



Madagascar is one of the most vulnerable countries in the world to climate change. Over the past 30 years, extreme weather events have caused \$1 billion in damages. Toamasina, Madagascar's second largest city, is particularly at risk and has already absorbed greater climate-related economic losses than any other city in Madagascar. The city, located on the Indian Ocean, is Madagascar's principal port, and faces compounding threats from climate change and urbanization.

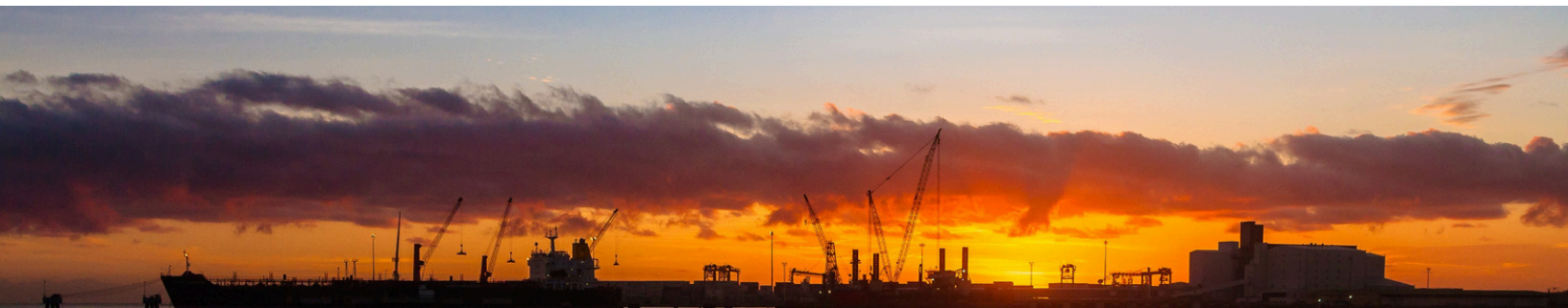
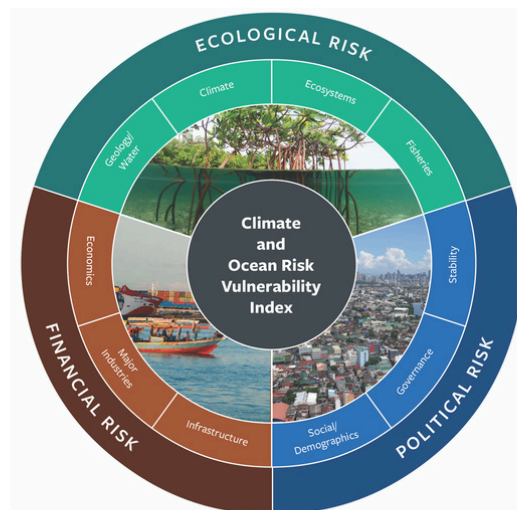
Using CORVI, research teams in Madagascar and the U.S. collected data and conducted 82 expert surveys and 26 interviews to provide decision makers with a complete picture of risk for Toamasina. Stimson is pleased to announce the release of findings from the CORVI Toamasina assessment.

CORVI, The Climate and Ocean Risk Vulnerability Initiative, is a science-based, stakeholder-led process that assesses climate risk and vulnerability in coastal communities to help make climate-smart investments to **build resilience where it matters most.**

Key Findings from Toamasina, Madagascar

Known as the “lungs of Madagascar”, Toamasina is home to an estimated 350,000 people in the city itself, with another 275,000 in the surrounding district. It is also Madagascar's economic capital and principal port, responsible for 90% of imports and exports for the country. **Notable sources of risk and vulnerability include:**

- **Frequent coastal and flash flooding** caused by tropical cyclones and heavy rainfall is exacerbated by unmanaged solid waste, loss of coral reef coverage, and deforestation. Flooding threatens Toamasina's roads, airport, and vulnerable housing in flood-prone areas.
- **Limited economic opportunities** has resulted in a large informal economy and high levels of poverty. The informal sector accounts for 60% of employment in Toamasina. COVID-19 reversed more than a decade of gains in poverty reduction. The lack of financial resources limits resilience investments and pushes people into environmentally destructive activities.
- **Inadequate waste management infrastructure.** Toamasina only collects an estimated 20% of municipal solid waste and 97% of the population uses latrines. Plastic trash and untreated wastewater contaminate freshwater sources, exacerbate flooding, and can cause infectious disease and waterborne illness.
- **Vulnerable infrastructure (natural and built)** including roads, airport, and coral reefs are threatened by sea level rise, flooding, untreated wastewater, and habitat destruction. This increases Toamasina's vulnerability to flooding, inhibit economic activity, and limit the circulation of people and goods.





Priority Recommendations:

Based on the risks and vulnerabilities described above, we developed three priority areas of action to build climate resilience in Toamasina. Further details on these recommendations, including around potential partners and financing sources, can be found in the full assessment report.

Implement an Integrated Flood Management and Adaptation Strategy

- Establish an emergency operations center to unify and coordinate flood response operation across government agencies, link disaster response planning to climate adaptation projects, and strengthen advance planning to reduce disaster risk.
- Set up neighborhood disaster risk management committees to improve the reach of early warning alerts, education and the implementation of early response actions.
- Provide anticipatory cash relief for the most vulnerable residents to pay for individual and community-level preparation measures immediately prior to an extreme weather event.
- Improve solid waste management by investing in waste collection trucks, support informal waste collection workers, construct new landfills, and develop innovative projects such as waste-to-energy plants.
- Relocate residents living in the most flood-prone areas, particularly in informal settlements, through a consultative process that also provides services and land rights to less flood-prone areas. Government should partner with civil society to improve mapping of informal settlements and assess relative flood risk.
- Support nature-based solutions in Toamasina's informal settlements to reduce flooding, clean wastewater, improve food security, provide income generation opportunities, and strengthen local communities.
- Empower local adaptation strategies by strengthening local access to climate finance, supporting coordinating institutions, and building local technical expertise together with connections to regional expertise.

Strengthen Inclusive Management of the Blue Economy and Coastal and Marine Resources

- Stop destructive mangrove harvesting and plant additional mangroves based on regional best practices such as the UN Environment Programme's "Guidelines on Mangrove Restoration for the Western Indian Ocean Region" and "Seagrass Ecosystem Restoration Guidelines for the Western Indian Ocean Region."
- Create locally managed marine areas (LMMAs) and marine protected areas (MPAs) to effectively expand marine protections and restore vulnerable marine ecosystems, using a community-led approach to siting and enforcing nearshore LMMAs and MPAs.
- Develop a fishery management plan to foster a more sustainable approach to managing the shrimp trawl fishery and reduce its negative environmental impacts through practices such as turtle excluder devices, bycatch reduction devices, and area-based closures.
- Undertake science-based stock assessment to support setting fishery effort limits and provide a deeper understanding of the current state of coastal and offshore fisheries that will support longer-term marine management goals.

Invest in Climate Resilient Infrastructure and Economic Growth

- Increase investment from the national government in renewable energy supported by international programs like USAID's Power Africa to improve economic productivity, support education, and strengthen disaster management.
- Simplify national regulations for new power generation by accelerating the process to connect to the electricity grid, assist with siting new power plants, and reduce import burdens for power generation equipment.
- Protect and improve transportation infrastructure by restoring natural ecosystems such as coastal forests and wetlands to protect the airport from flooding, providing dedicated maintenance funding for the road network, and clear debris from the Pangalanes Canal.
- Provide support to private sector businesses who offer climate adaptation products and services. Support can include affordable financing, public education, and project preparation services.





Worsening Flooding and its Impacts

Toamasina faces growing impacts from storm surge and flash flooding. Projected stronger tropical cyclones and rising sea levels are exacerbated by reduced protection from degraded ecosystems. The impacts of this flooding are worsened by unmanaged solid waste, and limited sewage treatment facilities. **Key risks and vulnerabilities identified include:**

- **Sea level rise** is projected to reach a total of 11 cm by 2030 and 22 cm by 2050, increasing storm surge and coastal flooding. This threatens critical infrastructure and coastal housing.
- **Tropical cyclones** have already increased in intensity due to climate change resulting in excessive rainfall. Toamasina was hit by 6 cyclones in 13 months in 2022 and 2023.
- **Destruction of coral reefs and inland forests** will increase the intensity of storm surge and flash flooding. Slash-and-burn agriculture and destructive fishing practices contribute to loss of marine and land ecosystems.
- **Unmanaged solid waste and wastewater** clog drainage channels and Pangalanes Canal, get washed out to sea, contaminate drinking water, and harm the health of residents and ecosystems. The city only collects an estimated 20 percent of solid waste and 97 percent of the population uses latrines.

Key Risk Scores

- Projected Change in Sea Level Rise (8.78)
- Number of Tropical Cyclones (8.72)
- Level of Coral Reef Coverage (8.58)
- Number of Wet Days (7.45)
- Effectiveness of Solid Waste Management Practices (6.94)
- Level of Resilience for Airports (6.47)
- Level of Housing Damage from Extreme Weather Events (6.41)
- Proportion of Wastewater Safely Treated (6.10)

Limited Economic Opportunities and Basic Services

Located in one of the poorest countries in the world, the people of Toamasina have limited opportunities for formal employment. Basic services, such as electricity and healthcare, are often unavailable, intermittent, or difficult to access. This situation leaves few resources for individuals, businesses, and government to invest in climate adaptation and build resilience and offers limited fallback options after a disaster. **Key risks and vulnerabilities identified include:**

- **Few formal job opportunities** drive high levels of poverty and a very large informal sector (~95% of employment). Informal firms have little money to invest in climate adaptation and provide little tax revenue for the government to build resilience.
- **Limited coverage of basic services** especially electricity and healthcare. 53% of the people across Toamasina I and II have access to electricity. More than 66% of health facilities in Madagascar are missing at least one essential medicine.
- Local authorities have **limited access to finance**, with most tax revenue going to the central government. This leaves the city dependent on outside funders for climate resilience investment.
- **Dense informal housing** is often located in flood-prone areas of the city and is washed away by flooding. Rapid urbanization also contributes to the destruction of protective ecosystems.

Key Risk Scores

- Percent of Population Below Poverty Line (8.82)
- National GDP Per Capita (7.99)
- Percent of Population with Adequate Access to Electricity (7.61)
- Investment in Climate Resiliency Development Projects (7.07)
- Access to Healthcare (6.91)
- Level of Informal Economy (6.25)





Eroding Foundations of Toamasina’s Sustainable Blue Economy

Small-scale and artisanal fishing are key to food and economic security for the people of Toamasina. Nearshore fish stocks face numerous threats, including from loss of coral reefs, overfishing, rising ocean temperatures, marine debris, and untreated industrial waste and sewage. The government has taken steps to improve fisheries management, including joining the Fisheries Transparency Initiative. **Key risks and vulnerabilities identified include:**

- **The health and extent of coral reefs** - which provide habitat for nearshore fish, attract tourists around Nosy Alanana (Ile aux Prunes) off the coast of Toamasina, and protect shorelines - are at risk from coral bleaching, pollution from untreated wastewater, and habitat destruction from human activity and cyclones.
- **Declining and migrating fish stocks** reduce food security in Toamasina. Local fishers identified warming ocean temperatures, destruction and bleaching of coral reefs, sediment runoff from deforestation, and marine pollution from terrestrial (solid waste & wastewater) and marine (oil spills) sources as key drivers.

Key Risk Scores

- Level of Coral Reef Coverage (8.58)
- Nearshore Fish Stock Status (8.42)
- Level of Seagrass Bed Coverage (6.34)
- Health of Existing Coral Reefs (6.31)
- Fish Consumption Per Capita (6.21)
- Percent of Fisheries Managed Sustainably (6.00)

Inadequate Coordination and Information Sharing

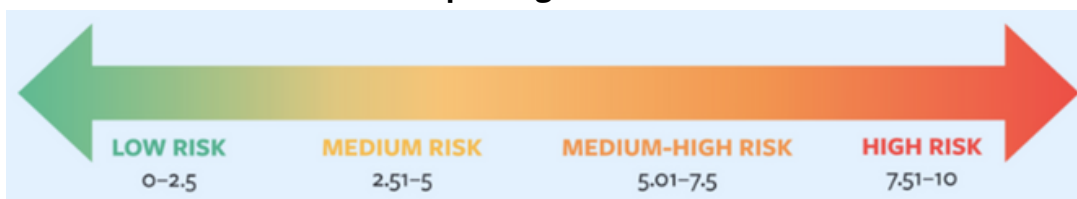
In the face of Toamasina’s growing climate risks and limited available resources, building climate resilience will require a coordinated effort between municipal, regional, and national government, citizens, the private sector, and civil society. Local stakeholders, however, identified coordination and sharing of information between government and non-government actors, as well as between different levels of government as key constraints to the effectiveness of climate adaptation in Toamasina. **Key risks and vulnerabilities identified include:**

- **Lack of public awareness** of the impacts and risks associated with climate change was identified as a key constraint in interviews with local stakeholders.
- **A disconnect between government and civil society** fosters a sense of disempowerment and disinterest in cooperating with government on the part of civil society.
- **Inadequate monitoring of adaptation projects** by government - notably coral transplantation and reforestation - limits their long-term effectiveness.

Key Risk Scores

- Level of Perceived Transparency within Government (6.38)
- Civil Society Participation (5.59)
- National Climate Adaptation Plan (5.31)

Interpreting Risk Scores



The Stimson Center is a nonpartisan policy research center working to protect people, preserve the planet, and promote security and prosperity. Please contact Carolyn Gruber for more details (cgruber@stimson.org).

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