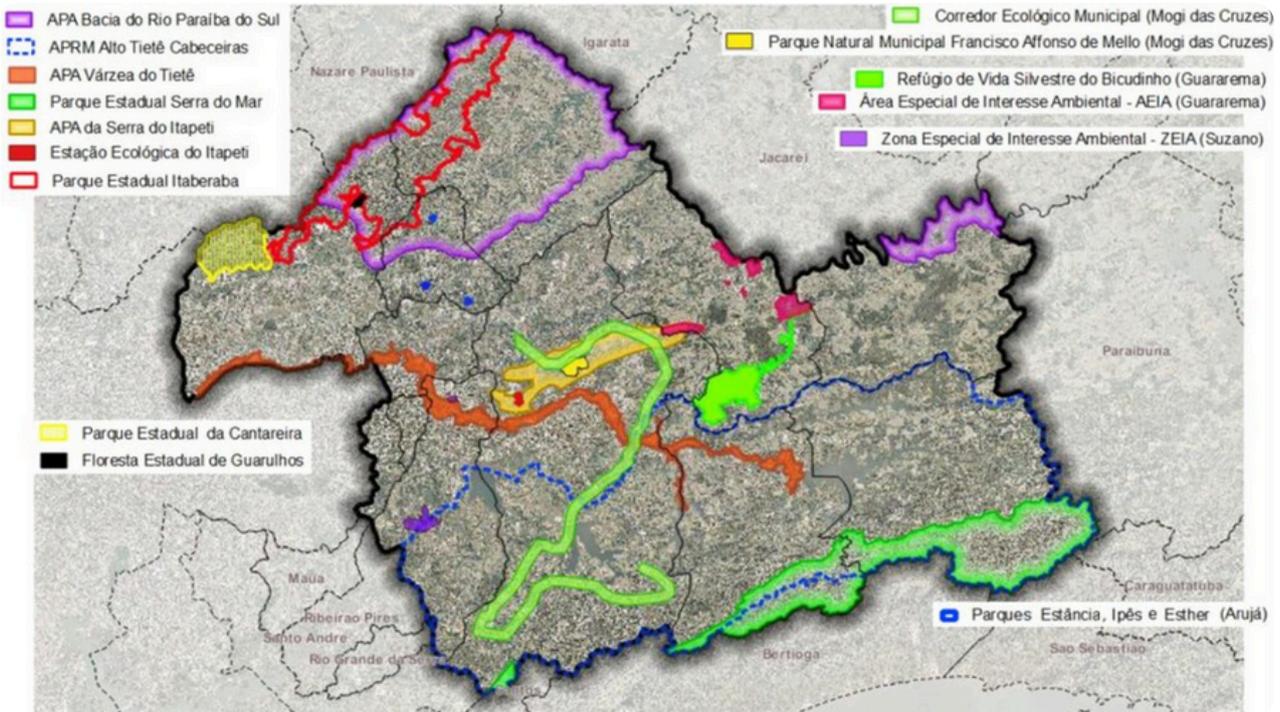
Justification: This project aims to improve the quality of life not only for the 829 families located in the eight risk areas of the Taiaçupeba-Mirim watershed but also for the residents living within this territory. The benefits of Nature-Based Solutions (NbS) go beyond climate change adaptation and risk reduction, bringing, for example, a reduction of the urban heat island effect, mitigation of carbon emissions through planting and reforestation, and improvement of the urban landscape quality.

ALTO TIETÊ-CABECEIRAS REGIONAL CLIMATE CHANGE ADAPTATION PLAN

Category: Regional climate change adaptation plan.

Location: Alto Tietê-Cabeceiras Sub-Watershed.

Figure 8: Image representing the mapping of protected areas in CONDEMAT.



Source: Working Group 3.

Climate Events Addressed: Water Security.

Target Audience: The population to be benefited by the proposed study corresponds to 3,017,584 inhabitants (IBGE, 2022). The PRAMC is being prepared to be distributed and proposed to the municipalities of the Alto Tietê Municipal Development Consortium (CONDEMAT), intended for the technical staff of each municipality as well as other interested parties in this material.

Description: The project is expected to bring various benefits, including environmental, social, and economic, to the coverage area, such as biodiversity conservation, natural resource conservation, carbon emission reduction, improvement of quality of life with access to infrastructure such as water and sewage, for example, and the involvement and participation of the community as the main actor in addressing this issue, as well as the adoption of sustainable practices and the construction of resilient infrastructure.

Justification: The target region of this proposal encompasses the headwaters of the Tietê River, one of the main water-producing areas in the State of São Paulo, responsible for about 30% of the water that supplies the Metropolitan Region. In addition, it concentrates more than 2% of the Atlantic Forest within São Paulo’s territory and integrates the green belt, being the largest producer of leafy vegetables in the country.



ECOSYSTEM REDESIGN AND SUSTAINABLE REURBANIZATION PROJECT OF JARDIM PANTANAL WITH A FOCUS ON CLIMATE ADAPTATION

Category: Risk area adaptation and sustainable reurbanization project.

Location: Jardim Pantanal neighborhood, São Paulo, SP.

Figures 9 and 10: Northern region of the Jardim Pantanal neighborhood, São Paulo, SP.



Source: Working Group 4; Braga Drones; Instituto Alana.

Climate Events Addressed: Flooding and waterborne diseases.

Target Audience: The project aims to directly benefit residents of the Jardim Pantanal neighborhood, composed of approximately 56,000 people, in addition to the indirect impacts on workers and residents of neighboring areas who transit through the neighborhood, as well as local entrepreneurs, among others.

Description: The project, conceived in an integrated manner with Phase II of the Jardim Pantanal Neighborhood Plan, primarily aims to provide the community with a safe and balanced environment, promoting easy access to the right of movement, as well as offering quality urban spaces and diverse opportunities for recreation, sports, and leisure activities. This strengthens intra-neighborhood cohesion, contributing to job creation and increased local income.

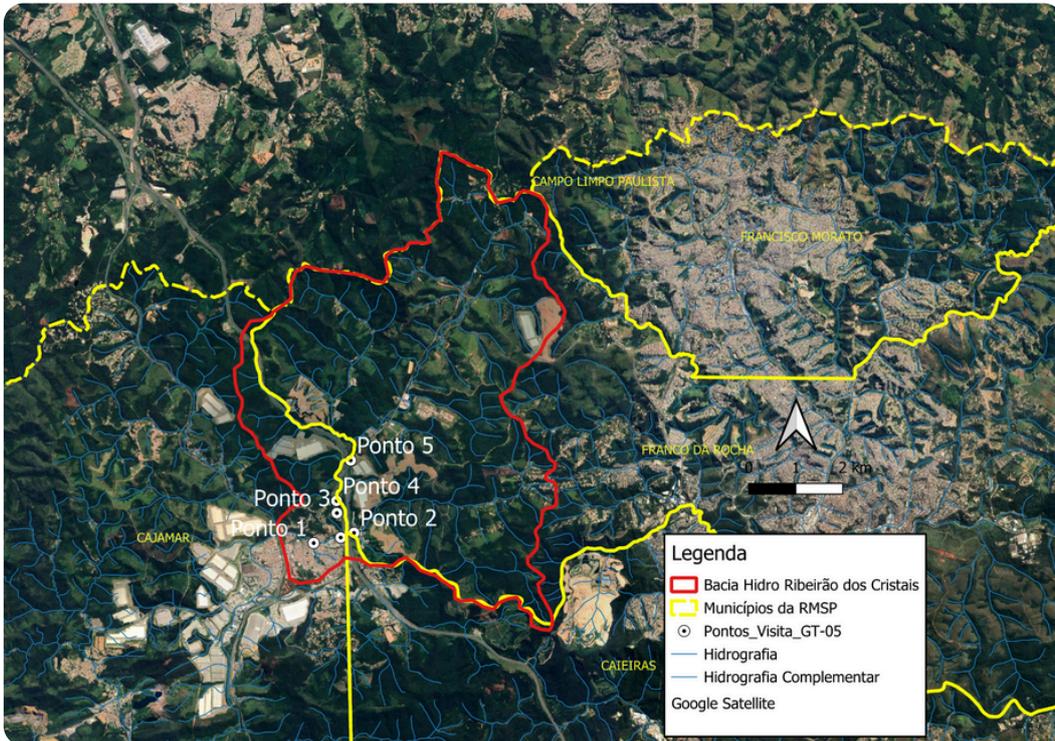
Justification: The execution of this project will result in increased active mobility through the improvement of public pedestrian infrastructure—including sidewalks, boulevards, and landscaped areas—and for cyclists. Additionally, the implementation of drainage systems complementary and integrated into the landscape, such as infiltration trenches, rain gardens, tree-lined corridors, cisterns, and green roofs, will significantly contribute to reducing the impact of extreme climate events, such as intense rainfall, heat waves, and periods of water scarcity. Finally, the requalification of public spaces will be enabled through urban restoration and environmental preservation initiatives.

STRATEGIC CLIMATE CHANGE ADAPTATION PLAN FOR THE RIBEIRÃO DOS CRISTAIS WATERSHED

Category: Strategic Climate Change Adaptation Plan.

Location: Ribeirão dos Cristais Watershed, municipalities of Franco da Rocha and Cajamar, SP.

Figure 11: Ribeirão dos Cristais watershed and technical visit points.



Source: Working Group 5.

Climate Events Addressed: Water Security.

Target Audience: Managers of state and municipal agencies (Cajamar and Franco da Rocha) responsible for environmental protection, health protection, water resource protection, and enforcement; civil society; and water users for consumption and multiple uses in the Ribeirão dos Cristais micro-watershed.

Description: The main goal of the proposal is the urban-environmental revitalization of the region, ensuring the control of raw water quality, reducing the risk of deterioration of the water resource quality, and improving the local biological condition through the adoption of Nature-Based Solutions, reforestation, and mitigation of pollution sources. It also aims to establish strategies and guidelines to promote the resilience of local communities, reduce vulnerability, foster life, and support sustainable and equitable development.

Justification: The Ribeirão dos Cristais Watershed is not protected by specific state legislation, as is the case with other water sources in the São Paulo Metropolitan Region. This has contributed over the years to the worsening of its degradation through the implementation of various activities that pose risks to the quality and quantity of water, endangering the water supply of the municipality of Cajamar and potentially generating new demands on the Cantareira System if proper preservation measures for the water source are not taken.



MUNICIPAL PLAN FOR CONSERVATION AND RECOVERY OF THE ATLANTIC FOREST AND CERRADO IN THE MUNICIPALITY OF MAIRIPORÃ (PMMAC-MAIRIPORÃ)

Category: Municipal Plan for Conservation and Recovery of the Atlantic Forest and Cerrado.

Location: Municipality of Mairiporã, SP.

Figure 12: Image of the municipality of Mairiporã, SP.



Source: Working Group 6.

Climate Events Addressed: Ecosystem degradation.

Target Audience: Population of Mairiporã and neighboring municipalities, especially low-income populations directly affected in areas more susceptible to climate risks and in the Terra Preta Industrial District, where the highest population density in the territory is located.

Description: The Municipal Plan for Recovery and Protection of the Atlantic Forest and Cerrado in the Municipality of Mairiporã (PMMAC-Mairiporã) aims to be an important strategic instrument to guide the protection and recovery of local fauna and flora, directing efforts for environmental control and enforcement in protecting these areas, as well as supporting initiatives for the orderly and sustainable use and occupation of the territory.

Justification: The municipality of Mairiporã has faced increasing problems with informal occupation of urban and rural areas, whose most immediate impact is the deforestation of the Atlantic Forest and Cerrado biomes, with significant biodiversity loss. This has repercussions related to drainage alterations, maintenance of water security, and an increase in risk areas for landslides. With the established plan, it will be possible to include and integrate these biomes into the municipality's management and planning system, respecting the general objectives expressed in Federal Law 11,428/2006 and Federal Decree 6,660/2008, and in State Law 13,550/2009, amended by State Law 16,924/2019.

LINEAR PARK WITH NATURE-BASED SOLUTIONS ALONG A SECTION OF THE RIBEIRÃO DOS COUROS - DIADEMA

Category: Linear park project.

Location: Section of the Ribeirão dos Couros, Diadema, SP.

Figure 13: Ribeirão dos Couros: proposed section 1.



Source: Working Group 7.

Climate Events Addressed: Flooding and waterborne diseases.

Target Audience: The intervention will target residents of the Casa Grande neighborhood in Diadema, near the border with the municipality of São Bernardo do Campo, also serving residents of this nearby region. Within Diadema's territory, there is a large number of housing complexes and residential nuclei lacking open spaces, such as the Portinari housing nucleus, Vila Nova III, Fundibem, Gazuza, Tomé de Souza, Jardim Alba II housing complex, Dona Ruyce, among others. The target audience also includes employees of local companies who will benefit from various leisure areas close to their workplaces.

Description: The project aims to implement climate adaptation measures around an important water resource in the municipality of Diadema, reducing local vulnerability to floods and inundations related to the Ribeirão dos Couros stream. It may also serve as a model for other urban areas.

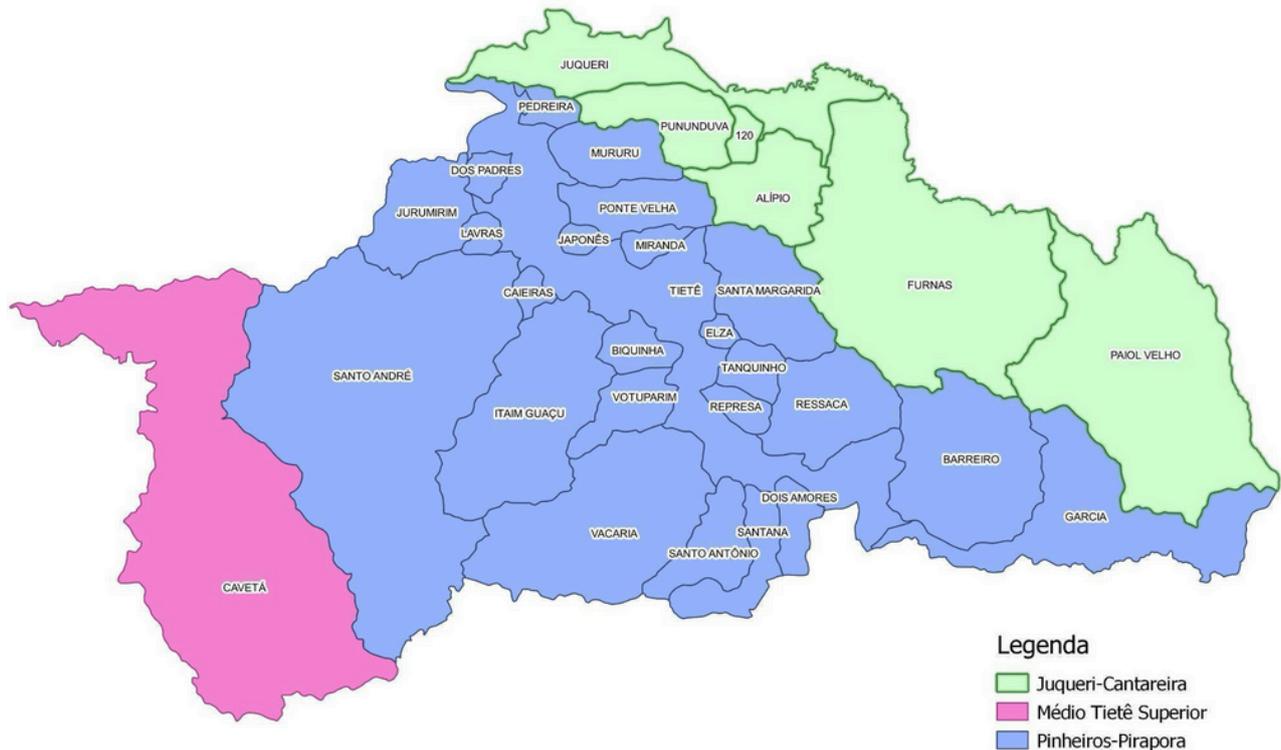
Justification: This is a highly important project for the population of Diadema, especially for residents living closest to the Ribeirão dos Couros, characterized by predominantly informal and low-income housing, who are more exposed and vulnerable to the impacts of climate change, specifically the intensification of flooding events.

INTEGRATED WATER MANAGEMENT PLAN IN THE CONTEXT OF ADAPTATION AND RESILIENCE OF THE MUNICIPALITY OF SANTANA DE PARNAÍBA TO CLIMATE CHANGE

Category: Integrated Water Management Plan.

Location: Municipality of Santana de Parnaíba, SP.

Figure 14: Micro-watersheds of the municipality of Santana de Parnaíba, SP.



Source: Working Group 8.

Climate Events Addressed: Flooding and landslides.

Target Audience: The entire municipality of Santana de Parnaíba will benefit. Initially, the directly benefited community is characterized by local residents of affected areas, including residents of adjacent neighborhoods, workers, merchants, and other users of urban services.

Description: This proposal aims to develop the Integrated Water Management Plan in the context of Adaptation and Resilience for the municipality of Santana de Parnaíba in the face of climate change, to support the revision of the Master Plan and the Basic Sanitation Plan.

Justification: Given the urgency and complexity of the challenges faced by the municipality of Santana de Parnaíba, the revision of the Master Plan and the alignment of the Sanitation Plan with the guidelines of the National Climate Change Policy represent essential steps to promote sustainable and resilient urban development. The systemic approach, integrating local water cycles with broader ones, aims not only to diagnose impacts arising from changes in land use and occupation but also to prepare the municipality to face the challenges imposed by climate change, thus ensuring a safer and better-planned future for all its inhabitants.



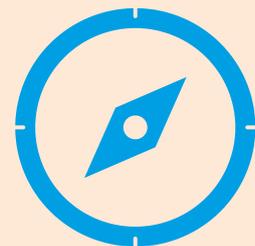
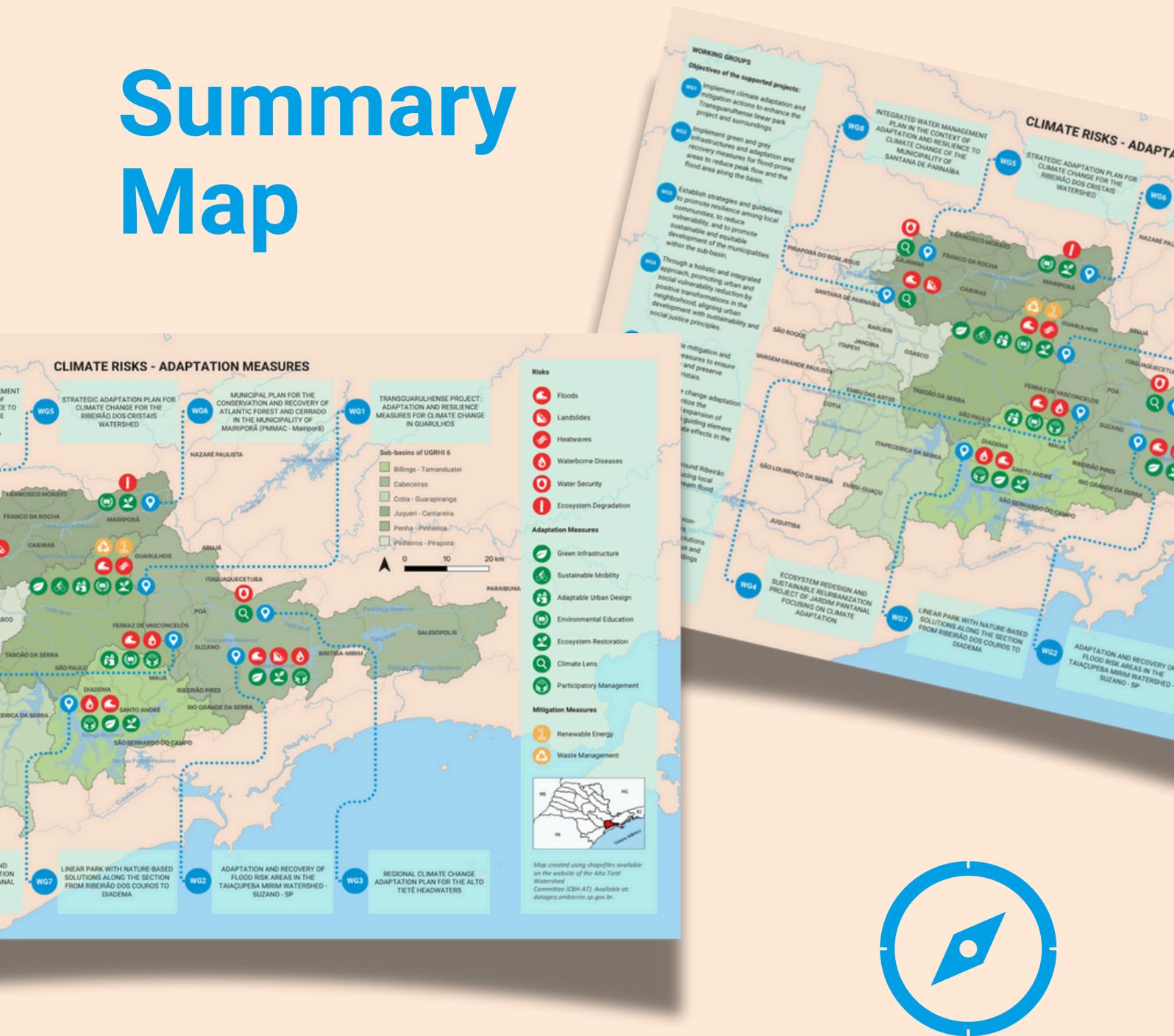
Lageado, São Paulo, SP, Roberto Rüsche.



Synthesis and Location of Capacity Building Results

Presented below is the Summary Map of Capacity Building Results illustrating the adaptation projects, emphasizing their connection to the climate risks identified in the regions. The map also highlights the proposed solutions and adaptations to mitigate these risks, providing a clear view of how each project seeks to promote resilience and sustainability in the face of climate change. In addition to the Summary Map, a brochure of the work carried out and results achieved was produced, available in digital and printed versions, in both Portuguese and English.

Summary Map

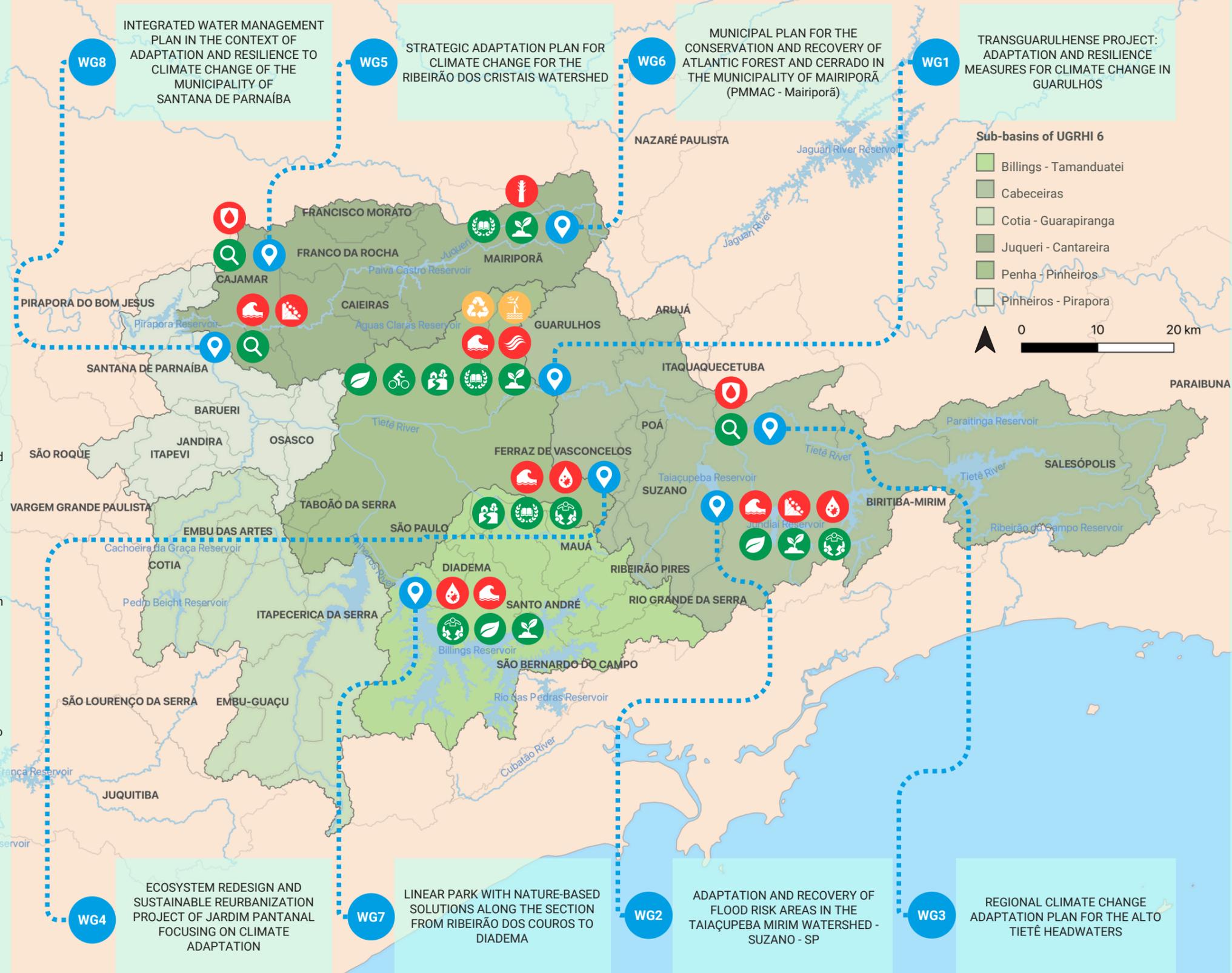


CLIMATE RISKS - ADAPTATION MEASURES

WORKING GROUPS

Objectives of the supported projects:

- WG1** Implement climate adaptation and mitigation actions to enhance the Transguarulhense linear park project and surroundings.
- WG2** Implement green and grey infrastructures and adaptation and recovery measures for flood-prone areas to reduce peak flow and the flood area along the basin.
- WG3** Establish strategies and guidelines to promote resilience among local communities, to reduce vulnerability, and to promote sustainable and equitable development of the municipalities within the sub-basin.
- WG4** Through a holistic and integrated approach, promoting urban and social vulnerability reduction by positive transformations in the neighborhood, aligning urban development with sustainability and social justice principles.
- WG5** Adopt climate mitigation and adaptation measures to ensure water security and preserve Ribeirão dos Cristais.
- WG6** Promote climate change adaptation actions that prioritize the conservation and expansion of these biomes as a guiding element in addressing climate effects in the municipality.
- WG7** Create a linear park around Ribeirão dos Couros creek, reducing local vulnerability to downstream flood events.
- WG8** Implement structural and non-structural control measures, prioritizing Nature-Based Solutions (NbS), promoting harmonious and functional integration of buildings and urbanized land with the municipal drainage system.



Risks

- Floods
- Landslides
- Heatwaves
- Waterborne Diseases
- Water Security
- Ecosystem Degradation

Adaptation Measures

- Green Infrastructure
- Sustainable Mobility
- Adaptable Urban Design
- Environmental Education
- Ecosystem Restoration
- Climate Lens
- Participatory Management

Mitigation Measures

- Renewable Energy
- Waste Management



Map created using shapefiles available on the website of the Alto Tietê Watershed Committee (CBH-AT). Available at: datagea.ambiente.sp.gov.br.



ALTO TIETÊ SUBCOMMITTEES

Due to the complexity and diversity of the Alto Tietê Watershed, it is divided into five distinct regions, each comprising specific municipalities, as follows:

ALTO TIETÊ - CABECEIRAS

Mogi das Cruzes; Salesópolis; Biritiba Mirim; Suzano; Poá; Ferraz de Vasconcelos; Itaquaquecetuba; Guararema.

BILLINGS - TAMANDUATEI

São Paulo; Santo André; São Bernardo do Campo; Diadema; São Caetano do Sul; Mauá; Ribeirão Pires; Rio Grande da Serra.

COTIA - GUARAPIRANGA

São Paulo; Cotia; Embu das Artes; Embu-Guaçu; Itapeerica da Serra; Juquitiba; Taboão da Serra; Vargem Grande Paulista.

JUQUERI - CANTAREIRA

Caieiras; Cajamar; Franco da Rocha; Mairiporã; São Paulo.

PINHEIROS - PIRAPORA

São Paulo; Osasco; Barueri; Santana de Parnaíba; Pirapora do Bom Jesus; Carapicuíba; Jandira; Itapevi; Taboão da Serra.

The capacity building was guided by principles such as Nature-Based Solutions (NbS) and Ecosystem-Based Adaptation (EbA), emphasizing ecosystem protection and restoration as responses to climate impacts. In addition, the co-creation, which includes the engagement of local communities in solution development, and the regenerative design, focused on restoring and revitalizing ecological systems, were the main guidelines of the capacity building. These principles supported a holistic and inclusive approach to addressing social and environmental challenges in the Alto Tietê Watershed.

CLIMATE CHANGE ADAPTATION CAPACITY BUILDING IN THE ALTO TIETÊ WATERSHED (CBH-AT)

The technical capacity building for identifying vulnerabilities and proposing adaptive measures was designed to address the critical need for a comprehensive approach about adaptation. This capacity building program emphasized not only the study of vulnerabilities and the development of policies and strategies to advance knowledge and learning, but also prepared municipalities and regions to identify and mitigate risks effectively. By doing so, it contributed to the proper planning and implementation of adaptive measures at both local and regional levels. Public agents and civil society members from 40 municipalities participated in the capacity building.

CLIMATE RISKS IN THE ALTO TIETÊ WATERSHED

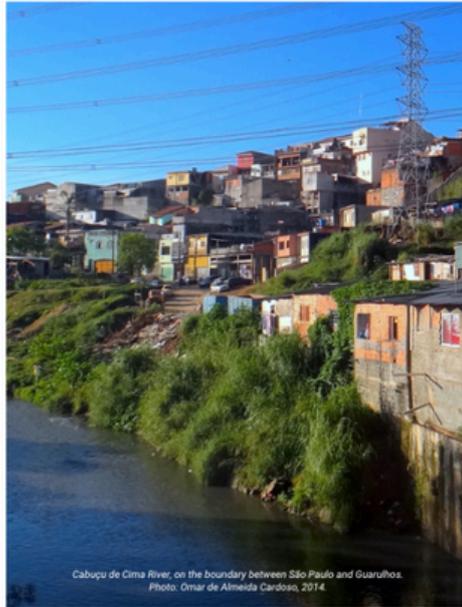
The São Paulo Metropolitan Region is characterized by a large and continuous urban sprawl within the Alto Tietê Watershed. It extends from the São Paulo Sedimentary Basin (in flood plains) to surrounding hills and mountains. With 20.7 million inhabitants, this densely populated area faces significant climate risks, including numerous flood-prone areas, landslides, heat island effects affecting entire neighborhoods, and water-related diseases like dengue. The region also has a recent history of water scarcity and risk of distribution collapse during 2014-2015, which stressed the entire water supply system and highlighted its vulnerability.

Capacity-Building Project Brochure

THE ROLE OF CETESB

Since 1995, CETESB has supported the implementation of commitments arising from international agreements under the United Nations Framework Convention on Climate Change (UNFCCC) (BRASIL, 1998), coordinating state programs and enforcing the State Climate Change Policy (PEMC) (SÃO PAULO, 2009).

During this period, CETESB has also conducted numerous courses and capacity building sessions on climate change and related topics for both external and internal audiences. More recently, following the release of the latest IPCC reports, which provided more effective and viable approaches to climate adaptation, CETESB has intensified its focus on adaptation, emphasizing the feasibility, effectiveness, and potential co-benefits of adaptation measures for public health, the economy, and the environment.



Cabuçú de Cima River, on the boundary between São Paulo and Guarulhos.
Photo: Omar de Almeida Cardoso, 2014.



Project's webpage:

CLIMATE CHANGE ADAPTATION CAPACITY BUILDING
IN THE ALTO TIETE WATERSHED
Government of the State of São Paulo

CETESB - Environmental Company of the State of São Paulo
São Paulo, 2024



CETESB - Environmental Company of the State of São Paulo
AS - Sustainability Department
ASM - Climate Change Division
<https://cetesb.sp.gov.br/adaptacao-as-mudancas-climaticas>



LEARNINGS AND RECOMMENDATIONS

The Climate Change Adaptation Capacity Building Project in the Alto Tietê Watershed (BAT) generated significant insights through its work process, conducted activities, and achieved results. These learnings relate to the applied methodology and provide recommendations aimed at both fostering new learning cycles and advancing the implementation of adaptation measures. Although the capacity building was conducted specifically within the Alto Tietê Watershed context, the lessons and recommendations outlined below are considered broadly applicable to other territories and experiences. They can support similar initiatives and strengthen the effective deployment of adaptation outcomes.

Key Learnings

Formalize the roles and institutional representation of the participants, to enable broader dissemination of information within the secretariats, public agencies, and organizations represented in the capacity building. This formalization also aims to foster greater engagement of key local and regional stakeholders, with the objective of enhancing the performance of institutions and their representatives, especially municipal secretariats and technical bodies.

Promote the connection and coordination between participants and decision-makers, expanding the opportunities for support to the projects and initiatives developed in each sub-watershed.

Promote collaborative learning aimed at achieving engagement among participants and speakers and welcoming different contributions on the expository content, case studies presented, and other issues presented, encouraging contributions based on theoretical-conceptual knowledge and practical experiences of the territory towards an effective and applicable interest of the participants.

Bring together specialists with relevant expertise on climate change and climate adaptation projects, enabling the presentation of up-to-date content from a critical perspective that considers local and regional complexities, while advancing strategies for implementing proposals within the territory.

Conduct new rounds of capacity building in regions with high vulnerability indices in the Alto Tietê Watershed (BAT), promoting effective actions characterized by benefits and low regret, especially in the peripheral zones of São Paulo and municipalities with a history of extreme climate events.

Deepen climate prognosis and implement alert and monitoring systems, leveraging increasingly accurate climate models for the BAT region, and addressing the need to establish early warning and monitoring systems.

Strengthen Civil Defense actions in the BAT, including monitoring of slopes and flood-prone areas, and the implementation of Early Warning Systems (EWS), which also encompass capacity building for extreme events with evacuation plans.

Implement and ensure the continuity of climate adaptation plans and projects, particularly in municipalities and sub-watersheds with higher vulnerability indices and lower mobilization to face extreme climate events.

Enhancing connections between participating teams and decision-makers is also crucial, as it can increase the assurance of continuity and support for projects to be developed in each sub-watershed.

Create financing lines for climate risk adaptation within FEHIDRO, providing conditions to obtain the necessary resources for implementing adaptive measures, including other possibilities established by the State Government, such as the creation of Finaclima-SP. This also enables the promotion of guidelines and support for implementing actions contained in the Climate Action Plan (PAC) and the State Climate Adaptation and Resilience Plan (PEARC).

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Government of the State of São Paulo
SEMIL – Secretariat for Environment,
Infrastructure, and Logistics
CETESB – Environmental Company of the
State of São Paulo

São Paulo, June, 2025

EXECUTIVE SUMMARY

**RESULTS OF THE CLIMATE
CHANGE ADAPTATION
CAPACITY BUILDING IN THE
ALTO TIETÊ WATERSHED**