# CLIMATE RISK COUNTRY PROFILE

# COLOMBIA

WORLD BANK GROUP

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## ACKNOWLEDGEMENTS

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).

This profile was written by Fernanda Zermoglio (Senior Climate Change Consultant, WBG) and MacKenzie Dove (Senior Climate Change Consultant, WBG). Additional support was provided by Yunziyi Lang (Climate Change Analyst, WBG) and Jason Johnston (Operations Analyst, WBG).

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

Colombia, located in the northwest corner of South America, is a topographically diverse country traversed by the Andes Mountains with lowland plains in the east. It has a 3,208 kilometers (km) coastline along both the Pacific Ocean to the east and the Caribbean Sea to the north and the northern edges of the Amazon basin's tropical rainforests are located in the southeast. The country is considered the 25th largest nation in the world, covering 1,138,910 km$^2$ of land. The Andes, represented by the Cordillera Occidental, reaches up to 15,000 ft in elevation, and the Cordillera Central hosts several snow-covered volcanos including the Nevado del Ruiz and Nevado de Santa Isabel, that extend to over 17,000 ft in elevation (**Figure 1**). Between these mountains, which traverse the country, lies the Magdalena River valley, home to Colombia's important oil reserves.

**FIGURE 1.** Topography of Colombia[1]


Colombia is a populous country, with an estimated 50.8 million people in 2020[2] with projections suggesting the country's population could reach nearly 56 million people by 2050 (**Table 1**). Most of the country's population is concentrated in the Andean highlands and along the Caribbean coast. The expansive eastern and southern llanos and tropical forests are home to less than 10% of the country's population. An estimated 81.4% of the country's population live in urban areas and this is projected to increase to 88.8% by 2050. Despite its middle-income status, Colombia's wealth is heavily concentrated in the country's capital city, Bogota, and in cities such as Medellin and Cali, and most rural regions of the country remain severely underdeveloped. Though poverty rates have seen significant improvements since the 2000s, extreme inequalities continue to be significant and the national poverty rate in 2017 was still estimated to be 49.6%, with Choco remaining the poorest province bordering the northern Pacific coast. After accelerating to 3.3% in 2019, economic growth was on track to accelerate further in 2020, however, the COVID-19 pandemic hit the economy hard, causing the worst recession in almost half a century.[3]

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1 World Bank Group (2019). Internal Climate Migration Profile – Colombia.

2 World Bank Open Data, Data Retrieved March 2021. Data Bank: Population Estimates and Projections, Colombia. URL: https://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics:-population-estimates-and-projections

3 World Bank (2021). Colombia – Overview. URL: https://www.worldbank.org/en/country/colombia/overview

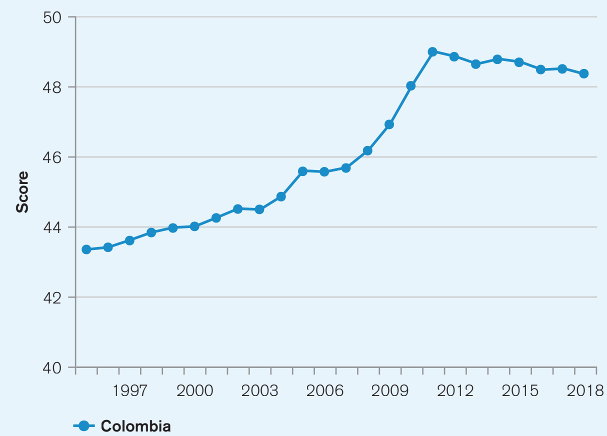
**TABLE 1.** Data snapshot: Key development indicators[4]

| Indicator | |
|---|---|
| **Life Expectancy at Birth, Total (Years)** (2019) | 77.3 |
| **Population Density (People per sq. km Land Area)** (2018) | 44.8 |
| **% of Population with Access to Electricity** (2019) | 99.8% |
| **GDP per Capita (Current US$)** (2019) | $6,428.71 |

The ND-GAIN Index[5] ranks 181 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, Colombia is recognized as vulnerable to climate change impacts, ranked 89 out of 181 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 be. Norway has the highest score and is ranked 1st. **Figure 2** is a time-series plot of the ND-GAIN Index showing Colombia's progress.

Colombia submitted its Nationally-Determined Contribution (NDC) to the UNFCCC in 2018, its Updated NDC in 2020, and its Third National Communication (NC3) in 2017, 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. The Colombian territory is highly vulnerable to extreme events, particularly flooding from "La Nina" phenomena. Vulnerability hotspots include the Caribbean and the Andean regions, with key sectors including housing, transport, energy, agriculture and health. Adaptation is guided by the National Adaptation Plan to Climate Change (PNACC in Spanish), which was formulated in 2011, and has been implemented through different territorial and sectorial efforts.[6]

**FIGURE 2.** ND-GAIN Index for Colombia




[4] World Bank (2021). DataBank – World Development Indicators. URL: https://databank.worldbank.org/source/world-development-indicators
[5] University of Notre Dame (2020). Notre Dame Global Adaptation Initiative. URL: https://gain.nd.edu/our-work/country-index/
[6] Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

## 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.

# CLIMATOLOGY

## Climate Baseline

### Overview

Colombia is recognized as a megadiverse country with a diverse range of ecosystems, such as paramos, mangroves, wetlands, coral reefs, glaciers, oceans, and tropical forests, as well as significant biodiversity and water resources.[7] Colombia's climate is tropical along the coast and the eastern lowlands, and cooler in the highlands and Andes. The country's topographic diversity defines the three recognized climatic zones: the high elevation cold zones (*tierra fria*), located above 2,000 meters (m) in elevation, with mean annual temperatures ranging between 13°C–17°C, a temperate zone (*tierra templada*), located between 1,000 m–2,000 m, with mean annual temperatures of approximately 18°C, and a tropical zone (*tierra caliente*), which covers all areas below 1,000 m and mean annual temperatures of 24°C–27°C. Average annual rainfall is 2,630 mm; but there is significant variability across the country. The West Pacific coast and in the Andean interior receive the highest rainfall amounts (approximately 6 mm–7,000 mm per year), while the drier steppe climates in the north and south west receive less than 500 mm per year. The Andean regions experience a bimodal pattern of rains during April–June and October–December, while the northern Caribbean region, due to its proximity to the equator, experiences a single rainy season between May–October. Inter-annual rainfall variability is influenced by the El Niño Southern Oscillation (ENSO). The ENSO brings droughts and warmer weather and La Niña is associated with floods and cooler weather in Colombia, particularly between June and August.[8]

7 Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

8 Colombia (2016). Plan Nacional de Adaptacion al Cambio Climatico. URL: https://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/1._Plan_Nacional_de_Adaptaci%C3%B3n_al_Cambio_Clim%C3%A1tico.pdf

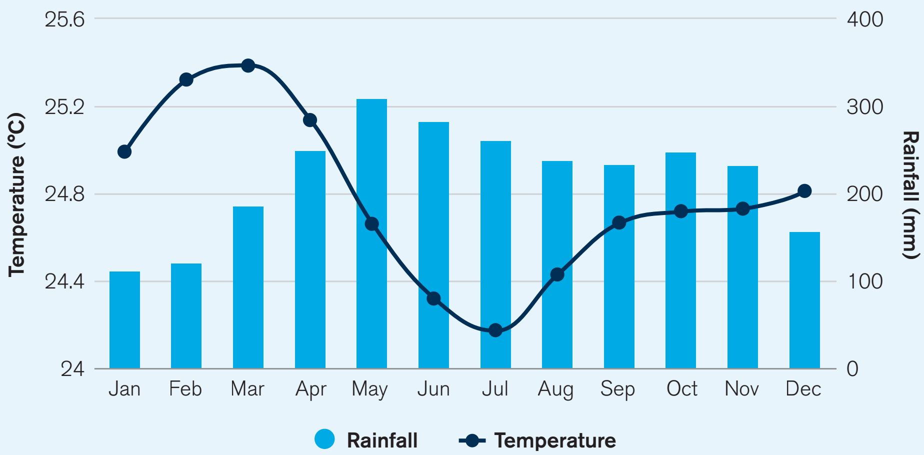
Colombia is highly vulnerable to the impacts of climate variability and change as the country already routinely experiences damaging droughts and floods. The heavy rains in 2010 and 2011, for example, caused over $6 billion in damages to crops and infrastructure, and displaced many. The economically important coffee industry is highly vulnerable to rising temperatures and hydrologic events. Water provision is heavily reliant on glacier melt, which under rising temperatures are projected to continue receding.

Analysis of data from the World Bank Group's Climate Change Knowledge Portal (CCKP) (**Table 2**) shows historical climate information. Mean annual temperature for Colombia is 24.37°C, with average monthly temperatures ranging between 23°C (June, July) and 35°C (March). Mean annual precipitation is 2,629 mm, with year-round rainfall and highest rainfall occurring May to July, as shown in the latest climatology, 1991–2020 (**Figure 3**).[9] **Figure 4** presents the spatial variation of observed average annual precipitation and temperature.

**TABLE 2.** Data snapshot: Country-level summary statistics

| Climate Variables | 1991–2020 |
|---|---|
| **Mean Annual Temperature (°C)** | 24.8°C |
| **Mean Annual Precipitation (mm)** | 2,627.9 mm |
| **Mean Maximum Annual Temperature (°C)** | 29.5°C |
| **Mean Minimum Annual Temperature (°C)** | 20.2°C |

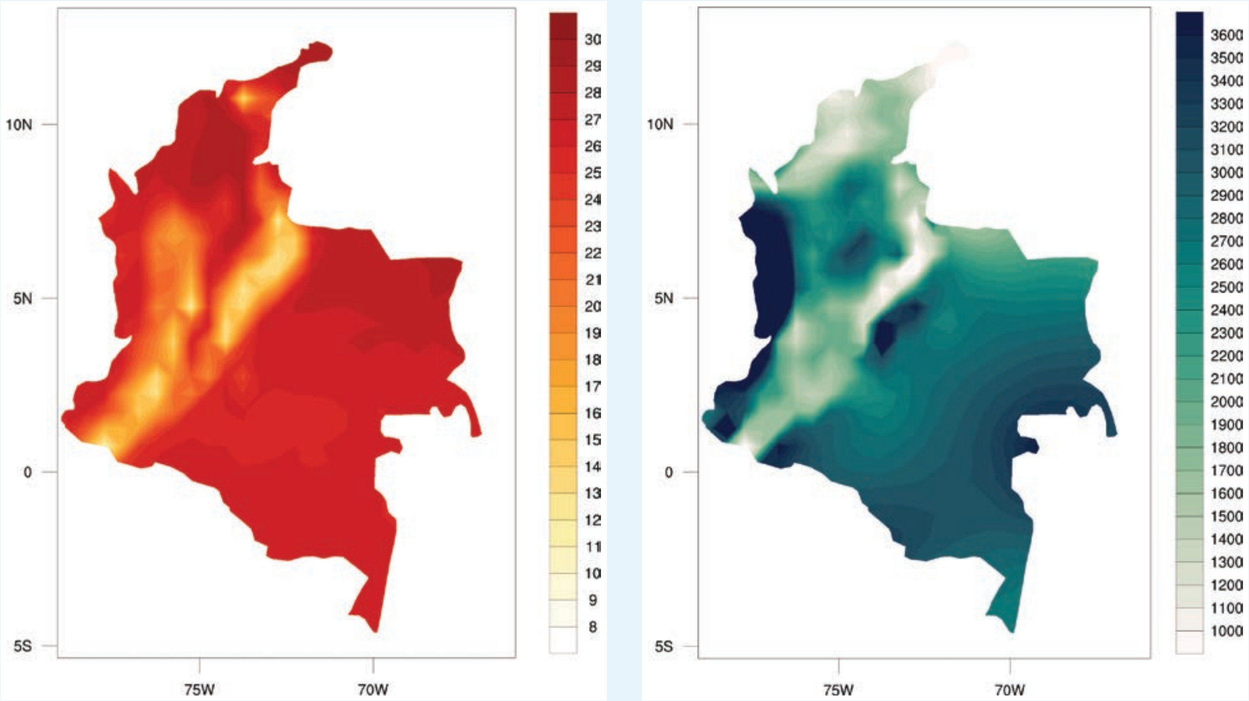
**FIGURE 3.** Average monthly temperature and rainfall of Colombia for 1991–2020[10]




9 WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Historical Data. URL: https://climateknowledgeportal.worldbank.org/country/south-africa/climate-data-historical

10 WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Historical Data. URL: https://climateknowledgeportal.worldbank.org/country/colombia/climate-data-historical

**FIGURE 4.** Map of average annual temperature (°C) (left); annual precipitation (mm) (right) for Colombia, 1991–2020[11]




## Key Trends

### *Temperature*

Temperatures in Colombia have already increased by at least 1°C in the last twenty years (**Figure 5**). Maximum temperatures have risen between 1°C per decade in the high mountains, and 0.6°C per decade in the sub-paramo regions. The number of warm nights[12] have increased, while the number of cold nights[13] have decreased.

### *Precipitation*

Precipitation patterns exhibit a high degree of inter-annual variability in Colombia, while ENSO brings droughts and warmer weather, La Niña is associated with floods and cooler weather in Colombia, particularly between June and August. Nevertheless, a statistically significant increase in rainfall between March and December was recorded between 1950 and 2006, which is partly offset by a decrease in June–April rains, though the latter are not statistically significant.

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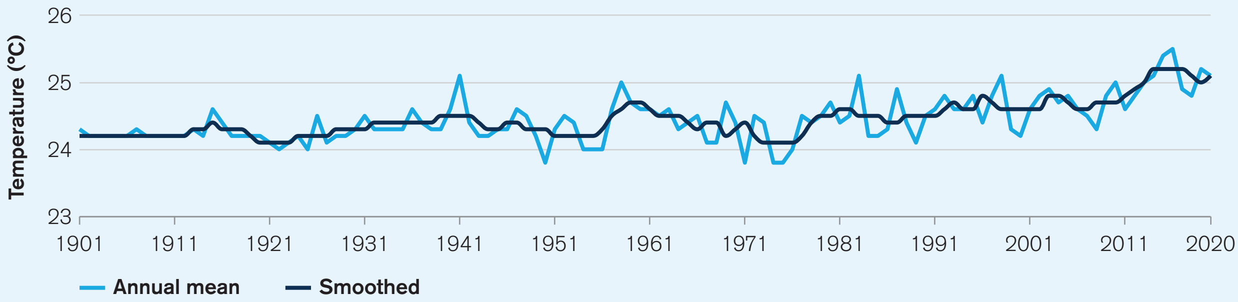
[11] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Historical Data. URL: https://climateknowledgeportal.worldbank.org/country/colombia/climate-data-historical

[12] "Warm: night is defined by the temperature exceeded on 10% of days or nights in current climate of region or season.

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

**FIGURE 5.** Observed temperature for Colombia, 1901–2020[14]




# Climate Future

## Overview

The main data source for the World Bank Group's Climate Change Knowledge Portal (CCKP) is the CMIP5 (Coupled Inter-comparison Project No.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.

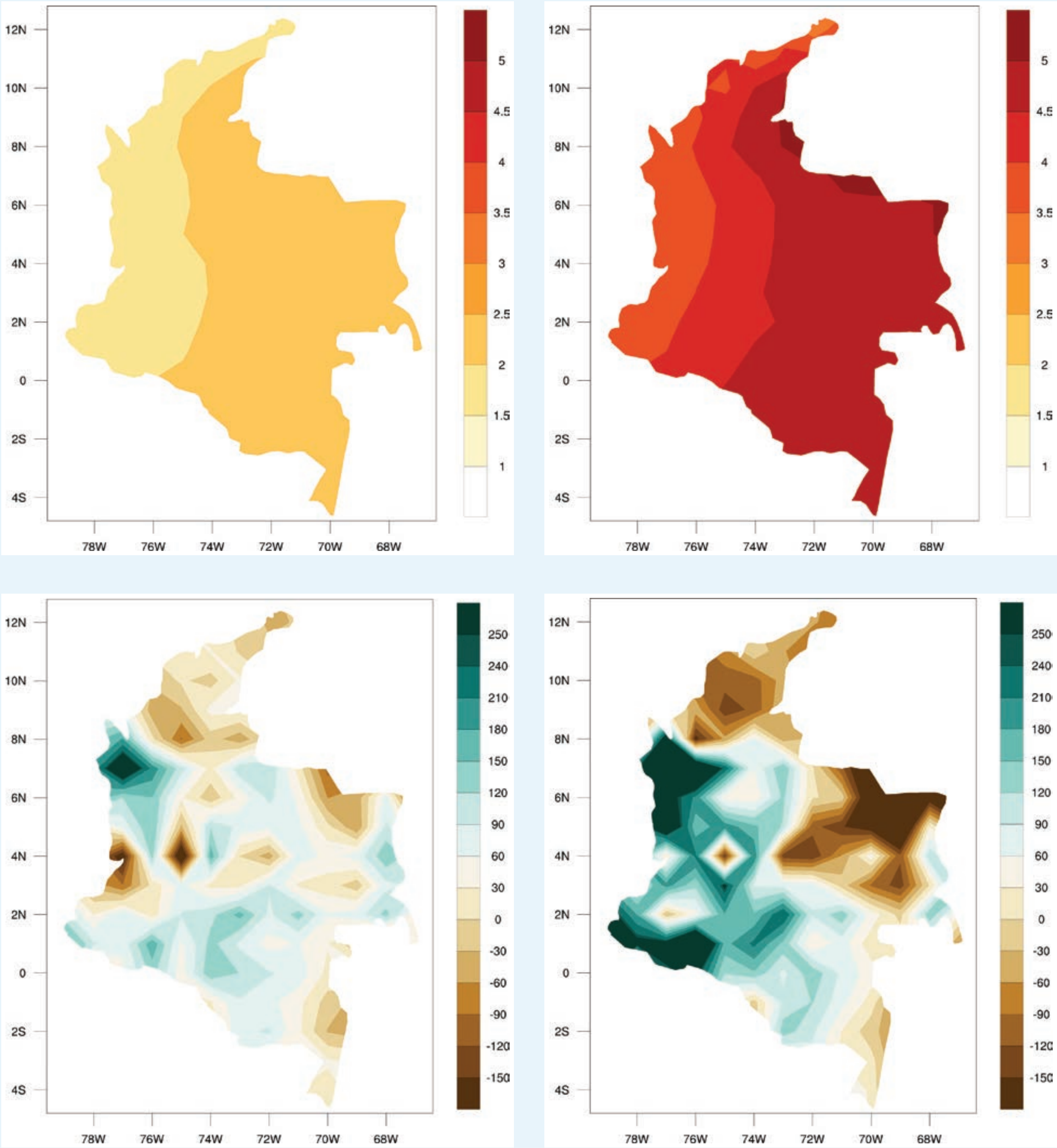
**TABLE 3.** Data snapshot: CMIP5 ensemble projection

| Cmip5 Ensemble Projection | 2020–2039 | 2040–2059 | 2060–2079 | 2080–2099 |
|---|---|---|---|---|
| **Annual Temperature Anomaly (°C)** | **+0.64 to +2.17** (+1.05°C) | **+1.2 to +3.87** (+1.88°C) | **+1.96 to +5.6** (+2.85°C) | **+2.54 to +7.13** (+3.88°C) |
| **Annual Precipitation Anomaly (mm)** | **–40.96 to +44.70** (+1.87 mm) | **–54.37 to +70.76** (+0.81mm) | **–73.28 to +92.24** (+5.15 mm) | **–89.78 to +116.43** (+5.99 mm) |

*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).

[14] WB Climate Change Knowledge Portal (CCKP, 2021). Colombia URL: https://climateknowledgeportal.worldbank.org/country/colombia/climate-data-historical

**FIGURE 6.** CMIP5 multi-model 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[15]




[15] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/el-salvador/climate-data-projections

## Key Trends

### *Temperature*

Temperatures across Colombia are projected to continue rising, with mean monthly temperatures projected to rise by +1.88°C by the 2050s and by 3.88°C by the end of the century under a high-emissions scenario (RCP 8.5). Rising temperatures are projected across all months, with slightly sharper increases between December and January. The highest temperature rise is projected for the northeast. As temperatures rise, particularly in the Andean regions, glacier loss is expected to continue, with critical consequences for water availability in this highly populated region. Of critical importance are the number of very hot days (where temperatures are above 35°C), which are projected to increase from approximately 16 to 131 days of the year by the end of the century, primarily impacting the Caribbean coast.[16]

Across all emissions scenarios, temperatures are projected to continue to rise in Colombia, through the end of the century. As seen in **Figure 7**, under a high-emissions scenario (RCP 8.5), average temperatures are projected to rise rapidly after the 2040s. Extreme temperatures, analyzed in terms of the number of days above 35 degrees, are expected to rise significantly across the seasonal cycle, with the most pronounced changes occurring during September-October and March to May (**Figure 8**). Rising temperatures and extreme heat conditions will result in significant implications for human and animal health, agriculture, water resources, and ecosystems.

**FIGURE 7.** Historical and projected average temperature for Colombia from 1986 to 2099 (Reference Period, 1986–2005)[17]

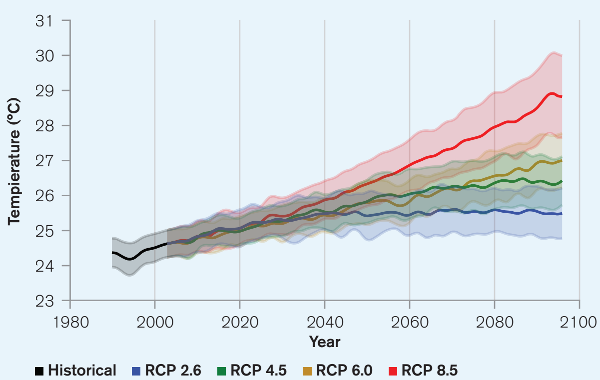
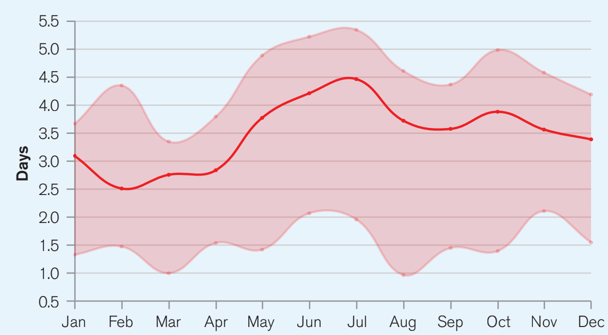



**FIGURE 8.** Projected change in summer days (Tmax >25°C), (RCP8.5, Reference Period, 1986–2005)[18]

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[16] Colombia (2016). Plan Nacional de Adaptacion al Cambio Climatico. URL: https://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/1._Plan_Nacional_de_Adaptaci%C3%B3n_al_Cambio_Clim%C3%A1tico.pdf

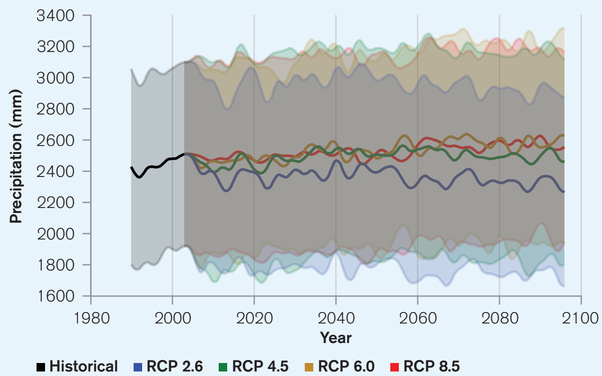
[17] WBG Climate Change Knowledge Portal (CCKP, 2021). Interactive Climate Indicator Dashboard - Agriculture. Colombia. URL https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=COL&period=2080-2099

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

### *Precipitation*

Rainfall in Colombia is subject to significant interannual variability due to the El Nino Southern Oscillation, which brings droughts and warmer weather, whereas La Niña episodes are associated with floods and cooler weather in Colombia, particularly between June and August. Nevertheless, statistically significant increases in rainfall between March, April and May, and June, July and August have been recorded since 1960. Additionally, the amount of rain (maximum 1-day rainfall totals) have seen an increase of 3.5 mm per decade in December, January and February. Maximum 5-day rainfall totals are recorded for all seasons except June–August but with the largest increases in March to May. Maximum 5-days totals in June–August recorded a decrease of 6.48 mm per decade).[19] As shown in **Figure 9** below, there is significant uncertainty on the future of rainfall patterns for Colombia,[20] with most scenarios pointing to an average projected increase in annual precipitation is by the end of the century under a high emissions scenario for Colombia as a whole (RCP8.5). However, projections point to significant regional variability, with rainfall increasing in Colombia's Amazon basin and the coastal areas and decreasing in the highlands.

**FIGURE 9.** Annual average precipitation in Colombia for 1986 to 2099, (Reference Period, 1986–2005)[21]




## CLIMATE RELATED NATURAL HAZARDS

## Overview

Colombia's diverse landscape is subject to the impacts of extreme events. The highland areas, where the majority of the country's population is concentrated, are subject to landslides and significant flooding due to increased surface run off from snow melt and extreme rainfall on degraded high elevation forest ecosystems which, additionally, increases sediment loads. As temperatures continue to rise, critical glaciers are likely to disappear, further contributing to water shortages in the highlands. In the coastal areas, rising seas, coupled with increased storm surges and hurricanes can lead to localized flooding.[22] Droughts are also common, particularly between January and March, as well as July and September, which are drier seasons, and which can lead to water supply shortages

[19] UNDP (2012). Climate Change Country Profiles. URL: https://www.geog.ox.ac.uk/research/climate/projects/undp-cp/

[20] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Water Dashboard. Data Description. URL: https://climateknowledgeportal.worldbank.org/country/colombia/climate-sector-water

[21] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data-Projections. Colombia. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=COL&period=2080-2099

[22] World Bank (2020). Modelación y análisis de riesgos catastróficos para la Alianza del Pacífico (Colombia, Peru, Mexico). Impacto fiscal y socioeconómico de eventos históricos de origen hidrometeorológico. Colombia. (Unpublished).

for human and agricultural needs.[23] The drought related conditions have seen an increase of approximately 2.2 times more frequent than in previous years.[24] Abnormal climatic conditions associated with the El Nino phenomenon can produce high temperatures and severe droughts in Colombia, damaging agricultural output and threatening operations at the hydroelectric power projects which generate most domestic energy supplies. Climate related disasters comprise nearly 90% of the emergencies reported in the country between 1998–2011 and represent significant economic losses. For example, the 2010–2011 floods from the La Nina phenomenon cost 500 million pesos (US$133,400) in natural parks; losses in agriculture and infrastructure were valued at 739.9 million pesos, over 470 people lost their lives through the proliferation of water-borne illnesses such as diarrhea, with damages to water infrastructure (sanitation and potable water) estimated at 3.4 billion pesos to infrastructure itself, 417.8 million pesos to operational costs, and over 525 homes affected, which costs 2.6 billion pesos to rebuild and/or relocate.[25,26] For the Amazonas regions, higher-intensity rainfall, associated floods and potential landslides and land erosion is expected to lead to increased risks of water turbidity and mobilization of pathogens, while periods of drought will lead to higher concentrations of pollutants in the reduced water flows. Higher sediment loads could have negative consequences for biodiversity by increasing hypoxia mortalities due to fine sediment obstruction of the gills, interruption of the photosynthesis of aquatic plants, among others. Enhanced hot seasons have been identified as increasing the risk of underground fires in the peatlands with severe ecological impacts and carbon emissions.[27]

Data from the Emergency Event Database: EM-Dat database,[28] presented in **Table 4**, shows the country has endured various natural hazards, including floods, landslides, epidemic diseases, storms, earthquakes and droughts, costing lives, and economic damage.

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23 Arora, D. (2019). Extreme weather events (drought) and its impact on assets, livelihoods and gender roles: Case study of small-scale livestock herders in Cauca, Colombia. CCAFS Working Paper. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen (Denmark). URL: https://cgspace.cgiar.org/bitstream/handle/10568/99725/LivestockPlus%20%20Gender%20%28002%29.pdf?sequence=5&isAllowed=y

24 Colombia (2016). Plan Nacional de Adaptacion al Cambio Climatico. URL: https://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/1._Plan_Nacional_de_Adaptaci%C3%B3n_al_Cambio_Clim%C3%A1tico.pdf

25 Colombia (2016). Plan Nacional de Adaptación al Cambio Climático. URL: https://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/1._Plan_Nacional_de_Adaptaci%C3%B3n_al_Cambio_Clim%C3%A1tico.pdf

26 World Bank (2020). Modelación y análisis de riesgos catastróficos para la Alianza del Pacífico (Colombia, Perú, Mexico). Impacto fiscal y socioeconómico de eventos históricos de origen hidrometeorológico. Colombia. (Unpublished).

27 Field Museum (2019). Rapid Biological and Social Inventories. Bajo Putumayo-Yaguas-Cotúa Colombia and Perú Región. URL: http://fm2.fieldmuseum.org/rbi/results.asp

28 EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium. http://emdat.be/emdat_db/

**TABLE 4.** Natural disasters in Colombia, 1900–2020

| Natural Hazard 1900–2020 | Subtype | Events Count | Total Deaths | Total Affected | Total Damage ('000 USD) |
|---|---|---|---|---|---|
| **Drought** | Drought | 2 | 0 | 11,000,000 | |
| **Epidemic** | Bacterial Disease | 2 | 412 | 17,137 | 0 |
| | Viral Disease | 4 | 260 | 104,057 | |
| **Flood** | Riverine Flood | 46 | 2212 | 10,198,629 | 3,452,500 |
| | Flash Flood | 2 | 132 | 166,283 | |
| | Coastal Flood | 2 | 14 | 11,050 | |
| **Earthquake** | Ground Movement | 28 | 3497 | 1,460,619 | 2,318,666 |
| | Tsunami | 1 | 111 | 46 | |
| **Landslide (Dry)** | Avalanche | 2 | 87 | 2,411 | |
| | Landslide | 1 | 160 | | |
| **Landslide (wet)** | Avalanche | 1 | 10 | 117 | |
| | Landslide | 37 | 2880 | 27,826 | 2,400 |
| | Mudslide | 4 | 538 | 48,139 | 100,000 |
| **Storm** | Tropical Cyclone | 4 | 28 | 103,074 | 50,500 |
| | Convective Storm | 3 | 17 | 8,258 | |
| **Volcanic Activity** | Ash Fall | 11 | 22826 | 56,964 | 1,000,000 |

## Key Trends

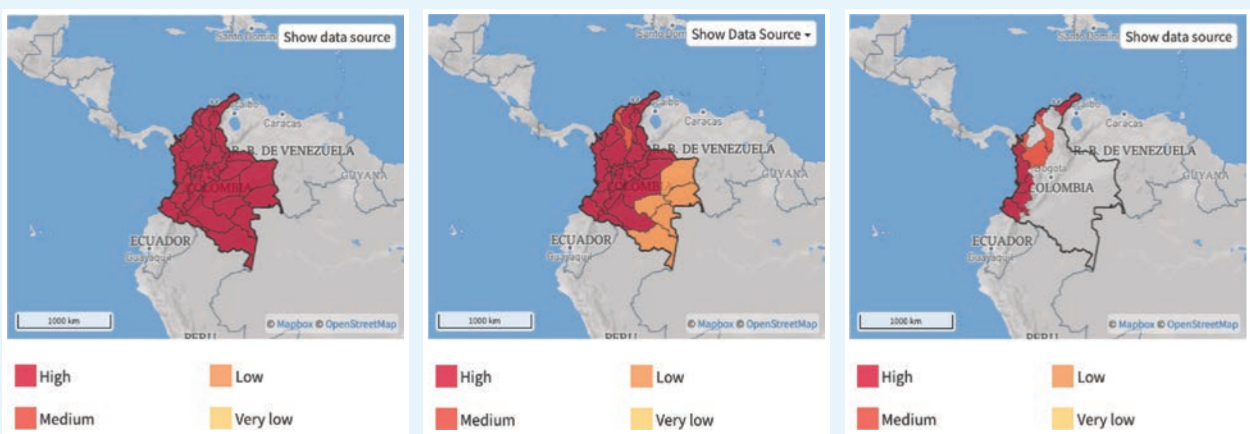
The potential for damage from floods, droughts and landslides affect millions of people, either due to the occurrence of a severe event, or by several that occur in the same year, is significant for Colombia. Since 2016, the Colombian Government has implemented a policy for mobilizing financial resources to address the effects of natural disasters and climate change. As the climate changes, weather related disasters are likely to continue, exacerbating existing vulnerabilities in Colombia, such as infrastructure conducted on unstable mountains, which could increase the damage and loss from landslides and avalanches. As temperatures rise, glaciers are likely to be diminished and this will pose a significant challenge for water resource management and likely affect all sectors of society.[29] The most significant disasters for the country include floods, primarily riverine but also along the coast as the seas rise and increase flash flood events. 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 their impacts. An increase in extreme rainfall events will likely continue to cause localized flooding events. The majority of the country's Pacific and Caribbean coasts are vulnerable to coastal flooding from rising seas and storm surges (**Figure 10**).

[29] GFDRR (2011). Analysis of disaster Risk Management in Colombia: A Contribution to the Creation of Public Policies. URL: https://www.gfdrr.org/en/publication/analysis-disaster-risk-management-colombia-contribution-creation-public-policies-2011

Riverine floods (**Figure 10**), already a hazard across the country, are likely to get more pronounced as snow melts faster due to rising temperatures from the country's glaciers. Coupled with the effects of the El Nino Southern Oscillation phenomenon, both the frequency of floods and droughts will likely increase. In 2015, for example, Colombia experienced one of the worst droughts in its history, with low rainfall drying rivers such as the critical Magdalena and Cauca rivers, the former of which flows were the lowest on record. The Colombian government earmarked 4.2 billion pesos to combat the drought, allocating half of the budget to delivering potable water to affected areas in the north and west, and the other half to the country's fire departments who struggled to contain the fires that emerged from the drought. The multiyear extreme drought (2012–2015) that occurred in La Guajira, a northeast department of Colombia, saw a more intense El Niño phenomenon, with the drought resulting in substantial losses in the agricultural sector, and numerous communities without water supply.[30]

As temperatures rise, these will likely (i) exacerbate existing tensions for water between agricultural and livestock needs as well as human populations needs, especially during the dry seasons; (ii) alter water quality from available surface sources; and (iii) increase pressures on urban zones as urbanization rates grow. Small-scale farmers are particularly vulnerable to the effects of climate change due to their dependency on rainfed agriculture for food production and income generation, as well as their limited capacity to adapt. Extreme weather events such as droughts negatively impact agro-pastoralists' livelihoods due to the loss of productive assets, severely affecting their food security.[31]

**FIGURE 10.** Risk of riverine flood (left),[32] landslides (center),[33] risks of costal floods (right)[34]

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[30] Velasquez, C. (2016). Disaster Risk Management in Colombia. URL: https://www.researchgate.net/publication/314090911_Disaster_Risk_Management_in_Colombia [accessed Jul 06 2020].
[31] FAO (2017). Colombia Resilience Programmer – 2017–2020. URL: http://www.fao.org/3/a-i7584e.pdf
[32] ThinkHazard! (2020) Colombia – River Flood: URL: https://www.thinkhazard.org/en/report/57-colombia/FL
[33] ThinkHazard! (2020) Colombia – Coastal Flood. URL: https://www.thinkhazard.org/en/report/57-colombia/CF
[34] ThinkHazard! (2020). Colombia – Landslide URL: https://www.thinkhazard.org/en/report/57-colombia/LS

# Implications for DRM

The potential for damage from floods, droughts and landslides affect millions of people, either due to the occurrence of a severe event, or by several that occur in the same year, is significant for Colombia. Since 2016, the Colombian Government has implemented a policy for mobilizing financial resources to address the effects of natural disasters and climate change.[35] The Colombian Government continues to be committed to strengthening its capacity to manage and reduce disaster risks. Colombia's National Adaptation Plan[36] considers disaster risk management and climate change adaptation as complementary actions that need to be taken to safeguard the country's development goals. Disaster risk management in Colombia 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 a decentralized system of intergovernmental councils and committees under the National Risk Disaster System (SNRGD). SNRGD coordinates among six agencies: the National Council for Risk Management, the National Unit for Disaster Risk Management, the National Committee for Risk Knowledge, the National Committee for Risk Reduction, the National Committee for Disaster Management and Departmental and municipal councils for Risk Management.[37]

### *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.[38]

[35] World Bank (2020). Modelación y análisis de riesgos catastróficos para la Alianza del Pacífico (Colombia, Peru, Mexico). Impacto fiscal y socioeconómico de eventos históricos de origen hidrometeorológico. Colombia. (Unpublished).

[36] Colombia (2016). Plan Nacional de Adaptación al Cambio Climático. URL: https://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/1._Plan_Nacional_de_Adaptaci%C3%B3n_al_Cambio_Clim%C3%A1tico.pdf

[37] GFDRR (2011). Analysis of disaster Risk Management in Colombia: A Contribution to the Creation of Public Policies. URL: https://www.gfdrr.org/en/publication/analysis-disaster-risk-management-colombia-contribution-creation-public-policies-2011

[38] 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 an important source of export earnings and food security in Colombia. The country's diverse climates allow for an equally diverse crop mix and accounted for 6% of GDP in 2018.[39] Coffee, produced at largely small scales, has long been the backbone of Colombia's agriculture, and the country is one of the most important exporters of coffee in the world. Tropical fruits such as bananas and plantains, along with sugarcane are important coastal and alluvial crops.[40] Cut flowers are a growing industry, worth over US$1 billion per year. Other crops grown include rice, maize, cotton, beans, oil palm, and tobacco. Cattle production is widespread, and the country's dairy industry is growing. Livestock rearing, and the deforestation associated, takes place across the country, however practices have impacted the Amazon region the most. In 2018, the Amazon represented 70% of deforestation in the country and in 2019, 62%. It is also a leading driver of deforestation in the tropical lowland regions of the Orinoco river watershed. The coastal zones around Magdalena have for over 20 years been used for palm oil production, and Colombia is among the top exporters of palm oil in the world. Oil palm production in the Orinoquia region, is has also been a driver of natural savannas and wetlands transformation Additionally, deforestation is linked to the production of coca plants, a source of cocaine, but only in certain areas of the country, Narino and Cataumbo. Despite considerable progress in poverty reduction - from 45% in 2005 to 30.6% in 2013, a significant portion of the Colombian population still lives in poverty and extreme poverty, requiring food assistance[41].

## Climate Change Impacts

Agricultural activity in Colombia 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.[42] The projected impacts from a changing climate on food production, agricultural livelihoods and food security in Colombia are significant national policy concerns. Impacts are crucially linked to future projected water supply constraints. The floods brought about through the La Niña phenomenon in 2010–2011 brought significant losses, lowered crop yields and damaging rice, vegetables, and corn. The livestock sector also suffered flooding of 1,165,413 hectares, equivalent to 3% of the livestock area. Small scale agriculture is especially vulnerable in areas over-exploited by livestock. Much of the country's agroecosystems are vulnerable to the effects of drought, soil erosion, desertification and changes in the rainfall and hydrological regimes. The increase of droughts in inland areas pose a risk to crops and livestock. Projections suggest that by 2050, climate change in Colombia will impact

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39 World Bank Group (2020). Databank – Country Profile: Colombia. URL: https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=COL [Accessed July 06 2020].

40 FAO (2020). Integrating Agriculture in National Adaptation Plans (NAP-Ag) – Colombia. URL: http://www.fao.org/in-action/naps/partner-countries/colombia/en/.

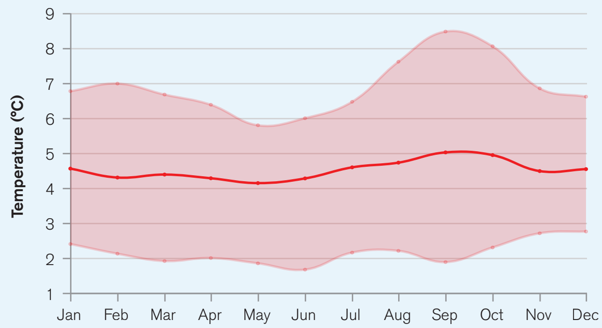
41 FAO (2017). Resilience Program in Colombia 2017–2020. URL: http://www.fao.org/3/a-i7584e.pdf

42 FAO (2020). National Adaptation Program in Colombia. URL: http://www.fao.org/in-action/naps/partner-countries/colombia/en/

14% of the GDP corresponding to agriculture, and that without adaptation, 80% of the country's crops could be impacted in more than 60% of their current areas of cultivation, especially high value perennial and export crops. Further, highly specialized niche crops such as coffee, cocoa, and other fruits will likely see critical changes in the prevalence of pests and diseases.[43]

Rising temperatures, particularly daily maximum temperatures, pose an increased risk of heat stress for livestock and could significantly reduce critical crop yields for rural populations. 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 and reproduction, particularly for cattle. As heat increases, so is the likelihood of altered growing seasons. **Figure 11** shows the projected change in average daily maximum temperatures for Colombia across the seasonal cycle. What is clear is that higher temperatures are expected throughout the year.

**FIGURE 11.** Average daily max temperature for Colombia, (RCP8.5, Reference Period, 1986–2005)[44]




## Adaptation Options

Colombia launched a National Adaptation Program specifically for agriculture in 2017, following the country's landmark National Adaptation Plan (Plan Nacional de Adaptacion al Cambio Climatico, PNACC) in 2012. One of the most important goals of the NAPag program is to build the evidence base for understanding the impacts of climate change on Colombia's diverse agriculture sector.[45] Adaptation strategies to be implemented include varietal changes to certain crops or aligning planting dates with evolving rainfall patterns. Such strategies could be successful in the cultivation of beans, potatoes and citric fruits. Irrigation systems to supplement water supplies during dry periods could help to reduce the risk from droughts to rice and other key crops. Other crops, such as coffee, however, would require specific adaptation strategies such as altitudinal migration to higher elevation areas or shading, whereas adaptation in the sugarcane industry will require the planting of varieties resistant to higher temperatures, which are also less water intensive. There is a clear role for the Ministry of Agriculture and Rural Development (MADR) to promote investments in climate impact assessments, funding smallholder adaptation pilots, financing and expanding national extension mechanisms to achieve an adequate level of technology transfer to rural producers, and establishing agricultural insurance mechanisms for smallholder farmers.[46]

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43 Ramirez-Villegas, J. M. Salazar, A. Jarvis and C.E. Navarro-Racines (2012). A way forward on adaptation to climate change in Colombian agriculture: perspectives towards 2050. Climatic Change 115,611–628(2012). URL: https://link.springer.com/article/10.1007/s10584-012-0500-y

44 WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Agriculture. Dashboard URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=SLV&period=2080-2099

45 Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

46 OECD (2015). OECD Review of Agricultural Policies – Colombia, URL: https://www.minagricultura.gov.co/Reportes/Colombia_%20Agc_Review.pdf

# Water

## Overview

Colombia is technically among one of the most water-rich countries of the world, with nearly 50,000 cubic meters of water available per person, per year. Nevertheless, the unequal distribution of the population in the Caribbean coast and the highlands, coupled with pollution, deforestation and a highly variable rainfall regime make water resources management a critical challenge for the country. The Magdalena-Cauca river basins, which traverse the Andes chains across Colombia, are critically important surface water sources in Colombia. Covering a total land area of approximately 273,000 km$^2$, or 24% of the Colombian territory, the basins house 80% of the country's population and supports a majority (80%) of the country's GDP.[47] Infrastructure developments intended to safeguard water supplies have increased the geographical imbalance of water resources.

## Climate Change Impacts

Altered rainfall patterns will inevitably impact water resource availability across Colombia. The reductions of river flows due to the El Nino phenomenon alone are significant, particularly in the Magdalena-Cauca river basin, which can see reductions of 26% in flows, the middle Cauca river basin with reductions of 38%, the Sogamoso and Suarez river basins reductions of 30%, and in Sumapaz and Antioquia Department reductions of 30–40%. La Nina impacts can exceed flows of the Cauca River by 60% of their normal level.[48] Over 60% of Colombia's energy is predominantly water-powered, further exacerbating the vulnerability of the country to reduced flows. High elevation glacier peaks in the Andes are a critical source of water for the country. Rising temperatures are already leading to rapid de-glaciations, particularly in the last 30 years, with losses of 3–5% of coverage per year and a retreat of glacial volumes of 20–25 m per year.[49]

**FIGURE 12.** Annual SPEI Drought Index in Colombia for the period, 1986 to 2099 (Reference Period, 1986–2005)[50]

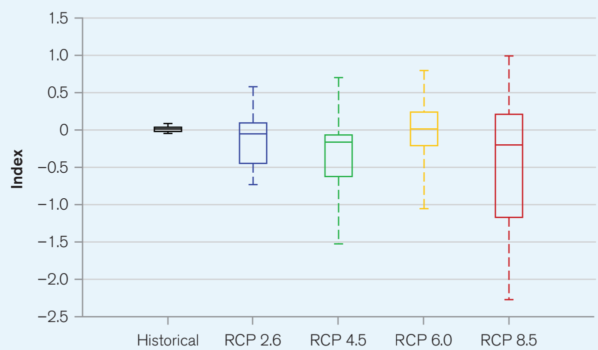


**Figure 12** shows the projected annual Standardized Precipitation Evapotranspiration Index (SPEI), an index which represents the measure of the given water deficit in a specific location, accounting for contributions of temperature-dependent evapotranspiration and providing insight into increasing or decreasing pressure on water resources. Negative values for SPEI represent dry conditions, with values below –2 indicating severe

[47] Viviscas, C. and Rodriguez, E. (2019). Evaluation of reanalysis data in the study of meteorological and hydrological droughts in the Magdalena-Cauca river basin, Colombia. URL: http://www.scielo.org.co/scielo.php?pid=S0012-73532019000400268&script=sci_arttext&tlng=en

[48] Garcia, M. et al., (2012). Climate variability, climate change and the water resource in Colombia. *Engineering Magazine.* 36 (2012). URL: http://www.scielo.org.co/scielo.php?pid=S0121-49932012000100012&script=sci_arttext&tlng=en

[49] World Bank (2017). Environmental Priorities and Poverty Reduction – A Country Environmental Analysis for Colombia. URL: https://openknowledge.worldbank.org/bitstream/handle/10986/6700/405210Env0prio101OFFICIAL0USE0ONLY1.pdf?sequence=1&isAllowed=y

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

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, Colombia is expected to experience slightly decreased SPEI through the end of the century, representing slightly drier conditions

### Adaptation Options

The basin is an essential unit of planning and management for Colombia. Vulnerability studies are underway to understand the varied degrees of impacts across the country's basins, information that will be useful in prioritizing adaptation measures. Adaptation in the water resources sector should focus on 1) strengthening the capacity of the research community to generate policy-oriented data on watershed management and climate change adaptation, 2) mainstreaming and integrating climate data in decision making related to watershed management, and 3) strengthening systems that optimize water use across a watershed.[51] Colombia's Department of National Planning (DNP) prioritized the long-term sustainability of ecosystem services that will benefit watershed conservation actions throughout the nation. The watershed management plan, Plan de Ordenación y Manejo de la Cuenca (POMCA), is the guiding policy of environmental management of the country's watersheds, owned and developed by regional corporations. The Policy and National Program for Payments for Environmental Services for the reconstruction of Peace (CONPES 3886) provides guidelines to strengthen the current PES schemes by providing economic incentives to local communities to engage in and improve the use and management of soil, forests and water resources.[52]

## Coastal Zones and Sea Level Rise

### Overview

Colombia's coastal region covers 3,208 km, with 1,760 km of these along the Caribbean Sea and 1,448 km along the Pacific Ocean. Coastal erosion is rampant, with approximately 50% of the Caribbean coastline suffering from erosion due to extreme waves rising seas, and ecosystem destruction brought about by a growing "sun, sea and sand" tourism industry centered around the cities of Cartagena, Barranquilla, Santa Marta and Riohacha. Millions have been invested to safeguard high value coastal infrastructure, including US$25 million in the Puerto Colombia pier, US$6 million for hard defenses including groins, seawall and rip rap revetments, among others.[53]

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51 Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

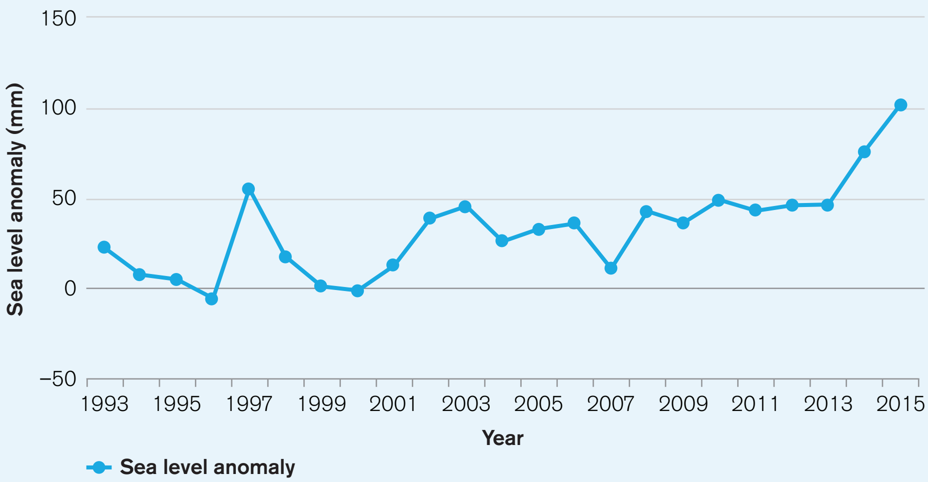
52 Garcia, M. et al., (2012). Climate variability, climate change and the water resource in Colombia. *Engineering Magazine.* 36 (2012). URL: http://www.scielo.org.co/scielo.php?pid=S0121-49932012000100012&script=sci_arttext&tlng=en

53 Rangel-Buitrago, N., Anfuso, G., and Williams, A. (2015). Coastal erosion along the Caribbean coast of Colombia: Magnitudes, causes and management. Ocean & Coastal Management. 114 (September), p. 129–144. URL: https://www.sciencedirect.com/science/article/pii/S0964569115001775?casa_token=DNaTe8evkLYAAAAA:-dkKBvQpbECposp8M69iP7wuhcHdrVUJsbzhqC21DTW5lQDGzj7E72nm61HhhOVmeoA5y6o6tw

## Climate Change Impacts

Warmer ocean temperatures are associated with coral bleaching episodes, as well as reduced growth and reproductive rates of surviving corals. Rising sea levels are projected to flood 4,900 km$^2$ of low coasts and 5,100 km$^2$ inland, affecting between 1.4 to 1.7 million people, 80% of which are living in the Caribbean coast and the other 20% in the Pacific coast. The island of San Andres would see significant flooding across its marshes, ridges, and mangroves, with over 10% of its land area flooded by a one-meter rise in sea levels.[54] Furthermore, more than 45% of Colombia's areas of coastal mangroves, grasslands, scrub and lagoons are vulnerable, particularly in the Departments of Magdalena, Nariño and La Guajira.[55] **Figure 13** shows the annual average sea level change from 1993 to 2015.

**FIGURE 13.** Sea level anomaly in Colombia (1993–2015)[56]




## Adaptation Options

Colombia's coastal zones are highly vulnerable to multiple stresses. To date, the many hard engineering defenses implemented to safeguard the coasts have had limited success. However, soft engineering measures, ones that work with nature, could help to build the resilience of coastal areas. For example, beach nourishment along popular tourist places such as San Andres, Santa Marta, Puerto Colombia, and Cartagena could protect beach structures. Relocation deserves a priority consideration, particularly along highly erosive coastal roads. Other adaptation strategies could focus on land use changes to reduce flooding and sedimentation, as well as adapting of homes and infrastructure in response to erosion and flooding. Colombia has committed to supporting investigation to better understand and identify hot spots of coastal risks, along with their stressors, in order to prioritize actions.[57]

[54] Colombia Plan Nacional de Adaptación al Cambio Climático https://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/1._Plan_Nacional_de_Adaptaci%C3%B3n_al_Cambio_Clim%C3%A1tico.pdf

[55] Colombia (2017). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/TCNCC%20COLOMBIA%20A%20LA%20CMNUCC%202017.pdf

[56] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia. Impacts-Sea Level Rise. URL: https://climateknowledgeportal.worldbank.org/country/colombia/impacts-sea-level-rise

[57] Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

# Energy

## Overview

Colombia has productive petroleum reserves, South America's most extensive coal reserves, and significant but largely untapped natural gas reserves. A large amount of potentially productive oil and natural gas areas remain unexplored. Demand for energy (petroleum, natural gas, and electricity) is expected to continue to grow. Colombia's energy is sourced primarily from hydro power (~60%) and coal (~25%).[58] Service quality, as measured by service interruptions, is low, and losses in transmission and leaks in the distribution system are a concern. Nevertheless, given the high reliance on hydro power, the droughts brought by phenomena such as El Nino could affect the country's energy sustainability. Colombia's Energy Plan 2050 aims to diversity the country's energy resources and ensure a reliable energy supply by diversifying the energy mix to include wind power plants, solar photovoltaic and geothermal energy generation. The country's he National Energy Plan (PEN), prepared by the Ministry of Mines and Energy and the Unit of Energy Mining Planning (UPME) has five specific objectives and two transversal ones. The specific ones are oriented to the projection of an efficient, productive, formal country and of opportunities in energy matters, and are the following: 1) Reliable supply and diversification of the energy basket, 2) Efficient demand management and incorporation of clean transport technologies, 3) Universalization and affordability of the energy service - energy equity, 4) International interconnection and infrastructure, and 5) Generation of value in the energy sector for the development of regions and populations.[59]

## Climate Change Impacts

Although plans are underway to diversify the Colombian energy mix, the country's reliance on hydropower as a primary energy source could wreak havoc on the population in years to come, as altered rainfall patterns, combined with higher temperatures which in turn increase energy demands of the population, and melting glaciers can reduce the flows and thus the productive potential of many of the country's rivers, especially the Magdalena basin which is a major power source for the country. Rainfall and temperature scenarios for 2071–2100 indicate that some regions may see a 30% reduction in rainfall, which would reduce runoff to rivers, water stored in dams and aquifer recharge. 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.[60]

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[58] Fossil Energy International (2003). An Energy Overview of Colombia. URL: http://www.geni.org/globalenergy/library/national_energy_grid/colombia/EnergyOverviewofColombia.shtml

[59] Colombia Plan Nacional de Adaptación al Cambio Climático https://www.minambiente.gov.co/images/cambioclimatico/pdf/Plan_nacional_de_adaptacion/1._Plan_Nacional_de_Adaptaci%C3%B3n_al_Cambio_Clim%C3%A1tico.pdf

[60] Colombia (2017). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/TCNCC%20COLOMBIA%20A%20LA%20CMNUCC%202017.pdf

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 14**, 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 15**, warm spells are expected to sharply increase in the second half of the century.

**FIGURE 14.** Change in Cooling Degree Days (65°F) in Colombia for the period 2040–2059, (RCP8.5, Reference Period, 1986–2005)[61]

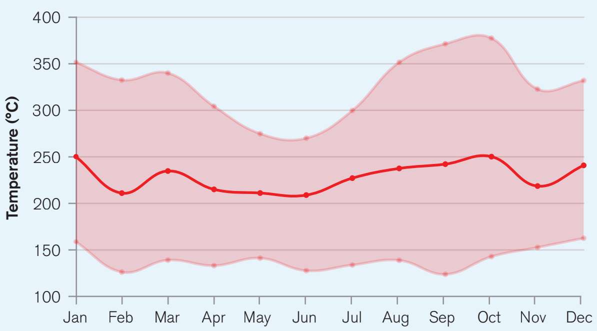
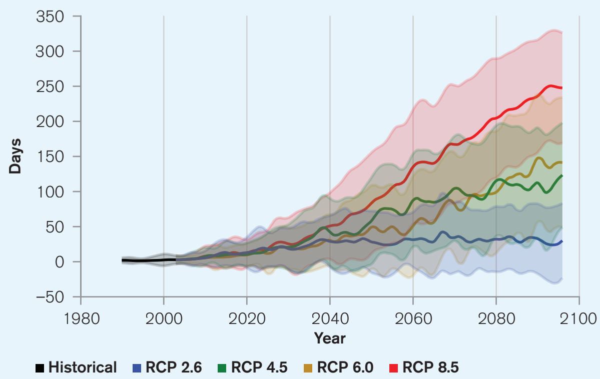



**FIGURE 15.** Projected change in Warm Spell Duration Index in Colombia for the period 2020 to 2099, (Reference Period, 1986–2005)[62]




## Adaptation Options

Adaptation options for the hydropower sector should focus on improved water resource management under changing conditions. 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.[63] Colombia's National Policy for Climate Change aims to incorporate climate change management into public and private decisions to advance in a climate-resilient and low-carbon development path that reduces the risks of climate change and allows opportunities to be seized. The long-term objective is for the country to be carbon neutral.

[61] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia – Energy. URL: https://climateknowledgeportal.worldbank.org/country/colombia/climate-data-projections

[62] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia – Energy. URL: https://climateknowledgeportal.worldbank.org/country/colombia/climate-data-projections

[63] Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

Forests and forest coverage are also critically important for the country's water supply for dams and human consumption. Sedimentation due to forest loss in upper watersheds is known to have resulted in adverse economic impacts. The country's protected areas, particularly in the Andes, is important for water production necessary for electricity and human consumption. Colombia has prioritized ecosystem-based adaptation, which is a central component of the adaptation and mitigation measures of Colombia's NDC,[64] where special attention is paid to protected areas, as well as to the conservation and restoration of strategic ecosystems, in recognition of their intrinsic value and the environmental services they provide for Colombia and the world. In its NDC, Colombia also recognized the value provided by Nature-based Solutions (NBS), the bioeconomy, sustainable infrastructure and climate-smart agriculture.[65] Adaptation options emphasized in the policy with respect to the energy sector include the promotion of energy efficiency and integrated water resources management, including educating the public on the impacts of climate change on energy supplies and implementing behavioral techniques to increase energy use efficiency in tandem with water conservation.[66]

# Health

## Overview

While Colombia is a middle-income country, it still faces high poverty rates and one of the highest inequality rates in the world, making the health of the country's population vulnerable to climate change impacts.[67] The 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 malaria, zika, chikungunya, as well as air pollution and associated respiratory illnesses, as well as water-borne illnesses such as cholera and diarrheal disease.[68]

## Climate Change Impacts

Rising temperatures will expand the range of vector-borne illnesses such as malaria and zika into higher elevation areas. More intense flooding such as that from La Nina events can spread water-borne illnesses such as diarrheal disease and cholera. Indeed, the "La Niña" phenomenon 2010–2011 increased the cases of acute respiratory infections and triggered the alerts of spread of malaria, cholera, leishmaniasis, tuberculosis and dengue.[69] At the end of 2011, observed a total of 470 cases of death from acute diarrheal infection in children under five years of age, higher than the cases that occurred in both 2009 and 2010. Rising temperatures year-round will bring a more

[64] Colombia (2017). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/TCNCC%20COLOMBIA%20A%20LA%20CMNUCC%202017.pdf

[65] Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

[66] Colombia (2020). Energy – Invest in Colombia. URL: https://investincolombia.com.co/en/sectors/energy/renewable-energy

[67] WHO (2015). Climate and Health Country Profile – Colombia. URL: https://www.who.int/globalchange/resources/country-profiles/PHE-country-profile-Colombia.pdf?ua=1

[68] WHO (2016). Country Cooperation Strategy – At a glance: Colombia. URL: https://apps.who.int/iris/bitstream/handle/10665/137151/ccsbrief_col_en.pdf;jsessionid=D7C70E7D273F545879D4A509FFCB03C0?sequence=1

[69] WHO (2017). Primary health care systems (PRIMASYS): case study from Colombia. URL: https://www.who.int/alliance-hpsr/projects/alliancehpsr_colombiaprimasys.pdf?ua=1

pronounced heat season with more frequent and intense heatwaves becoming a new norm. **Figure 16** shows the expected Number of Days with a Heat Index >35°C through the 2090s; appointing to a sharp increase in the number of very hot days, which will accelerate by mid-century and continue to sharply increase under a high-emission scenario (RCP 8.5) through the end of the century. Heat discomfort and heat stress increases mortality 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 17** 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 16.** Days with a Heat Index >35°C, (Reference Period, 1986–2005)[70]

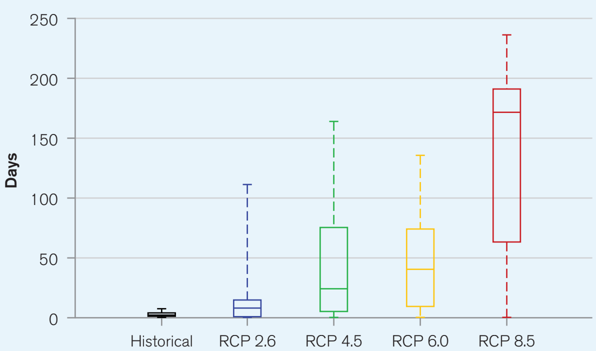
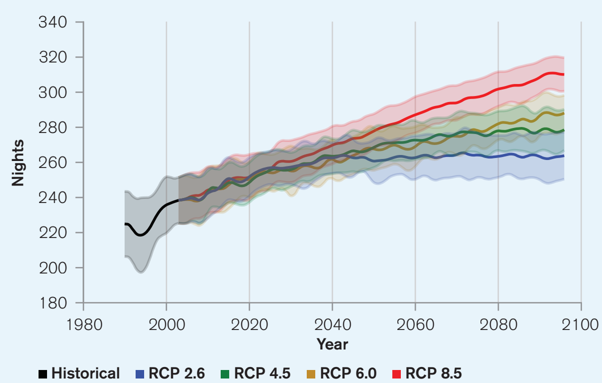



**FIGURE 17.** Number of Tropical Nights (Tmin >20°C), (Reference Period, 1986–2005)[71]




## Adaptation Options

A quantitative vulnerability and risk assessment for Colombia's health sector is an important first step in identifying the most critical climate change impacts and the most vulnerable populations and communities. 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.[72] As such, there is a need to develop locally relevant health vulnerability assessments. Strategic priorities include 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.[73]

[70] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Health Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/health/systems-and-service?country=COL&period=2080-2099

[71] WBG Climate Change Knowledge Portal (CCKP, 2021). Colombia Health Sector. URL: https://climateknowledgeportal.worldbank.org/country/Colombia/climate-sector-health

[72] WHO (2015). Climate and Health Country Profile – Colombia. URL: https://www.who.int/globalchange/resources/country-profiles/PHE-country-profile-Colombia.pdf?ua=1

[73] WHO (2017). Primary health care systems (PRIMASYS): case study from Colombia. URL: https://www.who.int/alliance-hpsr/projects/alliancehpsr_colombiaprimasys.pdf?ua=1

## Institutional Framework for Adaptation

Colombia's National Climate Change Policy (2017) aims to incorporate climate change management into decisions public and private to advance a path of development, climate-resilience and low-carbon economy, which reduces the risks of climate change and to take advantage of the opportunities that emerge.[74] It takes a broad, territorial vision that focuses on the cross linkages between sectors. Actions identified in the strategy fall under four pillars: (i) information, science, technology and innovation; (ii) education, training and public awareness; (iii) planning of climate change management and; (iv) financing and economic instruments.

Colombia's National Development Plan of 2010–2014 listed climate adaptation as a priority and established the National Climate Change System to improve institutional coordination. The country's National Adaptation Plan of 2012 outlined the priorities for climate adaptation and was followed by a 2013 Road Map for the country's National Adaptation Plan which outlines the process for implementing adaptation priorities.

## Policy Framework for Adaptation

Adaptation is guided by the National Adaptation Plan (Plan Nacional de Adaptación al Cambio Climático – PNACC), which identified five strategic lines for a planned adaptation to serve as work guides for different sectors and territories in the formulation of their adaptation plans:

1. Raise awareness about climate change,
2. Generate information and knowledge to measure climate risk,
3. Plan the use of the territory,
4. Implement adaptation actions,
5. Strengthen reaction capacity.

**National Frameworks and Plans**

- Updated Nationally Determined Contribution (2020) (Spanish)
- Second Biennial Update Report (2018) (Spanish)
- Colombia's First Nationally Determined Contribution (2018)
- Third National Communication to the UNFCCC (2017)
- National Climate Change Policy (2017) (Spanish)
- First Biennial Update Report (2016) (Spanish)
- National Adaptation Road Map (2013) (Spanish)
- National Adaptation Plan (2012) (Spanish)
- Second National Communication to the UNFCCC (2010)
- First National Communication to the UNFCCC (2001)

[74] Colombia (2017). National Climate Change Policy. URL: https://www.minambiente.gov.co/images/cambioclimatico/pdf/Politica_Nacional_de_Cambio_Climatico_-_PNCC_/PNCC_Politicas_Publicas_LIBRO_Final_Web_01.pdf

# Recommendations

## Research Gaps

- Support research on the impacts of climate change on key economic and social sectors, as well as the tourism industry, including the identification of hot spots of risk
- Support decision-based dialogues in critical watersheds such as the Magdalena in order to mainstream and integrate climate information into local decision-making contexts
- Engage vulnerable populations and address barriers to decision-making. Women, especially in rural areas lack access to decision-making processes.[75] As a result, decisions often fail to reflect women's needs and perspectives leaving them particularly vulnerable to the impacts of climate change. To make the decision-making process more accessible, it is important to review existing regulations and policies and suggest ways they can more clearly incorporate gender norms

## Data and Information Gaps

- Develop early warning systems for hot spot areas of flooding, building on Colombia's Wetlands Map and existing information on freshwater, coastal, and marine wetlands, their cycles and flooding regimes.
- Strengthen the technical capacity to integrate climate-smart agriculture and climate change risk management into farmer's and the wider agricultural sector
- Raise public awareness about climate risks[76]
- Use technology to reach greater audiences. The demand for knowledge-sharing, training and capacity building opportunities continues to grow. Programs that wish to strengthen and empower water management and local actors should include training and tools to develop individual and collective capacity of the water managers. Incorporate climate resilient considerations in the engineering and design of new infrastructure[77]

## Institutional Gaps

- Revise current legislation on coastal zone management
- Promote climate resilient production systems agriculture, forestry and livelihood sectors to improve competitiveness, income and food security, especially in vulnerable areas[78]
- Provide financing mechanisms for community investments in adaptation
- Facilitate community involvement on coastal erosion issues and related problems to land uses
- Move beyond awareness raising, capacity building and planning to actual implementation of appropriate adaptation measures at the watershed level
- Strengthen planning systems to optimize water use across a watershed in the context of climate change. For example, using the POMCAs as a guide, work to prepare projects for submission to various funding agencies to secure financing for adaptation strategies

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[75] Colombia (2017). National Climate Change Policy. URL: https://www.minambiente.gov.co/images/cambioclimatico/pdf/Politica_Nacional_de_Cambio_Climatico_-_PNCC_/PNCC_Politicas_Publicas_LIBRO_Final_Web_01.pdf

[76] Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

[77] Colombia (2017). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/TCNCC%20COLOMBIA%20A%20LA%20CMNUCC%202017.pdf

[78] Colombia (2020). Updated Nationally-Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf

CLIMATE RISK COUNTRY PROFILE

# COLOMBIA

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