



DOMINICAN REPUBLIC CLIMATE CHANGE VULNERABILITY ASSESSMENT *EXECUTIVE SUMMARY*

BACKGROUND

The U.S. Agency for International Development (USAID)/African and Latin American Resilience to Climate Change (ARCC) Project conducted the Dominican Republic Climate Change Vulnerability Assessment (DR VA) from December 2012 to May 2013 in response to requests from the USAID/Latin America and Caribbean Bureau and USAID/Dominican Republic. The overall DR VA approach has six steps: a desk review of all relevant literature, a scoping visit, a field assessment phase, data compilation and analysis, a presentation of results, and a participatory analysis and definition of climate adaptation options. The assessment seeks to improve understanding of climate change impacts on watersheds and coastal resources — as well as the people dependent on them — in the four climate-sensitive hotspots that the assessment targets. The methodology for the integrated assessment is multi-scalar and multi-locational (it focuses on four climate-sensitive hotspots — urban and coastal — encompassing Punta Cana/Bávaro; Yaque del Norte [Montecristi/Santiago]; Bajo Yuna [Samaná Bay and Peninsula]; and Santo Domingo). Its organizational structure follows the major components of the widely accepted proposition that vulnerability is a function of three things: **exposure to a stress** (in this case climatic); the **sensitivity** of a community, livelihood, or natural system to that stress; and their **adaptive capacity** to recover from the impacts of that exposure. The most vulnerable communities/households are those with high exposure, high sensitivity, and low adaptive capacity. To assess these factors, climate, watershed, marine and coastal resources, and institutional analyses were conducted in the targeted hotspots.

EXPOSURE

The climate analysis methodology involved a literature review of climate in the Caribbean Region and in the Dominican Republic; an analysis of historical climate variability and trends in selected areas in order to provide a context for projected changes in the future climate; and climate projections for the same areas. The analysis of variability and trends compared two periods, 1960-1984 and 1985-2012, to assess changes in mean and frequency of precipitation, temperature and wind, and the amplitude of rainfall decadal variability in the Dominican Republic. Climate projections were developed by downscaling output of eight General Circulation Models (GCM)¹ under two emission scenarios (high and low emissions) from the latest projection archive (Coupled Model Inter-comparison Project Phase 5 [CMIP5], Taylor et al., 2012) to meteorological station level, resulting in mean projected climate

¹ Ten different general circulation models with different resolutions and different architectures were used, and the two outliers were discarded.

conditions (temperature and precipitation) in two 30-year periods ending in 2030 and 2050. A complete methodology of this analysis appears in Annex A of the complete report.

The findings of the literature review of climate and analysis of historical climate variability and trends in rainfall, temperature, and wind lead to the following conclusions:

- Strong regional differences in seasonal and annual rainfall exist; temperature is mainly defined by altitude.
- All regions experience strong inter-annual rainfall variability linked to El Niño-Southern Oscillation (ENSO) as well as a decadal variability related to the Tropical Atlantic; decadal variability in the Tropical Atlantic also strongly affects the frequency of hurricanes.
- No robust and consistent long-term changes in rainfall variability were found. Temperature, on the other hand, exhibits a consistent increasing trend on the order of 0.5-1 °C during past decades.
- There is an indication of fewer extreme rainfall events in the Yaque del Norte watershed, in addition to more extreme events in the Santo Domingo watershed in the recent period, but no consistent pattern related to changes in flood patterns could be isolated.
- Analyses of changes in wind speed and direction did not yield robust and significant results; therefore, observed changes in beach erosion rates cannot be directly attributed to changes in wind.

Climate projections for temperature and precipitation reveal medium- and long-term potential for:

- A decrease in rainfall in May (a rainy month in all stations) and an increase in December (a dry month in all stations); and
- Temperature increases for 2030 and 2050, which are projected to be 0.5-1.0 °C and 1.0-2.5 °C respectively and will increase evaporation and induce additional water stress.

Furthermore:

- Sea-level rise will likely exacerbate coastal flooding and beach erosion; and
- The intensity of tropical storms and their accompanying precipitation will increase as ocean and global temperatures continue to rise. Combined with environmental degradation, tropical storm damage will worsen.

SENSITIVITY

Sensitivity is the degree to which a system will be affected by, or responsive to climate stimuli (Smit and Pilifosova, 2001). The current and anticipated climate impacts will increase the sensitivity of communities and natural systems in the four studied areas, making them increasingly vulnerable to these elements of exposure. The assessment found that, while sensitivity varies slightly among the studied areas, principal points of sensitivity are where flooding, storm surge, and coastal zone degradation affect populations and natural systems. Communities susceptible to flooding and storm surge are adversely and directly affected by the impact of flooding on roads, housing, businesses, and farm fields. Marine habitats suffer climate and non-climate induced impacts that have an indirect impact on the well-being of coastal communities by diminishing livelihoods that depend on fishing and the tourism industry. The study found that sensitivity to climate change manifests in the following ways:

- Increasing temperatures will continue to strain agricultural systems and groundwater availability and quality due to the possibility of hotter and drier conditions in Yaque del Norte, where precipitation is projected to slightly decrease.
- Increased frequency and intensity of flooding due to the combination of more intense storms and environmental degradation is likely to disproportionately affect already sensitive systems (e.g., livelihoods on the edge, people in poverty, coastal infrastructure).
- Populations on the margin of the economy (particularly those located in urban areas of Los Mina, Hoyo de Puchula, Fracatán, La Esperanza, and el Hoyo de Elias) as well as rural small farmers are more sensitive to impacts of disasters (floods, dry periods, landslides) because they have limited resources with which to influence and increase adaptive capacity.²
- Coastal zones (particularly mangroves and coral reefs) are particularly sensitive to sea-level rise and more extreme storms because of existing problems with critical habitat destruction from development pressures, overfishing, and other threats.
- Local communities are very sensitive to these same factors, which will likely increase the risk to coastal communities of flooding, diminish fisheries stocks, and degrade natural tourist attractions in the absence of more comprehensive resource management planning.
- Residential households and the agriculture and tourism sectors heavily depend on ground and surface water supply, which are sensitive to localized land use and likely to experience decreasing recharge and quality due to evaporation and salt water intrusion. Inadequate sewage management further compromises water quality. In the absence of adequate sewage treatment facilities, most raw sewage is dumped into the aquifer through injection wells called “pozos filtrantes” or directly into rivers and the ocean, worsening water quality and increasing health risks.

Non-climate stressors, including population, land, and economic pressures, exacerbate these manifestations of sensitivity and will continue to impede efforts to reduce vulnerability of communities and natural systems. Populations inadvertently increase their vulnerability as they exploit natural resources to support their livelihoods (e.g., unsustainable fishing, forestry and agriculture practices) causing irreversible damage to natural systems.

ADAPTIVE CAPACITY

Adaptive capacity is the inherent ability of a livelihood system, or community, to absorb climate change shocks and to buffer the impacts of those shocks. It is often described as recovery power or as a set of assets and strategies that result in resilience. For this assessment, adaptive capacity was gauged by reviewing the existing capacity and potential of communities, institutions, policies, and programs to address the sensitivities. The limited assessment of adaptive capacity and the collection of local adaptive responses included a secondary literature review in addition to an institutional analysis at the national and sub-national levels triangulated with focus group discussions and key informant interviews conducted in the four climate-sensitive hotspots. Overall findings from the institutional analysis follow:

- Climate change policy and plans have been developed at the national level.

² **Adaptive capacity** refers to the potential or capability of a system to adjust to climate change so as to moderate potential damages, to take advantage of opportunities, or to cope with consequences (Smit and Pilifosova, 2001).

- The National Meteorological Office (ONAMET) and the National Institute of Water Resources in the Dominican Republic (INDRHI) have established a solid foundation with which to strengthen and expand their capacity to collect data and analyze and disseminate climate information.
- Climate change action is emerging at the national level, but has not yet reached sub-national levels.
- Guidelines, capacity, and resources to support implementation of adaptation measures are still weak at all levels and across ministries.
- There is a lack of coordination and integration across ministries and policies.
- It is anticipated that capacity, guidance, coordination, and collaboration will improve when the new climate change law takes effect.
- To ensure that the law is effective, other actions will need to follow, such as the development and dissemination of clear guidelines; the effective enforcement of the law; and capacity building to ensure that the public is informed and capable of complying.
- Locally generated adaptive responses exist but are not leveraged to bring to scale.
- Institutional capacity to respond to disasters and improve the management of watersheds and water exists within some public agencies and NGOs, but is not implemented to scale or linked with climate change policy and programs.
- As the devolution of the National System for Prevention, Mitigation and Response to Disasters takes place, inter-institutional coordination and citizen awareness of the relationship between climate change and risk and disaster management pose challenges.
- Inadequate land-use and development planning and enforcement increase disaster risk in areas prone to flooding.

ADAPTIVE PATHWAYS AND RECOMMENDATIONS

Key donors and decision-makers participated in multi-stakeholder options analysis meetings in April in Santo Domingo, Samaná, Montecristi, Santiago, and Punta Cana. Participants discussed results, validated pathways, and defined strategies and recommendations based on evidence generated from the assessment. The adaptation pathways, strategies, and an overview of key recommendations are described herein (detailed recommended actions are provided in the recommendations section of the report).

Given the factors of exposure and sensitivity and gaps in adaptive capacity felt across the four hotspots, adaptive strategies need to be defined to improve policy and guidance, develop institutional capacity, and engage citizens (individuals, civil society organizations, and private businesses) to prevent, mitigate, and manage potential damage caused by flooding. To reduce the vulnerability of populations, livelihoods, and natural systems exposed to increases in extreme rainfall events and sea-level rise that will induce flooding (combined with storm surges), three adaptive pathways guide the direction that institutional actors can follow to strengthen resilience and adaptive capacity:

1. Disaster Risk Reduction and Early Warning Systems;
2. Development Planning: Infrastructure and Land Use; and
3. Management and Conservation of Coastal Habitats and Watersheds.

Much work has already been done in the Dominican Republic in this regard; therefore recommendations to improve adaptive capacity build on the policies, guidance, institutional capacity, and engagement platforms that already exist – at the national and local levels. These three pathways provide a higher-level framework with which to define and prioritize options for action – or recommendations for strengthening resilience and adaptive capacity. The pathways are distinct in dealing with climate vulnerability at different temporal scales.

The development planning and habitat management and conservation pathways are intended to develop adaptive capacity over the long term by shifting how development, land use, and natural resource management and conservation currently take place. It is envisioned that recommendations for these pathways would establish physical infrastructure, improve land use, and revive critical habitats that will protect communities, livelihoods, and natural systems from the anticipated sea-level rise and increased intensity of rainfall events that will exacerbate flooding. On the other hand, the pathway to reduction of disaster risk related to flooding is primarily aimed at protecting populations and improving their resilience in response to increasing flood risks in the short term. All three pathways depend on a cross-cutting recommendation to build capacity to collect, analyze, and use climate information, and leverage existing analysis, communications, and local networks to support the development of effective early warning systems and long-term planning processes for resource use, as well as land and infrastructure development.

DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS PATHWAY

Strengthen the capacity of stakeholders to improve preparedness and response to flood-induced disaster:

- Increase awareness about vulnerability to climate change and the need for natural disaster preparedness (*Centro de Operaciones de Emergencias* [COE], municipal governments, neighborhood associations, mothers' clubs, private businesses, and tourism clusters).
- Strengthen the capacity of organizations best placed to improve both disaster risk preparedness and response in populations susceptible to flooding (National Council for Climate Change, *Instituto Nacional de Formación Técnico Profesional* [INFOTEP], Ministries of Labor and Public Administration, academic institutions, Red Cross, ONAMET, National Emergencies Council [NCE], COE).
- Link local actors and agencies on the “front-lines” of disaster risk preparedness and reduction with national agencies that can support their development and ability to respond (NCE, COE, nongovernmental organizations [NGOs], municipal and provincial governments, private businesses, neighborhood associations, tourism clusters, academic institutions, etc.).

Improve development and communication of climate and natural disaster information:

- Strengthen the national network of meteorological stations and staff capacity to produce long-term climate records and improve tropical storm tracking (INDRHI and ONAMET).
- Produce climate information tailored to specific sectors (INDRHI, ONAMET, ministries of Agriculture, Environment and Natural Resources, Trade and Industry, CNE, etc.).
- Develop a national system to communicate incoming climate-related risks (ONAMET, INDRHI, NCE/COE, academic institutions, and sub-national governments).

Strengthen inter-institutional and international collaboration to improve coordinated preparation and response to flood-induced disaster risk:

- Strengthen the application of the *Ley de Gestion de Riesgos a Desastres* (NCE, COE, NGOs, municipal and provincial governments, private businesses, neighborhood associations, tourism clusters, academic institutions, etc.).
- Define and implement coordinated plans for disaster risk response and early warning among key lead national and sub-national agencies (ONAMET; INDRHI; The Climate Change Unit; Ministries of Agriculture, Environment and Natural Resources, and Trade and Industry; COE/CNE; academic institutions; neighborhood associations; and sub-national governments).
- Establish local multi-sectoral working groups to improve coordination for prioritizing, planning, and implementing climate change and disaster risk response activities (COE, municipal governments, neighborhood associations, mothers' clubs, private businesses, and tourism clusters).

DEVELOPMENT PLANNING: INFRASTRUCTURE AND LAND USE

Strengthen the capacity of professionals and institutions to prevent and mitigate climate change risk exposure:

- Develop university courses to train specialized personnel on climate change, planning, and risk management (academic institutions such as the Autonomous University of Santo Domingo, *Dirección General de Ordenamiento y Desarrollo Territorial* [DGODT], etc.).
- Train officials and other technical personnel to facilitate the development of land-use plans that integrate climate change adaptation (CCA) (personnel from the local governments and the Dominican Federation of Municipalities, among others, would be targeted for the trainings).

Improve urban and land-use planning to minimize exposure to climate change and risks to natural disasters:

- Approve and apply the new *Ley de Ordenamiento Territorial* (DGODT, Ministry of Economic Development and Planning, and sub-national governments).
- Provide guidance and capacity building on how to integrate climate change adaptation into planning processes at national and sub-national levels (DGODT; Climate Change Unit; NGOs; Federations of Local Government including *La Federación Dominicana de Municipios* [FEDOMU]; Ministries of Economic Development and Planning, Environment and Natural Resources, and Agriculture; *Consejo Dominicano de Pesca y Acuicultura* [CODOPESCA]; etc.).
- Stabilize and control flooding by building physical barriers and restoring natural barriers (Ministry of Environment and Natural Resources, sub-national governments, neighborhood associations, NGOs, private businesses, etc.).

Strengthen environmental assessment and licensing policies, guidance, and enforcement in order to prevent and mitigate environmental degradation and flooding:

- Continue to strengthen the environmental permitting process (NGOs and the Ministry of Environment and Natural Resources).
- Educate NGOs, the academic community, and citizens about the *Ley del Medio Ambiente* and regulations for the environmental permitting process (environmental impact assessments) (Ministry of Environment and Natural Resources, NGOs, and sub-national environmental offices).

- Support establishment of independent monitoring and reporting mechanisms for process/compliance (academic institutions and NGOs).
- Evaluate infrastructure and plans to ensure their soundness in the face of anticipated climate change vulnerabilities (*Colegio Dominicano de Ingenieros, Arquitectos y Agrimensores [CODIA]*, Risk Management Municipal Institute, Municipal Institute of Risk Management [IGER] in Santiago, Ministry of Public Works and Communications, etc.).

MANAGEMENT AND CONSERVATION OF COASTAL HABITATS AND WATERSHEDS

Strengthen institutions and create awareness related to climate change and the conservation of coastal-marine resources and watersheds:

- Train environmental and natural resource management professionals in climate change and improve understanding of climate change and conservation at the community level (the Climate Change Unit, academic institutions, ministries of Education and Agriculture, NGOs, etc.).
- Strengthen inter-institutional coordination across all related ministries and sectors to plan, coordinate, and address climate change through improved management and conservation of coastal-marine resources and watersheds (National Council for Climate Change, Ministries of Environment and Natural Resources and Agriculture, INDRHI, sub-national governments, neighborhood associations, private businesses, and NGOs).

Improve the management and conservation of watersheds:

- Promote forest conservation (Ministries of Environment and Natural Resources and Agriculture, academic institutions, provincial and municipal governments, NGOs, and others).
- Promote implementation of good agricultural and soil/water conservation practices (same as above and INDRHI).

Improve the integrated management of coastal-marine resources:

- Create awareness about and enforce laws that reduce the discharge of contaminants into coastal habitats (sub-national governments – environmental officers and neighborhood associations).
- Create awareness about and enforce laws that regulate fishing (*CODOPECSA, Marina de Guerra*, fishing associations, and NGOs).
- Promote the establishment and improved management of coastal/marine protected areas (public/private alliances, Ministry of Environment and Natural Resources, and NGOs).
- Restore coastal-marine ecosystems: coral reefs, mangroves, estuaries, and soft-bottom habitats (public/private alliances, Ministry of Environment and Natural Resources, *CODOPECSA*, and NGOs).
- Identify and promote environmentally-neutral income generation alternatives to fishing and salt harvesting (Ministries of Environment and Natural Resources, Trade and Industry; sub-national governments; federations of local governments; private businesses; and NGOs).

Promote the efficient use and management of water related to potable use, structures for divergence and storage (e.g., dams), irrigation for agriculture, and groundwater management:

- With the collaboration of government and NGO partners, support the Ministry of Environment to lead the promotion of best adaptation practices in water management and use.
- Strengthen local governance/enforcement, including capacities to control water management and use as an adaptation practice at the national and sub-national levels (Ministry of Environment and Natural Resources, INDRHI, the national sewage and water authority [INAPA], water service agencies, water user associations, and sub-national governments).
- Support INDRHI, INAPA, and local water service agencies to enhance water distribution systems, including water quality and waste reduction.
- Improve monitoring and management of watersheds during seasons of low runoff to mitigate floods and sedimentation (INDRHI and CNE).
- Continue to support promising payment for ecosystem services interventions (such as water funds) that promote watershed protection, improved water use, and management of solid waste (national and local utilities including water and energy service agencies, Ministry of Environment and Natural Resources, and NGOs).

For more information, please contact:

- *USAID/Dominican Republic, Acting Office Director, Climate Change Office, Monica Bansal. Tel.: + 809-731-7007; Email: mbansal@usaid.gov*
- *African and Latin American Resilience to Climate Change (ARCC), Study team leader, Patricia Caffrey. Tel.: 802.658.3890, Ext. 2238; Email: patricia.caffrey@tetrattech.com*