

The background image shows a mangrove shoreline. In the foreground, a green boat with white trim is beached on a rocky shore. The boat has some white text on its side, possibly 'Smile'. The shore is littered with plastic waste, including bags and bottles. In the background, there are dense mangrove trees and a body of water under a blue sky with white clouds.

STIMSON

REPORT

Climate & Natural Resources

Environmental Security Program

CORVI Project

CORVI: Measuring Multidimensional Climate Risks in Belize City, Belize

By Natalie Fiertz, Carolyn Gruber, Sally Yozell, and Tracy Rouleau

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Mangrove forests on the banks of the mouth of the Belize River. Credit: Natalie Fiertz.

Summary Findings

Belize City, home to 65,222 people,¹ is the country's largest city, principal port, and commercial hub. The city is located on a small peninsula at the mouth of the Belize River, and much of the city lies at or below sea level and is characterized by numerous freshwater streams and wetlands.² Belize City served as the capital until 1970, when the capital was moved to Belmopan following extensive damage to Belize City caused by Hurricane Hattie in 1961.

This Climate and Ocean Risk Vulnerability Initiative (CORVI) assessment describes a detailed road map to address the greatest risks and vulnerabilities facing Belize City. The assessment has identified three major clusters of risk and vulnerability^A in Belize City:

- 1) Increasing susceptibility to flooding;
- 2) Rising impacts of extreme marine and terrestrial heat events;
- 3) A fragile economy vulnerable to climate shocks.

The CORVI methodology^B builds on national-level data and fills information gaps through extensive surveys and interviews^C with local experts. This subnational data creates a more complete picture of the local and regional climate risks and vulnerabilities.³

CLUSTER 1: INCREASING VULNERABILITY TO FLOODING

The first cluster of risk for Belize City describes how the city is becoming increasingly vulnerable to flooding and extreme weather events. Experts rated the **Total Number of People Affected by Extreme Weather Events** as the highest risk in this assessment (score of 9.37^D) and the **Percent of People Living Below 5 Meters Above Sea Level** (score of 8.73) as the second-highest risk, reflecting Belize City's low-lying topography on a delta at the mouth of the Belize River. This topography leaves the city highly vulnerable to flooding from storm surge (coastal flooding), swollen rivers (fluvial flooding), and high levels of rainfall that exceed the absorptive capacity of the ground and drainage systems (pluvial flooding). This vulnerability is also reflected in several of the assessment's other highest risk indicators, including **Percent of Metro Area at Risk of Flooding** (medium-high risk, score of 7.17). This vulnerability is widely recognized by the local and national governments, and they have taken important steps to reduce the vulnerability, including installing pumping stations — to pump out floodwaters — as well as constructing new canals. Several factors, however, will contribute to an increasing level of vulnerability in the future. First, sea levels will continue to rise, highlighted in **Projected Change in Sea Level Rise** (medium-high risk, score of 6.80). In addition to the direct impacts of a projected rise in sea levels of 0.47 meters between 2040 and 2065, this could lead to storm surge of nearly six meters during a Category 5 hurricane.

^A A complete list of the risk indicators used for this assessment is provided in Appendix 1.

^B Details about the CORVI methodology are provided in Appendix 3.

^C A list of organizations represented in this assessment (which included 93 expert surveys and 20 interviews) is provided in Appendix 2.

^D All risk scores are out of 10.00; see Appendix 3 for more details about the risk score calculations.

A Category 5 hurricane⁴ would far exceed Belize City's existing seawalls, which have a maximum height of one meter. **Coastal Erosion** (medium-high risk, score of 7.10) will contribute to increased levels of relative sea level rise, further exacerbating these impacts. An increasing **Level of Shoreline Development** (medium-high risk, score of 6.53) will increase the value of the assets exposed to coastal flooding and may also contribute to the destruction of protective coastal ecosystems, especially mangroves. Mangroves play an important role in reducing storm surge and wind damage where they still exist, and many of them are located on privately owned lands. Belize City has also lacked a coherent plan for managing the influx of domestic and international migrants, reflected in the **Percent of International Migrants Living in Country** (medium-high risk, score of 7.17). Some of these migrants end up building informal settlements by clearing mangroves or wetlands, increasing the city's vulnerability to all types of flooding.

CLUSTER 2: ECONOMY VULNERABILITY TO CLIMATE SHOCKS

The second risk cluster provides context to how Belize's national economy is vulnerable to growing climate impacts. Experts rated **Market Losses from Extreme Weather Events** (score of 7.93) as a high risk, and all of the survey respondents expect losses to grow over the next ten years. These losses include loss and damage to Belize's tourism assets, 60 to 70 percent of which are located on or near the coast, where they are vulnerable to hazards such as sea level rise, hurricanes, storm surge, and ocean warming.⁵ The tourism sector is a major employer in Belize, accounting for over 40 percent of employment according to the World Travel and Tourism Council,⁶ reflected in the **Percent of People Employed in Tourism** (high risk, score of 8.45), the third-highest risk score in this assessment. The country has developed a *National Sustainable Tourism Master Plan* and implemented conservation policies to protect its key tourism attractions, such as the creation of new marine protected areas around the Belize Barrier Reef Reserve System. Short-term threats to Belize's tourism economy, such as hurricanes, as well as long-term threats, such as ocean warming, could increase the country's **National Unemployment Rate** (medium-high risk, score of 6.95), which remains above eight percent in 2023, well above the regional average.⁷ This would place a serious financial burden on a government already struggling with high debt levels, reflected in **Debt Ratio** (high risk, score of 7.95), the fourth-highest risk in this assessment. Although the government of Belize has succeeded in reducing public debt significantly in recent years thanks to a strong post-pandemic economic recovery, public fiscal reforms, and a debt-for-nature swap known as the Belize Blue Bond. Local stakeholders highlighted how this elevated level of debt shapes Belize's strategy for investment in climate adaptation projects. Recovery costs from a severe extreme weather event also has the potential to increase Belize's debt. Belize's comparatively low level of **National GDP per Capita** (high risk, score of 7.55) also reduces the government's financial resources and means that individuals and businesses have fewer resources to respond to climate events and build resilience.

CLUSTER 3: RISING IMPACTS OF EXTREME HEAT

The third cluster of risk and vulnerability relates to the impacts of extreme heat on both land and sea. Extreme heat on land has multiple negative impacts on human health, reflected by **Total Number of Extreme Heat Events** (high risk, score of 7.93). Although experts rated the direct **Mortality Attributed to Heat** (medium risk, score of 4.60) as only a medium risk, heat stress also exacerbates underlying non-communicable illnesses including cardiovascular disease, diabetes, and asthma.⁸ Experts rated the **Mortality Rate Attributed to Non-Communicable Diseases** (medium-high risk, score of 6.96)

as a medium-high risk, suggesting that Belize’s public health system is likely to experience an increase in the burden of non-communicable disease as extreme heat becomes more frequent and sustained. This elevated burden is likely to affect tourists in Belize in addition to the country’s residents. Belize’s maritime areas are also experiencing increased levels of heat, reflected in the **Change in Sea Surface Temperatures** (high risk, score of 7.69). This rise in ocean temperatures is having destabilizing impacts on Belize’s maritime ecosystems. One of the most damaging such impacts is the increased **Incidence of High Sargassum Abundance** (high risk, score of 7.81) which can lead to erosion, loss of habitat, and hypoxia — or oxygen depletion — in the water, which in turn can lead to the death of marine life and further harm the ecosystem.⁹ Additionally, high concentrations of sargassum on beaches can release toxic hydrogen sulfide gas into the air, which can cause respiratory problems for residents and tourists.¹⁰ These impacts will increase Belize City’s vulnerability to storm surge and extreme weather events, while also harming Belize’s tourism economy. Rising ocean temperatures is also harming **Nearshore Fish Stock Status** (medium risk, score of 6.57), contributing to the decline in the value of Belize’s fishing industry from 128 million Belizean dollars (BZE) in 2014 to 28.6 million BZE in 2017.¹¹

Summary of Priority Recommendations

Based on the above risks and vulnerabilities, three areas of action were developed to prioritize climate resilience in Belize City. Local leaders should continue to work with global financial institutions, international development organizations, and the United Nations to access climate funds to implement these recommendations and support Belize City’s sustainable blue economy.

Invest in Nature-Based Solutions to Strengthen Flood Management

Investments in green spaces in flood-prone areas can improve the capacity of Belize City to absorb and retain floodwaters, reducing the impact of flooding. These projects would also have co-benefits, including habitat provision, water purification, biodiversity protection, and protection from extreme heat. They should be informed and complemented by strengthened knowledge of flooding vulnerability, drainage planning, and supportive policy reforms.

- Conduct a comprehensive mapping of flood vulnerability in Belize City to identify areas that are more vulnerable to pluvial and fluvial flooding.
- Assess the value of flooding prevention and other ecosystem services provided by currently existing mangroves, wetlands, and savannahs in and around Belize City.
- Update Belize City’s master drainage plan to inform investments in flood management solutions.
- Reform land use policy and design zoning regulations to protect existing ecosystems that reduce flooding impacts.
- Protect and restore natural ecosystems to increase the absorptive capacity of the land in and around Belize City.
- Pilot innovative institutions to efficiently leverage available resources, including carbon credits, community land trusts,¹² and voluntary property acquisition programs (also known as buyouts).



Repairs to the Belize City port. Credit: Carolyn Gruber, October 2023.

Prepare for and Support Growth in Outlying Communities

Support for the economic development and improved provision of basic services in the communities outside of Belize City could help encourage the relocation of migration patterns toward those communities, reducing the burden on Belize City’s built and natural infrastructure and mitigating its vulnerability to climate hazards.

- Map vulnerability in the greater Belize City area to flooding, extreme heat, and other climate hazards and identify low vulnerability areas to support voluntary population relocation.
- Develop an integrated regional plan to incentivize growth in, and relocation towards, identified low vulnerability areas. Ensure that this planning is responsive to changing contexts on the ground and local population needs.
- Develop drainage plans for outlying communities to reduce their vulnerability to flooding and increase their climate resilience.
- Improve provision of basic services in targeted communities, with a particular emphasis on education, healthcare, and solid waste management.
- Strengthen climate-resilient transportation infrastructure and increase frequency and availability of public transportation between Belize City and surrounding communities.
- Provide job training, loans to micro-, small, and medium enterprises, business development support, and preferential tax treatments to support job growth in outlying communities.

Strengthen Institutional Capacity for Climate Resilience

Belize City's climate risk will continue to grow in the coming years and decades as temperatures rise and extreme weather events become more intense and more frequent. The threats posed by climate hazards will also interact in unpredictable ways with ecological, economic, and social developments in Belize. These changes demand an institutional architecture that is technically sophisticated, coordinated, and responsive to changing conditions and risks.

- Support data sharing to improve coordination between government agencies and promote a risk-informed public. Promote interoperability between data platforms currently under development.
- Consider a single, integrated data platform for climate risk under the National Climate Change Office or the Statistical Institute of Belize and integrate data sharing mandates into government agency workplans.
- Create a platform to share information on proposed, ongoing, and completed climate resilience projects.
- Build in-country technical capacity for key agencies, with a focus on climate data collection, analysis, and synthesis.
- Strengthen the disaster review capacity of the National Emergency Management Office to review disaster preparedness, response, and recovery actions in the wake of an extreme weather event and offer recommendations and technical assistance to improve policies, operational structures, and actions across key actors.
- Bolster institutional communication in Belize's disaster early warning system by supporting a multi-hazard, impact-based forecasting approach and implementing the National Framework for Weather and Climate Services.
- Provide support to the tourism industry to increase climate resilience through business continuity planning and recovery loans to improve recovery after extreme weather events.



Ecological Risk

Belize City lies at the mouth of the Belize River and Haulover Creek. Its low-lying terrain features rivers, creeks, and estuarine areas, with parts of the city below sea level.¹³ The city serves as a gateway to major tourist attractions like the Great Blue Hole, located within a UNESCO World Heritage Site. Mangroves, coral reefs, and seagrass beds along the coastline serve as essential protection against coastal erosion, hurricanes, and storm surges. Healthy coastal and marine ecosystems can play an essential role in reducing the impacts of climate change. This is especially the case when considering the vulnerability of Belize City to flooding from hurricanes and heavy precipitation events.

- The **CLIMATE** category (expert weighted average score of 5.99) highlights the threats to Belize City from a wide range of climate hazards. High risk scores were calculated for several climate indicators, including **People Affected by Extreme Weather Events** (high risk, score of 9.37), **Total Number of Extreme Heat Events** (high risk, score of 7.82), and **Change in Sea Surface Temperature** (high risk, score of 7.69). The **Total Number of Wet Days** received a medium-high risk score of 6.13, emphasizing the rising impact of climate hazards. **Cases of Vector-Borne Disease Infections** (score of 5.67) and **Mortality Rate Attributed to Non-Communicable Diseases** (score of 6.96) received medium-high risk scores, indicating increasing concerns about the impacts of climate change on human health.
- In the **GEOLOGY/WATER** category (expert weighted average score of 5.18), medium-high risk scores were identified for the **Percent of Metro Area at Risk of Flooding** (score of 7.17), **Rate of Coastal Erosion** (score of 7.10), **Projected Change in Sea-Level Rise** (score of 6.80), **Degree of Saltwater Intrusion in Coastal Aquifers** (score of 5.60), and **Percent of Bodies of Water with High Water Quality** (score of 5.00). The combination of these medium-high risks highlights the vulnerabilities of Belize City's low-lying natural geography.
- In the **ECOSYSTEMS** category (expert weighted average score of 4.86), a high risk score highlights Belize City's emerging and increasing challenges related to high **Sargassum Abundance** (score of 7.81). Medium-high risk scores were also identified for **Level of Seagrass Bed Coverage** (score of 6.35), **Health of Existing Seagrass Beds** (score of 5.73), **Percent of GDP Protected by Seagrass Beds** (score of 5.59), and **Health of Existing Coral Reefs** (score of 5.08), indicating the role of the decline of seagrass bed and coral reef ecosystems.
- The results in the **FISHERIES** category (expert weighted average score of 4.52) show the decline of the coastal fisheries in and around Belize City. Medium-high risk scores were recorded for **Nearshore Fish Stock Status** (score of 6.57) and **Fish Consumption per Capita** (score of 6.53).



Belize City. Credit: photosounds, December 2017. Shutterstock.

CORVI's ecological risk indicators reflect vulnerabilities from hurricanes, extreme rain, extreme heat, coastal erosion, and sea level rise. Belize City's low-lying topography means that many of these events—particularly flooding from heavy rains, swollen rivers, and surging seas—have impacts across the city, reflected in the **Total Number of People Affected by Extreme Weather Events** (high risk, score of 9.37), which local experts rated the highest risk in this assessment.

Low-lying terrain features of Belize City, such as riverbeds and lagoons, increase vulnerability to riverine and coastal flooding.¹⁴ Approximately 40 percent of Belize City is covered in wetlands, which can help to reduce vulnerabilities to flooding and storm surge.¹⁵ Nonetheless, low-lying areas and areas near the water, including Haulover Creek, Belize River, West and East Collet Canals, and Faber's Lagoon, are at high risk of flooding. This low-lying topography across much of the city is reflected in the **Percent of Metro Area at Risk of Flooding** (medium-high risk, score of 7.17). Several interview respondents highlighted flooding as one of the major challenges facing the city, underscoring its frequency and severity.

High risk scores for the **Total Number of Extreme Heat Events** (score of 7.82) and **Change in Sea Surface Temperature** (score of 7.69) reflect concerns of increased vulnerability from increased terrestrial heat and warming waters. Models predict that during the 2060s, air temperatures in Belize City are expected to increase by approximately two degrees Celsius.¹⁶ An increase in the number of heatwave days has already been observed; Belize experienced 8.8 more heatwave days per year between 2016 and 2020 compared to the period from 1986 to 2005.¹⁷ Extreme heat events may affect human health. Issues such as heat stroke, heat exhaustion, and dehydration are directly attributable to extreme heat, and will likely become more frequent in the future, although local experts rated **Mortality Attributed to Heat** (medium risk, score of 4.60) as a relatively lower risk. Extreme heat also worsens non-communicable diseases such as cardiovascular illness, respiratory disease, diabetes, and kidney disease,¹⁸ reflected in **Mortality Rate Attributed to Non-Communicable Diseases** (medium-high risk, score of 6.96). The elderly population, both residents and tourists, are most vulnerable to these types of diseases.

The rainy season and precipitation patterns of Belize City are also predicted to change in the future. Rainfall in the original main rainy season months, from May to July, is expected to decrease, while the monthly rainfall in October and November, toward the end of the rainy season, is projected to increase

by more than 55 millimeters by the 2060s,¹⁹ reflected in **Total Number of Wet Days** (medium-high risk, score of 6.13). The increase in precipitation is likely to increase the spread of vector-borne disease, reflected in **Cases of Vector-Borne Disease Infections** (medium-high risk, score of 5.67). The incidence of dengue fever in Belize, for example, has trended upward over the past two decades, according to the Pan-American Health Organization (PAHO).²⁰ While there is significant year-to-year variability in reported cases, in 2022, dengue affected nearly 1,300 out of every 100,000 people in Belize—the highest rate of incidence in the PAHO records, which go back to 1980. The 13 years with the highest incidence rate have all occurred since 2012.²¹ The country has made important progress against other diseases, however. Most significantly, the World Health Organization declared Belize officially malaria-free in 2019 thanks to strong and sustained surveillance, vector control, and investment in trained health workers.²²



Office of the National Meteorological Service of Belize. Credit: Carolyn Gruber, December 2024.



Belize City coastline. Credit: Natalie Fiertz, October 2023.

Projected changes in sea-level rise (medium-high risk, score of 6.80) also present an increasing climate hazard to Belize City. From 2040 to 2065, sea levels are expected to rise by 0.47 meters, potentially leading to 5.87 meters of storm surge during a Category 5 hurricane, which could result in significant flooding across much of the city.²³ To protect the low-lying coastal areas of Belize City from the sea-level rise and flooding caused by storm surges, the Government of Belize has constructed seawalls to cover part of the coastline. However, these seawalls are only about one meter high, with some even lower; this may not be sufficient protection in the near future. The construction of these seawalls has led to beach erosion, as wave energy is increased in areas adjacent to the seawalls. The erosion has prompted new measures to protect beaches, such as replanting mangroves, which is reflected in the medium-high risk score for the **Rate of Coastal Erosion** (score of 7.10). Furthermore, sea-level rise is expected to increase saltwater intrusion into freshwater resources, which is reflected in the scores for the **Degree of Saltwater Intrusion in Coastal Aquifers** (medium-high risk, score of 5.60) and **Percent of Bodies of Water with High Water Quality** (medium risk, score of 5.00).

Local experts rated **Incidence of High Sargassum Abundance** (high risk, score of 7.81) as the third highest ecological risk for Belize City, reflecting an emerging issue that has been a growing crisis throughout the Caribbean since 2011.²⁴ While small quantities of sargassum can be ecologically beneficial, the accumulation and decay of large quantities of sargassum has wide-ranging ecological harms. It can obstruct navigation for fishing boats entering and exiting ports and beaches. High concentrations of sargassum on beaches can also release toxic hydrogen sulfide, which can cause respiratory problems for residents and tourists.²⁵ Hydrogen sulfide can also kill mangroves, contributing to the decline of these protective ecosystems.²⁶ High concentrations of sargassum also trap marine litter, block light from reaching marine species, increase water temperatures, and host potentially harmful bacteria colonies.²⁷ All of these damage corals and numerous fish species, degrading the marine ecosystems that attract tourists, protect the coastline, and are critical for fishers. Even the process of removing sargassum from

beaches can be detrimental, as the use of heavy machinery can increase coastal erosion.²⁸ Belize is trying innovative approaches to address the challenges associated with sargassum, including developing a pilot project in 2023 to convert sargassum into biofuel.²⁹

Concerns related to seagrass beds are indicated by the medium-high risk scores for the **Level of Seagrass Bed Coverage** (score of 6.35), **Health of Existing Sea Grass Beds** (score of 5.73), and **Percent of GDP Protected by Sea Grass Beds** (score of 5.59). Seagrass beds support one of the main marine ecosystems in the country, covering 1,500 square kilometers along Belize's coastline. Seagrass ecosystems offer essential goods and services to coastal communities; they stabilize sediments, protect coastlines, support fisheries, mitigate climate change, and maintain biodiversity. At the national level, 41.6 percent of seagrass beds are within protected areas.³⁰ However, these seagrass beds are increasingly impacted by tourism development, polluted outflows from the Belize River, and urbanization.³¹

The ocean provides livelihoods for nearly 200,000 Belizeans, with coral reefs contributing to 15 percent of Belize's GDP.³² This includes approximately \$15 million USD from the fishing sector and \$200 million USD from the tourism sector. However, both commercial and herbivorous fishes in the coral reef declined by 50 percent during the COVID-19 pandemic.³³ In March 2020 in Belize, the pandemic led to movement restrictions, a tourism shutdown, and widespread job losses. This economic decline pushed many toward the fisheries sector for livelihoods and subsistence, which is reflected in the **Health of Existing Coral Reefs** (medium-high risk, score of 5.08).

Belize lost over five percent of its mangrove coverage between 1980 and 2017.³⁴ Mangroves protect against storm surge, with research showing that sufficiently robust mangrove forests can reduce wave energy by up to 66 percent.³⁵ The government has taken steps to reverse Belize's mangrove loss, reflected in **Level of Mangrove Coverage** (medium risk, score of 4.25). Of the remaining mangroves, 16.6 percent are protected as of 2019,³⁶ and a multi-stakeholder coalition of the public sector, civil society, academia, and local communities forms the Belize Mangrove Alliance, which has developed an Action Plan for 2022–2027 to increase mangrove protection and health. Belize City, however, has lost mangrove coverage around much of the city as a result of urbanization and development, increasing the city's vulnerability to storm surge, wind damage, and coastal erosion.

The fishing sector contributes about five percent of Belize's GDP,³⁷ significantly lower than tourism's 30 percent. Finfish are the primary focus of the domestic market for consumption, while the export market depends on spiny lobster (*Panulirus argus*) and queen conch (*Strombus gigas*).³⁸ Commercial and artisanal fishing occurs on nearshore coral reef and seagrass bed ecosystems and is conducted by small-scale coastal fishers. According to the latest annual report from the Statistical Institute of Belize, the GDP of the fishing industry decreased from 128 million Belizean dollars (BZE) in 2014 to 28.6 million BZE in 2017,³⁹ reflected in **Nearshore Fish Stock Status** (medium-high risk, score of 6.57). Several conservation and management measures have been implemented in Belize, including restrictions on fishing near coral reefs, which are reflected in lower scores for the **Percent of Fisheries Managed Sustainably** (medium risk, score of 3.85) and the **Level of Unreported Catch Estimates** (low risk, score of 2.27). The effects of climate change on fisheries may be underestimated as a result of the lack of efficient fisheries data, including details on harvests.

BELIZE CITY: ECOLOGICAL RISK

Each category score comprises multiple indicators.

Low 1 - 2.5 Medium 2.51 - 5 Medium-High 5.01 - 7.5 High 7.51 - 10

Category	Indicator	Score
Climate	Total Number of People Affected by Extreme Weather Events	9.37
	Total Number of Extreme Heat Events	7.82
	Change in Sea Surface Temperature	7.69
	Mortality Rate Attributed to Non-communicable Diseases	6.96
	Total Number of Wet Days	6.13
	Cases of Vector-Borne Disease Infections	5.67
	Total Number of Hurricanes	4.74
	Mortality Attributed to Heat	4.60
	Total Number of Flood Events	3.97
	Total Number of Droughts	3.81
Geology/Water	Percent of Metro Area at Risk of Flooding	7.17
	Rate of Coastal Erosion	7.10
	Projected Change in Sea Level Rise	6.80
	Degree of Saltwater Intrusion in Coastal Aquifers	5.60
	Percent of Bodies of Water with High Water Quality	5.00
	Degree of Soil Salinity in Arable Lands	4.93
	Piped Water Supply Continuity	3.37
	Percent of Landscape That is Arable Land	2.89
	Level of Geophysical Risk of Landslides	1.79
Ecosystems	Incidences of High Sargassum Abundance	7.81
	Level of Sea Grass Bed Coverage	6.35
	Health of Existing Sea Grass Beds	5.73
	Percent of GDP Protected by Sea Grass Beds	5.59
	Health of Existing Coral Reefs	5.08
	Percent of GDP Protected by Coastal Sand Dunes	4.79
	Health of Existing Coastal Sand Dunes	4.77
	Level of Coastal Sand Dune Coverage	4.76
	Health of Existing Mangroves	4.59
	Percent of GDP Protected by Mangroves	4.57
	Level of Coral Reefs Coverage	4.50
	Level of Mangrove Coverage	4.25
	Percent of GDP Protected by Coral Reefs	3.70
Rate of Occurrence of Harmful Algal Blooms	2.99	
Fisheries	Nearshore Fish Stock Status	6.57
	Fish Consumption Per Capita	6.53
	Number of Incidents of Foreign Vessels Fishing in EEZ	4.35
	Capacity of Fisheries Enforcement Institutions	4.20
	Offshore Fish Stock Status	4.15
	Percent of Fisheries Managed Sustainably	3.85
	Number of Fisheries Access Agreements with Foreign Nations	3.49
	Level of Unreported Catch Estimate	2.27

Table: Stimson Center • Created with Datawrapper

Economic Risk

Climate change poses serious risks to the economy of Belize City and to the broader national economy. Strong efforts by local leaders to build climate resilience in the low-lying, flood-prone city are constrained by financial and technical capacity limitations, including high levels of public debt. Belize City is critical to the economic health of the country, both as a hub for tourists traveling along the coast and throughout broader Belize, as well as through its local job growth and economic development.

- The ECONOMICS category (expert weighted average score of 6.32) is characterized by high risk scores for Belize’s **Debt Ratio** (score of 7.95), **Market Losses from Extreme Weather Events** (score of 7.93), and **National GDP per Capita** (score of 7.55), highlighting the risk of a vicious cycle in which extreme weather increases debt, reducing the resources to build climate resilience and leaving the city vulnerable to future extreme weather events.
- The INFRASTRUCTURE category (expert weighted average score of 5.30) includes the highest risk score in the Economics Risk area, the **Percent of People Living Below 5 Meters Above Sea Level** (high risk, score of 8.73). It also includes medium-high risk scores around the **Level of Shoreline Development** (score of 6.53) and **Percent of Low-Income Housing in Relation to Flood Zones** (score of 6.31), underscoring how Belize City’s low-lying topography increases its vulnerability to flooding.
- The MAJOR INDUSTRIES category (expert weighted average score of 4.68) includes medium-high risk scores for **Diversity of Lodging Types** (score of 5.73) and **Percent of National Economy Based in Agriculture** (score of 5.15). All other indicators in this category are medium risk, including **Percent of National Economy Based in Tourism** (score of 4.28), suggesting that local experts expect current efforts are effective in building climate resilience in the sector.

Belize’s key industries are agriculture, seafood products, and tourism. Although these industries do not have a major presence within the boundaries of Belize City, they are linked to the resilience of Belize City in two principal ways. First, Belize City is an important transport hub. Tourists transit through Belize City en route to destinations throughout the country, while agricultural goods—especially those grown in the north and center of the country—are shipped through the city’s port. Second, losses to these industries could destabilize the national economy and increase migration into Belize City, putting increased stress on the city’s infrastructure and increasing its vulnerability.

Key agricultural products for Belize include raw sugar (20 percent of exports in 2022), bananas (10 percent of exports), and citrus products, while exports of fish and other seafood products account

for another 13 percent.⁴⁰ Despite their large share of exports, agriculture and fishing account for only nine percent of GDP.⁴¹ The role of agriculture as an important economic sector for Belize is reflected in **Percent of National Economy Based in Agriculture** (medium-high risk, score of 5.15).

Research is mixed on the likely impacts of climate change on Belize's agriculture. A Food and Agriculture Organization (FAO) study found that the country faces a projected loss in production of 10 to 20 percent.⁴² These impacts are due primarily to increased frequency and intensity of extreme weather events, particularly hurricanes and drought. Studies on the projected impacts of climate change on Belize's key crops of banana⁴³ and sugarcane⁴⁴ suggest that changes in average temperature and precipitation may increase yield of both crops. Interviewees also specifically noted the threat that ocean acidification poses to lobster and queen conch,⁴⁵ which are the two most valuable fisheries industries in the country. Queen conch exports doubled in quantity from 200 metric tons to 400 metric tons between 2003 and 2018, and the value of those exports tripled over the same period.⁴⁶

Belize's banana crop is almost entirely made up of a single species, Cavendish bananas, which are threatened by Fusarium wilt tropical race 4 (TR4).⁴⁷ TR4 is a fungal disease that has devastated Cavendish bananas in Asia and that spread to Latin America in 2021.⁴⁸ Beyond production, Belize faces growing risks from food security, reflected in the **Percent of Population Experiencing Moderate or Severe Food Insecurity** (medium-high risk, score of 5.13). The share of the population facing moderate or severe food insecurity has grown from 35.7 percent to 45.5 percent between 2018 and 2021.⁴⁹

The Belize tourism sector experienced rapid growth from 13.3 percent to 27.1 percent of GDP between 2000 and 2019.⁵⁰ The number of tourist arrivals also doubled over the decade between 2008 and 2018,⁵¹ and tourism makes up 30 percent of Belize's economy.⁵² Overnight tourist arrivals have recovered strongly after the pandemic, and visitors through the first seven months of 2024 have exceeded visitors over the same period in 2019.⁵³ Cruise ship arrivals in 2023, however, are still 23 percent below 2019.⁵⁴ Belize City has accounted for 14 percent of all tourist visits in 2024, up slightly from 11 percent in 2019.⁵⁵ This makes the city Belize's third largest tourist destination, behind San Pedro (Ambergris Caye), Belize's largest offshore island, and Cayo District, which includes inland archeological sites. Local experts rated **Diversity of Lodging Types** as a medium-high risk (score of 5.73), likely reflecting the growth of rental living spaces like Airbnb, but household overcrowding is significantly lower in Belize District (~4 percent) than in more rural areas like Toledo District (~22 percent).⁵⁶

Belize's *National Sustainable Tourism Master Plan* (NSTMP) outlines the country's strategy to develop its tourism sector through 2030.⁵⁷ The NSTMP includes specific strategies for each of eight most important tourism areas in the country. Although it only includes a high-level assessment of how climate impacts may affect Belize's tourism sector, its focus on urban renovation as the strategy for Belize City presents an opportunity to address the climate vulnerabilities identified in this assessment. Experts rated the risk for the **Percent of National Economy Based in Tourism** (medium risk, score of 4.28) as relatively low, suggesting that they expect current resilience planning to be successful in building climate resilience in the tourism sector.



London Bridges informal settlements. Credit: Natalie Fiertz, October 2023.

The most critical such vulnerability is the city's susceptibility to flooding. Belize City is in a low-lying coastal area, reflected in **Percent of People Living Below 5 Meters Above Sea Level** (high risk, score of 8.73), the highest risk score in the Economic Risk section. Its location near the mouth of the Belize River means that the city is exposed to severe coastal, pluvial, and fluvial flooding. The loss of mangroves and wetlands in Belize City increases the city's vulnerability to flooding. The premium on space in the city resulting from its rapid urbanization and tourism development, reflected in **Level of Shoreline Development** (medium-high risk, score of 6.53), drives the loss of these ecosystems. Mangroves and wetlands are converted to tourism development,⁵⁸ residential zones (as in the Belama neighborhoods),⁵⁹ and informal housing for new migrants. Interviewees highlighted areas like Krooman Lagoon and London Bridges, both in southern Belize City, as examples of the way these types of urban expansion threaten coastal ecosystems. Lower-income areas of the city, most notably the Faber's Road Extension area in the southern part of Belize City, are also often geographically more susceptible to flooding,⁶⁰ reflected in **Percent of Low-Income Housing in Relation to Flood Zones** (medium-high risk, score of 6.31).



Belize City port. Credit: Natalie Fiertz, October 2023.

The Faber's Road Extension area is also the location of Belize City's existing wastewater treatment facility. The facility was completed in 1979, and continued population growth in the city requires its expansion and upgrade,⁶¹ reflected in **Proportion of Wastewater Safely Treated** (medium-high risk, score of 5.56). An upgrade is also necessary to reduce the risk of damage to surrounding wetlands and residents from polluted overflow, which would further increase the area's vulnerability to flooding. In July 2024, the World Bank and Belize Water Services began the environmental and social assessment for the upgrade of the facility.⁶² The port is also located near the Faber's Road Extension area, and local experts rated the **Level of Resilience for Ports and Shipping** a medium-high risk (score of 5.54), highlighting the multiple and potentially compounding risks faced by the area.

The city's high level of vulnerability to flooding and to tropical storm winds is reflected in **Market Losses from Extreme Weather Events** (high risk, score of 7.93). Even popular areas, such as Princess Margaret Drive in the Hangar area, are completely inundated with the rising tide.⁶³ The government has implemented important regulations to help mitigate this vulnerability, including a 66-foot setback from the coastline and building regulations to reduce wind damage.⁶⁴ Enforcement of the setback is not consistent, but the building regulations, which apply to new construction and rebuilding efforts, successfully reduced damage from Hurricane Lisa in 2022.⁶⁵ Local experts rated the risk of the **Level of Housing Damage from Extreme Weather Events** (medium-high risk, score of 5.52) higher than the **Level of Commercial Infrastructure Damage from Extreme Weather Events** (medium risk, score of 4.91), suggesting a higher level of vulnerability for residential structures and areas.

In 2018–2019, the government invested USD \$8.9 million in domestic public finance for resilience-building projects.⁶⁶ However, its investments are limited by the country’s high **Debt Ratio** (high risk, score of 7.95) and a **National GDP per Capita** (high risk, score of 7.55) of under \$8,000.⁶⁷ This is less than 60 percent of Mexico’s GDP per capita and below 50 percent of Costa Rica’s.⁶⁸

Hurricane Earl in 2016 cost Belize 11 percent of its GDP and led to an overall debt of 100 percent of its GDP.⁶⁹ The government succeeded in bringing debt down in the following years, but it spiked again in 2020 to 102 percent of GDP. A strong economic recovery, government fiscal reforms, and a debt-for-nature swap with the Nature Conservancy helped reduce the debt again, to 67.1 percent in 2022.⁷⁰ In January 2022, the prime minister established the Blue Bond and Finance Permanence Unit within the Office of the Prime Minister to coordinate the delivery of Belize’s commitments under the Blue Bond Agreements. The agreement has reduced the country’s national debt by 12 percent, lowered debt servicing costs, and increased the country’s long-term investment in ocean conservation for the next 20 years, with a commitment to protect up to 30 percent of Belize’s ocean.⁷¹ The 2024 International Monetary Fund (IMF) assessment, however, found that “debt dynamics have become more difficult,” and projects that public debt will fall slowly in the coming years, remaining above 58 percent in 2029.⁷²

Local experts also identified the **National Unemployment Rate** as a medium-high risk (score of 6.95). This suggests that the International Labor Organization’s (ILO’s) estimate of an 8.3 percent rate of unemployment in 2023⁷³ is more reflective of the situation on the ground than the IMF’s estimate of 3.4 percent.⁷⁴ Local businesses in Belize City, however, also report increasing difficulties in finding and retaining workers, driven in part by the recent growth in the business process outsourcing sector (such as customer service).⁷⁵ This suggests a bifurcated labor force in which businesses compete for a small share of sufficiently skilled workers even as the labor participation rate sits at 66 percent, below the regional average.⁷⁶

The ILO⁷⁷ and the Inter-American Development Bank (IDB)⁷⁸ note that climate impacts—including heat stress, extreme weather events, and loss of ecosystem services—will reduce working hours and employment. They also note that well-designed adaptation policies can create jobs both directly and by reducing climate impacts. This includes social protection policies such as “cash transfers and public employment programmes.”⁷⁹ Belize’s labor market dynamics also contribute to a high **Level of Informal Economy** (medium-high risk, score of 6.01), which accounts for between 40 and 47 percent of Belize’s economy.⁸⁰ Businesses in the informal sector are often less able to take steps to reduce their vulnerability to climate impacts, and they also generate less tax revenue, limiting the government’s ability to invest in climate adaptation.

Given the constraints on available financing, the Government of Belize is actively seeking funding opportunities to enhance infrastructure and systems that bolster climate resilience.⁸¹ The National Climate Change Office and the Climate Finance Unit are also engaging with institutions such as the Green Climate Fund, the Global Environment Facility, the Adaptation Fund, the IDB, the World Bank, and others to seek opportunities for grant and highly concessional loan financing for climate resilience solutions.

Interviewees specifically noted the work to build and strengthen a multi-hazard early-warning system for the Belize watershed, including Belize City.⁸² This includes water-level sensors on the Belize River, which can give residents of Belize City several hours’ warning of fluvial flooding.⁸³ Cooperation between different departments, such as the planning and sanitation departments, is crucial in these and other efforts to address issues such as flooding and using GIS mapping and inspections to identify vulnerable areas.⁸⁴



Sir Barry Bowen Municipal Airport. Credit: Natalie Fiertz, October 2023.

These efforts also aim to strengthen Belize City’s infrastructure. Several interviewees noted the importance of projects like the Climate Vulnerability Reduction Program, which is described in greater detail in the Status of Resilience Planning section of this report. Local experts rated some key indicators, such as the **Level of Water Distribution Infrastructure Resilience** (medium risk, score of 3.80) and **Percent of Population with Adequate Access to Electricity** (medium risk, score of 3.21), as relatively low priority, suggesting that existing efforts have successfully built resilience in these areas. Conversely, the **Level of Resilience for Airports** (medium-high risk, score of 5.20) suggests more work is needed to protect airports from climate impacts. Belize City’s primary airport, Philip SW Goldson International Airport, is protected by riverine forests. Two roads, the Philip Goldson Highway and the George Price Highway, connect the airport to the city. Both highways run very close to the Belize River and are at risk of flooding, blocking access to the airport. Sir Barry Bowen Municipal Airport, which is located in the northern part of Belize City and serves local Belizean tourist destinations, sits on the edge of the Caribbean Sea, with very minimal protection in some areas.

BELIZE CITY: ECONOMIC RISK

Each category score comprises multiple indicators.

Low 1 - 2.5 Medium 2.51 - 5 Medium-High 5.01 - 7.5 High 7.51 - 10

Category	Indicator	Score
Economics	Debt Ratio	7.95
	Market Losses from Extreme Weather Events	7.93
	National GDP per Capita	7.55
	National Unemployment Rate	6.95
	Level of Informal Economy	6.01
	Percent of GDP Generated in Coastal Cities	5.75
	National Youth Unemployment Rate	5.24
	Urban Unemployment Rate	5.23
	Percent of Population Experiencing Moderate or Severe Food Insecurity	5.13
	Income Inequality	4.95
Infrastructure	Percent of People Living Below 5 Meters Above Sea Level	8.73
	Level of Shoreline Development	6.53
	Percent of Low-Income Housing in Relation to Flood Zones	6.31
	Proportion of Wastewater Safely Treated	5.56
	Level of Resilience for Ports and Shipping	5.54
	Level of Housing Damage from Extreme Weather Events	5.52
	Level of Resilience for Airports	5.20
	Level of Grid Resilience	5.02
	Level of Informal or Unplanned Settlement	4.97
	Level of Commercial Infrastructure Damage from Extreme Weather Events	4.91
	Level of Resilience for Roads	4.70
	Effectiveness of Solid Waste Management Procedures	4.61
	Renewable Energy Share in Total Energy Consumption	4.37
	Level of Water Distribution Infrastructure Resilience	3.80
	Percent of Population with Adequate Access to Electricity	3.21
Major Industries	Diversity of Lodging Types	5.73
	Percent of National Economy Based in Agriculture	5.15
	Percent of National Economy Based in Nearshore Fishing Industry	4.85
	Percent of National Economy Based in Tourism Industry	4.28
	Percent of National Economy Based in Offshore Fisheries	4.17
	Percent of National Economy Based in Port and Shipping Industries	4.03

Table: Stimson Center • Created with Datawrapper



Social Risk

Because Belize City is Belize’s principal city and the gateway into the rest of the country, its vulnerability to climate risk has far-reaching effects. The risk scores in this section highlight the large role of Belize’s climate-vulnerable tourism sector, the impacts of increasing population on the city’s ecosystems and infrastructure, and challenges around funding for and consistent implementation of climate resilience projects.

- The STABILITY category (expert weighted average score of 4.99) includes the highest risk indicator in the Political Risk area, the **Percent of People Employed in Tourism** (high risk, score of 8.45), which highlights the importance of direct and indirect employment in a climate-vulnerable industry. A medium-high risk score for the **Number of Years that the Current Government Structure Has Been in Place** (score of 6.44) reflects the impact of political turnover on policy consistency.
- The GOVERNANCE category (expert weighted average score of 4.95) emphasizes challenges around securing funding climate resilience projects in **Investment in Climate Resiliency Development Projects** (medium-high risk, score of 6.24). Medium-high risk scores for **Rule of Law** (score of 6.24) and **Capacity of Ethics Enforcement Bodies** (score of 5.18) highlight local concerns around institutional integrity in Belize.
- In the SOCIAL/DEMOGRAPHICS category (expert weighted average score of 4.73), medium-high risk scores in **Percent of International Migrants Living in Country** (score of 7.17) and **Percent of Urban Population Below 30 Years of Age** (score of 5.53) highlight the way that immigration and population growth increase pressure on the city’s ecosystems and infrastructure, increasing its vulnerability to climate impacts. A medium-high risk score for **Percent of Population Below Poverty Line** (score of 5.23) underscores how limited resources and economic opportunities can shape both individual- and community-level vulnerability to climate change.

Launched in 2010, the Belize City Master Plan Project ambitiously aims to create a “renewed” and climate-resilient Belize City.⁸⁵ To support this vision, Belize has developed policy frameworks for climate adaptation. Priority sectors include coastal and marine resources, agriculture, water resources, tourism, fisheries and aquaculture, human health, and forestry.⁸⁶ This planning is reflected in the comparatively low risk score for **National Climate Adaptation Plan** (medium risk, score of 4.80). The *Climate Resilient Infrastructure Project*, for example, enhances the resilience of road infrastructure.⁸⁷ Even for the city’s major streets, however, drainage remains a challenge.⁸⁸



Belize City pumping station. Credit: Natalie Fiertz, October 2023.

Technical and financial limitations are a key barrier to addressing these types of gaps and other climate vulnerabilities in Belize City.⁸⁹ Several interviewees from both the municipal and national governments highlighted the importance of limited funding,⁹⁰ reflected in **Investment in Climate Resiliency Development Projects** (medium-high risk, score of 6.24).⁹¹ Interviewees noted that limited funding is often spread across multiple agencies such as the National Hydrological Service and the National Meteorological Service—and across multiple geographic areas.⁹²

Several interviewees also noted challenges around limited public support due to limited public awareness,⁹³ impeding consistent, long-term implementation of resilience projects.⁹⁴ Local experts also rated **Number of Years that the Current Government Structure Has Been in Place** as a medium-high risk (score of 6.44), suggesting that institutional turnover may also inhibit consistent, long-term implementation.

Local experts also highlighted concerns about institutional integrity in Belize, rating the **Rule of Law** (score of 6.24) and **Capacity of Ethics Enforcement Bodies** (score of 5.18) as medium-high risks. Although Belize has anti-corruption laws such as the *Prevention of Corruption in Public Life Act*, enforcement is inconsistent.⁹⁵ The Act requires public officials to make financial disclosures annually for review by the Integrity Commission, but the Commission reportedly does not function effectively, and there is little opportunity for the public to challenge these disclosures.⁹⁶ There have also been extended vacancies on the Commission and other key oversight bodies.⁹⁷ For example, the position of Auditor General was vacant for more than one year in 2021 and 2022.⁹⁸

Several recent high-profile cases highlight these challenges, but also potentially offer promise for stronger enforcement. In February 2020, John Saldivar, former Minister of National Security and Defense and head

of the United Democratic Party (UDP) at the time, was “implicated in a U.S. federal fraud trial in Utah, involving a conspiracy to obtain biofuel tax credits on false pretenses.”⁹⁹ The case prompted Saldivar to resign as head of UDP and from the cabinet and drew large protests in Belize City.¹⁰⁰ The UDP suffered a major defeat in general elections held in November of that year, which saw **Voter Turnout** (medium risk, score of 3.40) of 82 percent. As a result of the trial, the U.S. State Department barred Saldivar from entering the United States in 2022.¹⁰¹ That same year, former Minister of Works Rene Montero was arrested on charges of corruption.¹⁰²

Local experts rated the **Level of Perceived Transparency within Government** (medium risk, score of 4.85) as a lesser concern, suggesting that the government generally engages in policymaking with openness and transparency. However, in January 2020, the Supreme Court highlighted that the government of Prime Minister Dean Barrow (in office February 8, 2008–November 12, 2020) spent more than 1.3 billion BZE of public funds without prior approval from Parliament, equal to over 30 percent of Belize’s GDP.¹⁰³

The Belize Open Government Steering Committee was established in 2020 to advance open government through multi-stakeholder dialogue.¹⁰⁴ It includes six representatives from government agencies and five representatives from civil society organizations, providing an important avenue to enhance **Civil Society Participation** (medium risk, score of 3.96) in decision-making.

Tourism is the most important source of employment in Belize. The **Percent of People Employed in Tourism** (high risk, score of 8.45) is over 40 percent, and the World Travel and Tourism Council projects that it will grow to over 50 percent by 2034.¹⁰⁵ Local experts identified this as the biggest risk in the Political Risk section. Direct employment in the tourism sector before the COVID-19 pandemic accounted for 13.4 percent of total employment, rising to 37.3 percent when considering indirect employment, according to the IMF.¹⁰⁶



The waterfront in Belize City. Credit: Carolyn Gruber, December 2024.

Between 60 and 70 percent of Belize’s tourism assets are on or near the coast, making them vulnerable to climate hazards such as sea level rise, hurricanes, storm surge, and ocean warming. In addition, the growing tourism industry has contributed to the degradation of key coastal and marine ecosystems, reducing the sector’s resilience to climate impacts.¹⁰⁷ In response, the government has developed a *National Sustainable Tourism Master Plan* (NSTMP). Growth in overnight tourist arrivals has been almost three times higher than projections in the original 2011 NSTMP.¹⁰⁸ The government updated the NSTMP between 2022 and 2024. To help support the long-term health of its tourism sector, Belize has implemented several key conservation policies around the Mesoamerican Reef, including the creation of new marine protected areas.¹⁰⁹ Limited political will and a prioritization of short-term gains from growth of the tourism sector, however, continue to pose challenges for effective ecological protection and conservation.¹¹⁰

Another challenge to the effective implementation of policies for ecological protection in and around Belize City is unmanaged migration into the city. Migrants from both elsewhere in Belize and from neighboring countries move to the city because of its better job opportunities and better infrastructure, including access to education and healthcare. Some of these migrants build informal settlements by clearcutting local mangroves and wetlands. These environmentally destructive activities increase the vulnerability of Belize City to coastal flooding, reflected in **Percent of International Migrants Living in Country** (medium-high risk, score of 7.17). The lack of public services in these settlements, such as electricity and waste management, also harms the health of the surrounding ecosystems. International immigrants accounted for 17 percent of the population in 2020,¹¹¹ primarily from Guatemala, Honduras, and El Salvador. Although Belize has the Immigration Act (Chapter 156, revised in 2011 and amended in 2023), it has no dedicated migration strategy.¹¹² Continued population growth driven by a young population, reflected in **Percent of Urban Population Below 30 Years of Age** (medium-high risk, score of 5.53), will continue to put pressure on Belize City’s ecosystems and infrastructure.



Canals in low-lying areas. Credit: Carolyn Gruber, October 2023.

Elevated levels of poverty also contribute to climate vulnerability in Belize City, reflected in **Percent of Population Below Poverty Line** (medium-high risk, score of 5.23). Communities with high levels of poverty, like Monkey River and Gales Point, are often the most vulnerable to climate impacts.¹¹³ Interviewees noted that Monkey River, in particular, suffers from a high rate of coastal erosion.¹¹⁴ These communities also often lack the capacity to implement resilience projects and are excluded from decision-making.¹¹⁵ Furthermore, poverty drives people toward environmentally destructive activities, such as illegal fishing, which further increases the vulnerability of the city.¹¹⁶ Interviewees also noted that the lack of economic opportunities and access to services has reduced the viability of settlements located in less hazard-prone areas, such as Hattievile.¹¹⁷

BELIZE CITY: SOCIAL/POLITICAL RISK

Each category score comprises multiple indicators.

Low 1 - 2.5 Medium 2.51 - 5 Medium-High 5.01 - 7.5 High 7.51 - 10

Category	Indicator	Score
Stability	Percent of People Employed in Tourism	8.45
	Number of Years That the Current Government Structure Has Been in Place	6.44
	Percent of People Employed in the Commercial Fishing Industry	4.97
	Percent of People Employed in Agriculture	4.65
	Percent of People Employed in Artisanal and Subsistence Fishing	4.14
	Percent of People Employed in Port and Shipping Industries	4.07
	Level of Social Tension	3.00
	Number of Incidences of Civil Unrest or Instability	2.27
Governance	Investment in Climate Resiliency Development Projects	6.24
	Rule of Law	6.24
	Capacity of Ethics Enforcement Bodies	5.18
	Health Worker Density and Distribution	5.10
	Level of Perceived Transparency Within Government	4.85
	National Climate Adaptation Plan	4.80
	Capacity of Current Disaster Response	4.64
	Access to Healthcare	4.40
	Civil Society Participation	3.96
	Voter Turnout	3.40
Social/Demographics	Percent of International Migrants Living in Country	7.17
	Percent of Population at Risk of Mental Health Disorders and Stress-related Disorders	6.16
	Percent of Urban Population Below 30 Years of Age	5.53
	Percent of Population Below Poverty Line	5.23
	Urbanization Rate	5.07
	Percent of Population Achieving Proficiency in Literacy and Numeracy	4.86
	Urban Population Density	4.73
	Percent of Adult Citizens Living Outside of the Country	4.59
	Dependency Ratio	4.36
	Urban Population	3.54
	National Population Density	3.47
	National Population	3.37

Table: Stimson Center • Created with Datawrapper

The Status of Resilience Planning

Belize has two principal national frameworks that describe the country’s approach to building climate resilience, both published in 2021. The first is the country’s updated Nationally Determined Contribution (NDC) under the Paris Agreement. The NDC lays out a total of 44 adaptation target actions across eight sectors, with a total estimated cost of \$318 million, outlined in the table below. The document notes that \$172.4 million has already been committed, leaving a funding gap of \$145.8 million.¹¹⁸

Sector	Total cost	Funding committed/ requested	Funding requirements
Coastal and marine resources	\$35,684,740	\$23,934,740	\$11,750,000
Agriculture	\$113,474,000	\$41,474,000	\$72,000,000
Water resources	\$25,117,112	\$14,112,000	\$11,005,112
Tourism	\$35,554,715	\$18,604,715	\$16,950,000
Fisheries and aquaculture	\$12,978,000	\$12,228,000	\$750,000
Human health	\$12,571,575	\$4,300,000	\$8,271,575
Land use, human settlements, and infrastructure	\$82,747,969	\$57,697,969	\$25,050,000
Forestry and biodiversity	No cost estimates provided		
Total	\$318,128,111	\$172,351,424	\$145,776,687

Belize’s *National Climate Change Policy, Strategy, and Action Plan* (NCCPSAP) presents a five-year plan, from 2021 through 2025, to mitigate greenhouse gas emissions and build climate resilience. The NCCPSAP includes actions to strengthen adaptation across 13 sectors. These cover the same eight sectors as the NDC and add Disaster Risk Management, Education, Energy, Transportation, and Waste Management. For Belize District, within which Belize City is located, the NCCPSAP identifies the main risks as river overflows, sea level rise, saltwater intrusion, ocean acidification, and ocean warming.

The government has taken important steps to mainstream its climate adaptation objectives into its operations. The government established the Belize National Climate Change Committee in 2009 and created the National Climate Change Office in 2012. The NCCPSAP also explicitly identifies the responsibilities of the other ministries to implement the government’s plans. Several adaptation targets are also integrated into other planning documents, including #PlanBelize, which guides the country’s development strategy through 2026, and the *National Sustainable Tourism Master Plan* for Belize.

These efforts are supported by robust strategies to engage climate finance institutions, exemplified by the *Climate Finance Strategy of Belize, 2021–2026* and the *Green Climate Fund Strategic Framework and Country Programme, 2022–2026*. The government has also developed sector-specific adaptation plans for coastal areas and fisheries, freshwater, and agriculture. However, Belize’s approach to adaptation is often fragmented, and there is a lack of coordination between government departments. Interviewees noted, for example, that the Port Authority was not consulted during the development of the coastal and fisheries adaptation plan.¹¹⁹

Belize also benefits from its network of protected areas across its land and waters, the National Protected Areas System. The National Protected Areas System protects 36.6 percent of the country’s land and 10.8 percent of its marine environment and is characterized by a high level of co-management, a model that has received high praise internationally.¹²⁰ Thirty percent of mangroves and over 40 percent of both corals and seagrasses are within protected areas.¹²¹ Nearest to Belize City are the Burdon Canal nature reserve and Swallow Caye wildlife sanctuary just offshore. Also critical to the city are the protected areas around Turneffe Atoll (just over 30 kilometers offshore) and the Crooked Tree Wildlife Sanctuary in the Belize River watershed. The regulations that protect the National Protected Areas System, however, have been criticized as outdated and ineffective, particularly in the face of expanding tourism and other development priorities.¹²² In Crooked Tree, for example, local stakeholders highlighted causeways that inhibited the ability of the wetlands to manage floodwaters from the Belize River, thereby increasing flooding downstream in Belize City.¹²³

Belize is taking action to further strengthen the protection of key ecosystems. Belize’s blue bond agreement included an expansion of Biodiversity Protection Zones to cover 30 percent of Belize’s oceans, now enshrined in the Belize Sustainable Ocean Plan (BSOP). Belize launched the planning process for the BSOP in November 2022, and it is expected to be finalized by 2026. In addition, the Belize Mangrove Alliance Action Plan 2022–2027 aims to bring together an alliance of national organizations, civil society, key public sector organizations, local communities, and academic institutions to strengthen protections for mangroves in Belize.¹²⁴ The Mesoamerican Reef Fund launched a parametric insurance program to rapidly pay out funds for coral reef repair after a hurricane; the first pay-out happened on November 2, 2022, when Hurricane Lisa hit the reefs of Turneffe Atoll.¹²⁵ The World Bank has also supported strengthening Belize’s marine protected areas, including around Turneffe Atoll, through the *BZ Marine Conservation Climate Adaptation* project.¹²⁶

Climate adaptation projects in Belize City have focused on improving flood management in the city. The most important such project is the Climate Vulnerability Reduction Program (CVRP) funded by the IDB. The CVRP includes two components. The first is a series of infrastructure investments—including a pumping station, floodgates, and improvements to West and East Collet Canals—to reduce flooding in southern Belize City around Orange Street.¹²⁷ The Yarborough pumping station was inaugurated in October 2023,¹²⁸ with management turned over to the Belize City Council. Local stakeholders noted that

the city has not yet seen sufficiently heavy rainfall to test the station's effectiveness. They also highlighted concerns around canals previously constructed to manage flooding in the Belama Phase 1–4 residential districts. Instead, during high tide those canals reportedly fill with water that becomes stagnant.¹²⁹ Additionally, water still frequently covers neighboring streets, like Apollo Street, inhibiting transit into and out of these areas. Some repairs to the pumping station have also required overseas technical support.¹³⁰ The second component of the CVRP aims to improve disaster risk information sharing, including the development of a web-based platform that will form the foundation of a National Climate Risk Information System.¹³¹

The national and local governments also continue to explore new solutions to strengthen climate resilience in and around Belize City. The national government has installed a pilot automatic water quality monitoring system in Saltwater Caye and is working to quantify the economic value of ecosystem services in Belize.¹³² The Belize City Council, supported by the European Union and UN Development Programme, is piloting electric public transportation and solar photovoltaic installations on municipal offices.¹³³

Challenges to Resilience Planning and Action

Several factors hinder resilience planning and action in Belize City. One of the most significant is securing adequate funding, a problem exacerbated by the city's reliance on central government funding. Although the city receives direct revenue from property taxes, building permits, and traffic enforcement, most of its funding is provided by transfers from the central government. Municipalities also do not have full project autonomy and depend on the central government for project approval, which can delay implementation and limit the municipalities' responsiveness to changing local conditions. Social and economic vulnerabilities also complicate resilience efforts. Many of the city's residents live in flood-prone and water catchment areas, and often lack basic services like electricity, sewer systems, and clean drinking water.

Priority Recommendations to Build Resilience

Belize City faces high and growing risks from both extreme weather events—particularly hurricanes, extreme precipitation events, and extreme heat events—and long-term changes, such as warming ocean temperatures and increasing abundance of sargassum. This CORVI assessment highlights how high public debt, an economic reliance on coastal and marine tourism, and limited available financial resources exacerbate Belize City’s vulnerability to climate impacts. Unmanaged migration into Belize City and increased development also compounds these risks. Protective coastal ecosystems such as mangroves are often cleared to make way for housing and other construction, contributing to coastal erosion and increasing vulnerability to storm surge. The expansion of the built environment in Belize City also reduces the absorptive capacity of the ground, amplifying the extent and damage of flooding. It also increases the urban heat island effect, further raising the temperature and worsening illnesses like cardiovascular disease, diabetes, and asthma.

Invest in Nature-Based Solutions to Strengthen Flood Management

Belize City faces increasing risks from coastal, riverine, and pluvial (rainfall-driven) flooding. While gray infrastructure, such as seawalls and levees, may help reduce one type of flooding (coastal and riverine, respectively), they have several downsides. They are costly, increase erosion, reduce biodiversity, limit public access to beaches and other coastal areas, unduly reduce perceptions of risk and increase development behind such structures, and are difficult to change if risk levels exceed projections.¹³⁴ Belize City may benefit more from investing in increasing its absorptive capacity to allow the ground to absorb, retain, and slowly release floodwaters.¹³⁵ The “sponge cities” are an emerging model for doing this effectively.¹³⁶ This type of investment can provide significant benefits in reducing flooding; one study estimates that every one percentage point increase in the coverage of impervious surfaces (e.g., roads, sidewalks, parking lots) increases the magnitude of flooding by 3.3 percent.¹³⁷ Investments in nature-based solutions should be informed by improved understanding of flooding risk and drainage planning. Supportive policy and institutions can also increase the success of nature-based solutions.

STRENGTHEN KNOWLEDGE AND PLANNING

- **Conduct a comprehensive mapping of flooding vulnerability** in Belize City to identify areas most prone to coastal, fluvial, and pluvial flooding. Stakeholders in the December 2024 workshop noted that existing maps date back to 2014 and need to be updated. The National Hydrological Service and the Belize City Council should take the lead to do so. Since satellite data typically does not have sufficient

resolution for cities,¹³⁸ other technical, such as the use of Lidar sensors and participatory mapping processes, can help fill the gap. External partners, such as the Humanitarian OpenStreetMap Team,¹³⁹ have expertise that is particularly valuable in mapping flooding potential in densely populated areas where geospatial data is often the least effective. This mapping should be supported by investment in dynamic flood modeling that is responsive to changing weather conditions.

- **Assess the value of flooding prevention and other ecosystem services** provided by currently existing mangroves, wetlands, and savannahs in and around Belize City. This assessment should expand on the pilot ecosystem services assessment conducted in cooperation with Stanford University's Natural Capital Project,¹⁴⁰ which focuses on coastal and marine assets. Developing key performance indicators along with monitoring, reporting, and verification processes will help the Government of Belize access finance to implement nature-based solutions and develop regulations that are responsive to changes in ecosystem health and coverage.
- **Update Belize City's master drainage plan** to inform investments in flood management solutions. The current master drainage plan was launched in 2011 as part of the Belize City Master Plan, with the support of the IDB.¹⁴¹ The Belize City Council, in cooperation with national agencies such as the National Hydrological Service, should update this plan to account for population growth, urban expansion, updated climate projections, evaluations of the value of local ecosystems, and updated mapping of flooding vulnerability.

DESIGN SUPPORTIVE POLICY

- **Reform land use policy and design zoning regulations** to protect existing ecosystems that reduce flooding impacts. The Ministry of Natural Resources, Petroleum, and Mining's updating of the National Land Use Policy is currently in the final drafting stage. The Ministry should cooperate with the Ministry of Sustainable Development, Climate Change, and Disaster Risk Management to ensure that the revised policy promotes the protection of key terrestrial and marine ecosystems. In addition, the Protected Areas Conservation Trust has developed draft legislation to guide settlement patterns as part of an integrated coastal development framework. Belize City currently does not have zoning regulations. Such regulations could help restrict development on the existing ecosystems identified as being most important to managing flooding in Belize City. These types of restrictions would be particularly valuable on the margins of Belize City, where urban expansion is currently occurring. The Lands Department, which issues land titles, and Belize City Council, which issues building permits, should coordinate to enforce restrictions on clearing ecosystems for new development. Reforms to building permits could also include stronger housing design regulations to reduce the vulnerability of Belize's housing stock to high winds.
- **Protect and restore natural ecosystems** to increase the absorptive capacity of the land in Belize City. Increasing the ability of inland areas to absorb and retain excessive water from heavy rains, swollen rivers, and flooded coastlines is critical to strengthening Belize City's resilience to flooding. This is particularly important as climate change increases the quantity of rain from hurricanes and intense rainfall events.¹⁴² Increased local absorption throughout the city would also reduce the pressure on the city's water management infrastructure. Wetlands, parks, rain gardens, green roofs,

bioswales,^E and other greenways are all critical ways of increasing ground absorptive capacity,¹⁴³ and have successfully been used in cities such as Nairobi, Mumbai, and Singapore to reduce the impacts of flooding.¹⁴⁴ These types of solutions are also often more cost-effective than seawalls and other gray infrastructure, while providing additional benefits such as water filtration, carbon sequestration, and animal habitat,¹⁴⁵ and reducing the urban heat island effect. Given the high costs of acquiring currently utilized land to restore ecosystems, protection of existing ecosystems should be a high priority, and should be integrated into the “urban renovation” called for in the *National Sustainable Tourism Master Plan*. The Blue Bond and Finance Permanence Unit could build on its experience promoting nature-based solutions, with the support of the National Climate Change Office and the Ministry of Economic Development (MED). The MED could build on the World Bank Belize Blue Cities and Beyond Project,¹⁴⁶ scheduled to start in January 2025, which aims to strengthen Belize’s coastal and blue economy, increase safe water supply, and reduce land-based pollution discharges.

- **Pilot innovative institutions** to support the protection and restoration of natural ecosystems. Given limited financial and technical resources, the Government of Belize could consider innovative institutional frameworks that may leverage available resources most efficiently.
 - One such example is **carbon credits**. Mangroves and coastal wetlands sequester carbon annually at a rate ten times greater than mature tropical forests, making them an excellent candidate for high-quality carbon credits. Carbon credits often require a large minimum ecosystem size, which means this approach would likely be best suited to support the protection of existing ecosystems on the margins of Belize City.
 - Another innovative type of institution is **community land trusts (CLTs)**. CLTs are communal management institutions that develop and steward land for community use, including affordable housing, parks, and community gardens.¹⁴⁷ CLTs can help preserve housing affordability, strengthen community trust and cohesion, support green infrastructure, and advance managed retreat.¹⁴⁸ A useful example of CLTs for Belize City may be the one along the Martín Peña channel in San Juan, Puerto Rico, which was formed in 2004.¹⁴⁹ CLTs would likely be best suited to protecting smaller-scale nature-based solutions within Belize City.
 - **Voluntary property acquisition programs**, also known as buyouts, may be helpful in acquiring currently utilized land to restore natural ecosystems in Belize City. Research in the United States has estimated that buyouts save five to nine dollars for every dollar spent.¹⁵⁰ However, buyouts can also sometimes be slow, expensive, and difficult to administer.¹⁵¹ A pilot program in Belize City, drawing on lessons learned from the variety of buyout programs administered over the past three decades in the United States, may help determine whether such an approach could be useful to Belize City.

^E Bioswales are long, linear strips of vegetation in an urban setting used to collect runoff water. See <https://www.ctc-n.org/technologies/bioswales>.

Prepare for and Support Growth in Outlying Communities

Belize City faces compounding challenges from its low-lying topography and in-migration, both from elsewhere in Belize and from neighboring countries. The city's location—built on top of the soft soil of a river delta—limits the degree to which it can support increased population density by building upward. This forces people to settle in areas of high vulnerability, such as the low-lying southern part of the city. Migrants also sometimes clear protective ecosystems, such as mangroves, to build informal settlements, thereby increasing the city's vulnerability to flooding and coastal erosion. The government is investing in protective and absorptive infrastructure, which will help. These efforts, however, need to be complemented by investments in the communities surrounding Belize City, so that the region can accommodate a greater share of the population while still supporting economic growth and sustainable development.

PREPARE FOR GROWTH IN OUTLYING COMMUNITIES

- **Map climate vulnerability** in the greater Belize City area to identify areas most prone to flooding, extreme heat, and other climate hazards. In order to support the move of people away from highly vulnerable areas in Belize City to lower vulnerability areas in outlying communities, the areas of least vulnerability must be identified. Based on the results of this assessment, vulnerability to flooding and extreme heat should be priorities, but outlying communities may have a different vulnerability profile than Belize City. Integrating geospatial data with community knowledge will be most effective in identifying which communities—and which specific areas of each community—are least prone to flooding and other climate hazards. Based on this information, one or a small number of communities should be identified as candidates for the support outlined below, to avoid spreading resources too thinly.
- **Develop an integrated regional plan** to incentivize growth in, and relocation toward, lower vulnerability areas. The Greater Belize City Initiative provides a foundation for the Belize City Council and municipal governments—supported by the Ministry of Rural Transformation, Community Development, Labor, and Local Government and the National Climate Change Office—to coordinate climate resilience planning and economic development strategies. A regional plan to shift growth toward lower vulnerability areas should also learn from previous efforts to encourage growth in inland areas, such as Mahogany Heights and Blackberry Ridge. It could also learn from Fiji's Planned Relocation Guidelines¹⁵² and the Republic of the Marshall Islands' Pacific Resilience Program II.¹⁵³ This planning should also be structured to allow responsiveness to changing conditions on the ground and to changing needs of residents in outlying communities. The plan could also serve as the foundation for engagement and development between domestic actors and international partners such as multilateral development banks and international climate funders.
- **Develop drainage plans for outlying communities** to reduce their vulnerability to flooding. Communities identified as targets for relocation and growth will need greater investment in flood management measures, and that investment will need to be guided by informed planning to improve drainage. Local governments in target communities should take the lead, supported by the National Meteorological Service, the National Hydrological Service, and the Ministry of Rural Transformation, Community Development, Labor, and Local Government.

SUPPORT GROWTH IN OUTLYING COMMUNITIES

- **Improve basic service provision** to communities surrounding Belize City, such as Hattieville. Interviewees cited the difficulty in accessing basic services, particularly healthcare and education, as a major driver of migration into Belize City rather than towns like Hattieville. The Ministries of Education and Health should coordinate with the Ministry of Sustainable Development, Climate Change and Disaster Risk Management to ensure that new schools, hospitals, and health clinics are built in areas of low vulnerability to flooding.
- **Strengthen transportation infrastructure and expand access to public transportation** between Belize City and surrounding communities. While local economic growth is key to driving the development of the smaller towns around Belize City, strengthening transportation linkages would also help. Facilitating daily commuting for residents in outlying communities to and from their employment in Belize City will help shift populations out of high vulnerability areas in Belize City to lower vulnerability areas in the surrounding towns. Interviewees cited two major challenges with the current transportation linkages: flooding of roads and infrequent public transit service. Investing in climate-resilient roads and more frequent public transit can also help improve evacuation efforts during extreme weather events. This can include building on the E-Mobility Pilot Project implemented by the UN Development Programme, Belize City Council, Ministry of Public Utilities, Energy, Logistics, and E-Governance, and Department of Transport.¹⁵⁴
- **Provide support for economic growth** in outlying communities. Interviewees cited the lack of economic opportunities as another key factor limiting the attractiveness of these communities to migrants moving to the Belize City area. The MED should lead this effort in coordination with local governments. International partners such as the World Bank and the Inter-American Development Bank can support climate-resilient development by investing in job training, providing business development support, and making available loans to micro-, small, and medium-sized enterprises through programs such as the World Bank's International Development Association's Jobs and Economic Transformation agenda.¹⁵⁵ This support could also include preferential tax treatment of companies—such as business process organizations—that relocate to targeted, climate-resilient communities.

Strengthen Institutional Capacity for Climate Resilience

Belize City's climate risks will continue to grow and change over the coming years and decades. As global temperatures rise, extreme weather events such as hurricanes, heavy rainfall, and extreme heat events will become more frequent and, in many cases, more intense. The local context will also not remain static, as economic growth, ecological impacts, and social changes—both in Belize City and further afield in the country and its neighbors—will shape how climate hazards impact Belize City and the surrounding areas. Some of these changes will be unforeseeable, and most of them will reverberate throughout Belizean society. This context demands an institutional architecture that can manage the long-term, changing nature of climate risks, and that is far-sighted and responsive.

- **Support data sharing** to improve coordination around climate resilience actions. Several government agencies either previously have developed or are currently developing data platforms, including the National Climate Change Office; the Ministry of Rural Transformation, Community

Development, Labour and Local Government; the Ministry of Blue Economy; and the Statistical Institute of Belize. It is critical that these platforms at least provide interoperability to allow end users to gain an integrated picture of climate risk. A single, user-friendly visualization tool could effectively communicate complex climate risks to government, the private sector, and civil society to inform their decision-making. This type of tool would require a designated lead agency. Participants in the December 2024 workshop suggested that either the National Climate Change Office or the Statistical Institute of Belize would be an appropriate choice. Successful implementation of a shared climate risk data platform would also require that data sharing mandates be integrated into the workplans of agencies across national and local governments.

- **Share information on climate resilience projects** to address policy and project fragmentation. In addition to climate risk data, a shared platform could host information on proposed, ongoing, and completed climate resilience projects. Several interviewees highlighted fragmentation across agencies and geographies as a major challenge to effective integrated climate resilience. A platform to share information on resilience projects could either be integrated into the data sharing platform or be hosted separately, perhaps by the Climate Finance Unit.
- **Build in-country technical capacity** for staff in key agencies, with a particular focus on climate data collection, analysis, and synthesis. Sustainable climate resilience for Belize City requires informed, qualified, and experienced personnel. Building and maintaining in-country capacity means driving funding that would typically be spent on external consultants *inward*. Recruiting new talent and retaining existing experts is necessary to support the sustainable growth of key programs and agencies, like the National Emergency Management Organization, the National Meteorological Service of Belize, and the Ministry of Natural Resources. Building capacity effectively will require a map of government-wide climate deliverables and programs, a comprehensive assessment of existing staff, and an understanding of future growth.
 - **Strengthen the disaster review capacity** of the National Emergency Management Organization (NEMO). A standardized and independent process to review disaster preparedness, response, and recovery actions in the wake of an extreme weather event helps the agency learn lessons from each disaster event and improve its performance in the future. This review process should be able to offer recommendations to improve policies, operational structures, and actions across government and non-government actors, modeled on the U.S. National Transportation Safety Board, which is an independent agency responsible for civil transportation accident investigation.¹⁵⁶ NEMO could also offer technical assistance to carry out its recommendations, potentially in partnership with the Belize City Emergency Management Organization and with the support of the Caribbean Disaster Emergency Management Agency.
 - **Bolster institutional communication in Belize's disaster early warning system** to strengthen forecasting and response. Thanks to support from international partners like the Caribbean Catastrophe Risk Insurance Facility,¹⁵⁷ Belize has strong national coverage for rainfall and temperature monitoring. However, its early warning system faces challenges in connecting datapoints to inform and direct on-the-ground action.

- Alerts of high rainfall or extreme heat need to be translated to impacts, such as extent of flooding or harm to public health. The National Meteorological Service and NEMO are moving toward impact-based forecasting, and international partners should provide technical support to help model impacts of multiple types of climate hazards. One example of such support is the multi-hazard impact-based forecasting and early warning system being developed for the Belize River watershed, with the support of the Caribbean Development Bank.¹⁵⁸
- Early warnings of impacts from an extreme weather event need to be translated into early action to mitigate those impacts. Implementation of the National Framework for Weather and Climate Services should be central to improving early action. The Framework links the government, civil society, international partners, academia, the private sector, and the public for effective use of climate information and services. It was launched in 2018 in partnership with the World Meteorological Organization, but interviewees reported that little progress has been made in the intervening six years.¹⁵⁹
- **Provide planning and financial support to the tourism industry** through business continuity planning and recovery loans to improve organizational survival. Data from the U.S/ Federal Emergency Management Agency suggests that 40 percent of businesses without a continuity plan will never reopen following an extreme weather event and 75 percent will fail within three years.¹⁶⁰ Business continuity planning helps “protect assets (people, property, operations); sustain the capability to provide goods and services to customers and/or supply chain; maintain cash flow; preserve competitive advantage and reputation; and provide the ability to meet legal, regulatory, financial, and contractual obligations.”¹⁶¹ Government-provided recovery loans to small businesses after extreme weather events also “reduce exit and bankruptcy, increase employment and revenue, and unlock private credit.”¹⁶² This last effect shows that government-provided loans can have a larger impact than their size would suggest by crowding-in investment from the private sector through resolving uncertainty about repair.

Appendices

Appendix 1: Full List of Indicators for CORVI Belize City

ECOLOGICAL RISK

Category	Indicator
Climate	Cases of Vector-Borne Disease Infections
	Change in Sea Surface Temperature
	Mortality Attributed to Heat
	Mortality Rate Attributed to Non-Communicable Diseases
	Total Number of Droughts
	Total Number of Extreme Heat Events
	Total Number of Flood Events
	Total Number of Hurricanes
	Total Number of People Affected by Extreme Weather Events
	Total Number of Wet Days
Ecosystems	Health of Existing Coastal Sand Dunes
	Health of Existing Coral Reefs
	Health of Existing Mangroves
	Health of Existing Seagrass Beds
	Incidences of High Sargassum Abundance
	Level of Coastal Sand Dune Coverage
	Level of Coral Reefs Coverage
	Level of Mangrove Coverage
	Level of Seagrass Bed Coverage
	Percent of GDP Protected by Coastal Sand Dunes
	Percent of GDP Protected by Coral Reefs
	Percent of GDP Protected by Mangroves
	Percent of GDP Protected by Seagrass Beds
	Rate of Occurrence of Harmful Algal Blooms
Fisheries	Capacity of Fisheries Enforcement Institutions
	Fish Consumption Per Capita
	Level of Unreported Catch Estimate
	Nearshore Fish Stock Status
	Number of Fisheries Access Agreements with Foreign Nations
	Number of Incidents of Foreign Vessels Fishing in EEZ
	Offshore Fish Stock Status
	Percent of Fisheries Managed Sustainably

Category	Indicator
Geology/Water	Degree of Saltwater Intrusion in Coastal Aquifers
	Degree of Soil Salinity in Arable Lands
	Level of Geophysical Risk of Landslides
	Percent of Bodies of Water with High Water Quality
	Percent of Landscape that is Arable Land
	Percent of Metro Area at Risk of Flooding
	Piped Water Supply Continuity
	Projected Change in Sea Level Rise
	Rate of Coastal Erosion

ECONOMIC RISK

Category	Indicator
Economics	Debt Ratio
	Income Inequality
	Level of Informal Economy
	Market Losses from Extreme Weather Events
	National GDP Per Capita
	National Unemployment Rate
	National Youth Unemployment Rate
	Percent of GDP Generated in Coastal Cities
	Percent of Population Experiencing Moderate or Severe Food Insecurity
Urban Unemployment Rate	
Infrastructure	Effectiveness of Solid Waste Management Procedures
	Level of Commercial Infrastructure Damage from Extreme Weather Events
	Level of Grid Resilience
	Level of Housing Damage from Extreme Weather Events
	Level of Informal or Unplanned Settlement
	Level of Resilience for Airports
	Level of Resilience for Ports and Shipping
	Level of Resilience for Roads
	Level of Shoreline Development
	Level of Water Distribution Infrastructure Resilience
	Percent of Low-Income Housing in Relation to Flood Zones
	Percent of People Living Below 5 Meters Above Sea Level
	Percent of Population with Adequate Access to Electricity
Proportion of Wastewater Safely Treated	
Renewable Energy Share in Total Energy Consumption	

Category	Indicator
Major Industries	Diversity of Lodging Types
	Percent of National Economy Based in Agriculture
	Percent of National Economy Based in Near Shore Fishing Industry
	Percent of National Economy Based in Offshore Fisheries
	Percent of National Economy Based in Port and Shipping Industries
	Percent of National Economy Based in Tourism Industry

SOCIAL/POLITICAL RISK

Category	Indicator
Governance	Access to Healthcare
	Capacity of Current Disaster Response
	Capacity of Ethics Enforcement Bodies
	Civil Society Participation
	Health Worker Density and Distribution
	Investment in Climate Resiliency Development Projects
	Level of Perceived Transparency Within Government
	National Climate Adaptation Plan
	Rule of Law
	Voter Turnout
Social/Demographics	Dependency Ratio
	National Population
	National Population Density
	Percent of Adult Citizens Living Outside of the Country
	Percent of International Migrants Living in Country
	Percent of Population Achieving Proficiency in Literacy and Numeracy
	Percent of Population at Risk of Mental Health Disorders and Stress-Related Disorders
	Percent of Population Below Poverty Line
	Percent of Urban Population Below 30 Years of Age
	Urban Population
	Urban Population Density
	Urbanization Rate
Stability	Level of Social Tension
	Number of Incidences of Civil Unrest or Instability
	Number of Years that the Current Government Structure has been in place
	Percent of People Employed in Tourism
	Percent of People Employed in Agriculture
	Percent of People Employed in Artisanal and Subsistence Fishing
	Percent of People Employed in Port and Shipping Industries
	Percent of People Employed in the Commercial Fishing Industry

Appendix 2: Organizations Surveyed and Interviewed for CORVI Belize City

List of Organizations Surveyed and Interviewed	
Association of Professional Engineers of Belize	Humana People to People Belize
Atlantic Bank Ltd	Local Government Department
Belize Audubon Society	Ministry of Blue Economy
Belize Biltmore Plaza Hotel	Ministry of Economic Development
Belize City Council	Ministry of Health and Wellness
Belize Electricity Limited	Ministry of Infrastructure Development & Housing
Belize Fisheries Department	Ministry of Natural Resources
Belize Forest Department	Ministry of Rural Transformation, Community Development, Labour, and Local Government
Belize Fund for a Sustainable Future	Ministry of Sustainable Development, Climate Change and Disaster Risk Management
Belize Port Authority	Ministry of Tourism and Diaspora Relations
Belize Red Cross	National Bank of Belize Limited
Belize Sugar Industries	National Climate Change Office
Belize Water Services Ltd	National Emergency Management Organization
Beltraide	National Garifuna Council
Blue Bond and Finance Permanence Unit	National Meteorological Service
Bowen & Bowen	Protected Areas Conservation Trust (PACT)
BRO Consulting	RW Water Solutions
Caribbean Community Climate Change Centre	Social Investment Fund
Coastal Zone Management Authority and Institute	Statistical Institute of Belize
Danaus Consultants	Sustainable Development Unit
Development Finance Corporation Belize	TaiwanICDF
Financial Service Commission	The Belize Chamber of Commerce & Industry (BCCI)
Fisheries Department	The Nature Conservancy
Forest Department	The University of the West Indies
Galen University	Turneffe Atoll Sustainability Association
Geology & Petroleum Department	University of Belize
Government of Belize	Wildlife Conservation Society
Healthy Reefs for Healthy People	World Wildlife Fund
Hol Chan Marine Reserve	

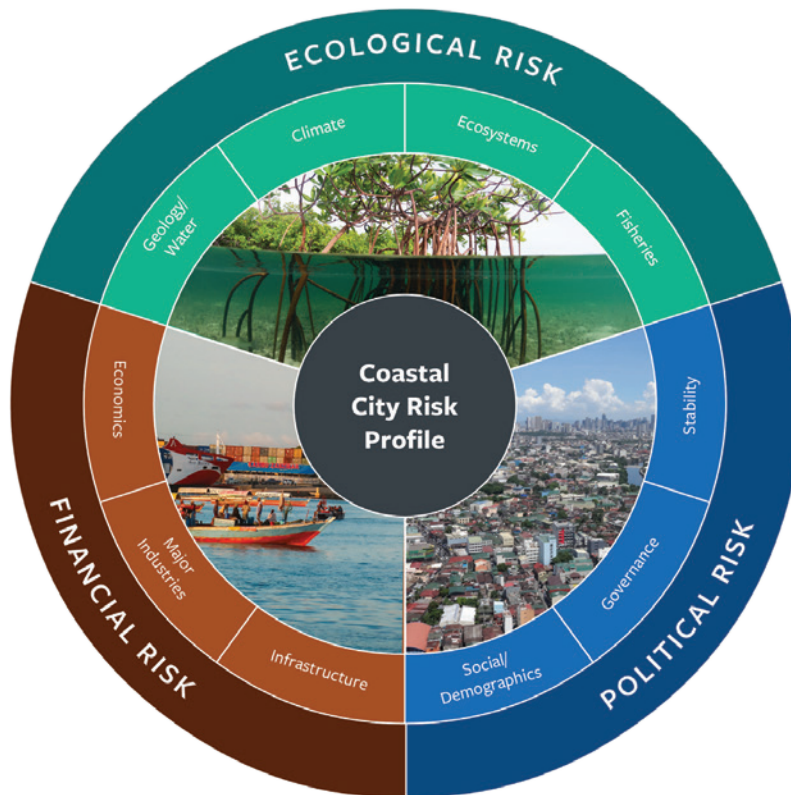
Appendix 3: The Climate and Ocean Risk Vulnerability Initiative

It is clear that urban coastal areas are likely to experience the earliest onset and potentially most severe impacts from climate change. The risks associated with climate change for specific coastal cities, however, are much more difficult to untangle. In order for coastal cities to efficiently allocate resources and enact effective adaptation strategies, it is critical that they understand their multidimensional climate risk. However, these efforts are impeded by poor and incomplete data.¹⁶³ Data on climate risks is rarely available at the city level, and when it does exist, it is often poorly managed and stored in silos that make it difficult to access and use, even for city government officials.¹⁶⁴ This issue is compounded by technical, financial, and capacity gaps, trapping coastal cities in a vicious cycle where they cannot develop holistic strategies to prioritize investment and access the funds needed to implement resilience actions.

Without data at the appropriate geographic scale, decision-makers are often left with the choice of either waiting for greater data availability, or attempting to downscale national level data, neither of which are ideal solutions for effective climate change adaptation. This problem is particularly acute in small and intermediate cities, which along with absorbing the bulk of East Africa's future urban population growth, often lack the resources to gather and maintain necessary data.¹⁶⁵

Despite these challenges, decision makers need to act now in the face of uncertainty to build resilience to the climate crisis. To do this, they need tools that will enable them to consider multidimensional climate risks, develop cohesive strategies, and utilize this information to unlock additional climate finance and implement resilience actions.

In response, the Stimson Center developed the Climate and Ocean Risk Vulnerability Initiative (CORVI). CORVI is a decision support tool which compares a diverse range of climate-related risks across the land-seascape to produce a coastal city risk profile. These risks are displayed across 10 categories, grouped under three risk areas: ecological, financial, and political (see figure 2). The 10 categories are in turn made up of close to 100 indicators, covering a range of issues including the vulnerability of vital infrastructure, the health of marine ecosystems, and urbanization dynamics in the chosen coastal city. Each indicator and category are scored using a 1–10 risk scale relative to other cities in the region, offering a simple reference point for decision-makers looking to pinpoint and categorize climate risks. The CORVI risk scores, which form the basis of a coastal city risk profile, are augmented with existing academic and grey literature, government documents, and key informant interviews to develop a comprehensive narrative and understanding of the coastal city's climate risks and identify priority policy recommendations.



HOW CORVI IS DIFFERENT

CORVI builds on the work of previous indices but is distinct in three ways.

- 1 **Locally-Based:** Unlike many other indices which tend to focus on the national or regional level, CORVI is city or small island based, providing sub-national level detail on the nature and impact of climate and ocean risks. This focus is based on extensive interviews with potential issuers of the CORVI tool, who noted that climate change is local and the difficulty of down-scaling national level risk and vulnerability data to inform policy action to build climate resilience in specific communities.
- 2 **Holistic:** CORVI looks across a broad set of ecological, economic, social and political risk factors connected to climate change impacts and that influence vulnerability of coastal cities and their residents. As part of the category and indicator selection process, indicator inclusion was primary based on its ability to capture and explain climate change risks in coastal cities, and not if data was available. This approach promotes a holistic understanding of climate change impacts to coastal cities.
- 3 **Data Driven:** Through using Structured Expert Judgment (SEJ), CORVI is suited to producing actionable insights in data sparse environments. By combining empirical and survey data across a wide range of indicators, CORVI fill data gaps to provide a holistic assessment, while reducing data availability bias. This approach provides a contextual and data driven assessment of climate and ocean risk vulnerability.

CATEGORIZING RISK



Interpreting Risk Scores

Low risk scores mean that either the coastal city has successfully built resilience in the issue area or the indicator is not as relevant for understanding risk in that city.

Medium risk scores indicate that while resilience has been built to address the specific risk, future changes could destabilize resilience gains.

Medium-High risk scores mean that current measures are insufficient and more attention is required to build resilience against future climate security impacts.

High risk scores indicate that the issue area represents a key threat to the coastal city with the potential to undermine the security of its residents.

CORVI began in 2018, with the first two assessments—of Castries, Saint Lucia and Kingston, Jamaica—completed and published in 2020. CORVI is now operating in 16 countries around the world, from the Caribbean to the South Pacific. The project now includes both full assessments, which incorporate around 100 risk indicators distributed across the 10 risk categories, along with rapid assessments, which incorporate 30-35 risk indicators across the same 10 risk categories.

ADVANCING THE SUSTAINABLE DEVELOPMENT GOALS

CORVI also aims to contribute to the delivery of the SDGs—an essential framework to guide lasting, positive change. By providing data and information to measure climate risks in coastal cities, this project supports the delivery of the following SDGs:



CORVI operates in collaboration with national governments authorities for every assessment. As a locally driven, comprehensive assessment of ocean and climate risk and vulnerability, the CORVI team engages with a wide range of partners on the ground, including national and local government, the private sector, civil society, and academia.

CORVI ASSESSMENT STATUS



Rapid Assessments Completed

- Western Province, Sri Lanka
- Southwestern Urban Corridor, Barbados
- Tarawa, Kiribati
- Dominica
- Mauritius



Full Assessments Completed

- Basseterre, St. Kitts and Nevis
- Belize City, Belize
- Castries, St. Lucia
- Chattogram, Bangladesh
- Dagupan, Philippines
- Dar es Salaam, Tanzania
- Kingston, Jamaica
- Mombasa, Kenya
- Toamasina, Madagascar
- Suva, Fiji



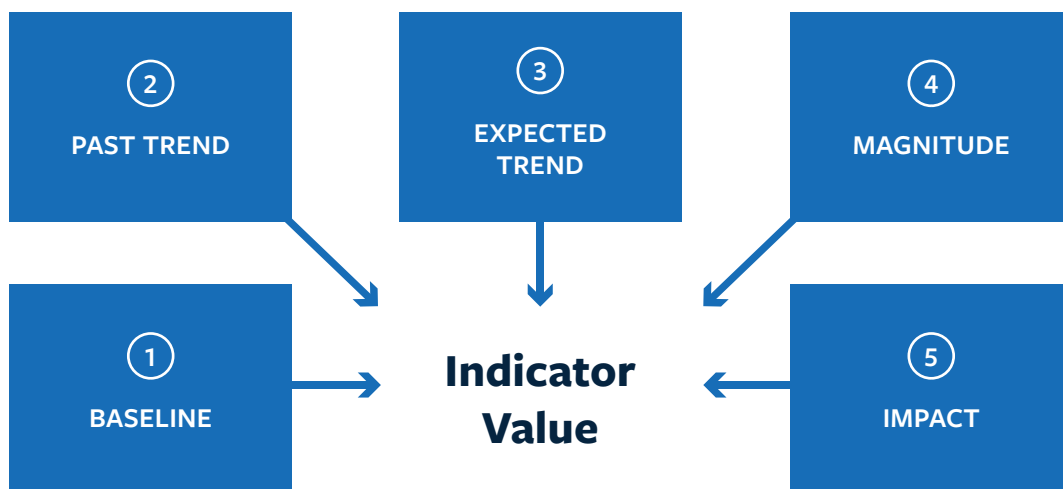
Assessments Underway

- Aruba

INDICATORS

To ensure that the CORVI indicator scores provide a holistic risk rating, each is made up of five factors: current, past, and expected trends, the rate of change of the risk, and the impact of this risk on the coastal city.

- 1 The **BASELINE** measures the current level of risk for each indicator relative to other coastal cities in the region. Baseline data for economic and social indicators is derived from the most recent year of complete data. Climate indicators use a longer time period of 15 years.¹⁶⁶
- 2 **PAST TREND** assesses the trend of risk for the past 10 years, measured from the baseline year. The only exception to the 10-year trend measure are the climate indicators, which use a 15-year trend horizon to account for slow onset changes.
- 3 **EXPECTED TREND** assesses the anticipated trend of risk in the next 10 years, measured from the baseline year. The only exception to the 10-year trend measure are the climate indicators, which use a 15-year trend horizon to account for slow onset changes.
- 4 **MAGNITUDE** assesses the degree of expected future trend change relative to other cities in the region. Change that happens quicker than expected is assumed to increase risk when compared to changes that take place over a longer time scale. This assumes that longer time periods of change contribute to less risk, as decision makers have more time to adapt and build resilience.
- 5 Finally, **IMPACT** assesses the importance of change for each indicator in describing future risk in the coastal city.



DATA COLLECTION AND STRUCTURED EXPERT JUDGEMENT

To overcome data gaps, CORVI employs structured expert surveys to collect data that is otherwise unavailable. This primary data is combined with secondary data using the approach of structured expert judgement (SEJ) to produce a comparative score for each indicator in the assessment.¹⁶⁷ SEJ is well-established social science technique that seeks to quantify risk when pre-existing secondary data is inadequate. Through interviews and surveys, as well as a series of weighting procedures to ensure data is representative, SEJ allows researchers to quantify topics that might otherwise be challenging to study in such a systematic fashion.

To apply SEJ to CORVI, subject matter experts across academia, government, civil society, and the private sector are identified through research and extensive outreach to stakeholders in the target coastal cities. These experts then refer the project team to other experts and stakeholders with appropriate expertise using “snowball sampling.”¹⁶⁸ To guard against confirmation bias, survey answers are compared to a regional secondary empirical dataset to weigh the expert responses by utilizing a coherence check.¹⁶⁹ This ensures that experts whose answers do not match secondary data are not weighed as highly as those who do.

This approach has several strengths. First, CORVI incorporates the views of subject matter experts and local stakeholders at each stage of its implementation. This allows the final product to better reflect the specific context which it is seeking to measure and provide more focused information for end users. Second, pairing primary survey data with secondary data through SEJ also allows CORVI to provide insight into risks relating to urban coastal environments that existing secondary datasets do not cover. While the use of SEJ allows CORVI to assess a diverse range of risks, it should not be regarded as a substitute for empirical data collection. Rather, SEJ is best viewed as an alternative research technique specialized to analyzing topics with significant data gaps.¹⁷⁰

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- ¹⁷⁰ 194 H. Kunreuther, S. Gupta, V. Bosetti, R. Cooke, V. Dutt, M. Ha-Duong, H. Held, J. Llanes-Regueiro, A. Patt, E. Shittu, and E. Weber, “Integrated Risk and Uncertainty Assessment of Climate Change Response Policies,” in O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel, and J.C. Minx (eds.), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge and New York: Cambridge University Press, 2014).

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