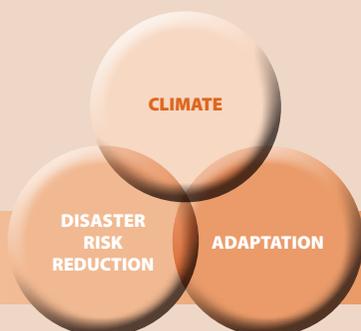




Vulnerability, Risk Reduction, and Adaptation to Climate Change

COSTA RICA



GFDRR
Global Facility for Disaster Reduction and Recovery



COUNTRY OVERVIEW

Situated between Nicaragua and Panama in Central America, Costa Rica occupies an area of 51,100 square kilometers and is bordered by both the Caribbean Sea in the north-east and the North Pacific Ocean in the south-west. The topography is varied and includes coastal plains separated by rugged mountains, including over 100 volcanic cones. Even though Costa Rica constitutes only 0.034% of the total Earth surface, its habitats represent around 5% of the planet's biodiversity. Costa Rica is known worldwide for its conservation efforts and is a hot spot for eco-tourism, with more than 26% of its land under protection.¹

Key Sectors

Agriculture
Forests and Ecosystems
Water Resources
Coastal Zones

With an annual GDP of \$29 billion, the country's 4.5 million people enjoy the highest standard of living in Central America, with a per capita income of about US \$10,569 and an unemployment rate of around 6%.

The poverty rate is also lower in comparison to the region as a whole, remaining around 15-20% for nearly 20 years.² Due to a combination of geographic variations and economic factors, Costa Rica is highly vulnerable to extreme climate events and natural hazards. Part of this vulnerability has to do with the presence of populations in areas prone to volcanic eruptions and in unstable lands, degraded by wide-spread cattle ranching, or in poorly planned settlements prone to landslides and flooding.

PRIORITY ADAPTATION MEASURES

Costa Rica has submitted two national communications to the United Nations Framework Convention on Climate Change (UNFCCC) in 2000 and 2009 respectively, both of which outline Government actions and policy frameworks to address climate change adaption. For both communications vulnerability studies were undertaken for the coastal area, water resources, agriculture, ecosystems, and forestry and adaptation measures for these sectors were identified. Key vulnerabilities outlined include sea level rise in coastal area studies, adverse affects of climate variability on crop productivity and efficiency, and forest coverage reduction of tropical premontane and montane life zones.³

Priority Adaptation Projects

Reducing erosion with improved land-use planning
Improving water and sanitation systems in urban areas
Payments for ecosystem services to protect biodiversity
Monitoring severe weather events for coastal protection

The Capacity Building for Stage II Adaptation to Climate Change in Central America, Mexico, and Cuba project carried out with the United Nations Development Programme and Global Environment Facility through 2007 builds upon the Stage I vulnerability and adaptation assessments of Costa Rica's initial National Communications and examines the vulnerability of the

Water System of the North Western zone of the Costa Rican Central Valley through the use of 15 demographic, housing, poverty, and land condition and hazard indicators. The project's focal points include strengthening the adaptive capacity of human systems to reduce vulnerability to the impacts of climate change, including climate variability, risks, and extreme events. The outputs of this project will guide the creation of an **Adaptation Policy Framework** for the preparation of adaptation strategies, policies and measures.⁴

¹ Costa Rica Second National Communication, 2009.

² World Bank Data Catalog and Country Brief : <http://data.worldbank.org/country/costa-rica>.

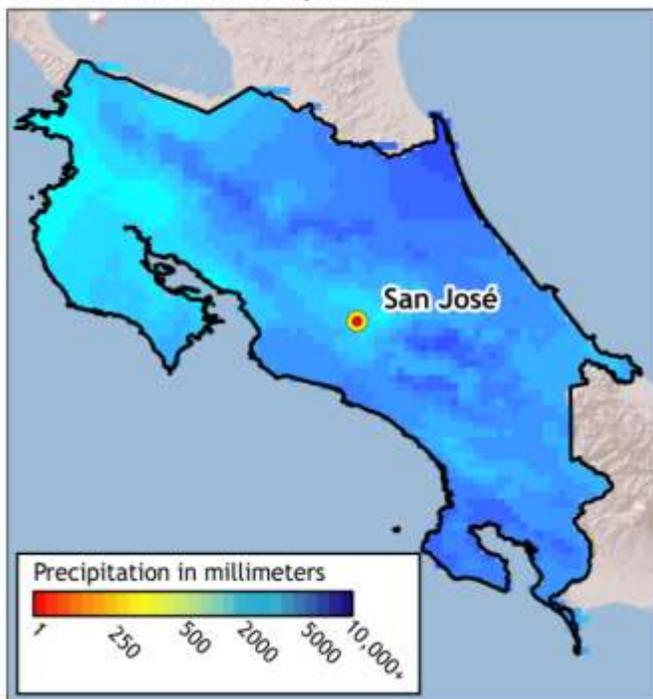
³ CATHALAC. Fomento De Las Capacidades Para La Etapa II de Adaptacion Al Cambio Climatico En Centro Americana, Mexico Y Cuba, 2008.

⁴ CATHALAC. Regional Work on Adaptation to Climate Variability and Change, 2006.

CLIMATE BASELINE AND CLIMATE FUTURE

CLIMATE BASELINE

Total Annual Precipitation



Mean Annual Temperature

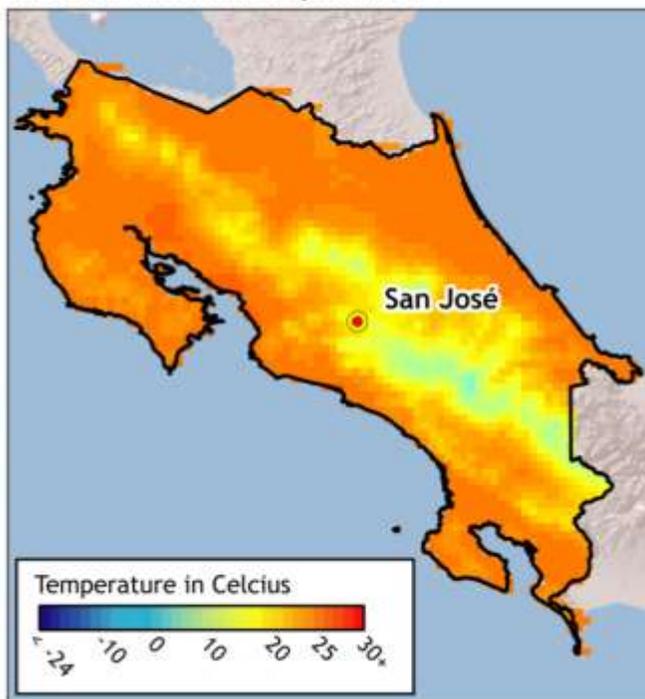


Figure 1: Total Annual Precipitation (left) and Mean Annual Temperature (right) for Costa Rica⁵

Costa Rica's climate display generally well-defined annual patterns, which are periodically affected by fluctuations in the temperature of the surrounding oceans, interaction of the atmospheric circulation with the volcanic mountain range that runs northeast to southeast, and the El Niño/La Niña cycles and Pacific Decadal Oscillation (PDO). The lowlands of the country harbor a tropical and subtropical climate while the highlands experience mountainous climate. The El Niño phenomenon causes severe droughts on the Pacific coast of Costa Rica, while masses of cold air moving in from North America during the winter months combine with the trade winds between July and August to produce intense rains that cause flooding on central Costa Rica's Caribbean slope.⁶

The interactions between the trade winds from the east and the region's topographic diversity creates the effects of "rain shadow," with the Caribbean slope experiencing rain practically all year round and the Pacific slope characterized by a prolonged dry season lasting approximately from November until April or May and a wet season during the rest of the year. The increased intensity of the trade winds in July produces a peak of precipitation on the Caribbean slope. Daily temperatures reach their maximum value before the start of the rainy season. Minimum

⁵ WorldClim 1960-1990 averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at the Museum of Vertebrate Zoology, University of California, Berkeley, in collaboration with Peter Jones and Andrew Jarvis (CIAT), and with Karen Richardson (Rainforest CRC). www.worldclim.org/current.

⁶ Miguel Cifuentes Jara. ABC of Climate Change in MesoAmerica. CATIE, 2010.

temperatures show a different pattern, with the highest values observed in July and the lowest values during the Northern Hemisphere winter.⁷

RECENT CLIMATE TRENDS FOR COSTA RICA (SINCE 1960):⁸

As with other Mesoamerican Countries, Costa Rica is considered a primary “hot spot” for climate change in the tropics. An analysis of temperature and precipitation reveal many changes in the extreme values of these variables during period between 1961 and 2003:⁹

- ➔ Temperatures have increased between 0.2 and 0.3°C per decade with a prolonged and hotter dry season
- ➔ The number of warm days increased by 2.5 percent and nights by 1.7 percent, while the number of cold nights and cold days decreased by -2.2 and -2.4 percent per decade
- ➔ Temperature extremes increased by between 0.2 and 0.3°C per decade;
- ➔ While most climate data show positive trends (increased precipitation), overall average annual precipitation in the region and the number of consecutive wet days do not show significant changes although there has been a slight increase in its intensity; and
- ➔ Extreme precipitation has increased significantly and is strongly correlated with the temperature of the tropical Atlantic Ocean. The latter indicates that prolonged rainy seasons are related to the warm waters in that oceanic basin.
- ➔ The trend over the last 40 years suggests a strengthening of the hydrological cycle, with more intense rain occurring during shorter periods of time that produce greater average precipitation per episode. This trend is expected to continue in the future due to climate change, possibly resulting in a greater frequency or intensity of extreme events such as floods and droughts. This poses obvious impacts on agricultural production, soil and forest conservation and water availability, all of which are already showing signs of stress and vulnerability.

CLIMATE FUTURE

At a Glance

Temperature	Warming is more pronounced in the lowlands than highlands	▲ 2 °C by 2050; 4°C by 2100
Rainfall	Varies by region and highly uncertain	▲ ▼ -63 - -46 percent
Extremes	The number of dry days is expected to increase, along with the frequency of more intense precipitations and extreme events such as storms and floods. Highest severity on the Caribbean Coast.	▲ Towards 2080

Source: Costa Rica Second National Communication using the PRECIS model, 2009.

Using the reference period for climate data from 1961 – 1990, the following possible climate future trends for 2100 reveal Costa Rica’s vulnerability to climate change:^{10,11}

- ➔ Temperatures are projected to increase by 1 to 2°C for 2050, and between 2 and 4°C higher in 2080; particularly during May to June, with the highest possible temperature increase of 3.8°C in Region I (which

⁷ Ibid note 5.

⁸ Ibid note 1.

⁹ Ibid note 6.

¹⁰ Costa Rica - Second National Communication, 2009.

¹¹ World Bank LAC Agriculture and Climate Country Note, 2009.

is in the north-west of the country, followed by Region IV (south-east of the country) with 3.5°C and Region II (north-east of the country) with 3.2°C;

- ➔ Temperature variance under future climate trends will be more pronounced at higher elevations than in the lowlands. In addition, the height of the orographic cloud base of tropical montane forests will shift. All of these changes pose negative implications for the ecosystems and endemic species that have been accustomed to a certain 'comfort zone'¹² and reveal a future with significantly more moisture stress due to higher temperatures and a reduction in precipitation from both horizontal and vertical processes:¹³

Changes in Rainfall were evaluated by Costa Rica's National Communication team using ONE Regional Climate Model (PRECIS) and are summarized from this document by region below:



Figure 2: Coverage of the PRECIS model for Costa Rica

- ➔ Temperature and rainfall projections:

- North Pacific:
 - Maximum Temperatures are projected to increase by +3 to +8°C, while minimum temperatures are projected to increase between +2 to +3°C
 - Rainfall is projected to decrease between 13 and 25%, with the least affected regions comprising of the Tilaran Mountains and the Nicoya Peninsula which are projected to experience rainfall reductions of 2-18%, while the Volcanic Mountains, Santa Elena Peninsula are projected to experience 20-29% reductions in rainfall.
- Central Pacific:
 - Maximum Temperatures are projected to increase by +2 to +4°C, while minimum temperatures are projected to increase between +1 to +3°C, with the south pacific region projected to experience the most significant increases in minimum temperatures for Costa Rica.
 - Projected increases in annual rainfall are expected, with the most significant increases projected for the Osa Peninsula and Punta Burica.

¹² These ecosystems are dependent on a narrow range of temperature and precipitation.

¹³ Kamalkar, A.V. Climate change scenario for Costa Rican montane forests, 2008.

- Caribbean region
 - Maximum Temperatures are projected to increase by +4 to +5°C, while minimum temperatures are projected to increase between +2 to +4°C.
 - Rainfall is projected to decrease between -16 to -23% by 2100, with the Eastern Valley the most significantly affected.
 - Central Region
 - Maximum Temperatures are projected to increase by +2 to +4°C, while minimum temperatures are projected to increase between +2 to +3°C.
 - Rainfall is projected to increase in the coast, while in the central valley; a tendency for reductions in rainfall is projected.
 - Northern Region
 - Maximum Temperatures are projected to increase by +4 to +5°C, while minimum temperatures are projected to increase between +2 to +3°C.
 - Rainfall is projected to decrease across the region by between -7 and -56%, with significant decreases projected in the areas near the Nicaraguan border.
- ➔ Possible increase of sea levels by up to 1m by 2100.
 - ➔ The number of dry days is expected to increase, along with the frequency of more intense precipitations and extreme events such as storms and floods toward 2080.
 - ➔ The Pacific lowlands show an increase in the variability and future climate variability may lead to an increase in the altitude of cloud formation in the region and seriously affect the moisture supply to the montane forests during the dry season. This trend which would increase under possible intensified hydrological cycle in future and would impact montane ecosystems.

CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

AT A GLANCE

Costa Rica is at risk from several natural disasters, of which the following pose the greatest threat under a changing climate.¹⁴

Costa Rica has the 8th highest economic risk exposure to three or more hazards and 6.8% of its total area is exposed to three or more adverse natural events. Further, 77.9% of Costa Rica's population and 80.1% of the country's GDP reside in areas at high risk of multiple hazards.¹⁵

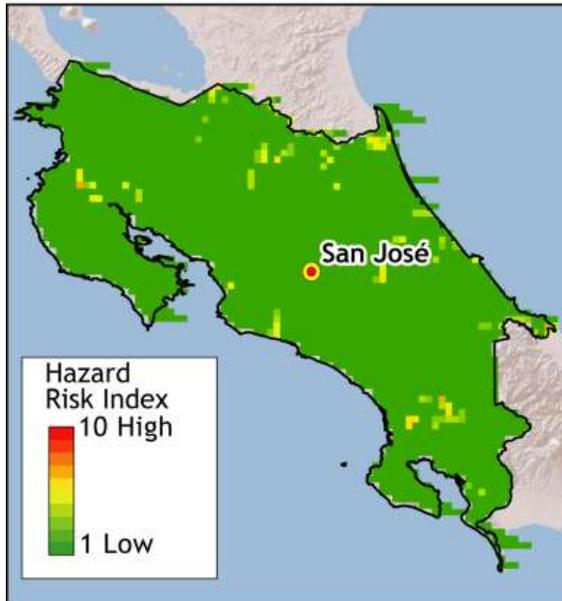
¹⁴ WorldClim 1960-1990 averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at the Museum of Vertebrate Zoology, University of California, Berkeley, in collaboration with Peter Jones and Andrew Jarvis (CIAT), and with Karen Richardson (Rainforest CRC). www.worldclim.org/current

¹⁵ GFDRR and ISDR. Costa Rica Disaster Risk Management Programs for Priority Countries, 2010

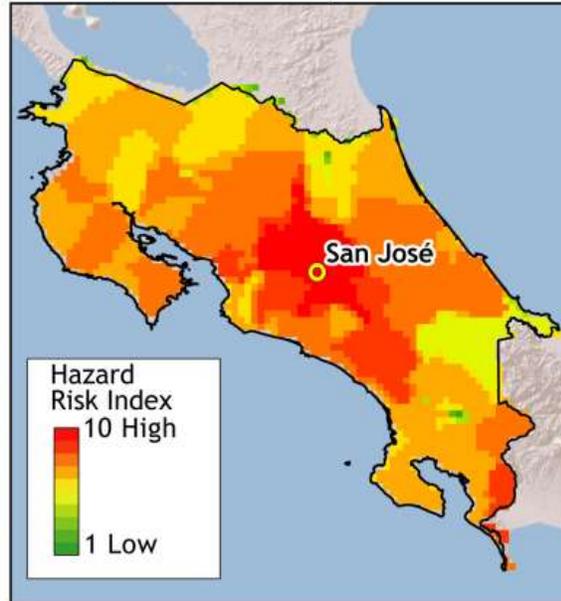
Floods and Landslides:¹⁶

➔ In recent years (between 2001 and 2008) floods and storms have had the highest human and economic impact in Costa Rica – 106,000 people have been affected by floods (8 events), with the cost of damages reaching US\$ 106 million.

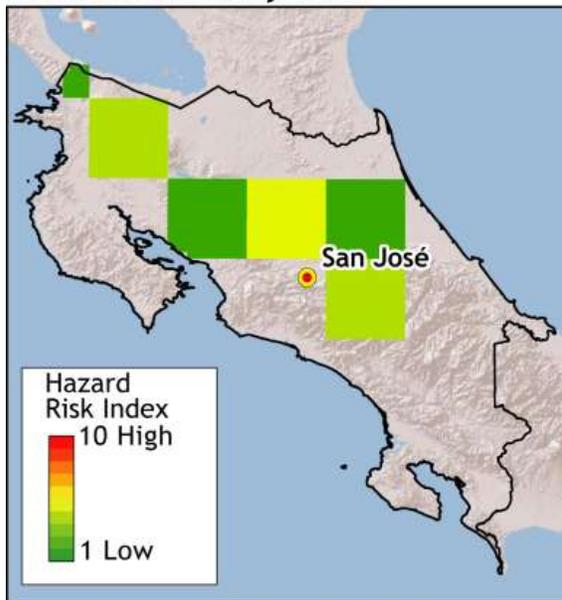
Flood Risk



Earthquake Mortality Risk



Volcano Mortality Risk



Cyclone Mortality Risk

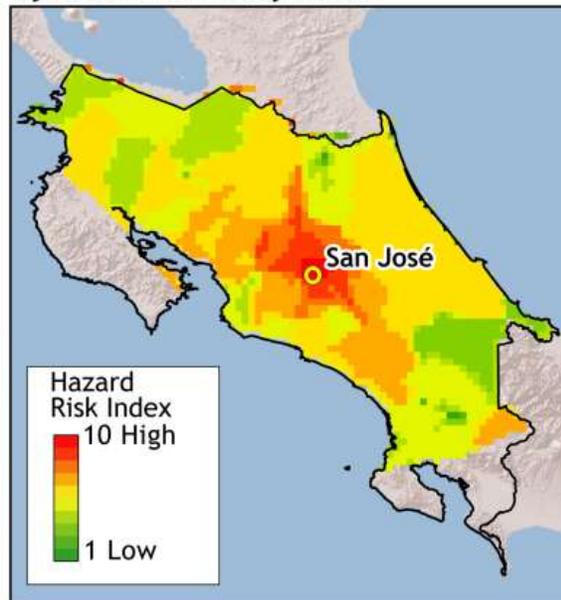


Figure 3: Exposure to hazards across Costa Rica¹⁷

¹⁶ CCAD and SICA. Regional Strategy on Climate Change, 2010.

¹⁷ UNEP's global risk data platform, Columbia University Center for Hazards and Risk Research (CHRR), and Columbia University Center for International Earth Science Information Network (CIESIN).

- ➔ In 2005, landslides caused major damage to agricultural fields and areas covered with primary forest.
- ➔ During the heavy rains in October 2007, a total of 14 people died in a landslide in the city of Atenas. After the January 2009 earthquake, at least 10 people died in another landslide in Cinchona, a rural community 50 miles west of the capital city, San José.
- ➔ During February 2009, heavy rains affected the Pacific Coast and Central Valley and caused floods and landslides in at least 65 of the country's 81 counties, with 18 deaths reported. There was serious damage reported to at least 27 major roads and at least 2,000 homes were flooded in the northern province of Guanacaste.

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Cyclones, Sea Level Rise, and Storm Surges¹⁶

- ➔ Costa Rica is vulnerable to tropical and subtropical cyclones and their associated storm surges on its Caribbean coast. Hurricane Mitch, one of the most destructive events in Central America, caused economic losses amounting to approximately US \$98 million in Costa Rica. This amount is much lower than that incurred in other countries; however, with increasing climate variability the likelihood of cyclones is expected to increase.
- ➔ Evidence of acceleration in sea level rise (up to 2-3 mm/yr) over the past decade suggests an increase in the vulnerability of low-lying coasts, which are already subjected to increasing storm surges.

Despite its high exposure to adverse natural events, Costa Rica has built an efficient disaster response system and has managed to limit vulnerabilities through the effective enforcement of building codes, environmental standards, and land use planning. Costa Rica has also made substantial progress in strengthening its institutional and legal framework and mainstreaming disaster risk management in its national development program.

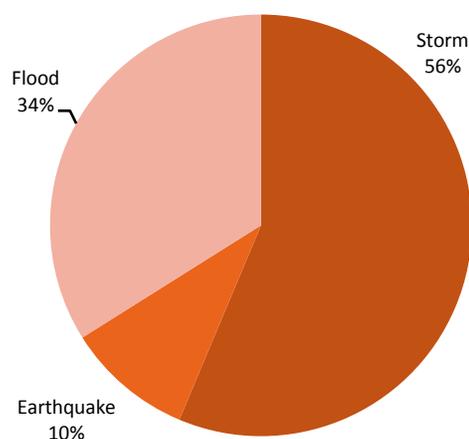


Figure 4: Percentage of people affected by natural disasters, by type of disaster.

Source of data: "EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium."

Implications for Disaster Risk Management (DRM)

- ➔ Storms and flooding are expected to impact the San Jose metropolitan area in the Northwestern Region of the Central Valley, with risks to water and sanitation systems as well as agricultural production. As these urban areas have high poverty rates, the climate-related trends should be analyzed in the context of social, economic, and political variables. Storm and flood warning systems, coupled with improved sanitation and agricultural adaptation measures, would curb damage and help protect vulnerable populations. Impact assessments should also be performed on the aquifers in this area as they are the primary source of water for over half of the country's population.
- ➔ Low-lying coastal regions impacted by sea level rise and increased severe weather require more adequate funding for preparedness, climate proofing, and strategic public infrastructure. Housing designs able to sustain some coastal flooding should be expanded through municipal building codes and land use guidelines.

¹⁸ GFDRR and ISDR. Costa Rica Disaster Risk Management Programs for Priority Countries, 2010

- ➔ Changes in storm regimes near the coast may further erode coastal morphology, disrupt fishing areas and agricultural lands, and salinize water sources. Impact assessments should be performed to identify the most at-risk ecosystems and water sources and to aid in the creation of appropriate adaptation measures and programs.

SECTORAL CLIMATE RISK REDUCTION RECOMMENDATIONS

AGRICULTURE

A total of 53% of Costa Rica's land use is attributed to agriculture—pasture accounts for 49%, arable land used for cultivation and agricultural production for 4%, and forestry for 44%. Three percent or 1,080 sq km constitute irrigated land.¹⁹ Agriculture accounts for 14% of the country's employment, and while the traditional agricultural exports of bananas, coffee, sugar, and beef are still the backbone of commodity export trade, coffee cultivation, primarily carried out in the Central region, is the key socioeconomic activity of the country constituting 20% of GDP and generating the bulk of employment. Bean cultivation is a traditional agricultural activity with great socioeconomic importance as it is the most consumed leguminous plant in Costa Rica. Potato production, which is located in the central region, is the third most consumed agricultural product.²⁰

Climate vulnerability studies on four crops - rice, beans, potatoes and coffee - show the following impacts under future climate trends (Table 1).

- ➔ Rice cultivation - A potential relative increase in yield is expected in certain areas of the country due to increased precipitation and CO₂ fertilization.
- ➔ Bean and potato cultivation - Results indicate that both potatoes and beans might show a decrease in yields with projected increasing temperature and change of precipitation patterns, with temperature appearing to be the biggest driver in this change.
- ➔ Coffee cultivation - The increase of environmental temperature might imply a rise in coffee yields, especially with an increase in maximum temperature of +2°C. However, this increase might be limited to implementation of sustainable soil and water management, as increased temperatures should also increase evapotranspiration and water availability.

Table 1: Projected Change in Crop Yields across Costa Rica (in kilograms per hectare)

Crop	Baseline Yield (1961-1990)	Projected Yield	Change %	Period
Rice	893	1044	16.91	2020s
Rice	893	1096	22.73	2050s
Rice	893	937	4.93	2080s
Maize	476	725	52.31	2020s
Maize	476	828	73.95	2050s
Maize	476	1428	200	2080s
Best Cereal	1100	1264	14.91	2020s
Best Cereal	1100	1381	25.55	2050s
Best Cereal	1100	1659	50.82	2080s

Source: World Bank Climate Change Data Portal – Agricultural Model Generated by IIASA.

To maintain ecological, socioeconomic, and human development and ensure food security, the following land use recommendations are made:²¹

¹⁹ Ibid. note 5

²⁰ Ibid note 1

²¹ Smith C. Climate Change Perception and Adaptation in a Remote Costa Rican Agricultural Community, 2010.

- ➔ Adjust sowing dates and crop zoning based on ENSO short and medium climate forecasts;
- ➔ Employ sustainable agroecosystem land management practices, including the establishment of seedbanks for the long-term storage of agricultural seeds, improved livestock forage quality, and agroforestry practices.
- ➔ Institute agroforestry and payment for environmental services (PES) or credit systems for soil, water, and biodiversity conservation and carbon sequestration. This approach would provide a long-term sustainable source of fruits, nuts, and fodder to people and livestock, while mitigating runoff and soil erosion.

COASTAL RESOURCES²²

The Costa Rican coastline constitutes over 1,100 km along the Pacific Ocean and 200 km along the Caribbean Sea. The proximity to a mountain range, multiple lava filtering and perpendicular folds to the coastline, as well as high precipitation have caused significant morphological and environmental variability.

Under future possible climate trends of sea level rise (SLR) of 1 m, all of the 1,300 km of coastal line might shift and widen the areas subject to tidal floods, including mangrove swamps and salt marshes:

- ➔ In Puntarenas, given a rise of only 0.3 m in sea levels, waters would penetrate an estimated 150 meters, affecting around 105 ha of tidal flood area, which constitutes 60% of the current residential area. If sea level rise reaches 1.0 m high, waters would penetrate 500 m in average and would instigate floods in 300 ha that are currently dry. This constitutes 90% of the current residential area.

To help coastal areas better adapt to flood damage the following recommendations are made:²³

- ➔ Local communities in Costa Rica have improved their housing design to better cope with floods by elevating them or using a reinforced concrete strip as a foundation. These houses are cost-efficient and last longer than regular structures and should be expanded through integration into municipal building codes.
- ➔ Coastal communities source much of their livelihood from fishing and tourism and thus future possible SLR threatens the long-term sustainability of these populations. Impact assessments to identify the most vulnerable coastal ecosystems and assess adaptation measures for coastal fisheries should be carried out.

WATER RESOURCES²⁴

Climate vulnerability studies on the three most important river basins in Costa Rica – the Reventazón, Térraba, and Grande de Tárcoles – show alarming trends in runoff rates and alterations in the hydrological cycle. Alterations in the water cycle could affect water runoff, erosion, and sedimentation, thus causing severe flood-related problems. Impacts would also be reflected in the exploitation of water resources to generate hydroelectricity, irrigation systems, aqueducts, and sewer systems.

Even though water availability is not a problem at present, the population's needs for reliable and clean water supply are not fully met due to a lack of integrated water management policies. A total of 76% of the national population receives water that is disinfected on an ongoing basis. The issue of access to quality potable water is more critical among the highest-risk populations of the country and future climate-induced flooding events will only exacerbate it. For example, in the Central Valley of Costa Rica an imbalance in the potable water supply is expected by 2022, due to a combination of the effects of climate change and an expected population growth of 1.1 million people.

²² Ibid note 1

²³ Ibid note 1

²⁴ Twelfth State of the Nation Report on Sustainable Human Development, 2005.

Further concerns exist under expected future severe dry conditions, as inappropriate agricultural practices, deforestation, soil erosion, and the excessive use of agrochemicals may deteriorate surface and groundwater quantity and quality in rural areas and around the San Jose metropolitan area.²⁵

Adaptation measures in water resources may include:

- ➔ Improving and strengthening the capacity of water resource systems through the evaluation of future and current vulnerability to watersheds.²⁶
- ➔ Water storage facilities, protection of aquifers, and monitoring of water resources.
- ➔ Water rationing, irrigation projects, along with projects aimed at increasing water efficiency and irrigation.
- ➔ Engaging key actors within the water resource systems in the Northwestern Central Valley to develop policy strategies and measures for adaptation at the local and national level.²⁷

FORESTS AND ECOSYSTEMS

Latin America as a whole and Costa Rica in particular are emerging as 'hot-spots', for which potential climate change impacts on the environment are likely to be particularly pronounced. Both the projected decrease in precipitation and the expected increase in precipitation variability pose significant threats to the region's unique biodiversity. Biological changes associated with changes in climate have already been identified in the Monteverde Cloud Forest Reserve (MCFR) and other montane forests that lie above 1,000 meters. Rising air creates a continual cloud layer that constantly bathes the vegetation in horizontal precipitation, allowing plants and animals to survive the dry season from December to April. These cloud forests are essential to maintaining freshwater resources in Costa Rica, and the height at which the clouds develop is a critical factor for these ecosystems. They are highly dependent on temperature and precipitation and thus are particularly vulnerable to even a small degree of climate change:²⁸

- ➔ Using rainfall and temperature data collected in Central America between 1961 and 1990 and assuming a doubling of carbon dioxide levels, the high tropical cloud forest regions would increase in temperature of more than 2°C. High elevation Pacific slopes and the Caribbean lowlands will also receive up to 30% less precipitation.
- ➔ As temperatures rise, various ecosystems will migrate upslope to where they are comfortable, disturbing other species and eventually running out of space as they reach the top of the mountains. The result may be losses of many species that are unable to survive the new conditions. For example, the extinction of the golden toad sometime between 1987 and 1989 corresponded with a warm event in the Pacific Ocean.
- ➔ Many of the ecosystems and species that are most likely to be affected by climate change already live within protected areas; if these areas continue to exist, these ecosystems and species stand a better chance of adapting to climate change.
- ➔ According to estimates using the Servir Climate Change Severity Index (CCSI),²⁹ approximately 15% of the area covered by broadleaf forests and agriculture and between 5 and 10% of the area covered by savannahs and mangroves would experience climate changes outside the range of their natural historic variability. In moist lowland forests, research shows that productivity falls and mortality increases during years when high temperatures and low precipitation prevail.

²⁵ AIACC. Assessment of Impacts and Adaptation Measures for the Water Resources Sector Due to Extreme Events Under Climate Change Conditions in Central America, 2003.

²⁶ Capacity Building for Stage II Adaptation to Climate Change in Central America, Mexico, and Cuba Project

²⁷ Ibid.

²⁸ Kamalkar, R.S. Climate change scenario for Costa Rican montane forests

²⁹ <http://www.servirglobal.net/tabid/337/Article/517/potential-impacts-of-climate-change-on-biodiversity-in-central-america-mexico-d.aspx>

Costa Rica has adopted new forestry laws and policies, which include better regulatory measures, sustainability principles, and certification of forestry products.

Other recommended multi-scale and multi-sectoral approaches include the adoption of ecosystem-based adaptation (EBA) policies and measures and their integration into national development policies:³⁰

- ➔ Identify the primary tropical wet forests that would be affected by climate change and adopt protection measures;
- ➔ Identify primary montane moist forests, which are especially threatened by deforestation, and adopt protection measures;
- ➔ Create and enforce linkages between ecosystem managers and vulnerable sectors benefiting from ecosystem services;
- ➔ Provide education and outreach policies to raise awareness about the relevance of ecosystem services and adaptation for sustainable development.

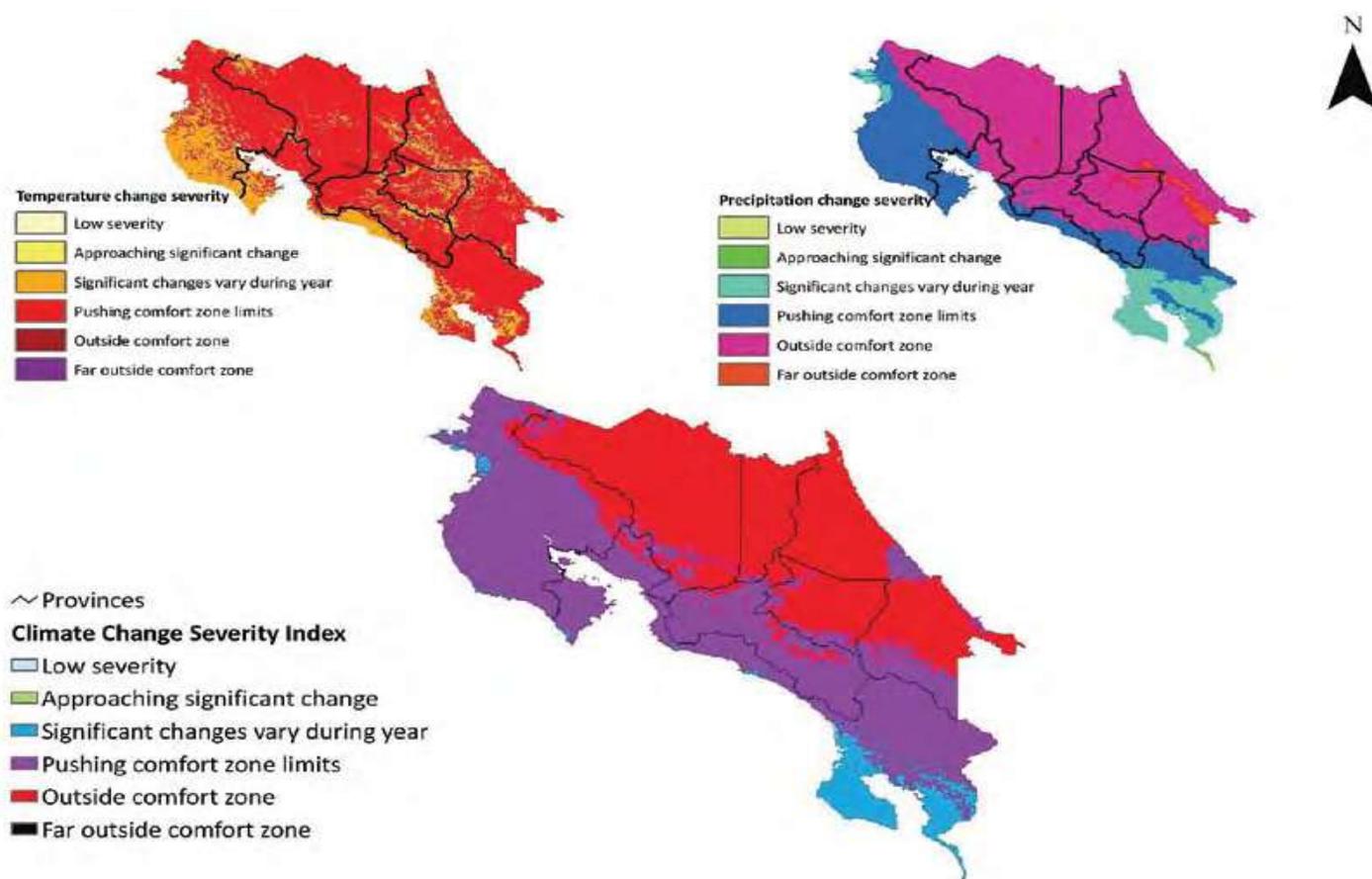


Figure 5: Climate change severity index for Costa Rica in 2020³¹

³⁰ Vignola, R. Negotiation analysis for designing mechanisms to conserve ecosystem services in Costa Rica, 2009.

³¹ Servir Climate Change Severity Index (CCSI)

ADAPTATION

To ensure continuity of its vulnerability studies and adaptation measures following its initial National Communication to the UNFCCC, Costa Rica participated in the *Capacity Building for Stage II Adaptation to Climate Change in Central America, Mexico, and Cuba Project*, which was carried out with the United Nations Development Programme and Global Environment Facility through 2007. The project centered on regional and local adaptation experiences with an emphasis on climate change implications and risk for watersheds and water resource systems. Socioeconomic and biophysical indicators were used for current climate variability and future climate threats to develop the following adaptation goals:³²

- ➔ Improving and strengthening the capacity of water resource systems through the evaluation of future and current vulnerability;
- ➔ Improving the scientific technical knowledge on adaptation to the climatic change among key players;
- ➔ Engaging key actors within the water resource systems in the Northwestern Central Valley to develop policy strategies and measures for adaptation at the local and national level;
- ➔ Creating agribusiness and water treatment incentives to improve water efficiency and improve the drinking water infrastructure;
- ➔ Expanding the national program of payment for environmental services (PES) to water resources in the area;
- ➔ Creating reforestation projects in the watershed areas to improve and ensure water quality.

Ongoing Efforts—At a Glance

Vulnerability Reduction

- A \$65 million loan through 2011 for a Catastrophe Deferred Drawdown Option (CAT DDO) to provide immediate sources of funding following natural disasters
- Strengthening a Municipal Information System for Disaster Prevention in Latin America and the Caribbean (SIMPD), funded by the International Development Research Centre, Canada
- Mesoamerican coordination system for territorial information by the Interamerican Development Bank
- Regional Plan for Disaster Reduction (PRRD), sponsored by Norway and Spain
- EU3sponsored Regional Program for Reduction of Vulnerability and Environmental Degradation (PREVDA)
- World Bank ongoing pilot project for an Early Warning Systems for Hydrometeorological Hazards
- Climate change vulnerability studies for agriculture and water carried out with the Netherlands in 2010
- UNFCCC's "Flood Preparedness in Costa Rica" to improve flood response following the 2002 floods
- A Pan American Health Organization (PAHO) climate vulnerability and adaptation study of the health sector
- A Community Risk Assessment and Action Planning Project by ProVention Consortium that offers toolkits for disaster preparedness and risk prevention and uses participatory research methods and action plans

GFDRR Interventions (in effect or under consideration)³³

- Costa Rica Public Asset Catastrophe Risk Insurance Facility Feasibility Study
- Support for phase II of the development of a Risk Assessment Platform for Costa Rica
- Support for the Pilot Project on Early Warning Systems for Hydrometeorological Hazards of Central America

³² Ibid. note 3

³³ World Bank. Global Facility for Disaster Reduction and Recovery Costa Rica Country Profile, 2009.

EXISTING ADAPTATION FRAMEWORK/STRATEGY/POLICY AND INSTITUTIONAL SET-UP

Costa Rica has made considerable gains in integrating environmental sustainability in its economic development. Adapting to climate risks in the disaster management sector will require both a coordinated national planning structure and local and community-level response measures. The following policies and programs target adaptation and vulnerability to climate change and climate-related events:³⁴

- ➔ **The National Climate Change Plan**, created in 2010 within the Ministry of Environment and Energy and coordinated by the National Meteorological Institute (IMN) and the Costa Rican Office for Joint Implementation (OCIC), outlines research related to the GHG inventory, vulnerability studies, and analysis of mitigation and adaptation measures.
- ➔ **The National Climate Change Strategy (ENCC)**, which was integrated into the National Development Plan for 2006-2010, calls for public institutions and all levels of government to produce action plans containing clear goals around six pillars: mitigation, adaptation, metrics, capacity building, public awareness and education, and financing — all with the common goal of mainstreaming climate change policy in line with national strategies. Focus areas are adaptation measures in water resource planning, conservation of biodiversity, environmental quality, public health, and territorial planning.³⁵
- ➔ **The Mainstreaming Market-Based Instrument Project** initiated by the World Bank for the period 2006-2012 strives to enhance the provision of environmental services of national and global significance and to secure their long-term sustainability through a scaled-up payment for environmental services system. Forests are the main focus of the project (accounting for 70% of its scope), with water, sanitation, and floods receiving additional attention.
- ➔ **The National Education Plan for the Reduction of Risks to Disasters** is undertaken by the Ministry of Public Education to build awareness about climate risks. **The Regional Strategy on Climate Change** is managed by the Central American Commission on Environment and Development (CCAD) and the System for the Integration of Central America (SICA).
- ➔ **The National Platform for DRR in Costa Rica**, created in mid-2004 by the Board of Directors of the National Commission for Disasters Prevention and Response (CNE), has developed a four-year institutional plan to implement the National Climate Monitoring System.
- ➔ **A new modification of the national Emergency Law** was published in 2006 and includes a chapter defining the management of risk as a public policy crosscutting to all development policies; it establishes the National System for Risk Management and assigns budgets to related activities.
- ➔ **The Consultative Commission on Climate Change (CCCC)**, under the **National System for Sustainable Development (SINADES)**, is a national entity that fosters inter-sectoral dialogue on adaptation and mitigation policies and measures for climate change.

RESEARCH, DATA, AND INFORMATION GAPS

Climate change and climate-related extreme weather events are already affecting Costa Rica and endanger agricultural production, biodiversity, and human settlements in areas prone to flooding, sea level rise, and storm surges. Despite its exposure to these events and its status as a developing country, Costa Rica has made great strides toward adapting through the establishment of a disaster response system and is working to limit vulnerabilities through enforcement of building codes and other measures.. The country has also made progress in

³⁴ HFA-Pedia – International Strategy for Risk Reduction: http://www.eird.org/wikien/index.php/Costa_Rica

³⁵ UNPD Adaption Learning Net: <http://www.adaptationlearning.net/country-profiles/cr>

strengthening its institutional policy framework and linking its disaster risk management to its National Development Plan and adaptation to climate change. Improvements are still needed, however, in assessing risk and bridging knowledge gaps.

➔ Monitoring of Climate Data

- Costa Rica has a nationwide network of meteorological monitoring stations and highly trained scientists working with leading research organizations around the world. There is increased need to improve the access and interpretation of available data.

➔ Use of Climate Data

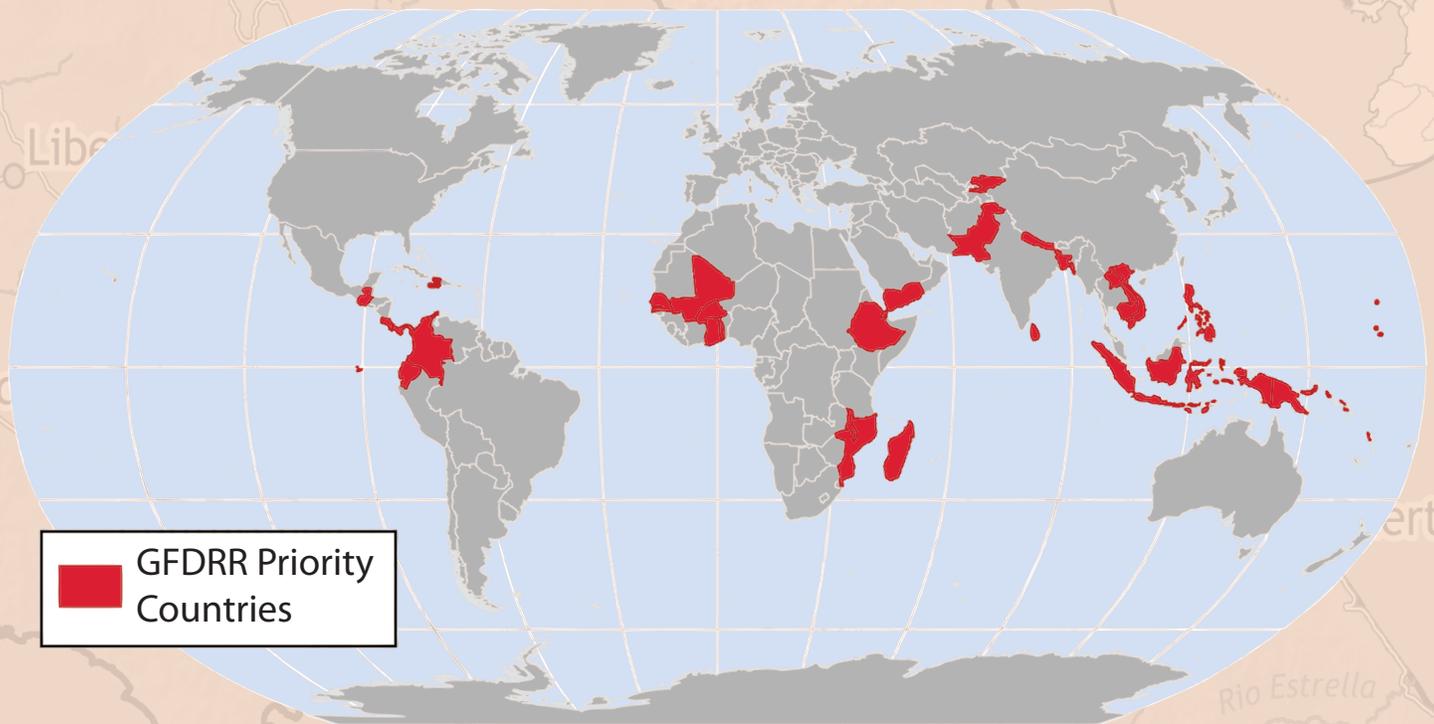
- The existing methodological approaches adopted in the country vary, as many are based on incremental scenarios, in particular for sea level rise (SLR 0.3-1.0 m for the Caribbean Coast). Very few are combined with sector impact models such as coastal river flooding data.
- Long-term and recent trends of SLR, flooding, and storm surges are not always available or analyzed properly, which is of particular concern as Costa Rica is highly exposed to all of these adverse weather events.
- Climate change data for the country relies more on analyzing increases in minimum temperature and sometimes neglects the analysis of maximum temperature. This results in a generalized stated pattern for recent and future climate trends, which would mean that certain highly vulnerable areas might be overlooked.
- Most GCM models in Costa Rica use the downscaling technique for only one scenario, when in fact it would be more effective to associate conceptual models that downscale several scenarios (A1, A2, B2).

➔ Impact Studies

- Assessments are needed in the cloud montane forests, as future trends reveal a climate severity index that would endanger the area's great biodiversity. Studies need to be made as to which species will be most affected and then adaption measures taken to ensure the least amount of harm to these vital ecosystems.
- Assessments are needed in both urban and coastal areas, where poor planning and unstable human settlements have created vulnerability to flooding and landslides. An increase in storms affecting these areas will also endanger water and sanitation systems, which are already showing signs of stress.
- The impact of drought events on the Pacific Slope has not yet been extensively studied. This is especially troubling since this region has high agricultural output. The country needs to take stock of all available climate information in this region to determine where systematic adaption measures should be taken.
- Impact studies on watersheds and water treatment facilities should be expanded to ensure water quality and quantity in the Northwestern Central Valley.

Climate Risk and Adaptation Country Profile

This Country Profile (<http://countryadaptationprofiles.gfdr.org>) is part of a series of 31 priority country briefs developed by the Global Facility for Disaster Reduction and Recovery (GFDRR) as part of its Disaster Risk Management Plans. The profile synthesizes most relevant data and information for Disaster Risk Reduction and Adaptation to Climate Change and is designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and operations. Sources on climate and climate-related information are linked through the country profile's online dashboard, which is periodically updated to reflect the most recent publicly available climate analysis.



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