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REPORT

Resources & Climate

Environmental Security Program

The Climate and Ocean Risk Vulnerability Index

CORVI: Measuring Multidimensional Climate Risks in Aruba

By Carolyn Gruber, Lead Author; Natalie Fiertz, Co-Author; Tracy Rouleau, Author; Madelyn MacMurray, Author; Lauren Risi, Editor

ABOUT STIMSON

The Stimson Center promotes international security, shared prosperity & justice through applied research and independent analysis, deep engagement, and policy innovation. For three decades, Stimson has been a leading voice on urgent global issues. Founded in the twilight years of the Cold War, the Stimson Center pioneered practical new steps toward stability and security in an uncertain world. Today, as changes in power, environment, and technology usher in a challenging new era, Stimson is at the forefront: Engaging new voices, generating innovative ideas and analysis, and building solutions to promote international security, prosperity, and justice.

As the climate crisis accelerates, competition over natural resources intensifies, and shifting demographics reshape global systems, the connections between environmental change and security are becoming increasingly complex — and consequential. Through cross-sectoral, solutions-driven analysis, and inclusive dialogue among international stakeholders across governments, civil society, industry, and communities, the Stimson Center's Environmental Security Program works to illuminate emerging risks and advance pragmatic strategies to build resilience for communities and countries.

Acknowledgments

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Cover photo: Coastal landscape in Aruba. Credit: Ryan Peterson.

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CORVI: Measuring Multidimensional Climate Risks in Aruba

> **In Aruba — where the economy is tethered to the health and resilience of coastal ecosystems — climate change is an existential threat.**

By Carolyn Gruber, Lead Author; Natalie Fiertz, Co-Author; Tracy Rouleau Author; Madelyn MacMurray, Author; Lauren Risi, Editor

This island-wide CORVI assessment unpacks the multidimensional and compounding impacts of climate change in Aruba. Rising sea levels, more intense and longer-lasting heat and drought, and coastal erosion threaten virtually all aspects of life in Aruba — from housing and healthcare to tourism, utilities, and infrastructure. Drawing on 94 environmental, social, and economic risk indicators, the analysis identifies both urgent vulnerabilities and opportunities to strengthen resilience. Investing in ecosystem restoration, advancing a robust spatial development plan, and reinforcing economic resilience can position Aruba as a regional leader in climate-smart governance.

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Foreward

Our home, a paradise known for its pristine beaches, vibrant culture, and welcoming people, stands at a critical juncture. The very natural beauty that defines Aruba is now facing an unprecedented threat: the accelerating impacts of climate change. This research report, prepared by the Stimson Center, serves not only as a record of distress, but more importantly, as a beacon of commitment and a call to national action. We are grateful to all the partners and stakeholders who participated in this comprehensive study and continue to be actively engaged in strengthening Aruba's climate resilience.

This report presents with stark sincerity the multiple vulnerabilities we face, from the direct risks to our coastal communities to the cascading effects on our economy and the most vulnerable in our community. It confirms what many of us have seen with our own eyes — the degradation of our precious coral reefs, the increasing intensity of extreme heat, and the delicate balance of an ecosystem that sustains our way of life. The report's findings are a powerful reminder that our prosperity is not separate from the health of our society and environment; they are inextricably linked.

However, this report is not a conclusion; it is a starting point of a transformative and transformational enterprise. It provides us with a clear, data-driven roadmap to fortify our island's resilience. It challenges us to look beyond conventional solutions and embrace innovation, collaboration, and a shared sense of responsibility. Building climate resilience is not a task for any single ministry, business, foundation, or non-governmental organization. It is a shared national endeavor that requires a whole-of-society approach. It calls for our government to enact forward-thinking legislation and policies, for our private sector to invest in responsible practices, for our academic institutions to drive research, and for every citizen to become a steward of our natural and cultural heritage.

The challenges are significant, but so, too, is our potential. Our history is a testament to our resilience and adaptability. Let this report galvanize us to move from awareness to action. Let us build a more inclusive and climate resilient Aruba, not just for ourselves, but for the generations to come. We are confident that by working together, we can transform these vulnerabilities into opportunities to strengthen our island and safeguard our future.

With deepest gratitude,

Ryan R. Peterson, PhD
Chairman
National Climate Resilience Council of Aruba

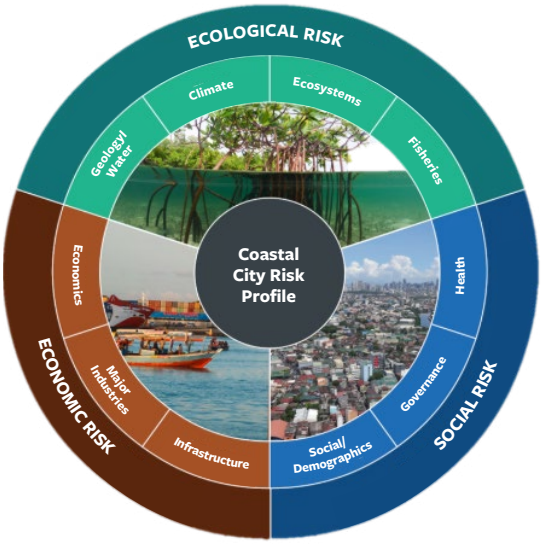

Hadicurari

Introduction

The Climate and Ocean Risk Vulnerability Initiative

For coastal cities and small islands, efficiently allocating resources and enacting adaptation strategies are imperative. Yet these efforts are often hindered by incomplete or unavailable subnational data as well as technical, financial, and capacity gaps. The result is a cycle where coastal communities struggle to develop comprehensive strategies, secure funding, and implement resilience measures. Breaking this cycle requires tools that account for multidimensional climate risks and support cohesive planning to unlock climate finance and advance resilience efforts.

THE CORVI TOOL



In response, the Stimson Center developed the Climate and Ocean Risk Vulnerability Initiative (CORVI), a decision-support tool that compares a diverse range of climate-related risks across the land-seascape to produce a coastal city risk profile. Risks are organized across 10 categories within three areas — ecological, economic, and social — and assessed through nearly 100 indicators tailored to each community.[1] These indicators capture factors such as infrastructure vulnerability, marine ecosystem health, and urbanization dynamics. The CORVI risk scores, which form the basis of a coastal city risk profile, are supported by existing academic and grey literature, government documents, and semi-structured interviews with key informants.

THE CORVI METHODOLOGY

To overcome data gaps, CORVI uses structured expert surveys to collect site-specific 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. SEJ is a well-established social science technique that seeks to quantify risk when pre-existing secondary data is inadequate. Through interviews and surveys with subject matter experts across academia, government, civil society, and the private sector, 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 a systematic fashion. Pairing primary survey data with secondary data through SEJ allows CORVI to provide insight into risks relating to urban coastal environments that existing secondary datasets do not cover.

USING THE CORVI RESULTS

CORVI integrates quantitative and qualitative data to create a comprehensive, interdisciplinary picture of a coastal city's climate risks. This approach highlights the interconnections that can either exacerbate or reduce overall vulnerability, helping decision-makers identify interdependent ocean and climate-related risks, allocate resources effectively, make proactive decisions, and avoid costly mistakes. Armed with the CORVI results and recommendations, decision-makers and policymakers in governments, international financial institutions, civil society, and the private sector can better target adaptation and resilience efforts. Assessments in Kingston, Belmopan, and Belize City have led to prioritized actions — advancing nature-based solutions like flood mitigation and coastal restoration, promoting more integrated urban planning, strengthening institutional capacity, and supporting social protection programs.

Executive Summary

Under business–as–usual greenhouse gas emission scenarios, Aruba faces a dramatic climate transformation in the coming decades.[2] Rising sea levels, more intense and longer-lasting heat and drought events, and accelerating coastal erosion are urgent and dynamic challenges that will have wide-ranging and significant impacts on Aruba's public health, tourism, energy systems, critical infrastructure, and coastal ecosystems.

This Climate and Ocean Risk Vulnerability Initiative (CORVI) assessment, funded by the Government of Aruba and its CORVI partners, provides a comprehensive overview of these risks. The CORVI methodology[3] builds on national level data and closes information gaps through extensive surveys and interviews[4] with local experts. The subnational data generated by the assessment provides a more complete picture of climate risks at both the local and regional levels.[5]

Based on the CORVI assessment data — both quantitative and qualitative — three clusters of risk in Aruba emerge as the most urgent for policy- and decision-makers to address:

1. **Declining Ecosystem Health**
2. **Changing Demographic Patterns**
3. **Fragilities of a Tourism-Dependent Economy**

These risk clusters highlight the critical interdependencies between the health and resilience of Aruba's tourism economy, and the health and resilience of the community and nature. They underscore the multidimensional and compounding impacts of climate change in Aruba, including the loss of biodiversity, intensifying urban expansion, strained infrastructure, and diminishing returns from unregulated tourism growth.[6]

The Government of Aruba, together with partners in civil society, the private sector, and academia, has opportunities to strengthen and better integrate climate resilience into decision-making, beginning with its governance framework. Embedding climate change and its anticipated impacts across all government ministries and departments — in plans, programs, and budgets — will help solidify Aruba's position as a regional leader in climate-smart governance.

INVEST IN VITAL INFRASTRUCTURE THROUGH ECOSYSTEM RESTORATION

Several ecological risk indicator scores rank among the highest in the Aruba risk profile, reflecting significant vulnerabilities tied to the declining health of coastal ecosystems, compounded by climate-driven shifts in weather patterns and extreme weather events. Healthy coastal and marine ecosystems serve as critical "lines of defense" against wave energy and flooding, while also providing co-benefits such as habitat for nearshore fisheries. Investing in ecosystem restoration is therefore essential to lay the groundwork for nature-based solutions that strengthen climate resilience. To achieve this, the Aruban government, private sector, and civil society should work together to protect existing marine ecosystems, restore degraded areas, and prioritize the health — and long-term resilience — of all Aruba's coastal environment.

DEVELOP AND IMPLEMENT AN INCLUSIVE SPATIAL DEVELOPMENT PLAN

Increased population and economic activity along Aruba's coastal strip are expanding the human footprint and placing pressure on fragile ecosystems. New developments are clearing and fragmenting natural protections, heightening vulnerability to climate, and intensifying the urban heat island effect. At the same time, the aging of both Aruba's resident and tourist populations is increasing their susceptibility to heat-related illnesses and reducing their ability to cope with storm events. Reducing Aruba's climate vulnerability will require deliberate shaping of residential and commercial growth through a comprehensive spatial development plan. Updating Aruba's Spatial Planning Ordinance is a key step, but a forward-looking plan must go further — and be grounded in inclusive, community-based, and multi-stakeholder dialogue that integrates nature-based approaches to ensure its sustainable success.

STRENGTHEN THE RESILIENCE OF ARUBA'S ECONOMY

Aruba's economy is concentrated in coastal tourism, particularly along the northwestern coastline running north from Oranjestad. Increasing climate hazards — particularly extreme heat, coastal erosion, and storms — threaten both the infrastructure and ecosystems that sustain this sector. At the same time, rapid tourism growth has strained existing infrastructure and public services while fueling social tensions and inequality. Strengthening the resilience of Aruba's built environment and natural ecosystems will be critical to sustaining the tourism economy. These efforts should be complemented by measures to boost the industry's capacity to withstand and recover from extreme weather, diversify tourism towards less climate-vulnerable models, and support the development of synergistic industries. Transparent, inclusive planning for the tourism sector can further enhance effectiveness by improving coordination and cooperation across stakeholders.

Revitalization of Lagoen parking lot area. Credit: Aruba Department of Nature & Environment.

Climate Risks to Aruba

Least responsible yet hardest hit, island nations are on the frontlines of the climate crisis. The Caribbean's total share of global carbon dioxide emissions is just 0.3%, yet its countries face climate impacts that threaten the fabric of their communities and the foundations of their economies.[7] From stronger, earlier hurricanes, to longer and hotter periods of extreme heat, coastal erosion, and sea level rise, climate change poses an existential threat to the Caribbean region — and to island nations around the world. In Aruba, where the economy depends on the health and resilience of coastal ecosystems, a perfect storm emerges. The island's small, open, tourism-dependent economy is exceptionally vulnerable, with climate impacts directly threatening the infrastructure that underpins daily life and economic stability, from hotels and housing to healthcare services and vital public utilities.

Under business-as-usual greenhouse gas emission scenarios, Aruba is facing a dramatic climate transformation in the coming decades.[8] The island's average annual mean surface air temperature is expected to rise from 26.81°C (2020-2039) to 28.64°C (2080-2099), accompanied by a severe expansion of periods of excessive heat. From 1951 to 2020, Aruba's most intense heat typically lasted three months, from August through October. By 2100, extreme temperatures are projected to persist for seven months, stretching from May through November. This profound shift poses urgent challenges with far-reaching and substantial impacts on public health, tourism, energy, systems, critical infrastructure, and coastal ecosystems.

Aruba's water resources will also face additional stress. Annual rainfall is projected to drop nearly 14%, from 678.02 millimeters (1995-2014) to 583.89 millimeters (2080-2099). At a granular level, Aruba's precipitation patterns will shift towards increasingly extreme and unpredictable rainfall patterns with longer drought periods interrupted by intense but brief storm events. The combination of rising temperatures, extended heat periods, and reduced precipitation with greater rainfall variability will fundamentally alter Aruba's climate profile and adaptive capacity.

This Climate and Ocean Risk Vulnerability Initiative (CORVI) assessment, funded by the Government of Aruba and its CORVI partners, provides a comprehensive overview of the climate risks and vulnerabilities facing Aruba. The CORVI methodology[9] builds on national level data and fills information gaps through

extensive surveys and interviews[10] with local experts. This subnational data creates a more complete picture of the local and regional climate risks and vulnerabilities.[11]

Based on the CORVI assessment data — both quantitative and qualitative — three clusters of risk in Aruba emerge as the most urgent for policy- and decision-makers to address:

1. **Declining Ecosystem Health**
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RISK CLUSTER 1: DECLINING ECOSYSTEM HEALTH

The first cluster of risks relates to the essential role that coastal and marine ecosystems play in supporting Aruba's coastal communities, growing its blue economy, and ensuring its long-term climate resilience. Several ecological risk indicator scores rank among the highest in the Aruba risk profile, reflecting substantial vulnerabilities driven by coastal erosion and declining health of key ecosystems. The **Coverage** and **Health of Sand Dune Systems, Sea Grass Beds, Mangroves, and Coral Reefs** received scores of 6.02 and above, with the highest concerns related to **Coral Reef Coverage** (medium-high risk, 7.24), the **Health of Existing Coral Reefs** (high risk, 7.78), and **Mangrove Coverage** (high risk, 8.92).

Healthy coral reefs, mangroves, seagrass beds, and sand dunes can play an enormous role in climate resilience by serving as natural barriers that reduce coastal erosion, control flooding, and absorb wave energy.[13,14] Surveys and interviews with experts overwhelmingly indicate that Aruba's coastal and marine ecosystems are under threat from existing and expanding coastal development, overuse, and fragmentation. The decline of these ecosystems reduces coastal protections, endangers the growth and sustainability of Aruba's sun-sand-sea tourism-based economy, and limits nature-based adaptive solutions to climate change. Rising sea levels, **Coastal Erosion** (medium-high risk, 7.43), particularly for Druif Beach and Eagle Beach, invasive species, and terrestrial and marine heat waves further degrade and disrupt these ecosystems, increasing Aruba's vulnerability to acute **Extreme Heat Events** like heat domes and marine heat waves (medium-high risk, 6.86), as well as longer-term changes such as **Change in Sea Surface Temperature** (medium-high risk, 6.28), and more frequent and prolonged **Droughts** (medium-high risk, 7.17).

Beyond ecosystem services to support economic security, small islands like Aruba are already inherently limited in terms of availability of natural resources to support food and water security, as reflected in the high risk scores for **Percent of Arable Land** (8.07) and **Bodies of Water with High Water Quality** (7.93).[15] These scores indicate serious threats to Aruba's freshwater supply and reinforce Aruba's dependence on imports to provide food, energy, and other materials to meet community and industry needs.

RISK CLUSTER 2: CHANGING DEMOGRAPHIC PATTERNS

The second cluster of risks arises from Aruba's shifting population patterns, which increase its vulnerability to climate hazards. The most important of these changes is the increase in Aruba's **National Population Density** (high risk, 8.96). Between 1988 and 2018, Aruba's population density increased from 330 to 605 people per square kilometer, an increase of 83%.[16] The Central Bureau of Statistics Aruba (CBS) projects that the population will grow by an additional 28,000 people between 2020 and 2040, an increase of over 25% in 20 years.[17] These figures only include Aruban residents, not tourists and temporary migrants. In 2019, on an average day, Aruba hosted 21,518 stayover visitors, 2,568 cruise visitors, and 17,000 undocumented Venezuelan migrants, increasing the island's population density by more than 36%.[18] The ongoing expansion of hotel rooms and other short-term rentals and accommodations will lead to a continued increase in tourist numbers and population density.[19]

Aruba's population is concentrated along the coast where communities are vulnerable to storm surge and coastal erosion. Coastal development drives ecosystem destruction by clearing mangroves, increasing pressure on sand dunes, and pushing people into **Informal or Unplanned Settlements** (medium-high risk, 6.72). These losses reduce the natural protection of coastal ecosystems and heighten vulnerability to coastal hazards. The density of populations and structures are also increasing the urban heat island effect in Aruba, driving up temperatures and the incidence of heat-related illnesses, and limiting space for adaptation solutions, such as grey measures like seawalls and green measures like ecosystem restoration. Rapid urbanization is also straining public services, particularly those as already under stress, like wastewater treatment.

Aruba is also experiencing a rapidly aging population. The share of the population aged 65 and above nearly tripled in thirty years, rising from 6% in 1994 to 17% in 2024.[20] The proportion aged 80 and above is projected to grow by 3.6 times between 2020 and 2040, reaching 9% of the population.[21] At the same time, Aruba's tourist population is aging, with visitors over 60 accounting for over one-fifth of all visitors in 2022.[22] Older populations are more vulnerable to climate hazards such as extreme heat, as reflected in the medium-high risk score for **Mortality Attributed to Non-Communicable Diseases** (7.18), and face greater challenges evacuating during storms. In addition, an aging Aruban population increases pressure on the island's old-age pension system[23], further straining the very resources needed to support the aging population's ability to adapt to climate change.

RISK CLUSTER 3: FRAGILITIES OF A TOURISM-DEPENDENT ECONOMY

The third cluster of risks for Aruba relates to the fragilities of the island's tourism-dependent economy, as reflected in the high risk scores for **Percent of National Economy Based in Tourism Industry** (8.83) and the **Percent of People Employed in Tourism** (9.59). Tourism accounts for approximately 70% of Aruba's economy,[24] an increase from 65% prior to the COVID-19 pandemic. Tourism makes up an even larger share of employment in Aruba, exceeding 88% as of 2023,[25] and experts rated it as the highest risk indicator in this assessment.

Tourism in Aruba is overwhelmingly based around a sun-sand-sea model, leading to a heavy concentration of people, infrastructure, and economic activity on the country's coastline. This concentration of development has led to the destruction of and damage to coastal ecosystems, reducing the protections they offer and increasing the **Level of Commercial Infrastructure Damage from Extreme Weather Events** (high risk, 8.36). In addition to direct damage, storms and other extreme weather events can deter tourists, who may choose alternative destinations if they perceive a high risk of disruption. On the other hand, Aruba's location at the outer edge of the Caribbean Hurricane Belt could provide an opportunity to increase its relative tourism advantage vis-à-vis regional neighbors.

Aruba's tourism economy also faces significant risks from extreme heat. Already one of the hottest countries in the world,[26] Aruba is projected to experience a greater **Number of Extreme Heat Events** (medium-high risk, 6.86), including heat domes intensified by the urban heat island effect along its highly developed coastline. As one interviewee observed, "*A lot of people are feeling that the heat is too much. [It is hot at] all times, it used to be a very specific time of the year, maybe September, October, but now [it is hot] throughout the year.*"[27] The aging of both Aruba's resident and tourist populations[28] heightens vulnerability to heat-related illnesses, as reflected in the medium-high risk score for **Mortality from Non-Communicable Diseases** (7.18).[29] Interviewees consistently expressed concern for those most exposed to extreme heat — hotel staff, landscapers, airport ground crews, the elderly, schoolchildren at recess, and even pets. Heat-related mortality for people over 65 years of age increased by approximately 85% between 2000–2004 and 2017–2021.[30] Marine heatwaves add another dimension of risk, threatening the island's natural attractions. Coral reefs, which account for more than 20% of tourist expenditures,[31] are increasingly vulnerable to bleaching and loss as global temperatures rise.[32]

Beyond its vulnerability to climate hazards, Aruba's tourism-dependent economy creates other challenges. Tourism growth is no longer an effective driver of economic growth; between 2009 and 2019, annual visitors rose 37%[33] while GDP per capita rose only 5%.[34] Aruba's tourist arrivals are also heavily concentrated in a single market, the United States. Just three states — New York, Massachusetts, and New Jersey — accounted for one-third of all stopover visitors to Aruba in 2024.[35] This lack of diversification makes Aruba's economy highly vulnerable to economic fluctuations in the U.S. economy, and to the regional economies of the Mid-Atlantic and New England specifically. Finally, overreliance on tourism has contributed to growing income inequality in Aruba.[36]

View of Aruba's coastline. Credit: Ryan Peterson.

Ecological Risk

Aruba is renowned for its warm, steady climate, white-sand beaches, mangroves, coastal forests, coral reefs, and saliñas[37].[38] Its coastal and marine ecosystems not only attract tourists — the cornerstone of Aruba's economy — but also provide critical natural defenses against coastal erosion and flooding. Healthy and resilient ecosystems offer essential goods and services to coastal communities; they stabilize sediments, support water filtration and flood management, protect coastlines from storm surge, support diverse fisheries, and maintain biodiversity.[39] The **loss** of these ecological communities can result in broader ecosystem collapse.[40]

- The **ECOSYSTEMS** category (expert weighted average score of 6.46) demonstrates the important role that healthy and resilient ecosystems can play in reducing vulnerability to climate change. Every indicator in this category but one (Sargassum Abundance) received a medium-high or high-risk score. The **Coverage** and **Health of Sand Dune Systems, Sea Grass Beds, Mangroves, and Coral Reefs** received scores of 6.02 and above, with the highest concern around the **Level of Coral Reef Coverage** (7.24), the **Health of Existing Coral Reefs** (7.78), and the **Level of Mangrove Coverage** (8.92).

- The **FISHERIES** category (expert weighted average score of 5.90) illustrates the role fisheries management plays in supporting the growth of a sustainable blue economy. Medium-high risk scores were calculated for **Nearshore Fish Stock Status** (6.50), **Percent of Fisheries Managed Sustainably** (6.47), **Fish Consumption Per Capita** (6.40), and **Offshore Fish Stock Status** (6.17).

- The **GEOLOGY/WATER** category (expert weighted average score of 5.54) reflects serious threats to Aruba's freshwater supply and the impacts on human security. High scores for the **Percent of Arable Land** (8.07) and **Bodies of Water with High Water Quality** (7.93). Medium-high risk scores for the **Rate of Coastal Erosion** (7.43), **Degree of Saltwater Intrusion in Coastal Aquifers** (6.62), **Projected Change in Sea-Level Rise** (5.57), **Degree of Soil Salinity in Arable Lands** (5.39) reflect experts' concerns about increasingly limited on-Island natural resources.

- The **CLIMATE** category (expert weighted average score of 5.23) highlights the threats to Aruba from heat. Medium-high risk scores were calculated for three linked climate indicators, including **Total Number of Droughts** (7.17), **Total Number of Extreme Heat Events** (6.86), and **Change in Sea Surface Temperature** (6.28).

Aruba, along with its neighboring islands, Curaçao and Bonaire, is climatologically unique due to its location off the northwestern coast of Venezuela. Generally, Aruba is much drier than other Caribbean Basin countries; most of the rain in Aruba falls from October to January, whereas in the rest of the region, rain falls from May to October.[41] According to the World Bank, Aruba ranked as the eighth hottest country in the world in 2022 with an average temperature of 28.8°C (83.8°F).[42] This vulnerability to heat is pervasive and will continue to impact ecosystems and people in and around the Caribbean Basin. In Aruba, the effects of heat stress will be particularly acute, which is reflected in the medium-high risk scores for **Total Number of Extreme Heat Events** (6.86) and **Total Number of Droughts** (7.17). These scores, coupled with the medium-high risk score for **Change in Sea Surface Temperature** (6.28), reflect an increased vulnerability to prolonged terrestrial heat and warming waters.

For coastal populations — both local community members and tourists — heat can be dangerous and deadly. Heat stroke, heat exhaustion, and dehydration are directly attributable to extreme and prolonged heat. Vulnerability to heat is shaped by physiological factors, including age and health status, and exposure factors, like occupation and socioeconomic status.[43] Since 1980, the average air temperature in Aruba has increased by at least 1.5 degrees Celsius.[44] Together with an increase in relative humidity across the island, the risks for Aruban citizens and visitors is increasing. Aruba faces a growing likelihood of heat dome formation[45] between May and November, putting communities at greater risk for **Mortality Attributed to Heat** (medium-high risk, 5.64). Extreme heat also worsens non-communicable diseases such as cardiovascular illness, respiratory disease, diabetes, and kidney disease, and this risk is reflected in the medium-high risk score for **Mortality Rate Attributed to Non-Communicable Diseases** (7.18). The difference between these scores can be attributed to the fact that Aruba's elderly population — both residents and tourists — is most vulnerable to non-communicable diseases. Aruba is facing a rapidly growing aging population, and the country's prominent tourism industry is also experiencing an increase in older tourists from the Baby Boomer and Silent generations.

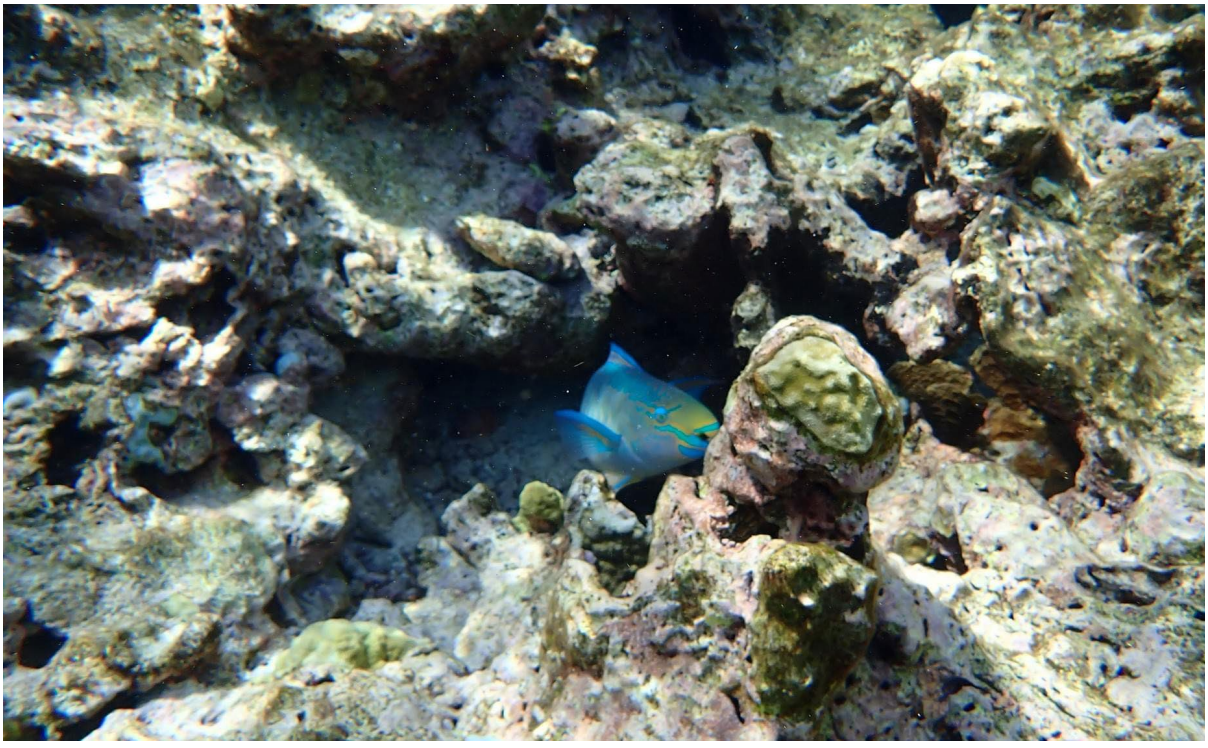
Similarly, warming waters and terrestrial heat, whether long-term changes in sea surface temperature or prolonged drought or short-term shocks, like marine heat waves[46] and terrestrial heat domes, will continue to negatively impact all of Aruba's coastal and marine ecosystems. This is particularly concerning when considering the already-degraded status of much of Aruba's ecological communities. Heat stress, together with the effects of **Projected Change in Sea-Level Rise** (medium-high risk, 5.57), the **Rate of Coastal Erosion** (medium-high risk, 7.43), and **Percent of Bodies of Water with High Water Quality** (high risk, 7.93) will limit Aruba's ability to build and maintain nature-based climate resilience.

For coral reefs, **Change in Sea Surface Temperature** (medium-high risk, 6.28) and degraded water quality — whether because of sedimentation due to **Rate of Coastal Erosion** (medium-high risk, 7.43), land-based sources of pollution, or invasive algae species — make a deadly combination. These threats are reflected in the high risk score for **Health of Existing Coral Reefs** (7.78). Most of Aruba's coral reefs exist on the windward (eastern) coast and are dominated by sandy bottoms due to the country's location on the Venezuelan continental flat.[47] This means that there is less area available for corals to grow, so the **Level of Coral Reefs Coverage** in Aruba is naturally low (medium-high risk, 7.24).[48] However, from this already naturally low level of coverage, coral reef coverage further decreased from

22.2% to 8% from 1988 to 2019 and continues to decline.[49] This decline is attributed to stony coral tissue loss disease and bleaching events related to heat stress.[50]

Due to rising ocean temperatures, coral reefs around the world are exposed to higher temperatures more frequently. Heat stress is a precursor to coral bleaching, disease outbreaks, and coral die-offs.[51] Severe heat disrupts the symbiotic relationship between corals and algae, impeding the corals' ability to obtain energy and increasing its vulnerability to stressors such as disease. Since 2003, the Caribbean has been under constant heat stress.[52] Between 1985 and 2017, the Southern Caribbean experienced the most bleaching and coral die-offs of any Caribbean sub-region. On average, the lower Lesser Antilles region experiences nine bleaching risk events per year and three coral mortality risk events per year.[53]

Research shows that the increasing presence of microalgae and turf algae in Aruba's coral reef systems is a clear sign of reef degradation, with some reef communities disappearing entirely. Healthy populations of parrotfish, which are key herbivores in the Caribbean Basin that help control algal growth, have declined, contributing to unchecked algal proliferation in certain areas.[54] Notably, the central section of the island, especially in shallow waters, still supports relatively high parrotfish populations and correspondingly lower algal abundance. In contrast, the northwestern reef sections of Aruba are experiencing eutrophication, driven largely by land-based pollution and runoff, including discharges from sewage systems.[55] Eutrophication is linked to increased algal growth and declining reef health in Aruba and throughout the Caribbean Basin.[56] Along the southern coast of Aruba, nuisance algae such as turf and macroalgae are less prevalent, which suggests that algae management efforts should prioritize the more affected northwestern areas, while supporting herbivorous fish populations in the central and southern regions to prevent future outbreaks.



Queen parrotfish on the reefs of Aruba. Credit: Ryan Peterson.

Aruba: 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	
Climate	5.35	Total Number of Hurricanes	3.19
		Total Number of Wet Days	3.63
		Total Number of Flood Events	4.36
		Total Number of People Affected by Extreme Weather Events	5.12
		Change in Sea Surface Temperature	6.28
		Total Number of Extreme Heat Events	6.86
		Total Number of Droughts	7.17
Ecosystems	6.97	Incidence of High Sargassum Abundance	3.80
		Rate of Occurrence of Harmful Algal Blooms	6.12
		Health of Existing Sand Dune Systems	6.48
		Health of Existing Sea Grass Beds	6.56
		Level of Sand Dune Coverage	6.75
		Level of Sea Grass Bed Coverage	6.86
		Health of Existing Mangroves	6.98
		Level of Coral Reefs Coverage	7.24
		Health of Existing Coral Reefs	7.78
		Level of Mangrove Coverage	8.92
Fisheries	5.97	Number of Fisheries Access Agreements with Foreign Nations	3.47
		Number of Incidents of Foreign Vessels Fishing in EEZ	5.66
		Capacity of Fisheries Enforcement Institutions	6.10
		Offshore Fish Stock Status	6.17
		Fish Consumption Per Capita	6.40
		Level of Unreported Catch Estimate	6.40
		Percent of Fisheries Managed Sustainably	6.47
		Nearshore Fish Stock Status	6.50
Geology/Water	5.70	Piped Water Supply Continuity	1.77
		Level of Geophysical Risk of Landslides	1.80
		Percent of Study Area at Risk of Flooding	5.30
		Degree of Soil Salinity in Arable Lands	5.39
		Projected Change in Sea-Level Rise	5.57
		Degree of Saltwater Intrusion in Coastal Aquifers	6.62
		Rate of Coastal Erosion	7.43
		Percent of Bodies of Water with High Water Quality	7.93
		Percent of Landscape that is Arable Land	8.07

Table: Stimson Center • Created with Datawrapper

Harmful Algae Blooms (HABs) have been documented in Latin America and the Caribbean for at least 50 years.[57] Recent workshops and research conducted by the government of Aruba indicate that warming waters will further degrade the marine ecosystems that help limit HABs, while also creating favorable conditions for nuisance algae to thrive, as reflected in the medium-high risk score for the **Rate of Occurrence of Harmful Algal Blooms** (6.12). Experts point to sargassum as a growing threat in Aruba, fueled by warming water and shifting ocean chemistry. Across the Caribbean basin, sargassum has devastating ecological impacts: entangling fish, blocking sunlight from corals and the seabed, and contributing to coral bleaching and disease outbreaks. Its effects extend beyond ecosystems, disrupting coastal communities and tourism-dependent economies. In June 2025, for example, toxic gases from sargassum forced one school in nearby Martinique to close temporarily.[58]

In addition to the high perceived risk related to mangrove and coral reef health, experts expressed concerns about the status of Aruba's seagrass beds and sand dunes. These fragile ecosystems are under significant pressure from unchecked human activity. The medium-high risk scores for the **Health of Existing Sea Grass Beds** (6.56) and **Sand Dune Systems** (6.48), the **Level of Sea Grass Bed Coverage** (6.86), and **Sand Dune Coverage** (6.75) reflect coastal decline. Seagrass ecosystems are declining due to reduced water quality, human activities like dredging, and the encroachment of invasive seagrass species. Sand dunes are particularly vulnerable to disturbance from unplanned beach houses, recreational ATV use, and foot traffic that damages vegetation and destabilizes the sand. Key dunes including Boca Druif, Boca Daimari, Wariruri, and the Sasarawichi dunes — face mounting pressure with limited signage, trail management, or enforcement of access rules.[59] The loss of dune habitat threatens nesting seabirds, coastal biodiversity, and reef systems. While Aruba has environmental laws, and the Ministry of Tourism is taking steps such as placing boulders to prevent dune erosion, enforcement remains limited.[60]

Climate change is altering Caribbean fisheries by shifting habitats, distributions, growth, and reproduction.[61] Overfishing and habitat degradation compound the effects of these climate shifts. While commercial and recreational fisheries play a relatively small role in Aruba's economy, experts nonetheless flagged overfishing as a concern, as reflected in the medium-high risks for **Percent of Fisheries Managed Sustainably** (6.47), **Nearshore and Offshore Fish Stock Status** (6.50 and 6.17, respectively), and the **Level of Unreported Catch** (6.40). Survey respondents and interviewees also highlighted weaknesses in the **Capacity of Fisheries Enforcement Institutions** (6.10) as an area of concern.

Mangrove forests — red, black, white, and the fofoti — are a vital part of Aruba's coastal ecosystem.[62,63] The Department of Nature and Environment (DNM) estimates[64] that the **Level of Mangrove Coverage** (high risk, 8.92) on the island is 1.15% of Aruba's territory.[65] Recent studies identify Aruba as a hotspot for mangrove fragmentation, a key driver of ecosystem degradation that undermines their ability to provide critical ecosystem services, as reflected in the medium-high risk score for the **Health of Existing Mangroves** (6.98).[66] Fragmentation reduces mangrove's capacity to buffer wave action, increasing sediment erosion and weakening the forests' resilience to sea level rise.[67] It also makes forests more accessible to human disturbance, driving up rates of deforestation and threatening critical habitat for birds and many fished species.[68] Despite growing fragmentation, Aruba's mangroves have experienced relatively low loss rates when compared to other global mangrove forests.[69] Since 1996, the extent of mangroves in Aruba has decreased by less than one square kilometer.[70]

Coastal mangroves in Aruba. Credit: Ryan Peterson.

Aruba's national census records indicate short-term, high-impact climate shifts. Over the past 20 years, the **Number of Flood Events** (medium risk, 4.36), both residential and commercial, have increased by 82%.[71] Local experts report noticeable changes in beach erosion following these flood events; "*It used to be that naturally...the sand would come back, but I've noticed the past few years that that's not the case.*"[72] Aruba, located in the Lesser Antilles on the southern edge of the Caribbean Hurricane Belt, experiences fewer direct hurricane strikes than much of the region, as reflected in the relatively low score of **Total Number of Hurricanes** (medium risk, 3.19). However, the interval between major hurricanes in the region has shortened dramatically over the past half century, from 80 years to an estimated six to eight years.[73] This is reflected in the medium risk score for **Total Number of People affected by Extreme Weather Events** (5.12). While direct landfall in Aruba is rare, hurricanes still bring strong wind, heavy rain, and storm surges that have historically caused significant flooding events, with rainfall events reaching up to three times the annual average in Aruba.[74,75]

Small islands like Aruba face inherent constraints in natural resources needed to ensure local food and water security, which is reflected in the high risk score for **Percent of Arable Land** (8.07) and medium-high risk score for **Degree of Soil Salinity in Arable Lands** (5.39). In 2023, Aruba imported $380 million worth of food and food products, primarily from the United States, the Netherlands, and China. This heavy reliance on food imports, coupled with rising global food prices, contributes directly to food insecurity.

Aruba has extremely limited groundwater[76] and no freshwater lakes or rivers, which reflects challenges related to **Bodies of Water with High Water Quality** (high risk, 7.93) and the **Degree of Saltwater Intrusion in Coastal Aquifers** (medium-high risk, 6.62).[77] The indicators point to serious threats to the island's freshwater supply and underscore Aruba's dependence on imports of food, energy, and other materials to meet the needs of both residents and tourists. Aruba currently produces sufficient desalinated tap water for local consumption through its state-owned utility, Water en Energiebedrijf N.V. (WEB Aruba), but bottled water and non-alcoholic bottled beverages remain popular, with imports valued at $14.6 million in 2023.[78] The desalination plant has begun bottling locally produced desalinated water for both domestic use and export, which may reduce reliance on imports in the future.[79] However, this critical piece of infrastructure sits directly on the coast to access ocean water for desalination, leaving it highly vulnerable to coastal erosion, storm surges and wave action, and sea-level rise. Disruption to the plant's operations, whether short- or long-term, would create a national security crisis, threatening the island's entire water supply.

Social Risk

Aruba's siloed, single-sector approach to climate change adaptation undermines resilience, especially given the island's inherently limited natural resources — most notably space — to support and sustain local and visiting populations.

*See **Aruba: Social Risk** graphic on pg. 24.

- The **SOCIAL/DEMOGRAPHICS** category (expert weighted average score of 6.05) includes the two highest risk indicators in the Social Risk Area: **National Population Density** (8.96), and **Percent of International Migrants Living in Country** (7.86). These findings underscore how immigration and population growth intensify pressure on Aruba's ecosystems and infrastructure.

- The **HEALTH** category (expert weighted average score of 5.47) is characterized by medium-high scores for most indicators, the highest score attributed to the **Mortality Rate Attributed to Non-Communicable Disease** (medium-high risk, 7.18). The risk scores for **Cases of Infectious Disease** (medium-high risk, 5.60) and **Mortality Attributed to Heat** (medium-high risk, 5.64) reflect local experts' concerns about the impacts that climate change may have on Aruba's healthcare system.

- The **GOVERNANCE** category (expert weighted average score of 4.98) highlights persistent challenges in securing sustained investment in climate resilience — both through **Investment in Climate Resilience Development Projects** (medium-high risk, 6.85) and the development and implementation of a **National Climate Adaptation Plan** (medium-high risk, 6.96). A medium-high risk score for **Civil Society Participation** (5.45) further reflects concerns about ensuring broad stakeholder engagement in Aruba's climate planning and strategy development.

Aruba's average **National Population Density** of 598 persons per square kilometer has almost doubled since 1961 and is reflected in the high risk score (8.96). The impacts of this are particularly acute in highly developed tourism districts, where the population density can reach well over 1,500 persons per square kilometer.[80] Spatial analysis shows that 46% of households are located in coastal residential areas with population densities exceeding 1,000 persons per square kilometer, with an additional 10,000+ tourists per square kilometer.[81] These densely populated coastal zones are prone to storm surges, inland flooding, and extreme heat, compounded by non-climatic factors such as water contamination, solid waste pollution, and biodiversity loss.[82]

Aruba: Social 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	
Governance	5.10	Number of Incidences of Civil Unrest or Instability	2.62
		Voter Turnout	3.22
		Rule of Law	4.17
		Level of Perceived Transparency within Government	4.86
		Capacity of Current Disaster Response	5.09
		Civil Society Participation	5.23
		Capacity of Ethics Enforcement Bodies	5.32
		Investment in Climate Resiliency Development Projects	6.76
		National Climate Adaptation Plan	6.77
Social/Demographics	5.54	Percent of Population Achieving Proficiency in Literacy and Numeracy	3.37
		Level of Social Tension	4.08
		Percent of Population Below 30 Years of Age	4.15
		Urbanization Rate	4.50
		Percent of Population Below Poverty Line	4.78
		Dependency Ratio	5.13
		Percent of Adult Citizens Living Outside of the Country	5.13
		Urban Population (% of total population)	5.29
		Percent of International Migrants Living in Country	7.86
		National Population Density	8.96
Health	5.60	Access to Healthcare	4.01
		Mortality Rate Attributed to Unsafe Water, Unsafe Sanitation and Lack of Hygiene	4.23
		Health Worker Density and Distribution	5.37
		Cases of Infectious Disease	5.44
		Percent of Population Experiencing Moderate or Severe Food Insecurity	5.57
		Mortality Attributed to Heat	5.71
		Percent of Population at Risk of Mental Health Disorders and Stress-Related Disorders	6.67
		Mortality Rate Attributed to Non-Communicable Diseases	7.53

Table: Stimson Center • Created with Datawrapper

Urbanization and energy consumption (and subsequently, GHG emissions) have been increasing in Aruba since the 1990s.[83] Between 1990 and the current day, Aruba's total urban population increased by 70%.[84] In the same time period, however, **Urban Population as a Percent of Total Population** (high risk, 8.83) has decreased 50% to 44%.[85] In urban environments, climate impacts like rising temperature, relative humidity, and heat waves and domes, are amplified. These factors spur the formation of urban heat islands[86], impacting health outcomes, particularly for Aruba's aging population.[87]

The cascading health risks are reflected in the relatively high score for **Mortality Rate Attributed to Non-Communicable Diseases** (7.18). The Caribbean carries the highest burden from non-communicable diseases (NCDs) for developing nations in the Americas, with chronic conditions the leading cause of death in the region.[88] In Aruba, much of the population is already at elevated risk for developing an NCD: 98% of the population have at least one risk factor, and 38% of those have three to five (e.g., overweight, high blood pressure, daily smoking, poor diet, physical inactivity).[89] Obesity alone affects 46% of Arubans. Other prevalent risk factors include tobacco and alcohol use. By contrast, cases of infectious diseases are low in Aruba, as reflected in the relatively low score for **Cases of Infectious Disease** (5.60).[90]

Local concerns about the **Percent of Population at Risk of Mental Health Disorders and Stress-Related Disorders** are reflected in the medium-high risk score of 6.53. Extreme weather events can trigger or worsen these conditions. According to "Steps 2023 Aruba," a report published by the Aruban Ministry of Tourism and Public Health, the Pan American Health Organization, and the Central Bureau of Statistics, 17% of the population reported mild levels of anxiety and depressive symptoms, 44% reported moderate levels, and 2% reported severe levels, with higher percentages among women than men. Younger people also reported more mental health challenges than older age groups. In 2023, Aruba's suicide rate was about 5%.[91] At the same time, time spent in nature has been shown to reduce stress and improve wellbeing. In Aruba, 78% of the community reported feeling connected to nature, and many visit natural areas weekly, with beaches and the underwater world (41%) being the most popular.[92]

Though climate change drives compounding and cascading health impacts, Aruba's **Access to Healthcare** received a relatively low risk score (4.13). Ministry of Public Health, Social Affairs and Elderly Care and Addiction Care oversees healthcare delivery, and the Netherlands manages hospital clinical services and operations. The Aruban government finances 96.1% of health care costs, with 75.8% funded through public revenues from social premiums and taxes, managed primarily by the General Health Insurance.[93] However, the health system faces resource constraints, as reflected in the medium risk score for **Health Worker Density and Distribution** (5.36). Resource constraints have worsened, particularly in the aftermath of COVID-19, which heavily affected Aruba's tourism-dependent economy.[94] In 2017, Aruba had 15.9 physicians per 10,000 people, compared to 27.7 in Antigua and Barbuda, and 26 in the United States.[95] Vulnerability is further compounded by geography: Over 80% of hospitals are located in low-lying areas exposed to natural disasters.[96] As one interviewee noted, *"...at the current rainfall and sea level, it is a challenge, but also around the hospital, when we have heavy rain, water will be accumulating, and then the hospital is difficult to access..."*[97]

The greatest source of **Social Tension** (medium risk, 4.08) in Aruba stems from the expansion of the tourism industry. Although **Incidences of Civil Unrest** are rare (2.76), those that have occurred have

centered on tourism growth, coastal privatization, and ecosystem damage.[98] While Aruba has maintained a 0% poverty rate under the international poverty line ($5.15/day)[99] since at least 2019, income inequality remains a significant concern. In 2016, 31% of households earned more than USD $2,950 per month, 48% of households earned between USD $983 and $2,949, and the remaining 20.3%[100] earned less than USD $983. The bottom half of households (48.8%) accounted for only 20.5% of total accumulated household income, underscoring the extent of income inequality.[101]

As of late 2023, 36% of Aruba's population was foreign-born, with the largest shares coming from the Netherlands Antilles (22.1%), Venezuela (19.7%), Colombia (19.6%), and the Netherlands (14.7%).[102] Over the past 50 years, Aruba's immigration rate has fluctuated, with surges followed by declines.[103] In the last decade, the rate peaked at 33.33% in 2022 and fell to its lowest point of 17% in 2020.[104] Aruba hosts roughly 17,000 Venezuelan refugees and migrants, which is globally the highest number of refugees relative to a country's population, as reflected in the high risk score for **Percent of International Migrants Living in Country** (7.86).[105] Around 2,000 Venezuelans file for asylum claims each year, but many remain without legal status[106], forcing them into informal work and leaving them without access to healthcare or legal employment.[107] Neither Dutch nor EU law applies to Aruba's management of international migrants. While no significant tensions have emerged to date, the lack of integration into the island's economic and political life presents a potential source of instability, particularly if exclusion extends to responses to climate hazards.[108]

Aruba's ability to respond reactively to short-term climate hazards is hindered by limited climate literacy and a lack of island-wide, multi-sector coordination. This is reflected in the medium-high risk score for **Disaster Response Capacity** (5.11).[109] Recent investments, however, have helped strengthen disaster response in Aruba. In late 2024, 16 new alert towers were installed as part of a new multi-hazard early warning system (EWS).[110] The EWS was launched in early 2025, accompanied by trainings and a public education campaign.[111] Earlier this year Aruba, together with five other Dutch Caribbean islands, received training on community disaster response through the Caribbean Disaster Risk Management.[112]

Opuntia cactus in Aruba. Credit: Ryan Peterson.

Similarly, Aruba's ability to proactively plan for long-term climate impacts is limited by sector silos. Although Aruba has integrated climate change considerations into specific sectoral development plans, the island still lacks a comprehensive, coordinated approach through a **National Climate Adaptation Plan** (medium-high risk, 6.96). Interviewees noted that tourism companies develop their own solutions to address waste and energy challenges in isolation rather than through collective action.[113] As one noted, "*We* [*Aruba*] *need a cohesive plan where everybody is collaborating towards a specific goal. Right now, what you have is companies that are coming up with waste solutions, for example, or an energy solution, all separately…Aruba is bad at connecting dots. So, we have a lot of people that are doing a lot of great things, but they are all separately siloed.*" **Civil Society Participation** (medium-high risk, 5.45) in these efforts has promoted local-level adaptation measures, such as rainfall harvesting, but is often excluded from formal planning processes.[114]

Beyond disaster response and adaptation planning, governance concerns further constrain effective climate action, which is reflected in the medium-high risk scores for **Capacity of Ethics Enforcement Bodies** (5.47 and **Level of Perceived Transparency within Government** (5.00). In early 2022, the Interamerican Press Association criticized a deterioration in press freedom, while a 2025 IMF report[115] noted that key budget documents "are currently not transparently published nor easily located by the public" and pointed to "limited to no transparency" for funds created under Article 40 of the Transparency Law.[116] Lack of institutional transparency and perceptions of corruption have also hindered the design and enforcement of housing policy. Given Aruba's limited financing for climate adaptation, stronger accountability and transparency will be critical to ensure that scarce resources are allocated and used effectively.

Launched on April 22, 2024, the National Climate Resilience Council (NCRC) is Aruba's principal initiative to close gaps in adaptation planning. Its mandate includes promoting climate literacy and engaging with the public sector, private sector, civil society, academic institutions, and supra-national agencies. The NCRC is also tasked with developing enabling legislation, strengthening institutional capacity, and coordinating risk and resilience assessments. In addition to overseeing this CORVI assessment, the NCRC supervised the creation of a *Climate Impact Atlas* for Aruba, which compiles climatological and geographic maps of the island covering topics such as sea surface temperature, coastal ecosystems, and sea level rise.

The NCRC's mandate also includes identifying and mobilizing climate finance to implement the projects and policies needed to strengthen Aruba's climate resilience. However, Aruba's status as a constituent country within the Kingdom of the Netherlands precludes its access to many sources of international financing and funding. As a result, its **Investment in Climate Resiliency Development Project** (medium-high risk, 6.85) relies heavily on domestic sources of funding from tax revenues and state-owned enterprises. Interviewees highlighted this as a major concern: "*…the majority of the people understand the problem* [*of climate change*]*, but when it comes to mitigation and readiness, that will require investment, so it* [*the biggest challenge*] *will probably be financial.*"[117] Aruba does not receive climate resilience funding from the Netherlands, though it benefits from limited international funding and technical assistance from institutions like the World Bank, including the Global Facility for Disaster Reduction and Recovery (GFDRR), and the European Union.[118]

Economic Risk

Aruba's economy is heavily based on leisure tourism, particularly its beaches and waters. This economic model is already under strain and faces mounting risks from climate hazards, most notably extreme heat, storms, sea level rise, and coastal erosion. The dual pressures of rising tourism demand and growing climate risks are threatening Aruba's critical infrastructure, driving a negative feedback loop of economic and climatic risks.

*See **Aruba: Economic Risk** graphic on pg. 30.

- The **INFRASTRUCTURE** category (expert weighted average score of 5.17) highlights the vulnerability of Aruba's built infrastructure to extreme weather. The highest score in this area — **Level of Commercial Infrastructure Damage from Extreme Weather Events** (8.36) — reflects the significant threat posed by storms and other hazards. Additional risks stem from overburdened infrastructure and housing pressures, particularly the prevalence of **Informal or Unplanned Settlements** (6.72) and challenges with **Wastewater Treatment** (6.08).

- The **ECONOMICS** category (expert weighted average score of 4.83) highlights the vital importance of Aruba's highly built-up coastline, as reflected in the high score for the **Percent of GDP Generated in Coastal Cities** (7.95). There are concerns that "tourism exhaustion" is driving **Income Inequality** (6.25) and contributing to economic stagnation.

- Although the **MAJOR INDUSTRIES** category has the lowest average score (expert weighted average score of 4.57), it contains two of the highest risk scores across the entire assessment — the **Percent of National Economy Based in Tourism Industry** (**8.83**) and **Percent of People Employed in Tourism** (**9.59**). These scores underscore the crucial importance—and vulnerability—of Aruba's tourism industry to climate hazards.

Aruba's economy is highly dependent on tourism, which accounted for over 70% of national GDP in 2023, as reflected in the high risk score for **Percent of the National Economy Based in Tourism** (8.83), up from 64.7% before the COVID-19 pandemic. This rebound followed a sharp 24% GDP contraction in 2020, the third largest globally among non-conflict countries.[119] Tourism's share of the economy is projected to rise further, reaching 72% by 2034. The sector accounts for an even larger share of employment, as reflected in the high risk score for **Percent of People Employed in Tourism** (9.59), with more than 88% of jobs tied to tourism in 2023.[120] Aruba's reliance on tourism is intrinsically linked to the health of

Aruba: 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	
Economics	4.94	National GDP Per Capita	2.58
		National Unemployment Rate	3.70
		Market Losses from Extreme Weather Events	3.88
		National Youth Unemployment Rate	4.02
		Debt Ratio	5.32
		Level of Informal Economy	5.95
		Income Inequality	6.02
		Percent of GDP Generated in Coastal Cities	7.65
Infrastructure	5.17	Percent of Population with Adequate Access to Electricity	2.78
		Effectiveness of Solid Waste Management Procedures	2.90
		Level of Shoreline Development	3.95
		Level of Resilience for Ports and Shipping	4.56
		Level of Housing Damage from Extreme Weather Events	4.61
		Renewable Energy Share in Total Energy Consumption	4.82
		Level of Resilience for Airports	4.93
		Level of Grid Resilience	5.05
		Level of Resilience for Roads	5.36
		Percent of People Living Below 5 Meters Above Sea Level	5.70
		Level of Water Distribution Infrastructure Resilience	5.98
		Percent of Low-Income Housing in Relation to Flood Zones	6.06
		Proportion of Wastewater Safely Treated	6.08
		Level of Informal or Unplanned Settlement	6.72
		Level of Commercial Infrastructure Damage from Extreme Weather Events	8.36
Major Industries	5.10	Percent of People Employed in Agriculture	2.27
		Percent of National Economy Based in Offshore Fishing	2.47
		Percent of People Employed in Artisanal and Subsistence Fishing	2.60
		Percent of People Employed in Commercial Fishing	2.63
		Percent of National Economy Based in Nearshore Fishing	2.87
		Percent of National Economy Based in Agriculture	2.90
		Percent of People Employed in Port and Shipping Industries	4.43
		Percent of National Economy Based in Port and Shipping Industries	6.23
		Percent of National Economy Based in Tourism Industry	8.83
		Percent of People Employed in Tourism	9.59

Table: Stimson Center • Created with Datawrapper

its coastal and marine environments. Climate impacts — particularly sea level rise, coastal erosion, and warming ocean temperatures — directly threaten the hotels, resorts, and beaches that are the island's core economic assets. Any damage to the tourism sector has cascading effects across the broader economy. Experts from the Central Bank van Aruba warned that such impacts would manifest as higher credit risks from loan defaults, decreased public revenues as a result of reduced tax revenue from tourism, and major disruptions to the employment structure.[121]

Sea level rise is one of the most persistent and far-reaching consequences of climate change, with profound implications for coastal communities and small islands. Global mean sea level rise is projected to rise by 0.43 and 0.84 meters by 2100 relative to 1986-2005 levels, with rates accelerating dramatically in the coming decades.[122] The Caribbean archipelago, composed almost entirely of small islands with high concentration of populations, assets, and critical infrastructure along its coastlines, faces particularly acute risks.[123] Scientific projections estimate that more than 3,100 square kilometers of Caribbean coastal land will be permanently lost at 1.5°C of warming.[124] Such losses will trigger cascading effects across the region's social and economic systems. Rising baseline sea levels, when combined with increasingly powerful storm surges, amplify coastal flooding exponentially.

Approximately half of the Caribbean's population lives within 1.5 kilometers of the coast. A one-meter rise in sea level could permanently displace at least 110,000 people across Caribbean Community countries, with informal settlements at particular risk due to low-lying locations, inadequate housing, and limited protective infrastructure.[125] Nearly 80% of the region's harbor facilities would be inundated under this scenario, while power plants, roads, airports, and seaports would also face heightened flooding exposure.[126] The region's economic backbone — tourism — faces equally severe threats. With one meter of sea level rise, an estimated 49% to 60% of Caribbean tourist resorts would be damaged,[127] including the permanent inundation of about 29% of all resort properties and significant vulnerability of an additional 49% to enhanced storm surges and coastal flooding.[128]

Aruba's tourism market is heavily concentrated: 83% of visitors are from the United States, leaving the economy heavily exposed to fluctuations in the U.S. economy. Moreover, 96% of Aruba's tourism is based in leisure tourism, with minimal diversification to business travel.[129]

The tourism-based economy faces serious risks. A 2017-2018 study by the Aruba Tourism Authority concluded that the island has already exceeded its tourism carrying capacity,[130] while other studies point to "tourism exhaustion," where growth delivers diminishing economic returns.[131] Between 2009 and 2019, annual visitors increased by 37%,[132] yet GDP per capita rose only 5%.[133] Average visitor expenditures also declined between 2005 and 2018.[134] At the same time, **Income Inequality** (medium-high risk, 6.25) has also grown in recent years, reflected in Aruba's Gini coefficient[135] of .44 in 2019.[136] In response, the government launched the National Strategic Plan (Nos Plan, Nos Futuro, or NSP), which aims to shift to

high-value, low-impact sustainable tourism by cultivating new niche markets, including cultural, sports, adventure, and medical tourism.[137]

View of Aruba's coastline. Credit: Ryan Peterson.

Interviewees voiced concern that hotel expansion and beach privatization are limiting access to public spaces, fueling frustration among local residents.[138] They also noted that tourism development causes crowded beaches and strains critical infrastructure, including the power grid and road network.[139] Stakeholders highlighted the growth of short-term vacation rentals as a driver of oversaturation, recommending caps to curb uncontrolled growth and safeguard housing availability and community well-being.[140] Many warned that continued expansion of tourism threatens to displace residents and further degrade Aruba's natural resources.[141] Even tourists expressed unease: Long-time visitors to Aruba feel uncomfortable with the island's changes, citing excessive hotel construction and crowding.[142]

Small boat hull on the water in Aruba. Credit: Ryan Peterson.

Tourism's dominance in Aruba's economy has marginalized other economic sectors, such as agriculture and fisheries.[143] By 2021, agriculture contributed just 0.03% of GDP,[144] leaving the island heavily reliant on international imports, primarily from the United States.[145] While the share of the national economy tied to ports and shipping is relatively modest, as reflected in the medium-high risk score for the **Percent of National Economy Based in Port and Shipping Industries** (6.23), Aruba's ports remain vital for handling imports and accommodating cruise tourism.

Aruba's sun-sand-sea tourism model has concentrated housing, tourist structures, and key infrastructure along the coast, leaving them highly vulnerable to sea level rise, storms, coastal erosion, and other climate hazards. This includes 46% of households at risk from storm surge and flooding,[146] as well

as many tourist accommodations, the port, Queen Beatrix International Airport, water and power plants, and wastewater treatment facilities. Their low-lying coastal locations expose them to coastal erosion, storm surge, sea level rise, and strong winds, as reflected in the high risk score for the **Level of Commercial Infrastructure Damage from Extreme Weather Events** (8.36). Interviewees noted that both the airport and hospital already experience operational disruptions from heavy rainfall and flooding.[147] The World Bank and Global Facility for Disaster Reduction and Recovery estimate that damages from a single extreme event could reach $310 million, or 9.2% of GDP.[148] The loss of protective natural ecosystems such as mangroves and sand dunes — often cleared to make way for new coastal infrastructure — further compounds these risks. Dense development along the coast also decreases ground permeability, heightens flooding, and prevents ecosystems from migrating inland as sea levels rise, further endangering them and the benefits they provide.[149] Coastal build-up also increases the urban heat island effect and extreme heat temperatures. Heat stress is projected to significantly affect Aruba's most important industries, particularly tourism and construction, with an estimated 40% of GDP exposed to extreme and chronic heat stressors.[150] A recent study projects that, under a business-as-usual scenario, total losses from environmental degradation and climate change will reach at least 20% of GDP by 2050.[151]

Damage from extreme weather events is exacerbated by Aruba's challenges with wastewater management. Rapid tourism growth paired with insufficient investment in plant maintenance resulted in the closure of the Parkietenbos Facility[152] and pushed the Bubali plant beyond its capacity.[153] Insufficient **Proportion of Wastewater Safely Treated** (medium-high risk, 6.08) caused "disturbances in the neighborhood"[154] and may also have damaged local ecosystems, particularly wetlands. Properly treated wastewater can help sustain wetlands and enhance their ability to absorb floodwaters,[155] but insufficient treatment damages these ecosystems and undermines their protective function. To address these shortcomings, the government of Aruba enacted a reform package that transferred wastewater treatment facilities to Aruba Wastewater Sustainable Solutions (AWSS) and introduced a new $20 sustainability fee charged to visitors to fund maintenance and capital expenditures.[156] AWSS, a subsidiary of Utilities Aruba, N.V. (wholly owned by the government of Aruba), now owns the island's four wastewater treatment plants, incinerator, and sewage network. These reforms have already produced results, including the reopening of the Parkietenbos Facility in late November 2024.[157]

Rising population density and increased tourism development are putting growing pressure on Aruba's housing market. Properties purchased by overseas investors and wealthy Arubans for tourist rentals have driven up real estate prices, leaving many local families facing low affordability and high rents.[158] By mid-2024, more than 3,000 were on the waitlist for housing from the FCCA (Fundacion Cas pa Comunidad Arubano).[159] Policy prioritization of detached and self-built homes, coupled with the conversion of residences to short-term tourism rental spaces,[160] have also increased demand for land. As a result, many residents – particularly migrant workers – have been pushed into marginal or environmentally sensitive areas, raising the already medium-high risk of **Informal or Unplanned Settlements** (6.72). Interviewees emphasized the vulnerability of these settlements, as well as **Low-Income Housing in Flood Zones** (medium-high risk, 6.06), given the lack of infrastructure to manage rising sea levels and heavy rainfall.[161] Informal settlements also place additional stress on ecosystems that are critical for buffering climate hazards and filtering water resources.

Aruba's transportation infrastructure faces moderate risks. Approximately one-third of the island's roads are unpaved, mainly in the interior, while paved roads serve the more densely populated and economically critical coastal areas. These networks face distinct climate hazards, requiring tailored measures to increase the **Level of Resilience for Roads** (medium-high risk, 5.36). Unpaved roads are vulnerable to increased rainfall intensity, which can wash away road surfaces. Coastal paved roads face threats from erosion and extreme heat: Erosion can undermine road foundations or increase flooding, particularly along the northwestern coast, while heat can soften asphalt, causing cracking, buckling, and accelerated wear.[162] Queen Beatrix International Airport, which recently expanded through the Gateway 2030 project to meet increased tourism, faces similar risks. Its runway sits less than 40 meters from the sea at its closest point, leaving it exposed to coastal hazards. The airport, however, benefits from some natural protection provided by Renaissance Island immediately offshore, which contributes to its assessed **Level of Resilience for Airport** (medium risk, 4.93).

Aruba's power grid also faces significant challenges (**Level of Grid Resilience** - medium-high risk, score of 5.05). Outages already occur nearly every month due to aging equipment.[163] Increasing incidence of extreme heat will put additional pressure not only on the electrical grid but also on other public utilities, leading to higher costs and the potential for more or prolonged service disruptions. Despite these risks, there are restrictive limits on solar energy adoption on the island. One interviewee noted, "... *Allowing companies and people to install more solar* [*would be helpful*], *now residentially you can only install 10 kilowatt*[*s*] *and commercially 100* [*kilowatts*]." Higher demand for air conditioning, reduced efficiency of power plants and transmission lines in high heat,[164] and stronger storms that can topple transmission towers all threaten grid stability. These vulnerabilities cascade into the water sector, which depends on Oranjestad's desalination plant. Power outages can halt operations at the plant, as shown in the medium-high risk for Aruba's **Level of Water Distribution Infrastructure Resilience** (5.98). In 2021, Tropical Storm Elsa highlighted this risk when it knocked out the power supply for most of the island and cut off the water supplies completely in some areas.[165]

The Status of Climate Resilience Planning

Contributions of the Government of the Netherlands via the International Panel on Deltas and Coastal Areas (IPDC), the Climate Adaptation Services (CAS) office, and the National Climate Resilience Council (NCRC) comprise the key frameworks that guide climate adaptation planning in Aruba.

HISTORY AND OVERVIEW

The International Panel on Deltas and Coastal Areas (IPDC) was launched by the Dutch Ministry of Infrastructure and Water Management as part of the Government of the Netherlands' commitment to the global Water Action Agenda.[166] This flagship initiative focuses on improving the climate resilience of deltas, coastal regions, and islands, with a specific emphasis on bridging the gap between adaptation needs and the practical implementation of these solutions. IPDC's mission is to scale up and accelerate climate adaptation actions, especially in vulnerable regions, by enhancing governance, knowledge, capacity-building, and access to adaptation finance. By connecting various decision-making layers, including policy, scientific communities, and implementation networks, the IPDC works to address climate change and its impacts on vulnerable coastal areas.

In the Caribbean context, Aruba serves as a prominent case where IPDC's approach is being integrated into national efforts to build climate resilience. The National Climate Resilience Council of Aruba (NCRC), launched on Earth Day, April 22, 2024, is a central initiative in this regard, tasked with guiding and overseeing the development of a national climate adaptation strategy for Aruba (NAS-A). The formation of the NCRC aligns with broader goals of enhancing climate resilience in Aruba, as identified in national strategic plans such as the "Repositioning Our Sails" roadmap.[167] Both the NCRC and the IPDC highlight the need for integrated solutions that transcend sectoral boundaries and address the diverse challenges posed by climate change.

LEGAL AND REGULATORY FRAMEWORKS FOR CLIMATE ADAPTATION

Aruba's climate adaptation efforts are grounded in several key legal and regulatory frameworks that guide environmental and climate-related policy. Among the most relevant laws are:

- Disasters Ordinance (Calamiteitenverordening, 1992) - Provides the legal basis for disaster management and emergency responses.

- Spatial Planning Ordinance (Landsverordening Ruimtelijke Ontwikkeling, 2006) - Governs land-use planning and development, which includes considerations for climate resilience in urban and rural areas.
- Nature Conservation Ordinance (Natuurbeschermingsverordening, 1992) - Protects the island's biodiversity and natural ecosystems, essential for resilience against climate impacts such as sea-level rise and extreme weather events.[168]

These regulations provide the backbone for implementing climate adaptation measures and support but require further refinement to incorporate elements like Environmental-Social-Governance (ESG) criteria and climate-related financial disclosures, areas where the current framework is still developing through the NCRC.

In April 2024, Aruba unveiled a constitutional amendment to enshrine the rights of nature into its constitution. The amendment would recognize and affirm both a human right to a "clean, healthy, and sustainable environment" and a right for nature, both on land and water, to "protection, conservation, and restoration of its ecosystems and biodiversity and to regeneration of its life cycles."[169] The national ordinance would make Aruba the second nation in the world (after Ecuador) to constitutionally recognize the "rights of nature" and would be the first amendment to Aruba's constitution since the island broke with the Netherlands Antilles in 1986. The ordinance would also require the government to periodically assess the state of the island's environment and present reports to the legislature every five years. A memorandum published alongside the draft ordinance stated that the amendment aims to provide a broader ecosystem-level of protection, building on Aruba's Nature Conservation Regulation, which provides targeted protection to individual species.[170]

Aruba's Biodiversity Strategy and Action Plan, 2024-2030 outlines the island's approach to harmonize people and nature and ensure that Aruba's ecosystems and environment remain intact, healthy, and able to support the Aruban people and economy into the future. The Plan describes three strategic goals to pursue this vision: 1) Reduce threats to biodiversity loss, 2) Sustainable use of natural resources, 3) Tools and solutions for implementation. Within these three goals, the Plan includes numerous specific targets, including protecting 30% of Aruba's land, coastal, and marine areas; restoring 30% of degraded land, coastal, and marine areas; promoting local, sustainable agriculture and fisheries; and public nature education.[171] Under the auspices of the Plan, Aruba also launched in July 2025 the Aruba Reforestation Project, which aims to plant 100,000 trees around the island over the following four years.[172]

MISSION AND PURPOSE OF THE NCRC

The NCRC's primary goal is to enhance Aruba's climate resilience and adaptive capacity for the wellbeing of society and nature.[173] The Council aims to integrate climate adaptation efforts across multiple sectors and stakeholders, overcoming existing silos that fragment decision-making and resource allocation. The NCRC will focus on creating inclusive and just platforms for collaboration, facilitating connections between the public and private sectors, NGOs, academia, and regional and international institutions.

One of the NCRC's most innovative contributions is the introduction of the "Climate Quintet" model. This model emphasizes the importance of diverse actors working together, from government bodies and

private companies to non-governmental organizations, academic researchers, and international agencies. By fostering inter-institutional relationships and building collective capacity, the NCRC seeks to create a robust and inclusive climate adaptation framework for Aruba. Furthermore, the NCRC aims to address challenges related to data fragmentation, governance inefficiencies, and insufficient climate resilience capacities, all of which hinder effective climate action.

The NCRC also plays a crucial role in Aruba's ongoing planning efforts for climate adaptation, particularly through initiatives like the Climate Impact Atlas for Aruba (developed by Climate Adaptation Services). These projects provide critical data to inform policy and guide investment in resilient infrastructure, water systems, and ecosystems. The Council's work intersects with broader national strategies, such as the National Strategic Plan (NSP), which outlines key actions in natural resource management, sustainable energy, and climate resilience.

CONTRIBUTIONS BY THE GOVERNMENT OF THE NETHERLANDS VIA THE IPDC

The Dutch Government's support for the IPDC plays a pivotal role in the development of climate adaptation strategies for the islands within the Kingdom of the Netherlands, including Aruba, Curaçao, Sint Maarten, and the special municipalities of Bonaire, Sint Eustatius, and Saba. Through the IPDC, the Netherlands facilitates a collaborative platform for governments, financial institutions, scientific experts, and practitioners to work together on shared climate challenges. The Dutch Ministry of Infrastructure and Water Management is central to IPDC's operations, ensuring that water-related issues are prioritized in the climate adaptation discourse.

The Dutch Government has been instrumental in mobilizing knowledge and financial resources, helping to break down barriers to climate adaptation implementation in these vulnerable regions. This support helps islands like Aruba to not only develop climate action plans but also access the necessary tools, expertise, and funding mechanisms to turn these plans into tangible actions. The IPDC's efforts are particularly valuable in terms of overcoming implementation barriers related to governance, finance, and knowledge development, and fostering multi-actor collaborations at the local, regional, and international levels.

Gulf fritillary in Aruba. Credit: Ryan Peterson.

The establishment of the National Climate Resilience Council (NCRC) represents a significant milestone in Aruba's climate adaptation journey. It is a direct result of the Government of Aruba's vision, as outlined in the "Repositioning Our Sails" master plan and receives critical support from the Government of the Netherlands via the IPDC. The NCRC's inclusive approach, centered around the "Climate Quintet" model, offers a strategic framework for addressing climate resilience in a holistic and collaborative manner. With its focus on cross-sector collaboration, data-driven decision-making, and capacity-building, the NCRC is poised to play a central role in strengthening Aruba's adaptive capacity in the face of climate change. Through the IPDC, Aruba and other Caribbean islands are supported in their efforts to bridge the gap between adaptation needs and implementation, ensuring that these vulnerable regions can thrive in a changing climate.

OPPORTUNITIES FOR IMPROVING CLIMATE RESILIENCE GOVERNANCE IN ARUBA

There are opportunities for the Government of Aruba and its partners in civil society, the private sector, and academia to support and better integrate climate resilience into its governance framework. Including references to climate change and its anticipated impacts on Aruba in all Government ministries and departments — plans, programs, and budgets — will solidify Aruba as a leader in climate-smart governance in the region.

- ***Incorporate climate change into national planning and budgetary processes:*** Climate resilience should be a component of all national and sectoral development plans, including urban planning, tourism strategy, and infrastructure projects.

    - Barbados' *Roofs to Reefs* program, first launched in 2021, was developed to integrate economic and environmental resilience planning. R2R aims to bring together small-scale, disconnected adaptation projects and integrate environmental and economic resilience planning.[174] It aims to leverage innovative financial tools such as green and blue bonds to reinforce homes, increase the use of renewable energy and rainwater harvesting, and restore coral reefs and other nature-based solutions.[175] R2R also includes the increased use of data to identify hazards and set targets as well as aims to create a circular economy.[176]

    - Green budget tagging involves assessing each individual budget measure and giving it a "tag" according to whether it is helpful or harmful to green objectives. Green objectives may relate to climate or other areas of the environment, such as biodiversity, air, and water challenges (quantity and quality). "Information gathered from tagging individual measures can be useful to understand how overall budget policy impacts cross-cutting goals relating to climate and the environment."[177] Two examples of green budget tagging include Colombia and the Philippines. In the former, "tagging covers national, regional, and local expenditures along 12 sectors considered the most directly linked to mitigation and adaptation efforts."[178] In the latter, "tagging identifies expenditure across seven areas: food security, water sufficiency, ecosystem and environmental and ecological stability, human security, climate-smart industries and services, sustainable energy, and knowledge and capacity development."[179]

- ***Develop a National Adaptation Strategy:*** A comprehensive national adaptation strategy is essential for prioritizing actions, estimating costs, and securing future financing to support climate resilience. Several countries in the Caribbean have submitted National Adaptation Plans to the UNFCCC that describe their comprehensive strategies. Two examples, one recently submitted and the other in 2019, provide useful examples.

    - The Grenada NAP (2019) was designed as "the overall political umbrella document to coordinate and guide external financing and donor contributions on adaptation to climate change."[180] The NAP encompasses 12 programs, including strengthening institutional arrangements, integrating climate change into national budgeting, integrated coastal zone management, resilient infrastructure and land management, sea level rise, and public education.[181]

    - The Antigua and Barbuda NAP (2025) outlines the country's "comprehensive strategy to address the escalating challenges posed by climate change."[182] The NAP describes five key strategies, including strengthening early warning systems, investing in climate-smart infrastructure, promoting sustainable land use, diversifying the economy, and building capacity.[183]

- ***Enact enabling climate legislation:*** Create a robust legal and regulatory framework that supports climate adaptation. This includes laws that promote sustainable development and climate-smart redevelopment; restore, protect, and preserve natural resources; and provide clear mandates for government agencies to implement climate-resilient policies and regulations.

- Launched in 2018 in the wake of the devastating impact of Hurricane Maria, the Climate Resilience Execution Agency for Dominica (CREAD) was designated as the lead and coordinating agency for building climate resilience in the country. CREAD led the drafting of the Dominica Climate Resilience and Recovery Plan (CRRP), and in cooperation with other government ministries, external partners, and the private sector, coordinated the initiatives needed to achieve the goals of the CRRP.[184]

- With support from the Green Climate Fund, St. Kitts and Nevis has worked to develop a National Development Planning Framework (NDPF) to cover the period 2022-2037. The NDPF aims to integrate climate resilience into economic development planning. The NDPF specifically includes sustainable goals for the tourism sector that include enabling legislation, vulnerability assessment, revision of building codes, and improved waste management, among others.[185]

- ***Enhance and expand climate data and research capacity:*** Invest in and strengthen the institutional capabilities and organizational capacities to collect and analyze real-time climate and environmental data, including the installation of remote data sensors on land and across Aruba's substantial EEZ.

  - Dominica's Disaster Vulnerability Reduction Project (DVRP) dramatically expanded the country's hydrological and meteorological monitoring capability. Before the project, the capability was limited to two airports on the east and west coasts of the island. DVRP expanded that network to 44 automatic water stations, rain gauges, and water level sensors covering the entire island. The expanded overage allows for real-time, localized tracking of heavy rainfall events and the capture of finer-grained storm surge projections.[186]

  - Although still in the Adaptation Fund's active project pipeline, one of the four components of St. Kitts and Nevis' proposal entitled "Coastal Adaptation and Resilience Initiative"[187] is to strengthen data management and monitoring systems. This component aims to map the country's coastal zones, marine habitats, and adaptation needs; improve data collection and management processes; and implement early warning systems for beaches and coastal ecosystems.[188]

- ***Establish a Climate Resilience Fund***: Establishing a separate fund for climate adaptation investments will reinforce any policy or regulatory changes.

  - A GCF project to support Antigua and Barbuda, Dominica, and Grenada includes a small grant facility for community adaptation projects and a revolving loan fund for adaptation in private sector buildings aimed at strengthening resilience to more intense hurricanes and higher temperatures. Both components are fairly small-scale, totaling $9 million, but can provide a template for analogous funding mechanisms.

  - Belize's blue bond agreement, facilitated by The Nature Conservancy, reduced Belize's public debt by 12% of GDP and created a long-term stable source of financing dedicated to marine conservation. The agreement locked in a commitment for Belize to protect 30% of its oceans; promised the development of a science-based, participatory marine spatial plan; and created a Conservation Fund.[189]

Priority Recommendations to Build Climate Resilience

Based on the above risks and vulnerabilities, three areas of action were developed to prioritize climate resilience in Aruba.

Invest in Vital Infrastructure through Ecosystem Restoration

Several ecological risk indicator scores rank among the highest in the Aruba risk profile, reflecting significant vulnerabilities tied to the declining health of coastal ecosystems, compounded by climate-driven shifts in weather patterns and extreme weather events. Healthy coastal and marine ecosystems serve as critical "lines of defense" against wave energy and flooding, while also providing co-benefits such as habitat for nearshore fisheries. Investing in ecosystem restoration is therefore essential to lay the groundwork for nature-based solutions that strengthen climate resilience. To achieve this, the Aruban government, private sector, and civil society should work together to protect existing marine ecosystems, restore degraded areas, and prioritize the health — and long-term resilience — of all Aruba's coastal environment.

- Healthy and resilient mangrove ecosystems can protect Aruba's critical infrastructure from flooding and storm surge, reduce damage from extreme weather events, reduce — and even reverse — coastal erosion, improve nearshore water quality, provide essential habitat and nursery grounds for fish, and support the growth of a sustainable blue economy. To reap these benefits — and ultimately to employ mangrove-focused nature-based solutions to climate change, including a storage source for blue carbon — the Aruban government, together with local community leaders, should **support mangrove replanting and restoration efforts**. Adopting best practices that are tailored to conditions in the Caribbean Basin, like the UN Environment Programme's *Manual for the Ecological Restoration of Mangroves in the Mesoamerican Reef System and the Wider Caribbean*, will support geographically relevant approaches. Successful examples in Puerto Rico, where Surfrider has planted more than 22,000 mangroves in several critical locations around the island, have realized ecological, economic, and community benefits, offering opportunities for local organizations, students, and communities to collaborate on and take ownership of ecosystem restoration.[190]

- **Establishing or expanding locally managed marine areas** (**LMMAs**) could increase marine protections, restore vulnerable marine ecosystems, and foster local leadership in coastal and marine resource management. Replicating the success of neighboring St. Lucia's Soufriere Marine Management Area and the Canaries & Anse La Raye Marine Management Area could not only support ecosystem

restoration but also offer premier opportunities for eco-tourism. Applying an inclusive participatory or community-led approach to siting and enforcing nearshore LMMAs and marine protected areas (MPAs) has been used by other coastal communities to great effect. Connecting to other Caribbean Island LMMAs, as is done through the Eastern Caribbean Marine Managed Area Network (ECMMAN), could further enhance the ecological benefits of new or expanded LMMAs in Aruba.[191]

- To reduce the impacts of "nuisance" flooding, the government and civil society partners should support and **implement nature-based solutions (NbS) to reduce flooding and coastal erosion**. NbS to reduce flooding can include constructed wetlands, community gardens, restoration of riparian vegetation, and swales,[192] which in Latin America and the Caribbean, have helped reduce flooding, clean and filter runoff and wastewater, and support ecosystems in low-lying, flood-prone areas.[193] In the United States, for example, coastal wetlands provide $23.2 billion annually in storm protection services.[194] NbS to reduce coastal erosion can include beach nourishment, dune restoration, mangrove restoration, and living shorelines. Living shorelines offer an alternative to traditional shoreline stabilization techniques like bulkheads, revetments, and breakwaters. Living shorelines can reduce damage and erosion while simultaneously providing ecosystem services to society, including food production, nutrient and sediment removal, and water quality improvement.[195]

- Conduct a **science-based fisheries stock assessment for coastal and offshore fisheries** to improve fisheries management. According to the CORVI risk scores and semi-structured interviews, fisheries in Aruba are declining because of overfishing and habitat degradation. However, quantitative data to support this qualitative data remains sparse. Investing in stock assessments will offer a deeper understanding of the current state of coastal and offshore fisheries, support longer-term marine management goals, and help determine fishing levels, gear types, closures, and areas for habitat protection.

- **Encourage sustainable fisheries management policies** by supporting science-based fishery management plans. Sustainable nearshore fisheries management relies on community engagement and leadership. An inclusive approach that connects all relevant stakeholders will support the development of a locally relevant, enforceable, and achievable fishery management plan for critical commercial and recreational fish stocks, including wahoo, mahi-mahi, marlin, and grouper. Replicating the Caribbean Fishery Management Council's island-based approach[196] to fisheries management in St. Croix, Puerto Rico, and the U.S. Virgin Islands could ensure the continued health of important fishery resources in Aruba's EEZ, and would allow for accommodation of the unique biological, ecological, economic, and cultural characteristics of those resources and the communities that depend on them.

Develop and Implement an Inclusive Spatial Development Plan

Increased population and economic activity along Aruba's coastal strip are expanding the human footprint and placing pressure on fragile ecosystems. New developments are clearing and fragmenting natural protections, heightening vulnerability to climate and intensifying the urban heat island effect. At the same time, the aging of both Aruba's resident and tourist populations is increasing their susceptibility to heat-related illnesses and reducing their ability to cope with storm events. Reducing Aruba's climate vulnerability will require deliberate shaping of residential and commercial growth through a comprehensive spatial

development plan. Updating Aruba's Spatial Planning Ordinance is a key step, but a forward-looking plan must go further – and be grounded in inclusive, community-based, and multi-stakeholder dialogue that integrates nature-based approaches to ensure its sustainable success.

Marina in Aruba. Credit: Ryan Peterson.

CLIMATE-PROOF EXISTING CRITICAL AND VITAL INFRASTRUCTURE

- **Shoreline "armoring" or "hardening"** of structures such as seawalls, breakwaters, groins, and revetments that are designed to protect the coast. Although these types of structures do offer protection — seawalls reduce storm surge, and breakwaters reduce sediment loss and coastal erosion — they can have serious drawbacks. They often have high upfront costs and may need expensive upgrades if climate change exceeds the projections upon which the structure is based. In addition, these structures interfere with natural processes and currents and can increase erosion and storm surge in areas adjacent to those protected by hardening structures. Therefore, these solutions should be used only for the most critical infrastructure that cannot be moved or protected in other ways, such as Aruba's desalinization plant.

- **Cool surfaces**, particularly white roofs, increase the amount of light reflected and heat radiated. Compared to black roofs, on a day with an air temperature of 37°C, light reflection increases from 5% to 80%, and the amount of light that heats the city air is reduced from 52% to 8%.[197] These effects can reduce annual

cooling energy use by 10% to 20% in a building's top floor, reducing pressure on the energy grid and providing cost savings.[198] Installing white pavements, in addition to white roofs, can reduce the urban heat island effect and reduce fatalities from extreme heat events.[199]

- **Increasing green areas** can provide a variety of benefits in reducing the damage from extreme heat and heavy precipitation. Absorptive natural surfaces reduce flooding; 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%.[200] Retention ponds and detention areas store floodwaters, reducing damages. The latter can serve multiple purposes, such as serving as playing fields during dry periods. Grass and tree cover can also reduce the urban heat island effect; one study found that grass can reduce local maximum surface temperatures by 24°C while tree shade can reduce local maximum surface temperatures by 19°C.[201]

- **Updated building codes** can help increase the implementation of climate proofing measures, including cool surfaces, insulation, and permeable surfaces. They can also incentivize measures such as the preservation or restoration of natural ecosystems, bioswales, coastal setbacks, permeable surfaces, and other risk reduction measures. Aruba could use certification schemes — analogous to the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) certification system — to incentivize the implementation of adaptation measures beyond mandatory minimums. Building codes can also help Aruba implement strategies that go beyond single buildings, such as district cooling. **District cooling** chills water in a central plant and circulates it to client buildings, providing the same cooling as distributed cooling systems, but with up to 50% lower energy and emissions impacts while reducing the urban heat island effect.[202] However, district cooling systems are only cost effective in dense areas, making them potentially applicable in Oranjestad but not in all areas of Aruba.

Fisherman hut in Aruba. Credit: Ryan Peterson.

INTEGRATE CLIMATE RESILIENCE IN INVESTMENTS, POLICIES, AND COMMUNITY OUTREACH

- Use **targeted investments, incentives, and policies** to support the implementation of the spatial development plan and climate adaptation measures. In areas of lower climate risk, Aruba can invest in targeted public infrastructure and clustering — increasing the height of residential and commercial structures to accommodate greater density in certain specified areas, reducing horizontal sprawl and opening space for retention areas, parks, and other green areas. In areas of higher risk, Aruba could enforce land use regulations to prevent new development and protect coastal ecosystems. The island could also consider the use of land acquisition strategies in higher risk areas to remove residents from vulnerable areas while compensating them in the form of either financial compensation or development rights in a lower risk area.[203] Once acquired, vulnerable land can then be converted into retention areas or used to restore natural ecosystems, such as wetlands. Aruba could also use incentives — such as tax breaks, rebates, and encouragement of favorable lending terms — to increase the implementation of adaptation measures by individual businesses and households.

- **Conduct regular stress testing** of current and proposed development. This stress testing is comprised of three potential components.

    - The first component is an assessment of the ability of major institutions in the Aruban economy to absorb and recover from the losses imposed by extreme weather events, both individual and compound. Extreme weather events have the potential to sharply reduce international visitor arrivals for an extended period and, given the importance of tourism to the Aruban economy, such an event would have serious knock-on losses to the broader Aruban economy.

    - The second component is regular assessments of Aruba's spatial development plan based on the latest climate science updates, including the speed of global climate warming. The uncertainties in both global greenhouse gas emission trajectories and physical climate processes produce wide estimates of likely total sea level rise by 2100, from 0.3 to 1.9 meters.[204] Aruba should assess and update its spatial plan as these uncertainties are narrowed.

    - The third component is an impact assessment of proposed changes or exceptions to the spatial development plan. This assessment should go beyond narrow consideration of the specific proposed changes to consider how such changes may affect adjacent areas of the island and broader development patterns.

- **Public communication and engagement** can help strengthen public support for climate adaptation measures and enhance their effectiveness. The government could undertake a public outreach campaign to educate the public on the climate risks that Aruba faces, public responses to mitigate these risks (including the spatial development plan), and measures that individuals and businesses can take to further mitigate their specific risks. This campaign should employ multiple avenues of communication, including written materials, radio, video, trainings, and in-person workshops. Finally, communication and engagement between the government and the public should be a two-

way undertaking, offering the opportunity for residents and community leaders to provide their own expertise and feedback.

Strengthen the Resilience of Aruba's Economy

Aruba's economy is concentrated in coastal tourism, particularly along the northwestern coastline running north from Oranjestad. Increasing climate hazards — particularly extreme heat, coastal erosion, and storms — threaten both the infrastructure and ecosystems that sustain this sector. At the same time, rapid tourism growth has strained existing infrastructure and public services while fueling social tensions and inequality. Strengthening the resilience of Aruba's built environment and natural ecosystems, as outlined in the next two recommendations, will be critical to sustaining the tourism economy. These efforts should be complemented by measures to boost the industry's capacity to withstand and recover from extreme weather, diversify tourism towards less climate-vulnerable models, and support the development of synergistic industries. Transparent, inclusive planning for the tourism sector can further enhance effectiveness by improving coordination and cooperation across stakeholders.

STRENGTHEN THE CAPACITY TO MANAGE EXTREME WEATHER

- **Facilitate coordinated adaptation planning** by large hotels and enterprises. Many of the larger tourism industry businesses in Aruba are aware of the risks that climate change poses to their operations and are taking initial steps to reduce that risk. Local experts, however, highlighted that these steps are often being taken in an isolated fashion, uncoordinated with those of adjacent businesses. This can be inefficient and can even result in unintended spillovers that increase damages to neighboring properties, as when a revetment or seawall increases coastal erosion to adjacent beaches and dunes.[205] The National Climate Resilience Council (NCRC) is well placed to take the lead in facilitating increased coordination between private sector stakeholders to identify and avoid these negative consequences and increase the overall effectiveness of private sector adaptation actions.

- **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."[206] Data from the U.S. Federal Emergency Management Agency suggests that 40%of businesses without a continuity plan will never reopen following an extreme weather event, and 75% will fail within three years.[207] This is particularly true for smaller, local enterprises that do not have the option of drawing on resources and expertise from international corporate networks that can fill gaps after an extreme weather event. Aruba's Crisis Management Office and the NCRC can help these smaller businesses to create continuity plans to better prepare for and recover from such an event.

- **Post-disaster recovery loans** to small businesses after extreme weather events "reduce exit and bankruptcy, increase employment and revenue, and unlock private credit."[208] This shows that the government can crowd-in investment from the private sector through providing these loans, thereby reducing uncertainty about the likelihood of repair. This type of uncertainty, and therefore these loans,

are particularly relevant for small local businesses that may already exist on thin profit margins that leave them with few resources to draw upon in the event of an unanticipated shock.

- **Occupational heat safety standards** provide protections for workers, particularly those working outside, as Aruba faces rising temperatures. Seven U.S. states have passed these types of standards, which can serve as a template for analogous regulations in Aruba.[209] These policies include measures such as provision of water, provision of shaded cool-down areas, cool-down rest periods, training, acclimatization, and emergency response plans. Several of them have a specific temperature threshold that triggers the enactment of these measures.

- Invest in Aruba's newly created **integrated multi-hazard early warning and response system** to better prepare for and recover from key extreme weather events, particularly storms, extreme heat events, and drought. Warnings provided just 24 hours in advance can reduce the damage caused by a storm or heatwave by 30%.[210] Early warning and response systems are more effective, particularly at reaching hard-to-reach populations (such as undocumented residents), when designed and implemented in coordination with local communities and the private sector (see case studies from Tanzania[211] and Senegal[212]). Their effectiveness is also amplified by linking warnings to clear, previously developed response actions. These can include water conservation measures in the case of drought, measures to surge public health capacity during a storm or heatwave, or check-ins for high-risk individuals such as the elderly.[213]

INVEST IN EVOLVING THE TOURISM MODEL

- **Continue to pursue higher-value-added forms of tourism**, and focus on sharing that added value with the Aruban community. The Aruba Tourism Association introduced "responsible tourism" during New York Climate Week in October 2025; responsible tourism would shift the balance of tourism benefits to the community, and would reduce the burdens placed on Aruba's natural and built environment.[214]

- **Local policy** — focused on developing entrepreneurship, production, and human capital — can help reduce economic leakage and increase the benefit that tourism provides to the local Aruban economy. This can include incentives to increase local sourcing, particularly for food products. It can also involve investing in digital up-skilling to build local capacity to provide "back-office" services, such as human resources, technology, and marketing, as Bali has pursued.[215] Increasing the availability of these types of back-office jobs can also reduce the share of the Aruban workforce that is exposed to the island's increasing temperatures.

- **Promote alternative and regulated forms of tourism**, such as cultural, business, wellness, and ecotourism. These types of tourism could focus on areas of the island outside of the coastal strip, such as Arikok National Park, thereby reducing Aruba's economic exposure to coastal hazards such as coastal erosion and storm surge. This could also reduce geographic inequalities and lessen the pressures on Aruba's coastal ecosystems, such as mangroves and sand dunes. Elevating these types of responsible tourism will, in some cases, require supportive policy. For example, a fisheries stock

assessment would help Aruba sustainably promote local sourcing of seafood products and promote sport fishing tourism, in addition to ensuring that the island's high level of seafood consumption can continue.

- **Support the growth of new industries** by leveraging Aruba's specific assets to reduce the Aruban economy's dependence on highly climate-vulnerable coastal leisure tourism. Aruba has access to, and should leverage, the Dutch educational system and Dutch capital markets, including investment funds for entrepreneurs. Aruba also has ready access to foreign demand through its international visitors and proximity to the U.S. market. Finally, Aruba's territorial sea encompasses a territory considerably longer than its densely populated terrestrial territory. Given these assets, Aruba could specialize in high-value marine products that use Dutch investment capital and international visitors to support early growth. Industries such as sustainable aquatic foods and bio-based materials are seeing rapid growth and could appeal to environmentally conscious tourists willing to pay a premium.

Reef flat in Aruba. Credit: Ryan Peterson.

Appendices

Appendix 1:
List of CORVI Indicators for Aruba

Appendix 2:
Surveyed and Interviewed Organizations

Appendix 3:
The Climate and Ocean Risk Vulnerability Initiative Methodology

Appendix 1: List of CORVI Indicators for Aruba

The following indicators of ecological, economic, and social risk were evaluated for Aruba.

ECOLOGICAL RISK

Category	Indicator
Climate	Total Number of Hurricanes
	Total Number of Flood Events
	Total Number of Extreme Heat Events
	Total Number of Droughts
	Total Number of People Affected by Extreme Weather Events
	Total Number of Wet Days
	Change in Sea Surface Temperature
Ecosystems	Level of Mangrove Coverage
	Level of Coral Reefs Coverage
	Level of Sea Grass Bed Coverage
	Level of Sand Dune Coverage
	Health of Existing Mangroves
	Health of Existing Coral Reefs
	Health of Existing Seagrass Beds
	Health of Existing Sand Dune Systems
	Rate of Occurrence of Harmful Algal Blooms
	Incidence of High Sargassum Abundance
Fisheries	Nearshore Fish Stock Status
	Offshore Fish Stock Status
	Fish Consumption Per Capita
	Level of Unreported Catch Estimate
	Percent of Fisheries Managed Sustainably
	Capacity of Fisheries Enforcement Institutions
	Number of Fisheries Access Agreements with Foreign Nations
	Number of Incidents of Foreign Vessels Fishing in EEZ
Geology/Water	Percent of Study Area at Risk of Flooding
	Percent of Landscape that is Arable Land
	Degree of Soil Salinity in Arable Lands
	Projected Change in Sea-Level Rise
	Rate of Coastal Erosion
	Degree of Saltwater Intrusion in Coastal Aquifers
	Piped Water Supply Continuity
	Percent of Bodies of Water with High Water Quality
	Level of Geophysical Risk of Landslides

SOCIAL RISK

Category	Indicator
Social/Demographics	National Population Density
	Percent of Population Below Poverty Line
	Percent of International Migrants Living in Country
	Urban Population (% of total population)
	Percent of Population Below 30 Years of Age
	Urbanization Rate
	Dependency Ratio
	Percent of Population Achieving Proficiency in Literacy and Numeracy
	Percent of Adult Citizens Living Outside of the Country
	Level of Social Tension
Governance	Level of Perceived Transparency within Government
	Capacity of Ethics Enforcement Bodies
	Voter Turnout
	Civil Society Participation
	National Climate Adaptation Plan
	Rule of Law
	Capacity of Current Disaster Response
	Investment in Climate Resiliency Development Projects
	Number of Incidences of Civil Unrest or Instability
Health	Mortality Attributed to Heat
	Mortality Rate Attributed to Non-Communicable Diseases
	Cases of Infectious Disease
	Percent of Population at Risk of Mental Health Disorders and Stress-Related Disorders
	Percent of Population Experiencing Moderate or Severe Food Insecurity
	Access to Healthcare
	Health Worker Density and Distribution
	Mortality Rate Attributed to Unsafe Water, Unsafe Sanitation and Lack of Hygiene

ECONOMIC RISK

Category	Indicator
Infrastructure	Percent of People Living Below Five Meters Above Sea Level
	Percent of Low-Income Housing in Relation to Flood Zones
	Level of Informal or Unplanned Settlement
	Level of Housing Damage from Extreme Weather Events
	Level of Commercial Infrastructure Damage from Extreme Weather Events
	Level of Shoreline Development
	Level of Grid Resilience
	Renewable Energy Share in Total Energy Consumption
	Percent of Population with Adequate Access to Electricity
	Level of Water Distribution Infrastructure Resilience
	Proportion of Wastewater Safely Treated
	Effectiveness of Solid Waste Management Procedures
	Level of Resilience for Roads
	Level of Resilience for Airports
	Level of Resilience for Ports and Shipping
Major Industries	Percent of National Economy Based in Agriculture
	Percent of National Economy Based in Nearshore Fishing
	Percent of National Economy Based in Offshore Fishing
	Percent of National Economy Based in Tourism Industry
	Percent of National Economy Based in Port and Shipping Industries
	Percent of People Employed in Agriculture
	Percent of People Employed in Tourism
	Percent of People Employed in Port and Shipping Industries
	Percent of People Employed in Commercial Fishing
	Percent of People Employed in Artisanal and Subsistence Fishing
Economics	National GDP Per Capita
	National Unemployment Rate
	National Youth Unemployment Rate
	Debt Ratio
	Income Inequality
	Level of Informal Economy
	Market Losses from Extreme Weather Events
	Percent of GDP Generated in Coastal Cities

Appendix 2: Surveyed and Interviewed Organizations

The following public and private sector organizations were surveyed and/or interviewed for the CORVI assessment in Aruba.

List of Organizations Surveyed and Interviewed for CORVI in Aruba
Amsterdam Manor Beach Resort
Anedna Watersports
Aruba Airport Authority
Aruba Bank NV
Aruba Birdlife Conservation
Aruba Conservation Foundation
Aruba Hotel and Tourism Association
Aruba Timeshare Association
Aruba Tourism Authority
Aruba Trade & Industry Association
Ban Lanta y Planta
Brouwerij Nacional Balashi
Bucuti & Tara Beach Resort
Caribbean Mercantile Bank
Centrale Bank van Aruba
Centro di Cuido SABA / Centro Medico pa Cuido Chronico (CMCC)
Centro di Pesco Hadikurari
Century 21 Aruba Real Estate
Chamber of Commerce and Industry Aruba
Crisis Management Office
Department of Agriculture, Livestock and Fisheries
Department of Economic Affairs, Commerce & Industry of Aruba
Department of Elderly Care
Department of Finance
Department of Finance Aruba
Department of Foreign Affairs Aruba
Department of Legislation and Legal Affairs
Department of Public Health
Directie Natuur en Milieu
Directie Ouderenzaken
Directorate of Nature and Environment
Divi Vacation Club
Eneda Engineering Services VBA

Fundacion Mangel Halto
Fundacion Proteccion y Conservacion di Commandeursbaai
Guia Sostenibel Consultancy
Horacio Oduber Hospital Aruba
Iberostar
Imagination of Development and the Nature of Values Aruba
Impact Blue Foundation
La Cabana Beach Resort & Casino
Marriott Aruba Ocean Club
Megaresorts (Divi Resorts Aruba)
Metabolic Foundation
Moons Consulting Engineers
Playa Linda Beach Resort
Public Health Department
Red Sail Sports
Sagicor Life
SETAR N.V.
Social Economic Council
Turtugaruba Foundation
UN Environment Programme
UNESCO Aruba
University of Aruba
W.E.B. Aruba N.V.

Appendix 3: The Climate and Ocean Risk Vulnerability Initiative Methodology

The Climate and Ocean Risk Vulnerability Initiative (CORVI) is a decision support tool that compares a diverse range of climate-related risks across the land-seascape to produce a coastal city risk profile. These risks are organized across 10 categories, grouped under three risk areas: ecological, social, and economic (see Figure 1). The 10 categories are made up of nearly 100 indicators, covering a range of regionally relevant and site-specific issues, including the vulnerability of vital infrastructure, the health of marine ecosystems, and urbanization dynamics. 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

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.

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.

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 comprehensive assessment, while reducing data availability bias. This approach provides a contextual and data-driven assessment of climate and ocean risk vulnerability.

RAPID CORVI ASSESSMENTS

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

FULL CORVI ASSESSMENTS

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

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.

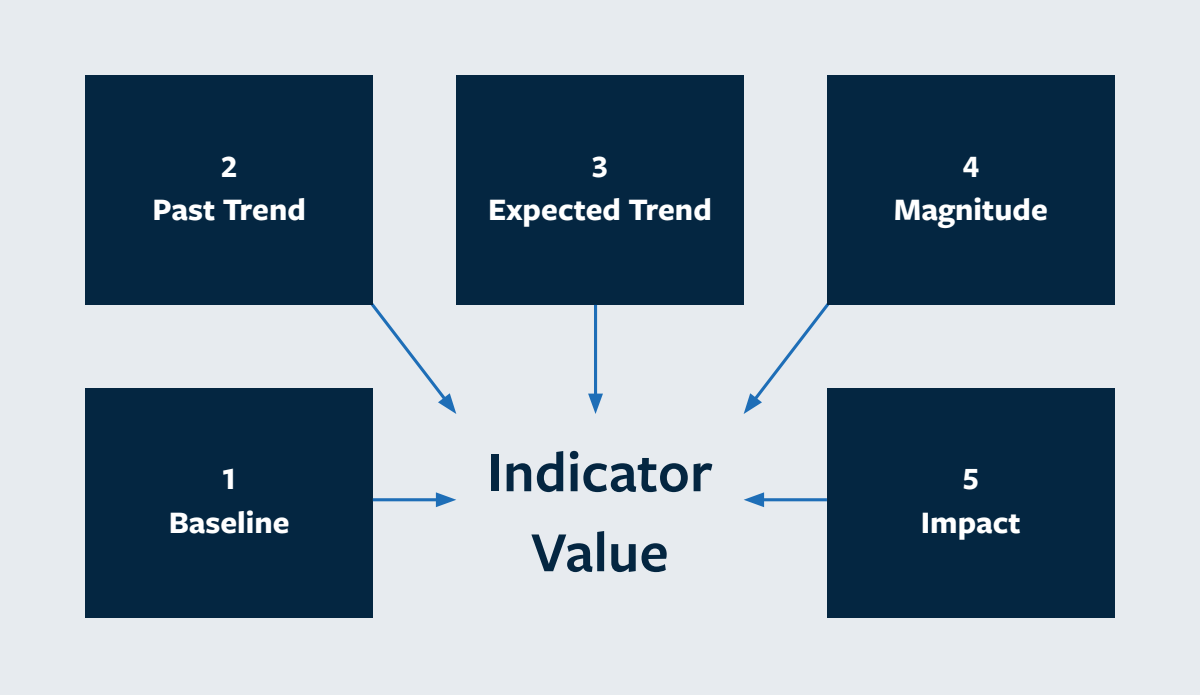
Medium risk scores indicate that while resilience has been built to address the specific risk, future changes could destabilize resilience gains.

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.

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.



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 period of 15 years.

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.

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.

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.

Finally, the **IMPACT** assesses the importance of change for each indicator in describing future risks 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. SEJ is a 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." 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. 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 a substitute for empirical data collection. Rather, SEJ is best viewed as an alternative research technique specialized in analyzing topics with significant data gaps.

CORVI PARTNERS

CORVI operates in collaboration with national government 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.

BENEFITS AND USE CASES

The results of CORVI assessments in Kingston, Belmopan, and Belize City have led to prioritized actions to support nature-based solutions like flood mitigation and coastal restoration, approached urban planning in a more integrated and holistic manner, build institutional capacity, and support social protection programming.

Endnotes

1 See Appendix 1 for the list of risk indicators used in the CORVI assessment for Aruba.

2 Greenhouse gas emissions scenarios used are the World Bank's SSP2-4.5 levels.

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

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

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8 Greenhouse gas emissions scenarios used are the World Bank's SSP2-4.5 levels.

9 Details about the CORVI methodology are provided in Appendix 3.

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11 Rouleau, Tracy; Jack Stuart; Maia Call; Sally Yozell; Nagisa Yoshioka; Miko Maekawa; and Natalie Fiertz. "The Climate and Ocean Risk Vulnerability Index: Measuring Coastal City Resilience to Inform Action." *Frontiers in Sustainable Cities* 4 (2022): 884212. https://doi:10.3389/frsc.2022.884212

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