GUANABARA BAY

IMPROVING WATER SECURITY AND ADAPTING TO CLIMATE CHANGE IN THE ATLANTIC FOREST WITH NATURE-BASED SOLUTIONS

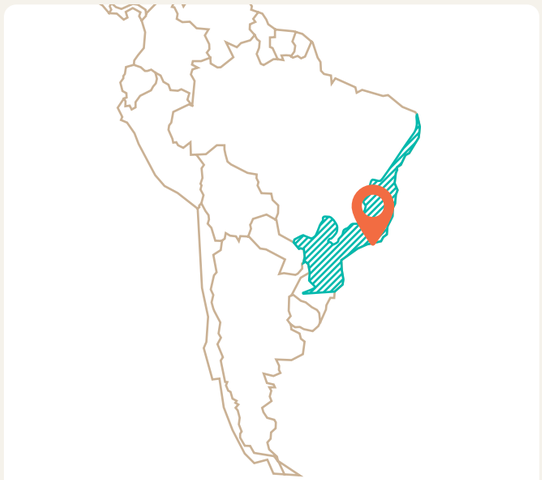
The Guanabara Bay Basin is one of the basins identified in a study conducted by WWF on key river basins in the Atlantic Forest that urgently require Nature-based Solutions (NbS) to bolster water security and climate resilience. Compared to conventional interventions, NbS offer long-term affordable and sustainable solutions to major water-related societal challenges, and have multiple co-benefits. The objective is to – together with partners – scale these solutions to generate significant positive impact on biodiversity, water security, and climate resilience.

The Guanabara Bay region, spanning 405,000 hectares and home to some 9 million people in the Rio de Janeiro Metropolitan Area, is facing a complex set of environmental challenges that are exacerbated by urban development, industrial activities, and climate change. These challenges are not only detrimental to the ecological health of the region but also pose significant risks to the millions of inhabitants who rely on these watersheds for their daily water needs.

The Bay is one of Brazil's most severely polluted coastal environments, stemming from untreated sewage, domestic waste, and industrial pollutants. After having lost a significant portion of their habitat to urban development, mangrove ecosystems along the bay are further impacted by environmental pollution, amplifying the region's vulnerability to environmental risks. Furthermore, **the combination of gentle slopes, impermeable soils, heavy rainfall, and extensive urban development has increased the risk of flooding in the coastal plain.** The deforestation and urbanization in the adjacent mountainous regions have made them susceptible to landslides, posing a threat to the inhabitants, particularly those in informal settlements (favelas).

Guanabara Bay is also vulnerable to the impacts of climate change, such as rising mean sea levels, strong winds, storm waves, heavy rainfall, and storm surges. These factors, when combined, can lead to devastating consequences for the coastal area, affecting both the environment and the socioeconomic well-being of the population.

Implementing Nature-based Solutions, such as reforestation on slopes and floodplains and mangrove restoration, can enhance the basin's resilience to extreme weather events. These measures can help mitigate the impacts of climate change, improve water quality, and protect the region from the adverse effects of natural disasters.



RELEVANCE FOR NBS

The Guanabara Bay is a priority basin for NbS due to the following key attributes:

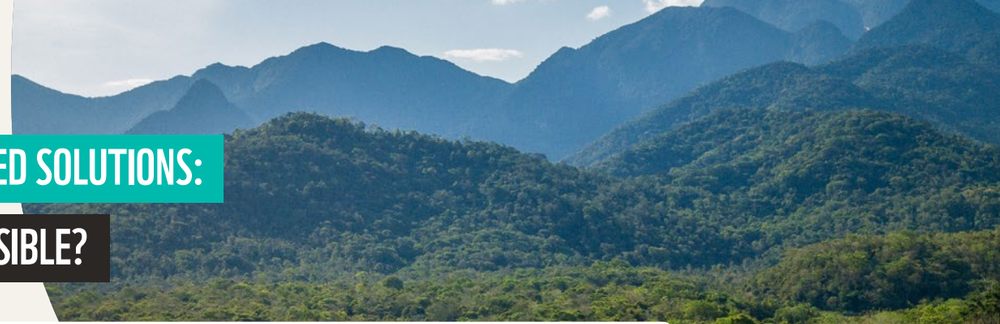
- **Essential water source,** as the local headwaters serve as a vital water source for downstream urban areas.
- **Increased flood and landslide risk,** and this vulnerability is amplified by the effects of climate change. Since 2010, almost 3 million people have been affected by floods and landslides. Material losses due to these extreme events exceeded US$240 million.
- **Escalating drought threat,** with more extreme droughts further exacerbated by climate change.
- **Classified as critical basin** by the National Water Agency (ANA), signifying the urgency to act.
- **ANA Water Security Index is low** due to high water demand combined with an irregular water flow.
- **Low Compliance with Forest Regulations:** The basin displays a substantial deficiency in adhering to the Brazilian Forest Code – 2,700 to 5,900 hectares in permanent preservation areas and 1,800 to 2,700 hectares in legal reserves – particularly concerning the degradation of riparian zones.

MAIN BENEFICIARIES OF NBS

- **Local population:** Reduced exposure to flood risks and landslides, in particular for the socially vulnerable.
- **Water supply company (Águas do Rio/AEGEA):** Benefit from more consistent river flow and lower water treatment costs due to cleaner water.
- **Farmers:** Witness improved soil conditions and become climate-smart through agroforestry.
- **Fishermen:** Experience increased income because of improved coastal water quality.
- **Tourism industry:** Options to grow sustainably considering a more attractive landscape with improved coastal water quality.
- **Ecosystems:** Improved environmental flow and biodiversity protection, leading to higher connectivity and ecosystem resilience.

POTENTIAL PARTNERS FOR NBS

- Águas do Rio/AEGEA (Water Supply Company for Rio de Janeiro Metropolitan Region)
- Guanabara Bay's Basin Watershed Committee
- Viva Água Guanabara Bay Movement
- Local municipalities
- Local farmers



NATURE-BASED SOLUTIONS: WHAT IS POSSIBLE?

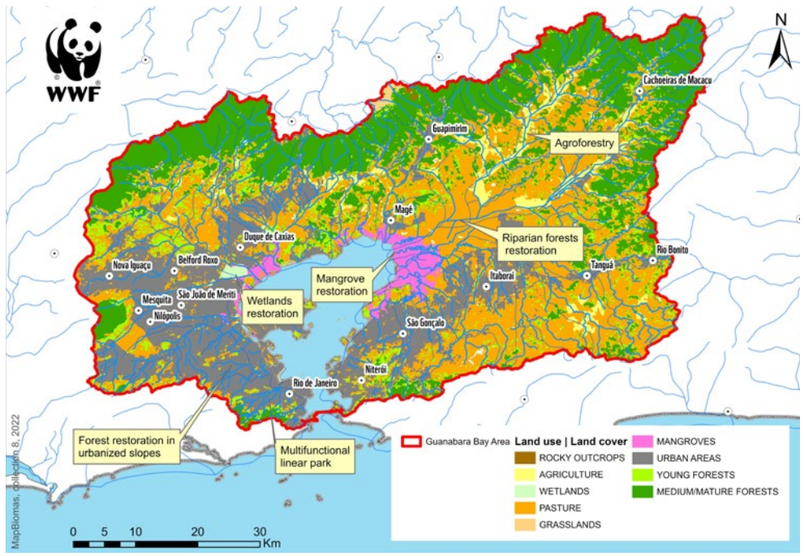


Figure 1:
Land use and land cover in the Guanabara Bay Rivers' Basin, with the suggested NbS.

FLOODPLAIN AND WETLAND RESTORATION

Floodplains and wetlands act as sponges and filters during flood events, storing large volumes of water, slowing the flow of water, and filtering upstream-sourced pollutants. Reconnecting these to the river system creates additional space for water retention, reducing in situ and downstream flood risk. The basin has approximately 2,600 hectares of wetlands, many of them near mangrove ecosystems.

RESTORATION AND PROTECTION OF RIPARIAN AND COASTAL AREAS

Riparian forests act as a buffer and natural water filter, reducing the sediment input to the river by 33% to 95%. By restoring and protecting these forests, sediment and other pollutants are trapped before they reach the river, thereby improving the river's water quality. The same filtering principle applies to Guanabara Bay's coastal areas.

MANGROVE RESTORATION

Mangroves play a crucial role in coastal ecosystems. They offer coastal protection, support fisheries, and sequester carbon, amongst others. The 10,000 hectares of mangroves experience challenges due to various sources of pollution. Initiatives for mangrove restoration are emerging within the basin, including a project led by the Niterói city hall covering 65 hectares.

AGROFORESTRY

Agroforestry is an agricultural practice that includes biodiversity and ecosystem services recovery, increasing infiltration rates and reducing erosion and sedimentation. The Macacu and Guapiaçu valleys are major agricultural hubs, especially known for guava, banana, and coconut growing, are well-suited for agroforestry.

MULTIFUNCTIONAL LINEAR PARK

A linear park follows the course of the river and is often designed for urban areas. This NbS addresses flood risk mitigation in the Guanabara Basin, by creating various forms of water buffers and retention areas along the river. Parque Orla de Piratininga (in Niterói) is a good example of a linear park with a strong NbS approach, with sedimentation ponds, water filtering gardens, rain gardens, and ecological ditches.

ENABLING CONDITIONS FOR NBS

Socioeconomic relevant area: The Guanabara Bay is an iconic estuary, resulting in the basin receiving special attention from both the state government and society, as well as from an international perspective.

Political will and financial mechanisms: The Watershed Committee's Water Resources Plan includes investment commitments in green infrastructure for improving water quality, offering opportunities for NbS.

Presence of programs and initiatives facilitating NbS: There are already initiatives in place that promote the use of green infrastructure for improving water security, biodiversity, and/or climate change adaptation. The presence of the following initiatives enhances the success of NbS adoption in the basin.

- **Viva Água Guanabara Bay Movement[1]:** Launched in 2021 and coordinated by the Boticário Group Foundation for Nature Protection, this initiative aims to increase water security, strengthen climate change adaptation, and foster green entrepreneurship in Guanabara Bay's watersheds. Activities include forest, mangrove, and restinga restoration and agroforestry. These are carried out by a network of businesses, civil society organizations, universities, and governments, and funded through a self-financing mechanism.
- **Reforest Rio Program[2]:** This program operates in the city's hilly areas, home to low-income residents vulnerable to flooding and landslides. From 1986 to 2022, the program has restored 3,600 hectares across 94 neighbourhoods, engaging local communities and providing income opportunities related to forest restoration. The program is coordinated by the Municipal Secretary for Environment and Climate.
- **Guanabara Bay Depollution Program[3]:** Coordinated by Águas do Rio/AEGEA, this program has over US$ 500 million reserved for investment until 2028 to enhance sewage systems, addressing sewerage pollution. This offers a significant opportunity to promote NbS for wastewater treatment within a green-grey infrastructure, for example by including wetlands and filtering gardens.

THE WAY FORWARD

1. **Focused feasibility study on NbS implementation.** Outputs include the identification of priority areas and activities considering water security and biodiversity needs, the integration of climate scenarios with socio-economic and cost-benefit analyses, and the design of a NbS implementation plan.
2. **Build or strengthen multi-stakeholder coalitions for NbS implementation** in the region, identifying main actors and commitments needed.
3. **Development of a proposition for large-scale NbS implementation,** further engagement of key partners, and integration with ongoing programs (such as the Viva Água Movement) where possible.
4. **Large-scale implementation** of the selected NbS.

Criteria
The Guanabara Bay was selected as 'priority basin' from a selection of 87 basins in total, based on three criteria as outlined in a policy brief of WWF Brazil (WWF Brasil, 2024). These criteria are: 1) importance in providing water ecosystem services, 2) vulnerability to water security risks, and 3) suitability for developing or enhancing NbS.

WWF Netherlands. (2024). Improving water security and adapting to climate change in the Atlantic Forest, Brazil, with Nature-based Solutions – Guanabara Bay [Fact sheet].

1. https://www.fundacaogrupoboticario.org.br/pt/acontece-por-aqui/Paginas/Seguranca-hidrica-e-desenvolvimento-sustentavel-sao-alvo-de-movimento-Viva-Agua-Baia-de-Guanabara.aspx
2. https://prefeitura.rio/meio-ambiente/programa-de-reflorestamento-da-prefeitura-completa-36-anos-com-mais-de-10-milhoes-de-mudas-plantadas/
3. https://aguasdorio.com.br/projeto-de-despoluicao-da-baia-de-guanabara-e-apresentado-em-seminario-de-saneamento-e-meio-ambiente/