CLIMATE RISK COUNTRY PROFILE

COSTA RICA

WORLD BANK GROUP

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This profile is part of a series of Climate Risk Country Profiles developed by the World Bank Group (WBG). The country profile synthesizes most relevant data and information on climate change, disaster risk reduction, and adaptation actions and policies at the country level. The country profile series are designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and policy making. This effort is managed and led by Veronique Morin (Senior Climate Change Specialist, WBG) and Ana E. Bucher (Senior Climate Change Specialist, WBG).

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Climate and climate-related information is largely drawn from the Climate Change Knowledge Portal (CCKP), a WBG online platform with available global climate data and analysis based on the latest Intergovernmental Panel on Climate Change (IPCC) reports and datasets. The team is grateful for all comments and suggestions received from the sector, regional, and country development specialists, as well as climate research scientists and institutions for their advice and guidance on use of climate related datasets.

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FOREWORD

Climate change is a major risk to good development outcomes, and the World Bank Group is committed to playing an important role in helping countries integrate climate action into their core development agendas. The World Bank Group is committed to supporting client countries to invest in and build a low-carbon, climate-resilient future, helping them to be better prepared to adapt to current and future climate impacts.

The World Bank Group is investing in incorporating and systematically managing climate risks in development operations through its individual corporate commitments.

A key aspect of the World Bank Group's Action Plan on Adaptation and Resilience (2019) is to help countries shift from addressing adaptation as an incremental cost and isolated investment to systematically incorporating climate risks and opportunities at every phase of policy planning, investment design, implementation and evaluation of development outcomes. For all IDA and IBRD operations, climate and disaster risk screening is one of the mandatory corporate climate commitments. This is supported by the Bank Group's Climate and Disaster Risk Screening Tool which enables all Bank staff to assess short- and long-term climate and disaster risks in operations and national or sectoral planning processes. This screening tool draws up-to-date and relevant information from the World Bank's Climate Change Knowledge Portal, a comprehensive online 'one-stop shop' for global, regional, and country data related to climate change and development.

Recognizing the value of consistent, easy-to-use technical resources for client countries as well as to support respective internal climate risk assessment and adaptation planning processes, the World Bank Group's Climate Change Group has developed this content. Standardizing and pooling expertise facilitates the World Bank Group in conducting initial assessments of climate risks and opportunities across sectors within a country, within institutional portfolios across regions, and acts as a global resource for development practitioners.

For developing countries, the climate risk profiles are intended to serve as public goods to facilitate upstream country diagnostics, policy dialogue, and strategic planning by providing comprehensive overviews of trends and projected changes in key climate parameters, sector-specific implications, relevant policies and programs, adaptation priorities and opportunities for further actions.

It is my hope that these efforts will spur deepening of long-term risk management in developing countries and our engagement in supporting climate change adaptation planning at operational levels.

Bernice Van Bronkhorst
Global Director
Climate Change Group (CCG)
The World Bank Group (WBG)

COUNTRY OVERVIEW

Situated between Nicaragua and Panama in Central America, Costa Rica occupies an area of 51,100 square kilometers (km) and is bordered by both the Caribbean Sea in the north-east and the North Pacific Ocean in the southwest.[1] The country's topography (**Figure 1**) 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. 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 is due to the presence of populations in vulnerable areas as well as the country's severe risk to sea level rise (primary at-risk areas include Puerto Limón, Jaco and Puntarenas). The country also has areas prone to volcanic eruptions and unstable lands which have been degraded by wide-spread cattle ranching or poorly planned settlements prone to landslides and flooding.[2]

FIGURE 1. Topography of Costa Rica[3]

Costa Rica is classified by the World Bank as an upper-middle-income country and ranks 62nd out of 189 countries in the United Nation's Human Development Index (HDI), placing it in the very high development category. With an annual GDP of $61.5 billion in 2020, the country's approximately 5 million people enjoy the highest standard of living in Central America, with a per capita GNI of about US $11,500 and an unemployment rate of around 17.4% in 2020.[4] 81% of Costa Rica's population resides in urban areas, and the annual urban growth rate in 2020 was approximately 2%.[5] Population projections for 2030 point to an additional 468,000 people living in the country, 85.8% residing in urban areas, while in 2050, the country's estimated population will top 5.773 million inhabitants, of which 90.1% will reside in urban areas.[6] The poverty rate of Costa Rica is lower in comparison to the region, remaining around 21% for nearly 20 years (**Table 1**).[7]

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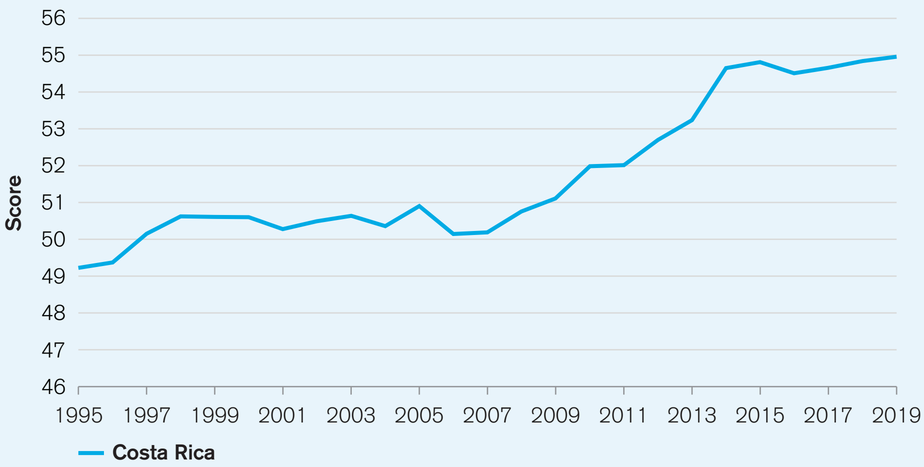
1 Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf
2 World Bank (2011). Climate Risk and Adaptation Country Profile: Costa Rica. URL: https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_CRI.pdf
3 World Bank (2019). Internal Climate Migration Profile – Costa Rica.
4 World Bank Open Data (2021). World Development Indicators. Costa Rica. URL: https://databank.worldbank.org/reports.aspx?source=2&country
5 World Bank Open Data (2021). World Development Indicators. Costa Rica. URL: https://databank.worldbank.org/reports.aspx?source=2&country
6 World Bank Open Data (2021). World Development Indicators. Costa Rica. URL: https://databank.worldbank.org/reports.aspx?source=2&country
7 World Bank Open Data (2021). World Development Indicators. Costa Rica. URL: https://databank.worldbank.org/reports.aspx?source=2&country

TABLE 1. Data Snapshot: Key Development Indicators[8]

Indicator	
Life Expectancy at Birth, Total (Years) (2019)	80.3
Population Density (People per sq. km Land Area) (2018)	97.9
% of Population with Access to Electricity (2019)	99.7%
GDP per Capita (Current US$) (2020)	$12,076.8

The ND-GAIN Index[9] ranks 182 countries using a score which calculates a country's vulnerability to climate change and other global challenges as well as their readiness to improve resilience. This Index aims to help businesses and the public sector better identify vulnerability and readiness in order to better prioritize investment for more efficient responses to global challenges. Due to a combination of political, geographic, and social factors, Costa Rica is recognized as vulnerable to climate change impacts and ranked 60th out of 182 countries in the 2020 ND-GAIN Index. The more vulnerable a country is the lower their score, while the more ready a country is to improve its resilience the higher it will rank. Norway has the highest score and is ranked 1st. **Figure 2** is a time-series plot of the ND-GAIN Index showing Costa Rica's progress

FIGURE 2. ND-GAIN Index for Costa Rica



[8] World Bank Open Data (2021). World Development Indicators. Costa Rica. URL: https://databank.worldbank.org/reports.aspx?source=2&country

[9] University of Notre Dame (2020). Notre Dame Global Adaptation Initiative. URL: https://gain.nd.edu/our-work/country-index/

Costa Rica submitted its updated Nationally-Determined Contributions (NDC) to the UNFCCC in 2020, in support of the country's efforts to realize its development goals and increase its resilience to climate change by enhancing mitigation and adaptation implementation efforts.[10] De-carbonization is a priority for the country as indicated in the country's decarbonization plan of 2019.[11] Costa Rica aims to achieve net-zero emissions by 2050.[12] Adaptation efforts, particularly in the water supply and agriculture sectors are high priorities and reflected in Costa Rica's NDC. In support of adaptation efforts, Costa Rica aims to strengthen capacities and promote a high degree of coordination and teamwork between different government and civil society entities. The country also aims to support inter-ministerial coordination efforts, which are important in guaranteeing synergies between entities and to increase national research budgets on climate change.[13] Climate change adaptation in Costa Rica is also strongly linked with components of the National Disaster Risk Management Policy,[14] through capacity building for resilience and technology transfer. Costa Rica completed its Third National Communication (NC3) to the UNFCCC in 2014.

Green, Inclusive and Resilient Recovery

The coronavirus disease (COVID-19) pandemic has led to unprecedented adverse social and economic impacts. Further, the pandemic has demonstrated the compounding impacts of adding yet another shock on top of the multiple challenges that vulnerable populations already face in day-to-day life, with the potential to create devastating health, social, economic and environmental crises that can leave a deep, long-lasting mark. However, as governments take urgent action and lay the foundations for their financial, economic, and social recovery, they have a unique opportunity to create economies that are more sustainable, inclusive and resilient. Short and long-term recovery efforts should prioritize investments that boost jobs and economic activity; have positive impacts on human, social and natural capital; protect biodiversity and ecosystems services; boost resilience; and advance the decarbonization of economies.

[10] Costa Rica (2020). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf

[11] Costa Rica (2018). Plan Nacional de Descarbonización (2018–2022). URL: https://cambioclimático.go.cr/wp-content/uploads/2020/01/PLAN.pdf

[12] Costa Rica (2021). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf

[13] Costa Rica (2021). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf

[14] Costa Rica (2016–2030). Política Nacional de Gestión de Riesgo. URL: http://politica.cne.go.cr/index.php/politica/politica-nacional-de-gestion-del-riesgo-2016-2030

Climate Baseline

Overview

Costa Rica's climate is characterized by well-defined annual patterns. However, these 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 El Niño/La Niña cycles as well as Pacific Decadal Oscillation (PDO). Regional long-term variabilities are also influenced by annual north-south displacement of the Intertropical Convergence Zone (ITCZ), the intensity of the subtropical high-pressure system over the Caribbean Sea, the strength of the trade winds and of the Caribbean Low-Level Jet (CLLJ).[15]

Costa Rica's mountains, dominant wind patterns and ocean influences characterize the seven recognized climatic zones of Costa Rica: North Pacific, Central Pacific, South Pacific, Central, North, and Caribbean North and Caribbean South. The lowland regions of the country harbor a tropical and subtropical climate, while the highlands experience colder climates. 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. 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. The Pacific slope is 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 temperatures show a different pattern, with the highest values observed in July and the lowest values during the Northern Hemisphere winter.[16]

In recent decades, Costa Rica has seen significant changes in the patterns of precipitation and increases in temperatures, as well as in land use and its degradation.[17] Variability continues to mark the annual expression of climate, since the frequency and intensity of multiple phenomena can increase or decrease. Therefore, the climate of Costa Rica, in its different regions, will be marked by dry extremes, such as the drought of 2008[18] and rainy extremes, such as during the El Niño of 2014–2015.[19] Costa Rica has already experienced the negative impacts of climate variability, including record economic losses from extreme hydrometeorological events such as episodes of the El Niño Southern Oscillation (ENSO).[20]

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15 Imbach, P. et al. (2018). Future climate change scenarios in Central America at high spatial resolution. PLOS One. DOI: https://doi.org/10.1371/journal.pone.0193570

16 Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

17 Costa Rica (2018). Política Nacional de Adaptación al Cambio Climático de Costa Rica 2018–2030 (2017. URL: https://cambioclimático.go.cr/wp-content/uploads/2018/11/Pol%C3%ADtica-Nacional-de-Adaptaci%C3%B3n-al-Cambio-Clim%C3%A1tico.pdf

18 Instituto Meteorológico Nacional Costa Rica (2008). Boletin Del Enos No. 11. 12 Mayo, 2008. URL: https://www.imn.ac.cr/documents/10179/28146/%23%2011

19 MINAE-IMN. (2015). Costa Rica Informe Bienal de Actualización ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático. (A. R. Ana Rita Chacón Araya, Ed.) San José, Costa Rica. URL: http://cglobal.imn.ac.cr/documentos/publicaciones/BUR2015/offline/download.pdf

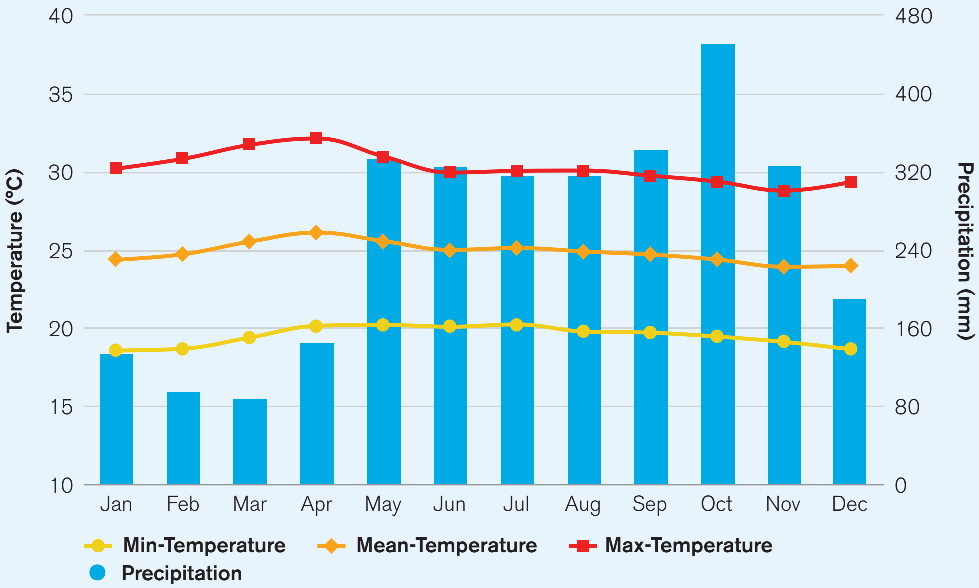
20 Costa Rica (2018). Política Nacional de Adaptación al Cambio Climático de Costa Rica 2018–2030 (2017). URL: https://cambioclimático.go.cr/wp-content/uploads/2018/11/Pol%C3%ADtica-Nacional-de-Adaptaci%C3%B3n-al-Cambio-Clim%C3%A1tico.pdf

Analysis of data from the World Bank Group's Climate Change Knowledge Portal (CCKP) (**Table 2**) shows historical climate information for the period between 1991–2020. Mean annual temperature for Costa Rica is 24.9°C, with average monthly temperatures ranging between 23.9°C (November) and 26.1°C (April). Mean annual precipitation is 3,061 mm, with year-round rainfall and highest rainfall occurring September to November (**Figure 3**).[21] **Figure 4** presents the spatial variation of observed average annual precipitation and temperature across Costa Rica, for the latest climatology, 1991–2020.

TABLE 2. Data Snapshot: Country-Level Summary Statistics

Climate Variables	1991–2020
Mean Annual Temperature (°C)	24.9°C
Mean Annual Precipitation (mm)	3,060.7 mm
Mean Maximum Annual Temperature (°C)	30.3°C
Mean Minimum Annual Temperature (°C)	19.5°C

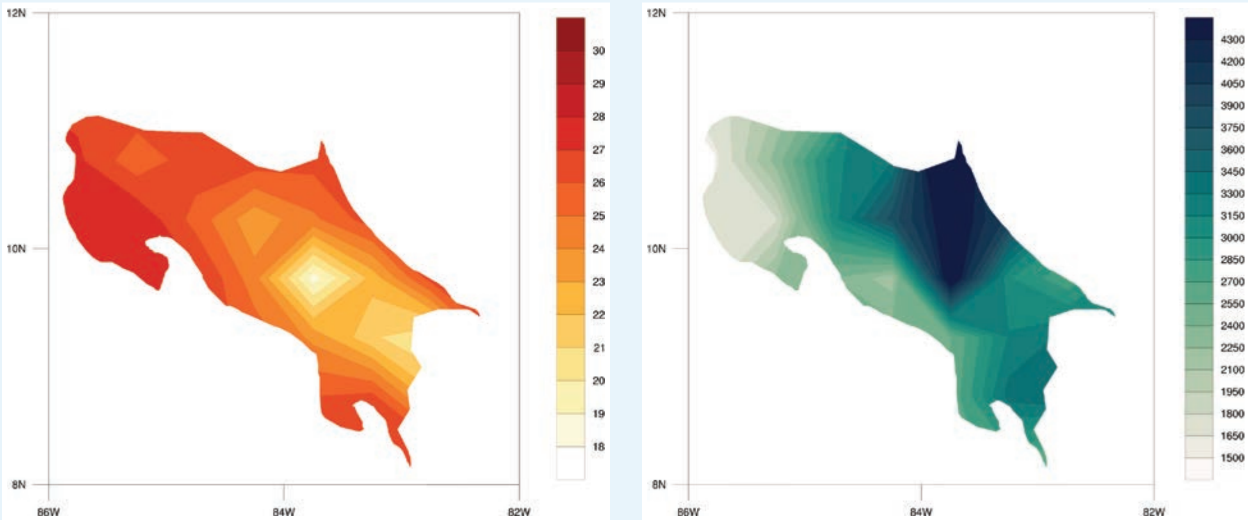
FIGURE 3. Average Monthly Mean, Max and Min Temperature and Rainfall of Costa Rica for 1991–2020[22]



[21] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica Historical Data. URL: https://climateknowledgeportal.worldbank.org/country/costa-rica/climate-data-historical

[22] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica Historical Data. URL: https://climateknowledgeportal.worldbank.org/country/costa-rica/climate-data-historical

FIGURE 4. Average Annual Temperature (°C) (left); Annual Precipitation (mm) (right) for Costa Rica 1991–2020[23]



Key Trends

Temperature

Temperatures in Costa Rica have already 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% and nights[24] by 1.7%, while the number of cold nights[25] and cold days decreased by -2.2 and -2.4% per decade. Temperature extremes increased by between 0.2 and 0.3°C per decade since 1960[26] (**Figure 5**). Costa Rica's high elevation areas have been observed to have experienced the greatest degrees of temperature change, as compared to coastal areas.[27]

Precipitation

Precipitation patterns exhibit a high degree of inter-annual variability in Costa Rica, while ENSO brings droughts and warmer weather, La Niña is associated with floods and cooler weather. Costa Rica's NC3[28] suggests increased precipitation across the country, in spite of the fact that overall average annual precipitation in the region and the number of consecutive wet days do not show significant changes. Nevertheless, from the mid-century on, extreme precipitation events have increased significantly in both frequency of occurrence and intensity. This also relates

[23] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica. Historical Data. URL: https://climateknowledgeportal.worldbank.org/country/costa-rica/climate-data-historical

[24] Luis, F. et al. (2012). Escenarios De Cambio Climático Regionalizados Para Costa Rica. Departamento de Climatología e Investigaciones Aplicadas Instituto Meteorológico Nacional Ministerio del Ambiente, Energía y Telecomunicaciones (MINAET) Costa Rica. URL: http://cglobal.imn.ac.cr/documentos/publicaciones/EscenariosCambioClimático/escenariosCCRegionalizados2012.pdf

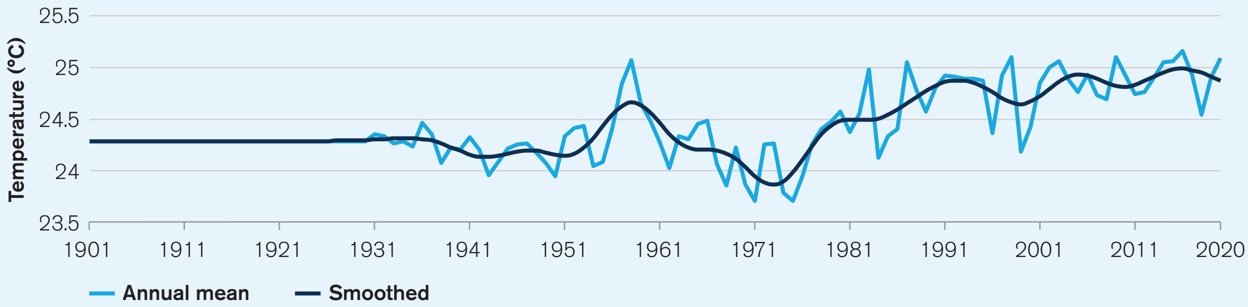
[25] "Cold" night is defined by the temperature below which 10% of days or nights are recorded in current climate of that region or season

[26] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

[27] Imbach, P. et al. (2018). Future climate change scenarios in Central America at high spatial resolution. PLOS One. DOI: https://doi.org/10.1371/journal.pone.0193570

[28] Costa Rica (2009). Segunda Comunicación Nacional de la República de Costa Rica. URL: http://cglobal.imn.ac.cr/documentos/publicaciones/ComunicacionesNacionales/segundaComunicacionNacional.pdf

FIGURE 5. Observed Average Mean Temperature for Costa Rica, 1901–2020



to experiencing longer dry periods in between heavy rainfall events. 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.[29]

Climate Future

Overview

The main data source for the World Bank Group's CCKP is the CMIP5 (Coupled Model Inter-comparison Project Phase 5) data ensemble, which builds the database for the global climate change projections presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. The RCP2.6 for example represents a very strong mitigation scenario, whereas the RCP8.5 assumes business-as-usual scenario. For more information, please refer to the RCP Database. For simplification, these scenarios are referred to as a low (RCP2.6); a medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile. **Table 3** provides CMIP5 projections for essential climate variables under high emission scenario (RCP 8.5) over 4 different time horizons. **Figure 6** presents the multi-model (CMIP5) ensemble of 32 Global Circulation Models (GCMs) showing the projected changes in annual precipitation and temperature for the periods 2040–2059 and 2080–2099.

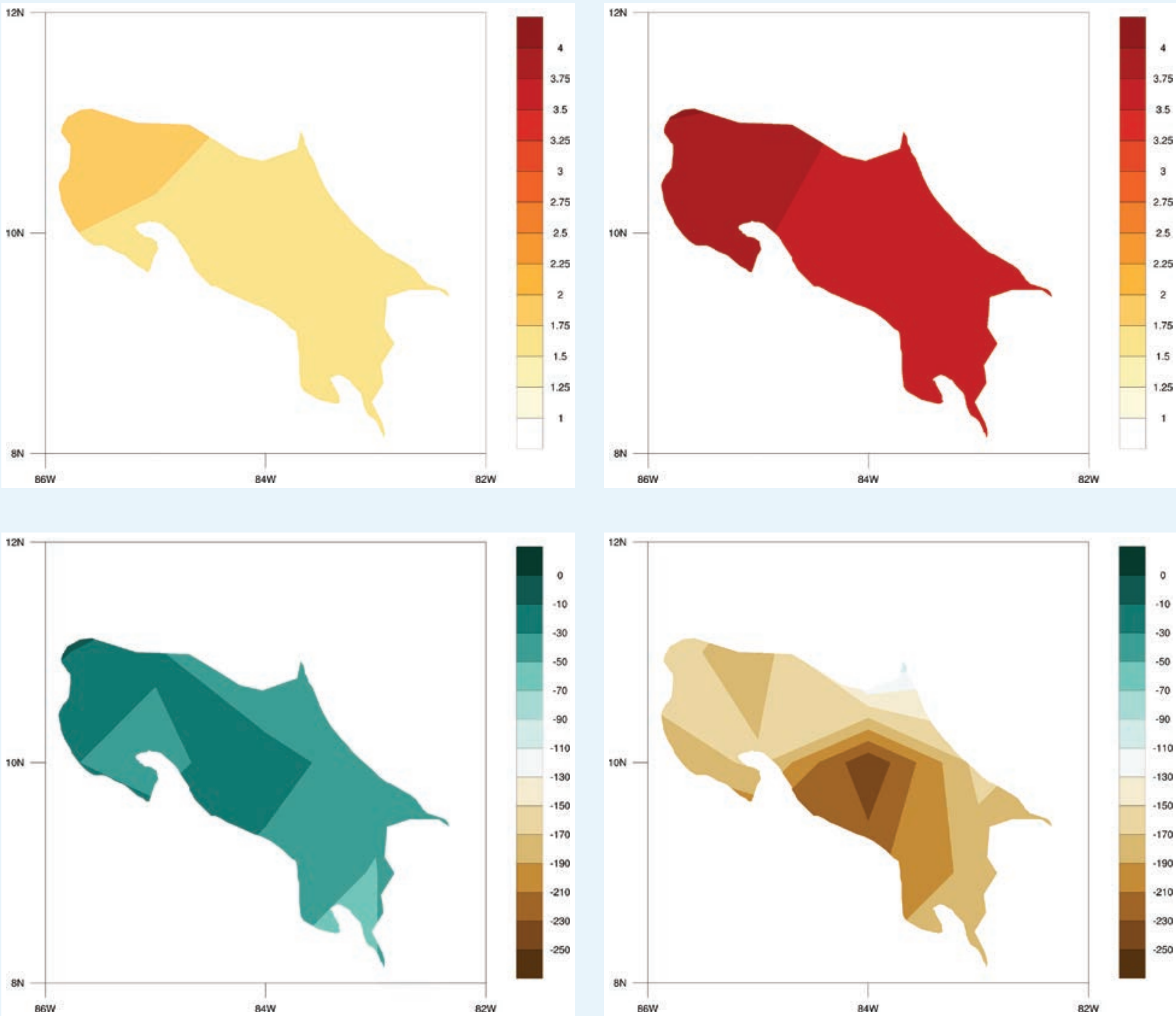
TABLE 3. Data Snapshot: CMIP5 Ensemble Projection

Cmip5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	**+0.60 to +1.48** (+0.88)	**+1.15 to +2.38** (+1.47)	**+1.69 to +3.56** (+2.22)	**+2.25 to +4.78** (+3.02)
Annual Precipitation Anomaly (mm)	**–23.47 to +26.62** (–0.97)	**–43.93 to 26.01** (–3.44)	**–53.48 to +43.74** (–6.89)	**–73.12 to +40.25** (–11.07)

Note: The table shows CMIP5 ensemble projection under RCP8.5. Bold value is the range (10th–90th Percentile) and values in parentheses show the median (or 50th Percentile).

[29] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

FIGURE 6. Multi-model (CMIP5) Ensemble Projected Change (32 GCMs) in Annual Temperature (top) and Precipitation (bottom) by 2040–2059 (left) and by 2080–2099 (right), Relative to 1986–2005 Baseline Under RCP8.5[30]



Key Trends

Temperature

Temperatures across Costa Rica are projected to continue rising, with mean monthly temperatures projected to rise by +1.48°C by the 2050s and by 3.08°C by the end of the century under a high-emissions scenario (RCP8.5). Rising temperatures are projected across all months, with no significant variability across these months or spatially. As temperatures rise, so will the critical consequences for water availability.[31] Of critical importance are the number

[30] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica. Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/costa-rica/climate-data-projections

[31] Luis, F. et al. (2012). Escenarios De Cambio Climático Regionalizados Para Costa Rica. Departamento de Climatología e Investigaciones Aplicadas Instituto Meteorológico Nacional Ministerio del Ambiente, Energía y Telecomunicaciones (MINAET) Costa Rica. URL: http://cglobal.imn.ac.cr/documentos/publicaciones/EscenariosCambioClimático/escenariosCCRegionalizados2012.pdf

of very hot days (where temperatures are above 35°C, which are projected to increase from approximately 6 to 72 days of the year by the end of the century, impacting especially the Pacific Coast and the Northern parts of the country.[32] Regionalized projections point to the most significant temperature rises occurring in the Pacific North Region by the end of the century, with maximum temperatures projected to rise between 3 to 8°C and a minimum temperatures projected to rise between 2 to 3°C.[33]

Across all emissions scenarios, temperatures are projected to continue to rise in Costa Rica, through the end of the century. As seen in **Figure 7**, under a high-emissions scenario (RCP8.5), average temperatures are projected to rise rapidly after the 2040s.[34] Average hot temperatures, analyzed in terms of the number of days above 25°C, are expected to largely be maintained across the seasonal cycle at a nationally aggregated scale (**Figure 8**). Rising temperatures and extreme heat conditions will result in significant implications for human health, agriculture, water resources, tourism, and ecosystems. The country's hotter climate is expected to significantly impact the country's unique ecosystems and biodiversity.[35]

FIGURE 7. Projected Average Temperature for Costa Rica (Reference Period, 1986–2005)[36]

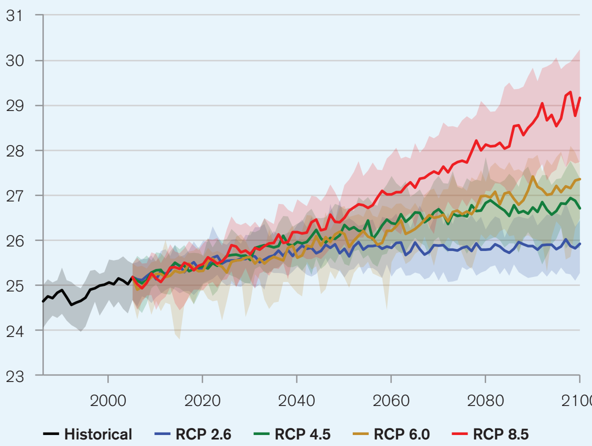
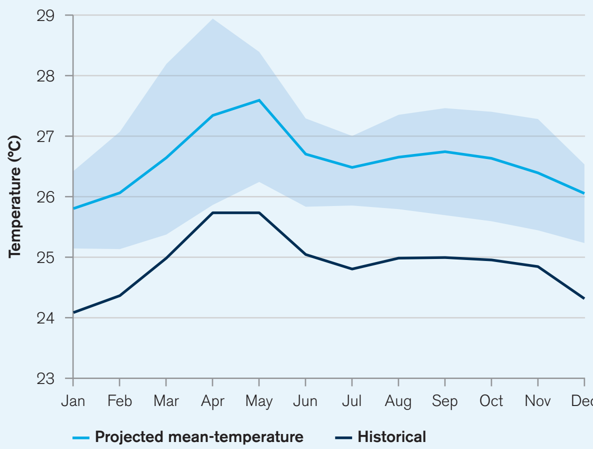


FIGURE 8. Projected Change in Summer Days (Tmax >25°C), 2040–2059 (RCP8.5, Reference Period, 1986–2005)[37]



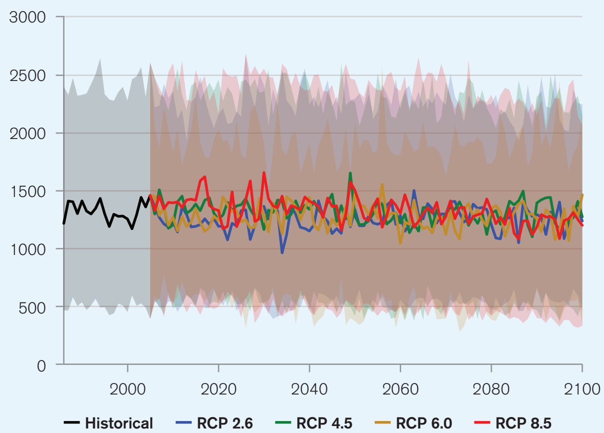
[32] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/costa-rica/climate-data-projections
[33] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf
[34] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/costa-rica/climate-data-projections
[35] Stan, K. et al. (2020). Climate change scenarios and projected impacts for forest productivity in Guanacaste Province (Costa Rica): lessons for tropical forest regions. *Regional Environmental Change*. 20. URL: https://link.springer.com/article/10.1007/s10113-020-01602-z
[36] WBG Climate Change Knowledge Portal (CCKP, 2021). Interactive Climate Indicator Dashboard – Agriculture. Costa Rica. URL https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=CRI&period=2080-2099
[37] WBG Climate Change Knowledge Portal (CCKP, 2021). Interactive Climate Indicator Dashboard – Agriculture. Costa Rica. URL https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=CRI&period=2080-2099

Precipitation

Rainfall in Costa Rica is subject to significant interannual variability due to the El Niño Southern Oscillation, which brings extremely hot and dry conditions to the Pacific and central regions of Costa Rica, while in the Caribbean it increases rainfall. Alternatively, La Niña episodes are associated with extreme rainfall in the Pacific, Central and Northern Regions,[38] while in the Caribbean rainfall deficits are common.[39] Costa Rica is also at risk from the increasing frequency and intensity of extreme rainfall events causing floods. Regionalized projections point to rainfall decreases by 2100, including a –13–24% reduction in the Pacific regions, especially in the Gulf of Nicoya zone, and additional reductions in the Pacific Central Zone, especially around Jaco and Herradura, increasing the likelihood of increased aridity and drought. Increased rainfall is projected for the southern zones of the Pacific, especially those around Puerto Quepos.[40,41] Changing rainfall patterns in the country by the second half of the century suggest an earlier onset of the rainy season as well as future drying conditions.[42]

As shown in **Figure 9**, there is significant uncertainty on the future of rainfall patterns for Costa Rica with scenarios pointing to both increases and decreases in annual precipitation by the end of the century under a high emissions scenario for Costa Rica as a whole (RCP8.5). However, projections point to significant regional variability, with rainfall decreasing in Costa Rica's Pacific Zones and increasing in the southern Zones.[43]

FIGURE 9. Projected Annual Average Precipitation in Costa Rica (Reference Period, 1986–2005)[44]



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38 Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

39 Luis, F. et al. (2012). Escenarios De Cambio Climático Regionalizados Para Costa Rica. Departamento de Climatología e Investigaciones Aplicadas Instituto Meteorológico Nacional Ministerio del Ambiente, Energía y Telecomunicaciones (MINAET) Costa Rica. URL: http://cglobal.imn.ac.cr/documentos/publicaciones/EscenariosCambioClimático/escenariosCCRegionalizados2012.pdf

40 Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

41 IMN (2017). Escenarios de Cambio Climático Regionalizados para Costa Rica. URL: http://cglobal.imn.ac.cr/index.php/publications/escenarios-de-cambio-climático-regionalizados-para-costa-rica/

42 Castillo, R., Amador, J., and Duran, A.M. (2018). Costa Rica Rainfall in Future Climate Change Scenarios. *Earth and Space Science Open Archive*, AGU 2017 Fall Meeting. URL: https://www.essoar.org/doi/abs/10.1002/essoar.bca73dd28032a2ab.b32e48ac7d934bec.1

43 IMN (2017). Escenarios de Cambio Climático Regionalizados para Costa Rica. URL: http://cglobal.imn.ac.cr/index.php/publications/escenarios-de-cambio-climático-regionalizados-para-costa-rica/

44 WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data-Projections. Costa Rica. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=CRI&period=2080-2099

Overview

Costa Rica is highly vulnerable to extreme hydrometeorological conditions and water scarcity, and climate change will increase the level of exposure and vulnerability of the country[45]. Its young geological formation renders the country's territory additionally vulnerable to tectonic and volcanic activity, as well as the associated landslides, avalanches, water and mud dams, and rising sediment loads.[46] 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.[47] Most of the country's emergencies are associated with events generated by rain and wind: floods, landslides, and rising tides. Disasters within the country's capital city of San Jose tend to be the most intense and best documented in terms of losses.[48] Outside of San Jose, on average, floods, among the most intense events on a regional scale, occur at least twice a year and a major earthquake every four years. Droughts generally affect only the Pacific Slope, associated with climate variability, while volcanic activity is permanent, with eruption episodes that may well be repeated every 30 years.[49] Floods, a result of extreme rainfall events, can affect all regions of the country and have significant impacts on the country's inhabitants. The floods that occurred in October of 2018, for example, brought 50–1,500 mm of rainfall over a period of 24 hours to the Pacific regions, especially affecting the Nicoya Peninsula and the Central Pacific and impacting over 125,000 people.[50] Droughts pose the greatest risks to the North Pacific and Northern zones near the border with Nicaragua, and increased in intensity, frequency and length, affecting agriculture and water resource availability. The costs of hydrometeorological disasters on infrastructure in Puntarenas, Guanacaste, Limon and San Jose between 2005–2011, for example, were estimated at $710 million dollars.[51,52]

Data from the Emergency Event Database: EM-Dat,[53] presented in **Table 4**, shows the country has endured various natural hazards, including droughts, floods, landslides, epidemic diseases, storms, earthquakes and wildfires, costing lives, and economic damage.

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45 UNDP (2019). Costa Rica moves forward in the process to implement its national adaptation plan. URL: https://www.globalsupportprogramme.org/costa-rica-moves-forward-process-implement-its-national-adaptation-plan

46 Costa Rica (2017). Política Nacional de Gestión del Riesgo (2016–2030). URL: https://cambioclimático.go.cr/wp-content/uploads/2018/08/POLITICA_NACIONAL_DE_GESTION_DEL_RIESGO.pdf

47 Costa Rica (2017). Política Nacional de Gestión del Riesgo (2016–2030). URL: https://cambioclimático.go.cr/wp-content/uploads/2018/08/POLITICA_NACIONAL_DE_GESTION_DEL_RIESGO.pdf

48 Barrantes, J. (2010). Tópicos Meteorológicos Y Oceanográficos, Vol. 19, No. 1(2020). URL http://cglobal.imn.ac.cr/documentos/revista/topicosmet20201/offline/RevistaTopicos2020-1.pdf

49 Costa Rica (2017). Política Nacional de Gestión del Riesgo (2016–2030). URL: https://cambioclimático.go.cr/wp-content/uploads/2018/08/POLITICA_NACIONAL_DE_GESTION_DEL_RIESGO.pdf

50 OCHA (2018). Costa Rica Floods – October 2018. URL: https://reliefweb.int/disaster/fl-2018-000165-cri

51 Barrantes, J. (2020).Tópicos Meteorológicos Y Oceanográficos, Vol. 19, No. 1(2020). URL: http://cglobal.imn.ac.cr/documentos/revista/topicosmet20201/offline/RevistaTopicos2020-1.pdf

52 Zuniga, B. (2013). Country Report for Costa Rica. URL: https://www.droughtmanagement.info/literature/UNW-DPC_NDMP_Country_Report_Costarica_2013.pdf

53 EM-DAT: The Emergency Events Database - Université Catholíque de Louvain (UCL) – CRED, D. Guha-Sapir, Brussels, Belgium. http://emdat.be/emdat_db/

TABLE 4. Natural Disasters in Costa Rica, 1900–2020

Natural Hazard 1900–2020	Subtype	Events Count	Total Deaths	Total Affected	Total Damage ('000 USD)
Drought	Drought	5			24,000
Epidemic	Viral Disease	3	3	21,638	
Flood	Riverine Flood	21	97	571,659	368,000
	Undefined	8	51	196,264	35,000
Earthquake	Ground Movement	17	2616	164,493	365,700
Landslide	Landslide	7	200		
Storm	Tropical Cyclone	8	114	769,836	562,390
	Undefined	1	3	216,000	
Volcanic Activity	Ash Fall	7	104	109,771	5,000
Wildfire	Forest Fire	2		1,200	

Key Trends

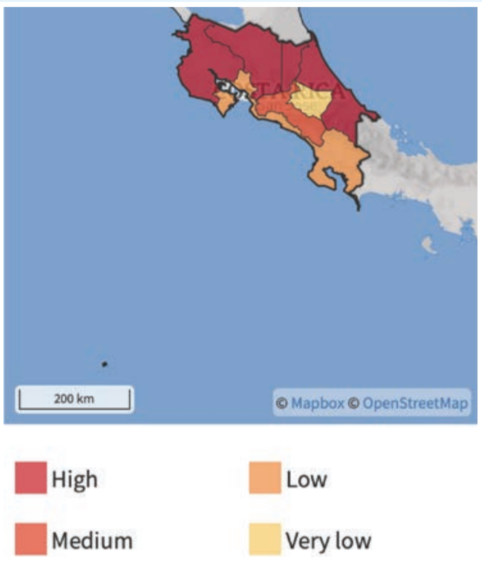
As the climate changes, weather related disasters are likely to continue, exacerbating existing vulnerabilities in Costa Rica. For example, infrastructure in the central mountains, could experience increased damage and loss from landslides and avalanches. The most significant disasters for the country include floods, primarily riverine, but also along both the Pacific and Caribbean coasts as sea levels rise. However, an increase in extreme rainfall events will likely continue to cause localized flooding events in urban areas. Studies suggest that climate change could increase the frequency of occurrence and the intensity of these phenomena. As such, the country is working to understand, anticipate, and take action to reduce these impacts. The country's Pacific and Caribbean coasts are vulnerable to coastal flooding from rising seas and storm surges (**Figure 10**). As rainfall becomes more variable and is more concentrated in extreme events, coupled with the effects of the El Niño Southern Oscillation phenomenon, both the frequency of floods and droughts will likely increase, especially in the Pacific zones. Projected losses from hydrometeorological disasters by 2030 and 2050 point to direct damages costing between US $7 million and $30 million.[54]

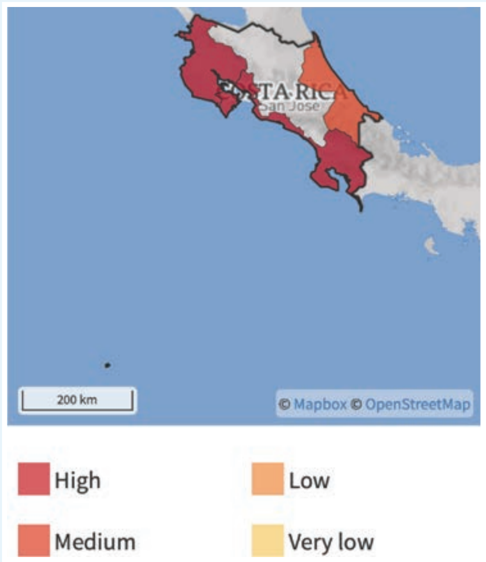
Costa Rica is vulnerable to tropical and subtropical cyclones and their associated storm surges on its Caribbean coast. Hurricane Mitch, one of the most destructive events in Central America, caused economic losses amounting to approximately US $98 million in Costa Rica. This amount is much lower than 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. 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. 65% of the population lives in Costa Rica's greater metropolitan areas and are at higher

[54] Costa Rica (2017). Política Nacional de Gestión del Riesgo (2016–2030). URL: https://cambioclimático.go.cr/wp-content/uploads/2018/08/POLITICA_NACIONAL_DE_GESTION_DEL_RIESGO.pdf

risk to damaging flooding and landslides due to poor infrastructure, urban sprawl from unregulated land-use planning, and poverty.[55] 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 adaption 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. Additionally, 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.[56]

FIGURE 10. Risk of Riverine Flood (left),[57] Coastal Flood (right)[58]





Implications for DRM

The Costa Rican government is committed to strengthening its capacity to manage and reduce disaster risks. 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

[55] Quesada-Roman, A., Villalobos-Portilla, E. and Campos-Duran, C. (2020). Hydrometeorological disasters in urban areas of Costa Rica, Central America. *J. or Environmental Hazards.* DOI: https://doi.org/10.1080/17477891.2020.1791034
[56] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf
[57] ThinkHazard! (2020). Costa Rica – River Flood: URL: https://thinkhazard.org/en/report/61-costa-rica/FL
[58] ThinkHazard! (2020). Costa Rica – Coastal Floods. URL: https://thinkhazard.org/en/report/61-costa-rica/CF

framework and mainstreaming disaster risk management in its national development program.[59] Costa Rica's National Disaster Management Policy for 2016–2030 recognizes the need to understand the differential vulnerabilities of people, social, economic, and environmental systems to climate variability and change. The Policy links adaptation to disaster risk management under a longer-term vision of capacity building that aims to prepare for future climatic risks.[60]

Further, Costa Rica's National Development Plan,[61] considers disaster risk management and development as complementary actions that need to be taken in order to reduce vulnerability and capacity at territorial, national, regional, local, and community levels to the impacts disasters on roads, energy production, and public service systems (water, sanitation and health). Disaster risk management in Costa Rica recognizes the need to integrate environmental, climate change and land use management into risk management process as a way of safeguarding the safety, welfare, and sustainable development of the country. It is managed through the National Disaster Risk Management System (SNGR in Spanish). SNGR coordinates several sub-directorates, including 1) Disaster Risk Reduction – which is responsible for projects and regulatory measures to mainstream risk management into social and economic planning and practices in order to mitigate disaster risks; 2) Preparing and Responding to Disasters – responsible for preparing and executing disaster responses under emergencies; and 3) Disaster Risk Recovery – whose role is to plan and implement actions to recover from risks. Regional and local coordination takes place in coordination with sectorial, institutional, and technical assistant committees of disaster management and emergencies.[62] The country has also implemented a National Committee on ENSO (COENOS in Spanish) to monitor the evolution of the ENSO phenomenon in the face of climate change and inform and coordinate with local institutions on risks (specifically, drought risk management).[63]

Gender

An increasing body of research has shown that climate-related disasters have impacted human populations in many areas including agricultural production, food security, water management and public health. The level of impacts and coping strategies of populations depends heavily on their socio-economic status, socio-cultural norms, access to resources, poverty as well as gender. Research has also provided more evidence that the effects are not gender neutral, as women and children are among the highest risk groups. Key factors that account for the differences between women's and men's vulnerability to climate change risks include: gender-based differences in time use; access to assets and credit, treatment by formal institutions, which can constrain women's opportunities, limited access to policy discussions and decision making, and a lack of sex-disaggregated data for policy change.[64]

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59 GFDRR (2014). Costa Rica. URL: https://www.gfdrr.org/sites/default/files/publication/country-program-update-2014-costa-rica.pdf

60 Costa Rica (2015). Política Nacional de Gestión del Riesgo 2016–2030 de la República de Costa Rica. URL: https://drive.google.com/file/d/0ByA2trMWnTn4dS1GOGNlQTFHMU0/view

61 Costa Rica (2015). Política Nacional de Gestión del Riesgo 2016–2030 de la República de Costa Rica. URL: https://drive.google.com/file/d/0ByA2trMWnTn4dS1GOGNlQTFHMU0/view

62 Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

63 Vignola, R., Kuzdas, C., Bolanos, I. and Poveda, K. (2018). Hybrid governance for drought risk management: the case of the 2014/2015 El Niño in Costa Rica. *International Journal of Disaster Risk Reduction*. DOI: https://doi.org/10.1016/j.ijdrr.2018.03.011

64 World Bank Group (2016). Gender Equality, Poverty Reduction, and Inclusive Growth. URL: http://documents1.worldbank.org/curated/en/820851467992505410/pdf/102114-REVISED-PUBLIC-WBG-Gender-Strategy.pdf

Agriculture

Overview

Agriculture is the foundation of economic development in Costa Rica. The agriculture and agribusiness sector represent a significant contribution to the national economy, accounting for a little over 12% of the country's employment[65] and contributed 4.25% of GDP,[66] while also playing a leading role in the country's exports, employment and incomes.[67] Agriculture is the largest employer in rural areas, and accounted for a little over 31% of employment.[68] Coffee, sugar cane, maize, beans, bananas, pineapple, and oil palm are widely cultivated while specialty crops such as cacao (in the north east) or melons and oranges (in the south) are also grown. Costa Rica's location in Central America and integration into regional and other trade agreements have enabled it to overcome the constraints of its small domestic market and benefit from its comparative advantage in exportable crops. Costa Rica is among the largest exporters of banana in the world, and the sector contributes significantly to the country's overall GDP. While the traditional agricultural exports of bananas, coffee, and pineapple, as well as sugarcane, palm oil and melon 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.[69]

In 2016, the agriculture and livestock sector occupied a little over 30% of Costa Rica's land area,[70] of which little is irrigated and 11.5% is classified as arable with permanent crops.[71] Since the 1980s, Costa Rica has promoted a model of export growth in the sector, including diversification and foreign direct investment. Diversification efforts expanded fruit and dairy products, which currently account for approximately 80% of agriculture exports, while coffee, tea and spices account for 11% of agriculture exports. Dairy and fisheries represent approximately 35% and 31% of livestock exports.[72] Food processing represented a significant percent (25%) of the country's manufacturing sector in 2014.

Livestock rearing and dairy production is concentrated in the central, northeast and in the Caribbean east. Livestock products include beef, pig meat, poultry and milk[73] and their share of agricultural production has increased attributable to livestock continues to increase, representing 35% of production in 2015. Dairy production continues

[65] Statista (2020). Costa Rica: Distribution of employment by economic sector for 2009–2019. URL: https://www.statista.com/statistics/454908/employment-by-economic-sector-in-costa-rica/
[66] Statista (2020). Costa Rica: Distribution of employment by economic sector for 2009–2019. URL: https://www.statista.com/statistics/454908/employment-by-economic-sector-in-costa-rica/
[67] FAO (2013). Margo de Programación Costa Rica, 2013–2015. URL: http://www.fao.org/3/a-bp519s.pdf
[68] OECD (2017). Review of Costa Rica's Agricultural Policies. URL: http://www.oecd.org/countries/costarica/AgPol_CR_en.pdf
[69] OECD (2017). Agricultural Policies in Costa Rica, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264269125-en. URL: http://www.oecd.org/countries/costarica/AgPol_CR_en.pdf
[70] FAO (2020). Costa Rica Country Profile. URL: http://www.fao.org/countryprofiles/index/en/?iso3=CRI
[71] Imbach, P. et al. (2017). Climate change, ecosystems and smallholder agriculture in Central America: an introduction to the special issue. *Climatic Change*. 141:1–12. DOI: 10.1007/s10584-017-1920-5
[72] FAO (2018). The successes and shortcoming of Costa Rica exports diversification policies Background paper to the UNCTAD-FAO Commodities and Development Report 2017 Commodity Markets, Economic Growth and Development URL: http://www.fao.org/3/I8308EN/i8308en.pdf
[73] OECD (2017). Review of Costa Rica's Agricultural Policies. URL: http://www.oecd.org/countries/costarica/AgPol_CR_en.pdf

to exhibit significant growth, and the sub-sector grew by 105% between 1995 and 2015. Fisheries concentrated in the southwest Pacific and northwest Pacific regions[74] are an important source of foreign exchange in the country, and a significant employer in the generally economically depressed and marginal coastal areas of the country.[75] Five landing points for fisheries products exist in the Pacific coast, while 2 landing sights are in the Caribbean coast.[76]

Climate Change Impacts

Agricultural activity in Costa Rica is vulnerable to the wide range of extreme events that the country regularly experiences, including floods and droughts, as well as rising temperatures and desertification driven by poor land use practices. Much of the country's agroecosystems are additionally vulnerable to the effects of drought, soil erosion, and changes in the rainfall and hydrological regimes. The projected impacts from a changing climate on food production, agricultural livelihoods, exports and food security in Costa Rica are significant national policy concerns.[77] Small scale agriculture is especially vulnerable to the impacts of El Niño and La Niña[78] in areas over-exploited by livestock. The costs of droughts have been significant in the production of basic grains (maize, beans and rice) in the provinces of Guanacaste and Puntarenas, with costs for just 3 events (1993, 1997 and 2009) were estimated at over US $30 million in Guanacaste and nearly 15 million US dollars in Puntarenas.[79] Floods, on the other hand, resulted in losses equating 9% of the production costs per hectare at the farm level between 1988–2009.[80]

Altered rainfall patterns and rising temperatures will significantly impact the country's principal crops: rice, beans, maize and coffee. Suitable areas for crops agricultural productivity (both for export and local food security) will change, with some cantons gaining productivity and for certain crops and others losing productivity.[81] Coffee and beans are projected to be the most sensitive to changes by the 2030s, with significant reductions in suitable area for these crops occurring in the provinces of San Jose, Heredia and Cartago.[82] Areas suitable for banana production will also likely to decrease, affecting the Pacific region (Provinces of Alajuela, Puntarenas and San Jose) as well as the provinces of Limon and Cartago in the Caribbean. In contrast, rising temperatures are likely to increase the extent of areas suitable for maize, sugarcane and cassava, particularly in the low-lying areas such as Bagaces and Santa Crus in Guanacaste and Puntarenas.[83] Further, highly specialized niche crops such as, cocoa, and other fruits will likely see critical changes in the prevalence of pests and diseases.

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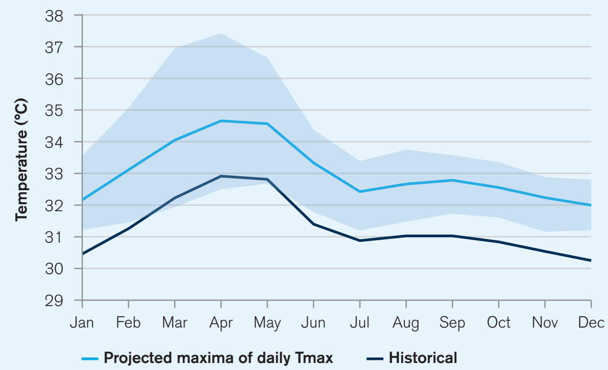
74 Costa Rica (2019). Infografías diagnósticos PNDIP 2019–2011. URL: https://documentos.mideplan.go.cr/share/s/gjeXDKA8SoW1zVBawuiGJQ
75 OECD (2017). Agricultural Policies in Costa Rica. URL: http://www.oecd.org/countries/costarica/AgPol_CR_en.pdf
76 INCOPESCA (2016). Report on Fisheries. URL: https://www.incopesca.go.cr/
77 CCAFS (2013). La agricultura de Costa Rica y el cambio climático: ¿Dónde están las prioridades para la adaptación? URL: https://www.researchgate.net/publication/269575938_La_agricultura_de_Costa_Rica_y_el_cambio_climático_Donde_estan_las_prioridades_para_la_adaptacion
78 Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf
79 Costa Rica (2009). Segunda Comunicación Nacional de la República de Costa Rica. URL: http://cglobal.imn.ac.cr/documentos/publicaciones/ComunicacionesNacionales/segundaComunicacionNacional.pdf
80 Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf
81 Hannah, L. et al. (2017). Regional modeling of climate change impacts on smallholder agriculture and ecosystems in Central America. *Climatic Change*. 141:29–45. DOI: 10.1007/s10584-016-1867-y
82 CCAFS (2013). Policy Brief: La agricultura de Costa Rica y el cambio climático: ¿Dónde están las prioridades para la adaptación? URL: https://www.researchgate.net/publication/269575938_La_agricultura_de_Costa_Rica_y_el_cambio_climático_Donde_estan_las_prioridades_para_la_adaptacion
83 CCAFS (2013). Policy Brief: La agricultura de Costa Rica y el cambio climático: ¿Dónde están las prioridades para la adaptación? URL: https://www.researchgate.net/publication/269575938_La_agricultura_de_Costa_Rica_y_el_cambio_climático_Donde_estan_las_prioridades_para_la_adaptacion

Rising temperatures, particularly daily maximum temperatures, pose an increased risk of heat stress for a range of crops, livestock as well as dairy production. Under present climate conditions, heat stress already poses challenges for heat dissipation in livestock populations, rendering them vulnerable to heat stress during certain periods of the year. Heat stress can reduce milk production as well as reproductive rates, particularly for cattle. Specialty crops, such as coffee, are at risk of surpassing thermal temperature ranges as high elevation areas in the country become increasingly warmer.[84] As heat increases, so is the likelihood of altered growing seasons. **Figure 11** shows the projected change in average daily maximum temperatures for Costa Rica across the seasonal cycle. What is clear is that higher temperatures are expected throughout the year.

FIGURE 11. Projected Change in Average Daily Max Temperature for Costa Rica, 2040–2059 (RCP8.5, Reference Period 1986–2005)[85]



Adaptation Options

Costa Rica has placed a strong emphasis on climate change adaptation and greenhouse gas mitigation from the agriculture and livestock sector.[86] The State's Policy for Agri-Food (Agro-Alimento) for 2010–2021 offers as set of adaptive measures for the sector. For example, the recent Nationally Appropriate Mitigation Actions for coffee growers emphasizes the commitment of the sector public, private and academic to search for innovations that reduce emissions from coffee cultivation by reducing fertilizer use, making more efficient use of water and energy, as well as carbon sequestration by combining coffee cultivation with timber trees.[87] Costa Rica is also committed to adaptation options include investing in the primary sector by providing incentives to diversity the crop mix, a reassessment of crop suitability zones based on a currently more variable and changing climate, including relocating agricultural lands which are at risk from sea level rise.[88] Additional adaptation options include investing in restoring degraded lands and replacing perennial, water dependent species with more drought resistant varieties; investing in technological improvements such as irrigation systems and observation technologies to address a changing climate profile; investing in improved quality beef products, especially in pasture management towards the end of the rainy season such as silage and haymaking;[89] strengthening productive value chains by incorporating small producers from rural territories and family farmers; and strengthening national agricultural policies.[90]

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[84] Hannah, L. et al. (2017). Regional modeling of climate change impacts on smallholder agriculture and ecosystems in Central America. *Climatic Change*. 141:29–45. DOI: 10.1007/s10584-016-1867-y

[85] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica Agriculture. Dashboard URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=CRO&period=2080-2099

[86] Bouroncle, C. et al. (2013). La agricultura de Costa Rica y el cambio climático: ¿Dónde están las prioridades para la adaptación? URL: https://www.researchgate.net/publication/269575938_La_agricultura_de_Costa_Rica_y_el_cambio_climático_Donde_estan_las_prioridades_para_la_adaptacion

[87] Costa Rica (2020). Proyecto de Apoyo a la NAMA Café de Costa Rica. URL: http://www.namacafe.org/

[88] Costa Rica (2020). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/INDC%20Costa%20Rica%20Version%202%200%20final%20ENG.pdf

[89] Alvarez-Vergani, C. (2015). Estratégia de adaptación climática en Costa Rica: bases para la gestión estatal e institucional. URL: https://library.fes.de/pdf-files/bueros/fesamcentral/12281.pdf

[90] Costa Rica (2015). NAMA Ganadería. URL: https://cambioclimático.go.cr/wp-content/uploads/2018/10/ENGBC.pdf

Water

Overview

Costa Rica is a water-abundant country; with 34 hydrological basins and 59 known aquifers.[91] Nevertheless, water scarcity is a growing challenge in certain agricultural regions. The total amount of water available is estimated at almost 113 million cubic meters per year; discounting losses for evaporation, infiltration and other processes, net available water is 75 million cubic meters per year.[92] More than 90% of water concessions (by volume) are granted to the agro-food sector as a whole: 85% to agriculture and 6% to agroindustry.[93] Costa Rica's topography and abundant rainfall have permitted construction of hydroelectric power plants, generating 66% of the country's energy. At the same time, water scarcity is a concern in some regions – the Northern Pacific in particular. Overuse exacerbates these concerns: according to a MINAE study on the hydrological balance in 15 of the country's 34 watersheds, inefficient water use is a significant challenge. Water availability is hindered by surface water runoff losses (10–30%) and while rain water collection, specifically in urban areas, is high (up to 96%), just 3–4% of this is treated.[94]

Climate Change Impacts

Irrigation is the major water user in Costa Rica (70.8% of mean annual inflow/recharge).[95] 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. The Costa Rican population's access to sources of drinking water rose slightly from 1995 to 2006, from 96% to 98%, respectively.[96]

Altered rainfall patterns will inevitably impact water resource availability across Costa Rica. Climate vulnerability studies on the three most important river basins in Costa Rica – the Reventazón, Térraba, and Grande de Tárcoles – show alarming reductions 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.[97] Additionally, Costa Rica is expected to experience increased drying in the second half of the century, and

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[91] OECD (2015). Water Resources Allocation in Costa Rica. URL: http://www.oecd.org/countries/costarica/Water-Resources-Allocation-Costa-Rica.pdf

[92] OECD (2015). Water Resources Allocation in Costa Rica. URL: http://www.oecd.org/countries/costarica/Water-Resources-Allocation-Costa-Rica.pdf

[93] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

[94] Shahady, T. and Boniface, H. (2018). Water quality management through community engagement in Costa Rica. J. *of Environmental Studies and Sciences*. 8: 488–502. URL: https://link.springer.com/article/10.1007/s13412-018-0504-7

[95] OECD (2015). Water Resources Allocation in Costa Rica. URL: http://www.oecd.org/countries/costarica/Water-Resources-Allocation-Costa-Rica.pdf

[96] Shahady, T. and Boniface, H. (2018). Water quality management through community engagement in Costa Rica. J. *of Environmental Studies and Sciences*. 8: 488–502. URL: https://link.springer.com/article/10.1007/s13412-018-0504-7

[97] OECD (2015). Water Resources Allocation in Costa Rica. URL: http://www.oecd.org/countries/costarica/Water-Resources-Allocation-Costa-Rica.pdf

with increases in extreme rainfall events, but longer time dry spells in between these heavy rainfall events. Drying is expected to be most pronounced in Costa Rica's southern zones.[98]

FIGURE 12. Projected Annual SPEI Drought Index in Costa Rica, 2080–2099 (Reference Period, 1986–2005)[99]

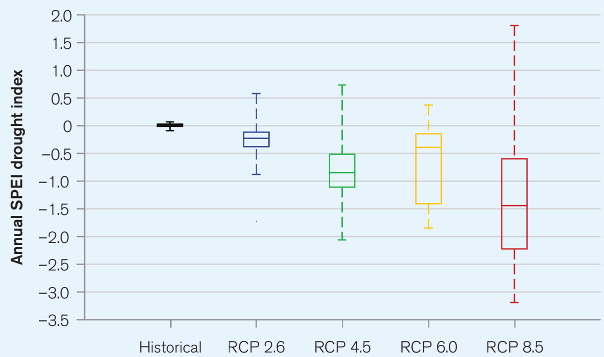

Figure 12 shows the projected annual Standardized Precipitation Evapotranspiration Index (SPEI), an index which represents the measure of the given water deficit in a specific location, accounting for contributions of temperature-dependent evapotranspiration and providing insight into increasing or decreasing pressure on water resources. Negative values for SPEI represent dry conditions, with values below –2 indicating severe drought conditions, likewise positive values indicate increased wet conditions. This is an important understanding for the water sector in regard to quantity and quality of supply for human consumption and agriculture use as well as for the energy sector as reductions in water availability impacts river flow and the hydropower generating capabilities. At national scale, Costa Rica is expected to experience decreased SPEI through the end of the century, representing drier conditions across a national scale.

Adaptation Options

Adaptation in the water resources sector should focus on 1) understanding the synergies between impacts from land use practices on water resources, both surface and groundwater; 2) updating and investing in compliance measures of the current legal framework for water resource management, taking into account basic principles of adaptation and projected risks, and including adaptive measures such as price regulation, encouraging the efficient use of water resources, and improving the equitable distribution of the same. Additional adaptation measures such include awareness raising activities aimed at civil society to improve their understanding the risks to water resources a changing climate can pose, and thus encouraging water conservation practices.[100] Water management capacity needs to be built, and in cooperation with all water use sectors, real water needs for the country are required to regulate supply and demand under a changing climate, especially in the dry season.[101] Guaranteeing water supply security via reforestation of springs, water recharge areas and riverine zones, together with the regulation and delimitation of buffer areas could safeguard future resources.

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[98] Castillo, R., Amador, J., and Duran, A.M. (2018). Costa Rica Rainfall in Future Climate Change Scenarios. *Earth and Space Science Open Archive*, AGU 2017 Fall Meeting. URL: https://www.essoar.org/doi/abs/10.1002/essoar.bca73dd28032a2ab.b32e48ac7d934bec.1

[99] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica. Water Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=CRO&period=2080-2099

[100] Costa Rica (2021). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf

[101] Alvarez-Vergani, C. (2015). Estratégia de adaptación climática en Costa Rica: bases para la gestión estatal e institucional. URL: https://library.fes.de/pdf-files/bueros/fesamcentral/12281.pdf

Energy

Overview

Costa Rica has a state-led electricity model focused on hydroelectric power, managed by the Electrical Institute (ICE).[102] Costa Rica's energy consumption is based on the use of three sources: oil derivatives, electricity, and biomass.[103] Installed capacity in Costa Rica is approximately 11,210 GWh, of which 77% is sourced from hydro, 0.3% from thermal plants, 6% from geothermal plants, 12% from wind, 1% from biomass and 0.2% from solar. In 2017, 70% of the country's energy as generated by Costa Rica's ICE. Demand increased by 1.1% between 2016 and 2017. The country's electricity generation in recent years has been almost 100% renewable and the country aims to achieve and maintain 100% electricity generation from renewable energy by 2030.[104] Installed thermal provides backup capacity of the system in critical hydrological periods when hydropower generation is reduced. Demand projections point to significant increases in energy needs for Costa Rica by 2040.[105]

Climate Change Impacts

Projected rainfall and temperature scenarios indicate that some regions may see reductions in rainfall, which would reduce runoff to rivers, water stored in dams and aquifer recharge.[106] Additionally, floods resulting from heavy rains can damage critical energy infrastructure. Runoff levels are expected to rise in coastal regions, negatively impacting energy infrastructure along the coast via floods and landslides, and the increasing the occurrence of natural disasters.[107] Gradual alterations in precipitation patterns, especially lower average precipitation will also affect the resource base of hydropower by leading to declining runoff and reduced river flows, which in turn affect the volume and timing of water availability. Additionally, higher temperatures, through evaporation, can significantly reduce water available from reservoirs. As temperatures rise, the dynamics of demand and supply of electricity will change in Costa Rica. A recent analysis on the impacts of rising temperatures on hydropower production identified the basins of the Reventazón, Pacuare, Parrita and San Carlos as facing significant reductions in energy generating potential, while the basins of Sixaola and Matina will likely face increased erosion and landslides.[108] As Costa Rica continues to pursue economic growth and increased living standards for its population, increased demand is likely to also focus on the attainment and use of air conditioning and other cooling mechanisms as the country warms. This will put additional strain on the country's energy transmission network and result in increasing spikes during high-heat periods.[109]

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[102] Feoli, L. (2018). The Policy and Institutional Effects on Contentious Politics in Costa Rica's Energy Sector. *European Review of Latin American and Caribbean Studies.* 106(2018): 75–102. URL: https://www.jstor.org/stable/26608621

[103] Costa Rica (2009). Segunda Comunicación Nacional de la República de Costa Rica. URL: http://cglobal.imn.ac.cr/documentos/publicaciones/ComunicacionesNacionales/segundaComunicacionNacional.pdf

[104] Costa Rica (2020). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf

[105] Instituto Costarricense De Electricidad Direccion Corporativa De Electricidad (2018). Informe Ejecutivo Del Plan De Expansión De La Generación 2018–2034. URL: Https://Www.Grupoice.Com/Wps/Wcm/Connect/F5fd219d-700d-4abc-8422-Ecbd27f9c9fd/Informe+Ejecutivo+Peg2018-2034.Pdf?Mod=Ajperes&Cvid=Mrl1q1w

[106] Instituto Costarricense De Electricidad Direccion Corporativa De Electricidad (2018). Informe Ejecutivo Del Plan De Expansión De La Generación 2018–2034. URL: Https://Www.Grupoice.Com/Wps/Wcm/Connect/F5fd219d-700d-4abc-8422-Ecbd27f9c9fd/Informe+Ejecutivo+Peg2018-2034.Pdf?Mod=Ajperes&Cvid=Mrl1q1w

[107] ICEX (2011). El sector Eléctrico en Costa Rica. URL: http://www.asamblea.go.cr/sd/Documents/referencia%20y%20prestamos/BOLETINES/BOLETIN%2001/publicaciones%20recomendadas/18093.%20%20El%20sector%20el%C3%A9ctrico%20en%20Costa%20Rica.pdf

[108] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

[109] Ramirez-Sandi, S. and Quiros-Tortos, J. (2018). Evaluating the Effects of Climate Change on the Electricity Demand of Distribution Networks. *INSPEC*. DOI: 10.1109/TDC-LA.2018.8511694

Cooling Degree Days show the relationship between daily heat and cooling demand, typically sourced through a form of active cooling or an evaporative process. The change in cooling degree days provides insight into the potential for extended seasons of power demand or periods in which cooling demand (power demands) will increase. As seen in **Figure 13**, seasonal increases for cooling demands are expected to increase throughout the year. The Warm Spell Duration Index represents the number of days in a sequence of at least six days in which the daily maximum temperature is greater than the 90th percentile of daily maximum temperature. As shown in **Figure 14**, warm spells are expected to sharply increase in the second half of the century.

FIGURE 13. Projected Change in Cooling Degree Days in Costa Rica, 2040–2059 (Reference Period, 1986–2005)[110]

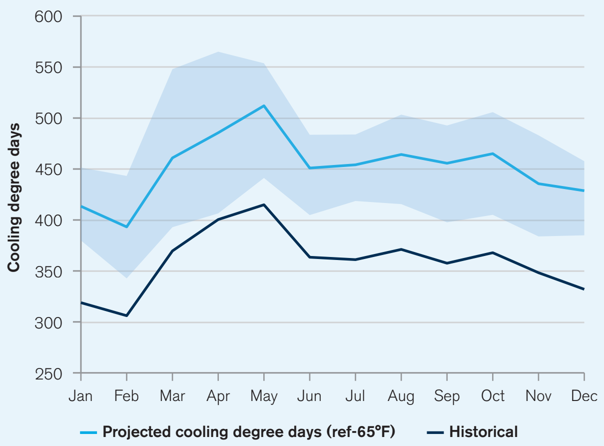
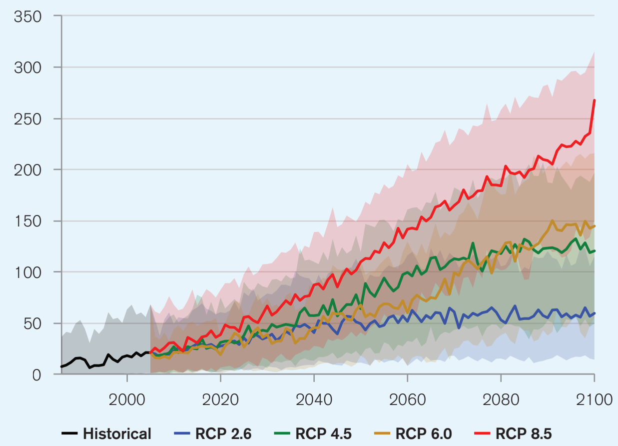


FIGURE 14. Projected Warm Spell Duration Index in Costa Rica (Reference Period, 1986–2005)[111]



Adaptation Options

Costa Rica's Expansion plan for Energy Generation for 2018–2034,[112] outlines a series of adaptation strategies for the energy sector under a changing climate. Recommendations included diversifying the energy mix, balancing supply and demand needs, with a focus on domestic demands, as declining river flows due to a decrease in rainfall will inevitably need to increase national prices in order to compete with energy export demands and improved water resource management under changing conditions.[113] Additional investments may need to be made in building more storage capacity, improving turbine efficiencies or other engineering measures to make efficient use of available resources. Integrated water use management will be required as competing demands for water begin to come into play through increased demand for water for other uses such as irrigation and urban demands. Costa Rica is committed to building

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[110] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica URL: https://climateknowledgeportal.worldbank.org/country/Costa Rica/climate-data-projections

[111] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica – Energy. URL: https://climateknowledgeportal.worldbank.org/country/CRO/climate-data-projections

[112] Instituto Costarricense De Electricidad Direccion Corporativa De Electricidad (2018). Informe Ejecutivo Del Plan De Expansión De La Generación 2018–2034. URL: Https://Www.Grupoice.Com/Wps/Wcm/Connect/F5fd219d-700d-4abc-8422-Ecbd27f9c9fd/Informe+Ejecutivo+Peg2018-2034.Pdf?Mod=Ajperes&Cvid=Mrl1q1w

[113] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

public awareness of improved methods of energy conservation should be linked with energy efficiency incentives.[114] Building a resilient power generation infrastructure needs to consider changes in ecological flows related to projected decreases in precipitation.[115]

Health

Overview

While Costa Rica is a middle-income country, it still faces high poverty rates, making the health of the country's population vulnerable to climate change impacts. Climate change projections point to continued rising temperatures, more variable rainfall, rising seas and more frequent extreme weather events. Impacts are expected in food and water security, human settlements, infrastructure and ecosystems, as well as health, the latter particularly through increasing heat stress, the altered range, seasonality and distribution of vector-borne diseases including dengue, malaria, as well as air pollution and associated respiratory illnesses, and water-borne illnesses such as cholera and diarrheal disease.[116] Highest rates of dengue transmission are associated with El Niño years located in the Provinces of Puntarenas and Guanacaste and the cantons of Oritina, Puntarenas, Cañas, Liberia, Santa Cruz, Garabito, Montes de Oro, and others. Malaria is concentrated in the Caribbean provinces and is associated with changes in annual precipitation and maximum temperatures.[117]

Climate Change Impacts

Rising temperatures will expand the range of vector-borne illnesses such as malaria and dengue into higher elevation areas. Rainfall increases will likely decrease malaria incidence as these two appear to be inversely related. Flooding and roughs such as those from La Niña and El Niño events can spread water-borne illnesses such as diarrheal disease and cholera.[118] Costa Rica also is affected by the presence of vector borne diseases such as malaria and dengue. The population is vulnerable to increased presence and thus infection due to increased warming throughout the year and changing precipitation patterns. This may result in changes to the 'traditional' malaria seasons, increasing vulnerability of populations[119]

Rising temperatures year-round will bring a more pronounced heat season with more frequent and intense heatwaves becoming a new norm. **Figure 15** shows the projected Heat Index >35°C through the end of century; appointing to a sharp increase in and emerging hot and humid season in mid-century and continue to sharply increase under a high-emission scenario (RCP8.5) through the end of the century. Heat discomfort and heat stress increases mortality

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[114] Costa Rica (2020). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf

[115] Alvarez-Vergani, C. (2015). Estratégia de adaptación climática en Costa Rica: bases para la gestión estatal e institucional. URL: https://library.fes.de/pdf-files/bueros/fesamcentral/12281.pdf

[116] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

[117] IMN (2008). Efectos del clima, su variabilidad y cambio sobre la salud humana en Costa Rica. URL: https://latinclima.org/multimedio-cc/recursos/mod-1/Documentos/salud-clima.pdf

[118] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf

[119] Chaves, L. et al. (2020). Health policy impacts on malaria transmission in Costa Rica. *Parasitology*. 147(9). DOI: 10.1017/S0031182020000621

and morbidity for the most vulnerable, especially the elderly, children and pregnant women. Additionally, children's learning ability significantly decreases with increased heat exposure. **Figure 16** shows that tropical nights, minimum temperatures (>20°C), will follow a similar warming as days with a high heat index, rising rapidly under a high-emission scenario (RCP8.5).

FIGURE 15. Projected Heat Index 35 Anomaly RCP8.5 (Reference Period, 1986–2005)[120]

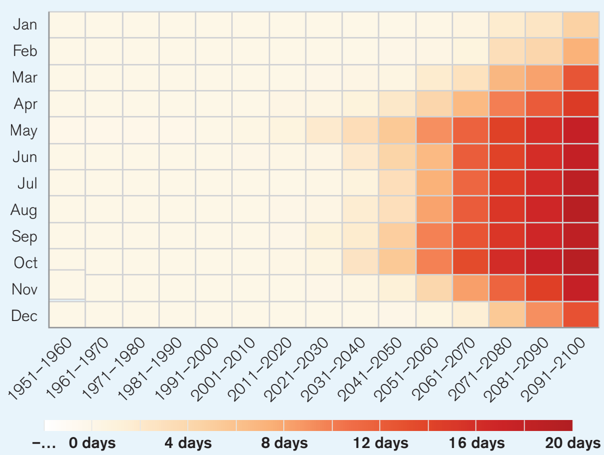
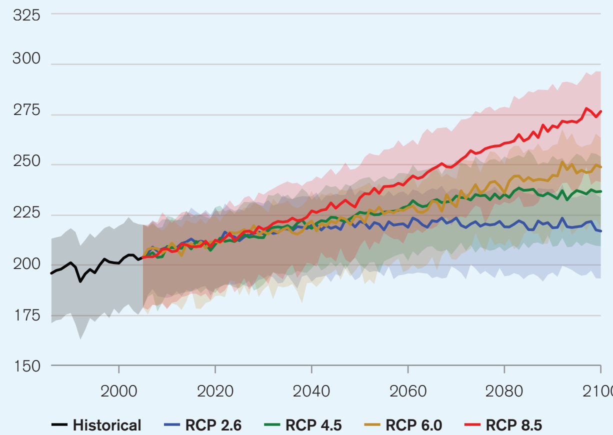


FIGURE 16. Projected Number of Tropical Nights (Tmin >20°C) (Reference Period, 1986–2005)[121]



Adaptation Options

To reduce the impacts of climate change on public health, context specific actions need to be implemented, particularly ones that align with the realities of the communities affected. As such, there is a need to develop locally relevant health vulnerability assessments.[122] Costa Rica is committed to 1) developing public policies to reduce inequities in health, 2) strengthening the primary health care system to improve access, timeliness, quality and economic sustainability, 3) strengthening interventions to address the health challenges associated with environmental changes, and 4) promoting interagency coordination particularly in light of climate change; and establishing early warning systems in non-traditional diseases in order to support prevention and response measures.[123]

Sea Level Rise

Costa Rica has a coastline of approximately 1,290 km, which is dominated by small scale aquaculture, fisheries, port infrastructure, and tourism. Evidence of the acceleration in sea level rise over the last 22 years suggests and increase in the vulnerability of low-lying coastal zones, which are already subjected to higher storm surges. These rising seas and

[120] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=CRO&period=2080-2099

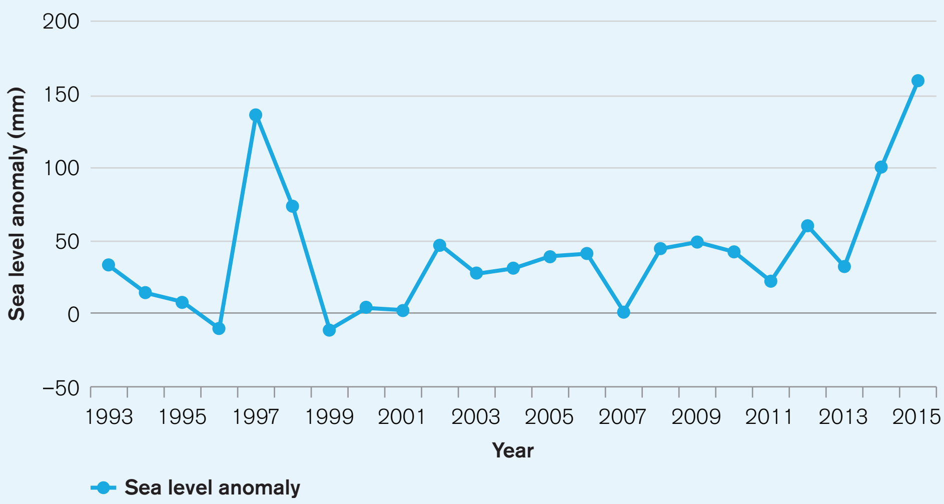
[121] WBG Climate Change Knowledge Portal (CCKP, 2021). Costa Rica. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=cro&period=2080-2099

[122] Alvarez-Vergani, C. (2015). Estratégia de adaptación climática en Costa Rica: bases para la gestión estatal e institucional. URL: https://library.fes.de/pdf-files/bueros/fesamcentral/12281.pdf

[123] Costa Rica (2020). Costa Rica's Updated Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Costa%20Rica%20First/Contribucio%CC%81n%20Nacionalmente%20Determinada%20de%20Costa%20Rica%202020%20-%20Versio%CC%81n%20Completa.pdf

changing wave patterns can cause coastal erosion, reduce land space near sea level, including urban space, and lead to increased saline intrusion into soils and aquifers. As shown in **Figure 17**, sea levels are rising around Costa Rica, along both coasts. Global sea level rise projections point to +10 cm by 2020 and 25 cm by 2050. By the 2090s, local sea level rise may approach 1 m above 1986–2005 levels. Rising seas are likely to cause the expansion of the areas subject to tidal flooding and the main port cities in the country would be affected: Puntarenas, Limón, Quepos, and Golfito.[124]

FIGURE 17. Observed Mean Annual Cycle of Sea Level for Coastal Costa Rica 1993–2015; Observed Anomalies Relative to Mean of 1993–2012[125]



ADAPTATION

Institutional Framework for Adaptation

National climate action in Costa Rica is coordinated by the Dirección de Cambio Climático, which sits within the Environment and Energy Ministry.[126] Costa Rica's National Climate Change Strategy seeks to reduce the social, environmental, and economic impacts of climate change, while addressing the vulnerability of key sectors including water resources, agriculture, and tourism. The country's National Development Plan for 2015–2018, considers the implementation of actions that introduce clean energy technologies, land management, and building the awareness

[124] Direccion de Cambio Climatico (2018). Generalidades del Cambio Climático en Costa Rica. URL: https://cambioclimatico.go.cr/cambio-climatico/generalidades/
[125] WBG Climate Change Knowledge Portal (CCKP, 2021). Impacts: Sea Level Rise. URL: https://climateknowledgeportal.worldbank.org/country/costa-rica/impacts-sea-level-rise
[126] Direccion de Cambio Climatico (2018). Generalidades del Cambio Climático en Costa Rica. URL: https://cambioclimatico.go.cr/cambio-climatico/generalidades/

among the public on climate risks. The National Biodiversity Policy for 2015–2030 guides actions related to the conservation and sustainable use of the country's extensive biodiversity resources, and aims to integrate adaptation, human health, and food security into its considerations. The National Health Policy also includes a comprehensive consideration of climate risk management and adaptation, with emphasis on the prevention of diseases known to be associated with climate, including dengue, chikungunya, and others.[127] Adaptation to climate change also has as a policy ally National Risk Management Plan (2016–2030), prepared by the National Risk Prevention and Emergency Care, which guides the actions of the State, civil society, and the private sector in order to promote "safe and sustainable" risk management. Adaptation linked to risk management recognizes the differential and changing nature of the context, the needs, the priorities, and the options available for transformation and incorporates a flexible approach to fostering the ability to act on events and prepare the systems in advance to withstand the likely events over time.[128]

Policy Framework for Adaptation

Costa Rica submitted its Third National Communication to the UNFCCC in 2014 and its updated Nationally Determined Contributions in 2020. The country 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. Adaptation is guided by the National Climate Change Directorate (DCC), whose aim is to implement a strategic vision that fosters the decarbonization of the Costa Rican economy while building resilience in human, productive and eco-systems.[129] The DCC aims to coordinate the Costa Rica's National Climate Change Strategy, whose goal is to make the country carbon neutral by 2021. In addition, the DCC has a role in making climate change a priority at the national level and providing technical support to efforts to support a competitive, low emissions development pathway for the country.

National Frameworks and Plans

- Updated Nationally Determined Contribution (2020)
- Second Biennial Update Report (BUR1) (2020) (Spanish)
- Política Nacional de Adaptación al Cambio Climático de Costa Rica 2018–2030 (2017) (Spanish)
- Nationally Determined Contribution (2016)
- Plan Nacional de Energía 2015–2030 (2015) (Spanish)
- Plan Nacional de Descarbonización (2018–2022) (2018) (Spanish)
- Plan de Acción de la Estratégia Nacional de Cambio Climatico (2015) (Spanish)
- Política Nacional de Gestión del Riesgo (2016–2030) (2015) (Spanish)
- Tercera Comunicación Nacional (2015) (Spanish)
- Plan Nacional de Energía (2015–2030) (Spanish)
- Plan Nacional de Desarrollo 2015–2018 (2014) (Spanish)

[127] Fundación Avina (2018). Proyecto LatinoAdapta Fortaleciendo vínculos entre ciencia y política en América Latina. URL: http://www.cambioclimáticoydecisiones.org/wp-content/uploads/2018/12/Informe-Costa-Rica_2019.pdf
[128] Costa Rica (2015). Política Nacional de Gestión del Riesgo 2016-2030 de la República de Costa Rica. URL: http://politica.cne.go.cr/index.php/politica/politica-nacional-de-gestion-del-riesgo-2016-2030
[129] Dirección de Cambio Climático. (2020). Costa Rica- Historia. URL: https://cambioclimático.go.cr/estructura/dcc/

- Costa Rica's Intended Nationally Determined Contribution (2015) (Spanish)
- Segunda Comunicación Nacional de La República de Costa Rica (2009) (Spanish)
- Estratégia Nacional de Cambio Climático (2009)
- Primera Comunicación Nacional (2001) (Spanish)

Recommendations

Research Gaps

- Overall planning and research needs at the federal level should be assessed in collaboration with the private sector, local communities and the scientific community to ensure effective climate change responses meet projected risks and need
- Increase the research budgets of Costa Rica's scientific institutions, particularly in promotion of research that will support public action and awareness to climate change
- Assessments are needed in Costa Rica for 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[130]
- Impact studies on watersheds and water treatment facilities should be expanded to ensure water quality and quantity in the Northwestern Central Valley
- Long-term and recent trends of SLR, flooding, and storm surges are not always available or analyzed properly, which is of concern as Costa Rica is highly exposed to all these adverse weather events

Data and Information Gaps

- A critical axis of action in the National Adaptation Policy (2018) is to generate robust information to regarding climatic and hydrological factors as well as their impacts, in addition to enhancing the capacities of institutions and actors to interpret and apply that knowledge in the national and local context. With regards to data and information, this includes the establishment of a national system to monitor climate change (Sistema Nacional de Métrica en Cambio Climático del MINAE/INEC (SINAMECC) that will collect, generate and disseminate climate scenarios to facilitate decision making and guide systems-based adaptation actions
- Communication and translation mechanisms need to be built and supported to address the differential needs of critical target groups, including the private sector
- With respect to droughts, a review of the drought index evaluation system is required, in coordination with the Caribbean Institute of Meteorology and Hydrology, including building regional capacity in understanding droughts[131]

[130] Fundación Avina (2018). Proyecto LatinoAdapta Fortaleciendo vínculos entre ciencia y política en América Latina. URL: http://www.cambioclimáticoydecisiones.org/wp-content/uploads/2018/12/Informe-Costa-Rica_2019.pdf
[131] Zuniga, B. (2013). Country Report for Costa Rica. URL: https://www.droughtmanagement.info/literature/UNW-DPC_NDMP_Country_Report_Costarica_2013.pdf

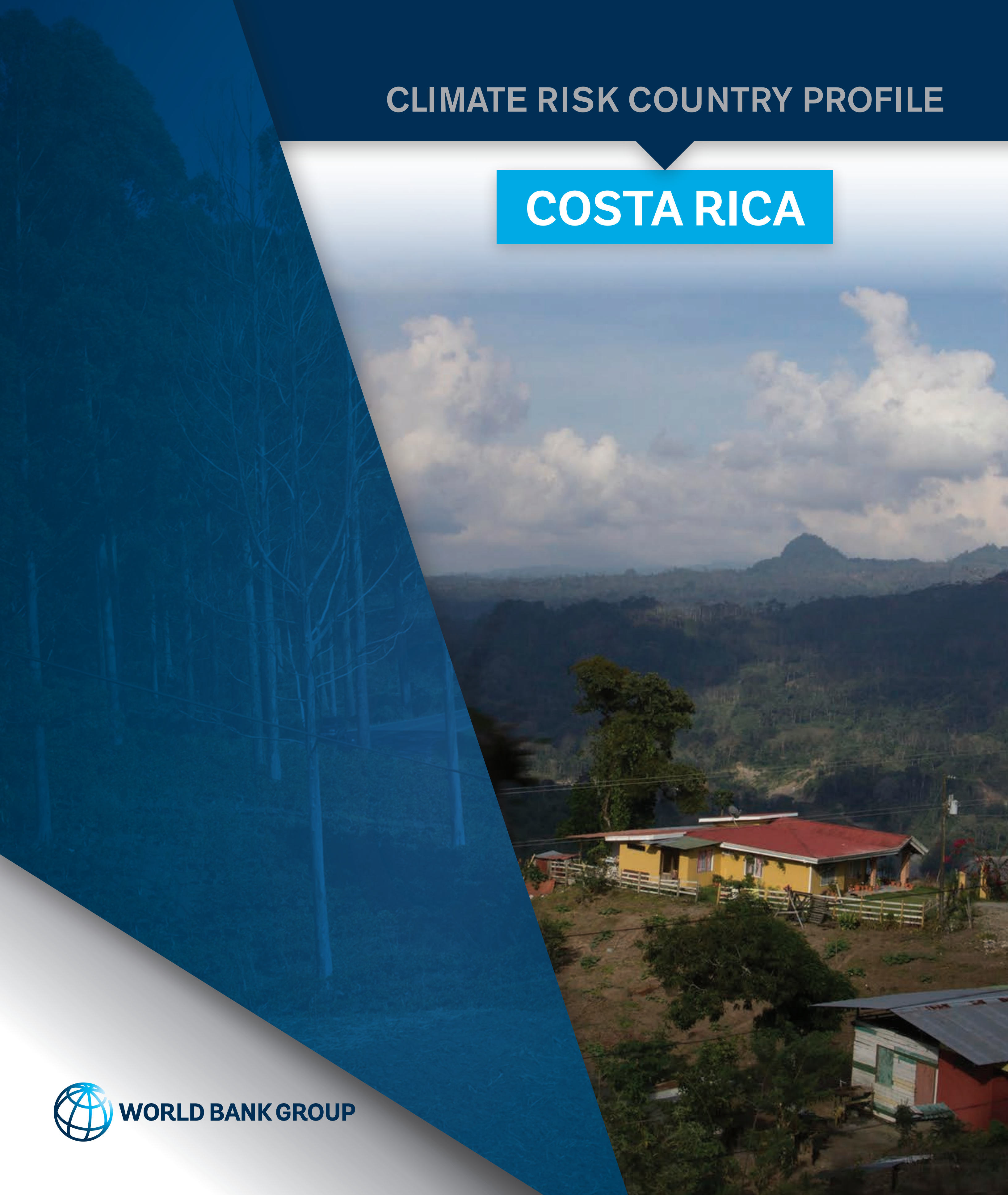
Institutional Gaps

- Improve institutional transparency with regards to information and knowledge by creating scientific advisory forums to help guide climate-related research
- Integrate and regionally coordinate activities related to the surveillance, monitoring and prediction of droughts by increasing the visibility of current activities, exploring the possibilities for regional integration of pilot projects with those of the Global Framework on Climate Services (GFCS), and strengthening institutional links to the Convention against desertification[132]
- Pilot activities with users (sectoral meetings) to know what the critical values of the drought indexes are in the different sectors (define thresholds). The better characterization of the drought will allow the improvement of early warning systems[133]

[132] Costa Rica (2014). Tercera Comunicación Nacional de la República de Costa Rica. URL: http://www.cac.int/sites/default/files/crinc3.pdf
[133] Costa Rica (2015). Política Nacional de Gestión del Riesgo 2016–2030 de la República de Costa Rica. URL: https://drive.google.com/file/d/0ByA2trMWnTn4dS1GOGNlQTFHMU0/view

CLIMATE RISK COUNTRY PROFILE

COSTA RICA



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