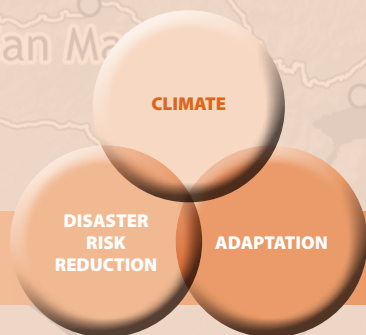


Vulnerability, Risk Reduction, and Adaptation to Climate Change

GUATEMALA



GFDRR
Global Facility for Disaster Reduction and Recovery



COUNTRY OVERVIEW

Occupying a total land area of 108,889 km², the Republic of Guatemala lies in the heart of Central America and is bordered by Mexico and Belize to the north, the Atlantic Ocean to the east, and El Salvador, Honduras, and the Pacific Ocean to the south. Two-thirds of the country are mountainous and dominated by a string of volcanic ranges running northwest to southwest.¹

Key Sectors

Agriculture and Land Use
Water Resources
Human Health
Disaster Risks

With an annual GDP of US \$37 billion, Guatemala is the largest economy in Central America and also one of the most densely populated. Even though Guatemala has the status of lower-middle-income country, it is one of the poorest countries in the region and is marked by social indicators that often fall below those of countries with far lower per capita income.² More than half of Guatemala's population lives in rural areas, and of that 70 percent live in poverty. These disparities acutely affect the indigenous Mayan majority who are oftentimes excluded from the political and social mainstream, making this group especially vulnerable to climate change and the frequent natural hazards that plague the region.³

As a result of widespread deforestation and land degradation, slash-and-burn subsistence agriculture, and overexploitation of water resources, Guatemalans rely on degraded natural resources and lands with low productivity, leading to increased food insecurity and vulnerability. Other factors that increase vulnerability include urbanization and rapid population growth in high-risk areas such as the highlands and Pacific coastal regions, highly unstable physical structures, limited access to clean water and health services, and low capacity to manage natural disaster risks.⁴

PRIORITY ADAPTATION MEASURES

Guatemala has submitted one national communication to the United Nations Framework Convention on Climate Change (UNFCCC) in 2001 outlining Government actions and policy frameworks to address climate change adaptation. Vulnerability studies were carried out to estimate future impacts on human health, grain production,

Priority Adaptation Projects

Improving adaption in dry and drought stricken areas
Limiting land degradation through agroforestry measures
Improving water resource quality and quantity
Reducing vulnerability to natural disasters

hydrological resources, and the natural environment. The first communication also considered many natural disasters that caused human, agricultural, and infrastructure losses.⁵

The First National Climate Change Program, which was completed in 2004 by the Ministry of the Environment and Natural Resources (MARN), built on studies on greenhouse gas inventories, vulnerability, and mitigation and adaptation. The program also analyzed adaptation to drought in the sub-basin of the San José River and adaptation to floods in the basin of the El Naranjo River.⁶

Guatemala is in the process of completing its second national communication with support from the Global Environment Facility (GEF) and the United Nations Development Program (UNDP). The outputs of this process include developing national institutional adaptation capacities to address vulnerabilities and risks associated with climate change and to improve deployment of adaption actions. To ensure that the country meets its long-term goals of reducing vulnerability to extreme weather events and climate change, the GEF support is used for

¹ IDB, Country Program Evaluation: Guatemala (2004 – 2007).

² World Bank Data Country Indicators: <http://data.worldbank.org/country/guatemala>

³ World Bank. Protecting and Expanding Opportunities for Vulnerable Groups in Guatemala, 2010.

⁴ Ibid note 1.

⁵ Guatemala Primera Comunicación Nacional Sobre Cambio Climatico, 2001.

⁶ Ministry of the Environment and Natural Resources. Guatemala National Climate Change Programme, 2004.

creating, among other things, a National Policy on Climate Change and a Regional and National Strategy for Climate Change.

CLIMATE BASELINE AND CLIMATE FUTURE

CLIMATE BASELINE

Total Annual Precipitation



Mean Annual Temperature



Figure 1: Annual mean temperature and total precipitation for Guatemala⁷

Guatemala's climate varies according to its diverse topography, ranging from cool highlands, tropical semi-dry savannah, tropical jungle in the northern lowlands, and humid coastal areas. Guatemala's patterns of precipitation and temperature are affected by fluctuations in the temperature of the surrounding oceans, the interaction of the atmospheric circulation with the Sierra Madre volcanic mountain ranges, El Niño/La Niña cycles, and intensification of the Inter-Tropical Convergence Zone (ITCZ) and Pacific Decadal Oscillation (PDO). The El Niño phenomenon in magnifies vulnerability in the region, in particular, causing frequent severe droughts in the eastern portion of Guatemala.⁸

⁷ WorldClim 1960-1990 averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at the Museum of Vertebrate Zoology, University of California, Berkeley, in collaboration with Peter Jones and Andrew Jarvis (CIAT), and with Karen Richardson (Rainforest CRC). www.worldclim.org/current

⁸ Miguel Cifuentes Jara. ABC of Climate Change in MesoAmerica. CATIE, 2010.

The average annual temperature for the coast ranges from 25°C to 30°C; for the central highlands the average temperature is 20°C, and drops to 15°C for the higher mountains.⁹ Overall, daytime temperatures reach their maximum before the onset of the rainy season and decrease toward January, while minimum temperatures reach maximum values in July when cloudiness associated with the rainy season reduces nighttime radiative cooling.¹⁰

The rainy season in Guatemala extends from May to October in the inland areas and from May to December along the coast, while the dry season extends from either November or January to April. Rainfall fluctuates between 1000 and 1200 mm annually in most of the country, whereas the Atlantic coastal area receives about 4000 mm annually. In almost all the country, the monthly values of evapotranspiration have little variation, ranging from 1300 mm/year to 1800 mm/year.¹¹

RECENT CLIMATE TRENDS

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

- ➔ Maximum temperature extremes increased by 0.2°C and minimum temperatures increased by 0.3°C per decade.¹²
- ➔ The number of cold days¹³ has decreased during the period December through February and the number of hot days¹⁴ has increased in March through May.¹⁵
- ➔ The number of hot days and nights has increased by 2.5 and 1.7 percent per decade, respectively. Conversely the number of cold days and nights has decreased by -2.2 and -2.4 percent.¹⁶
- ➔ Precipitation has exhibited a decrease in monthly values, with the greatest reduction seen in June and August.
- ➔ The number of consecutive dry days has increased and the dry season is warmer and more prolonged.
- ➔ Positive precipitation trends have been noted in some areas; however, the average annual precipitation and the number of consecutive wet days do not show significant changes. There has been a slight increase in rainfall intensity. Over the past four years the El Niño/La Niña climate cycles have increased in frequency. Cycles have alternated from one year to the next, with 2004 and 2006 as low rainfall El Niño years, while 2005 and 2007 were very high rainfall La Niña years.¹⁷
- ➔ According to climate newsletter 1-2010 of the Institute of Seismology, Volcanology, Meteorology and Hydrology (Insivumeh), the accumulated rainfall decreased by 33% in 2009 compared to 2008 due to the drought that affected mainly the dry corridor.

Overall, the trend over the last 40 years suggests a strengthening of the hydrological and climate cycles, with more intense rain occurring across shorter periods of time that produces greater average precipitation per episode. This trend may continue in the future due to climate change, possibly resulting in a greater frequency or intensity of both floods and droughts. This poses obvious impacts on agricultural production, soil, and land

⁹ Ibid note 6.

¹⁰ TroFCCA. Climate, Climate Variability and Climate Change in Central America, 2005.

¹¹ Ibid note 6.

¹² Ibid note 6.

¹³ Cold days or nights are defined as the temperature below which 10% of days or nights are recorded in current climate for that region and season.

¹⁴ Hot days or nights are defined as the temperature above which 10% of days or nights are recorded in current climate for that region and season.

¹⁵ PNUD. El cambio climático y sus efectos sobre el desarrollo humano en Guatemala, 2008.

¹⁶ Ibid note 8.

¹⁷ Ibid note 6.

and forest conservation as well as water availability and quality, all of which are already showing signs of stress and vulnerability.

In summary, Guatemala’s climate exhibits the following trends:

- ➔ The number of cold days decreased and the number of hot days increased.¹⁸
- ➔ The number of dry days has increased and the dry season is longer and more intense.
- ➔ An intensification of heat waves may occur provoking more droughts.
- ➔ An expansion of semi-arid areas is probable due to a reduction in precipitation.

CLIMATE FUTURE

The climate science community sources a suite of models to inform decision makers on future climate. Among the most widely used are GCMs (Global Climate Models), RCMs (Regional Climate Models), and downscaling techniques (both empirical and statistical) and several comprehensive reviews are available on the subject. Global Climate Models (GCMs) are our primary source of information about future climate. GCMs comprise simplified but systematically rigorous interacting mathematical descriptions of important physical and chemical processes governing climate, including the role of the atmosphere, land, oceans, and biological processes. The bullet points below offer insights into a changing climate are thusly derived for Guatemala from a suite of GCMs and RCMs used by the Intergovernmental Panel on Climate Change (IPCC).¹⁹ It is important to note, however, that Guatemala has several distinct climate regions that differ in terms of temperature, rainfall, and extreme event regimes. The magnitude of climate change is thus likely to vary at regional levels.

At a Glance

Temperature	Warming is more pronounced in the lowlands than highlands, southern coast may have the most significant changes in the temperatures while the western areas may exhibit low variability	▲ +1.0 to 4.5 °C
Rainfall	Reductions or increases depend on future time period and region The number of dry days may increase with higher temperatures averages.	-6% to +30%
Extremes	More frequent and prolonged heath waves and droughts possible. Flow rate studies in these basins show an increase in average flow rates in May (beginning of the rainy season), with increases of 89% to 141% over historical averages	▲ +89 to +141%

Source: Guatemala First National Communication 2001.

Using the reference period 1961-1990, the following future climate trends are possible by 2050:²⁰

- ➔ Temperatures are projected to increase between 1.5°C and 4.5°C, with the month of May being the hottest with temperatures exceeding 28°C; the southern coast may have the most significant changes in the temperatures while the western areas may exhibit low variability;
- ➔ Intensification of heatwaves and high temperature expansion into previously cooler regions such as mountainous areas;

¹⁸ The percentage of days and nights where the 90th percentile is exceeded for minimum temperature.

¹⁹ Unless otherwise noted, projections have been taken from the World Bank Climate Change Knowledge Portal:

<http://sdwebx.worldbank.org/climateportal/>

²⁰ Ibid note 5.

- ➔ As yet it is not possible to get a clear picture for precipitation change for Guatemala under a future climate. This is due to large model uncertainties, with multi-model analyses suggesting a drying trend, and some individual models suggesting a more humid future. What is clear, however, is that the future will increase climate variability and extreme events.
- ➔ With regards to projected rainfall changes , several studies offer interesting insights into future rainfall patterns in various parts of the country:
 - higher increase in average annual precipitation near the Pacific Coast and in the Western and Central Plains; a 30 percent reduction in precipitation in the Motagua Valley in the east and in the central plains;
 - total precipitation could decrease resulting in an expansion of semiarid areas and an increase in the “canicula”;²¹
 - precipitation decrease is projected for the beginning of wet season in the southwestern region.²²
- ➔ In the mountainous area, the severity index to climate change ranges from "significant changes vary throughout the year" to "outside comfort zone" for key species²³
- ➔ Flow rate studies in these basins show an increase in average flow rates in May (beginning of the rainy season), with increases of 89% to 141% over historical averages.²⁴
- ➔ Projected changes in sea level are expected between 6.05 - 7.4cm by 2030, between 9.71 - 13.37cm by 2050, and between 17.71 - 33.25cm by 2100.

CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

AT A GLANCE

Ranking 5th among countries with the highest economic risk exposure to three or more hazards, 83.3 percent of Guatemala’s GDP is located in at-risk areas.²⁵ The country also ranks in the top five countries in the world most affected by floods, hurricanes and earthquakes, with 40.8 percent of the population exposed to five or more threats simultaneously.²⁶

Exposure in Guatemala is to both low frequency and high impact events, such as earthquakes, volcanoes and hurricanes, and to high frequency and low impact events, such as floods and landslides. Some of these events may worsen under future climate trends:

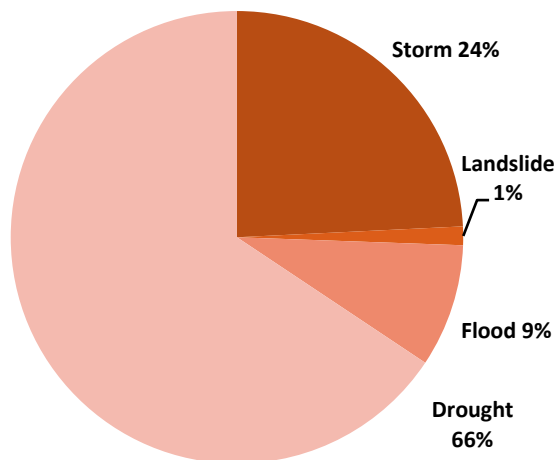


Figure 2 Natural hazards by type
Source: Prevention Web

²¹ Characteristic of the rainy season in Central America, the “canicula” is a spell of hot weather that occurs in the middle of the season. If it is not timely or is prolonged, it threatens crops and can lead to their partial or total loss. MARN (2001) First National Communication on Climate Change– Guatemala

²² Future Vulnerability and Adaptation Measures and Strategies– MARN (2007)

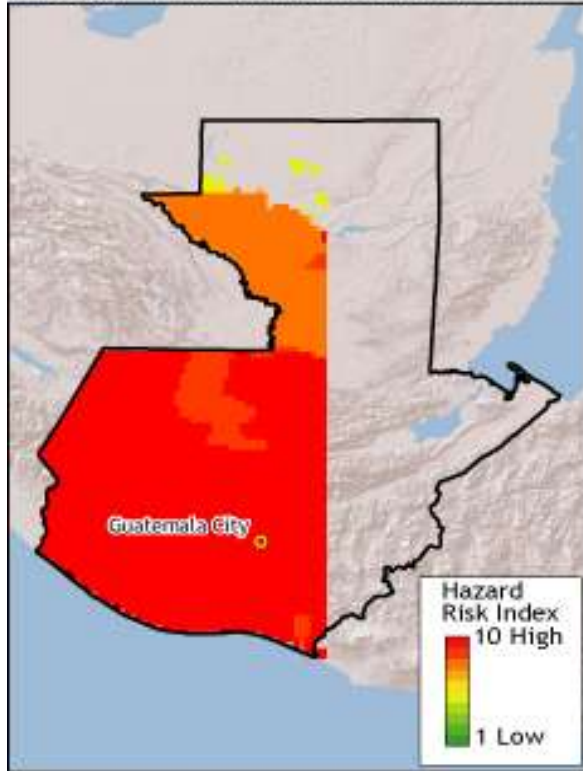
²³ Potential Impacts of Climate Change on Biodiversity (CATHALAC, 2008)

²⁴ Water flow trends in hydrometeorological stations during May 2010 (INSIVUMEH, 2010)

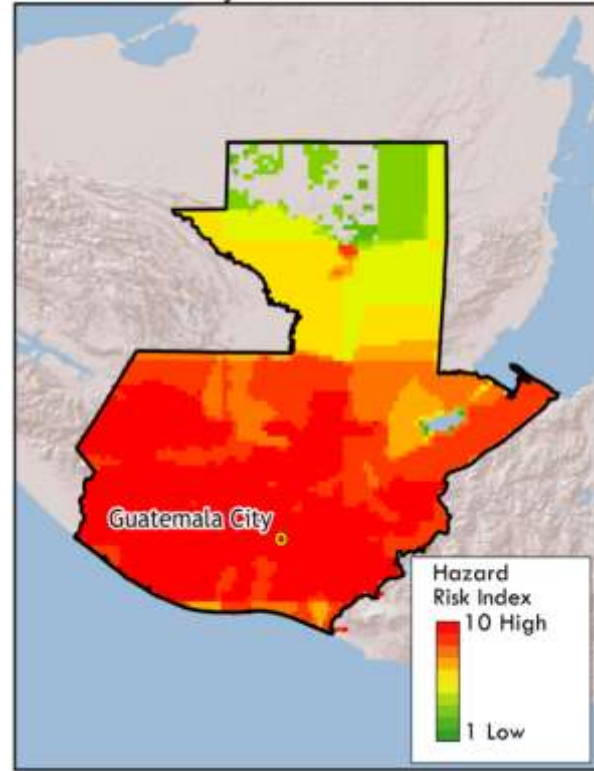
²⁵ GFDRR and ISDR. Disaster Risk Management Programs for Priority Countries, 2009.

²⁶ Country Partnership Strategy for the Republic of Guatemala, 2008.

Drought- Proportional Economic Loss



Flood Mortality Risk



Cyclone Mortality Risk

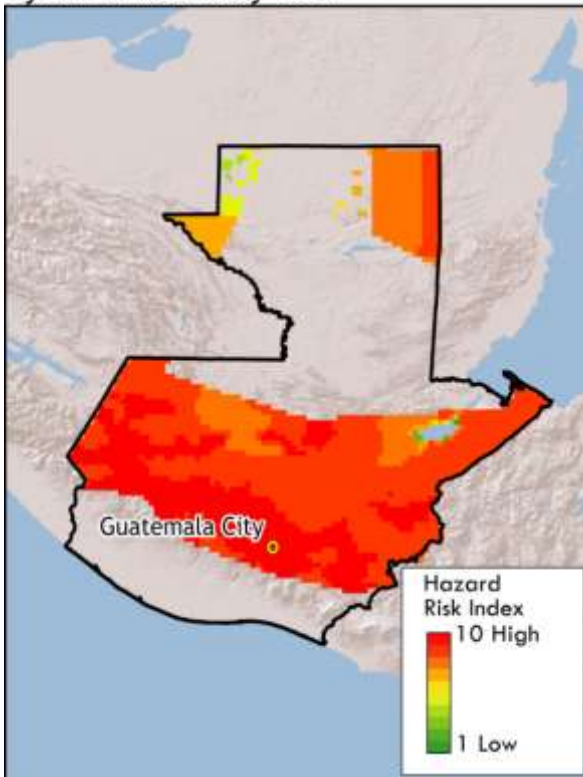


Figure 3: Flood mortality, cyclone mortality, and drought-related economic loss for Guatemala²⁸

- ➔ **Floods and Landslides** -- Flooding and landslides have numerous drivers, including the overflow of rivers and streams during storms and the rainy season. The lack of sewage systems in many regions and the discharge of waste into water bodies during flood events present serious environmental and health risks.²⁸
- Flooding and landslides associated with Hurricane Stan in 2005 caused 669 deaths, directly affected more than 470,000 people, and damaged or destroyed nearly 35,000 homes. 3.5 million Guatemalans, or 30 percent of total population, suffered either loss of life, property or access to basic services. Cases of hepatitis A and cholera caused by contaminated water were also reported in affected communities.²⁹
 - During the 2010 rainy season, which was one of the heaviest the country has seen in six decades, landslides and flooding caused additional damage to the country's weakened infrastructure.³⁰
- ➔ **Cyclones and Storms** -- Guatemala's location between the Caribbean Sea and Pacific Ocean makes it a target for hurricanes; however, most of the damage that occurs is not due to wind, but to flooding and landslides. For example, Guatemala has experienced its wettest rainy season in the last 60 years due to continuing tropical storms, posing serious implications for Guatemala's long-term growth and sustainability and increasing the vulnerability of the poor and marginalized:
- Hurricane Mitch in 1998 caused estimated damages of 4.7 percent of GDP.³¹
 - Tropical storm Stan in 2005 caused material damage worth US \$996 million. The initial assessment estimated losses of US \$530 million for the short- to medium-term, including the near-complete loss of bananas and shrimp grown on the South Coast, and major losses in cattle, sugar crops, horticulture, and short-cycle crops. The overall economic losses have been estimated to be a little under US \$1 billion.³²
 - Primarily due to landslides, Tropical Storm Alex killed 235 people and left almost 210,000 homeless when it hit the country in 2010.
- ➔ **Droughts**³³ -- The area known as the **Corredor Seco** or the dry corridor encompasses six provinces in Guatemala and is the hardest hit by frequent droughts. It is also the area where poverty is the highest.
- In terms of vulnerability, 1.53 percent of Guatemala's total land area is under extremely high threat of drought, 3.53 percent is under very high threat, and 5.99 percent under high threat. Adding to the natural variability of Guatemala, El Niño events, which typically last around 12 months, compound vulnerability by prolonging drought periods and causing crop failure due to a reduction in water availability:
 - A drought in 2001 affected 1.4 million people and caused 40 deaths due to malnutrition. Overall, the drought left at least 12,000 families without access to food staples.
 - In 2009, the worst drought in Latin America in 30 years hit Guatemala, reducing the harvest of staples like maize and beans by up to 50 percent and affecting 2.5 million Guatemalans. The dry spell was exacerbated by the El Niño weather pattern, and pest infestations, which are common during drought periods, further reduced food supply,

²⁷ WorldClim 1960-1990 averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at the Museum of Vertebrate Zoology, University of California, Berkeley, in collaboration with Peter Jones and Andrew Jarvis (CIAT), and with Karen Richardson (Rainforest CRC). www.worldclim.org/current.

²⁸ DARA, Risk Reduction Index Analysis of the Capacities and Conditions for Disaster Risk Reduction, 2011.

²⁹ USAID: <http://www.usaid.gov/gt/disaster.htm>

³⁰ World Bank. Guatemala: Protecting and Expanding Opportunities for Vulnerable Groups, 2010.

³¹ Ibid note 18.

³² Ibid note 21.

³³ Relief Web: Guatemala Drought Events

causing the highest price rise since 2007. In the dry corridor, 25 children died due to malnutrition.

- The El Niño event of 2009-2010 caused agricultural losses totaling US \$70 million in Costa Rica, El Salvador, Guatemala, Nicaragua, and Panama.
- Crop failures in 2010 led to the deaths of more than 2,000 children under five years of age due to malnutrition.

➔ **Other risks** -- Guatemala's densely populated highlands lie along the Montague Fault, which is part of the boundary between the Caribbean and North American Tectonic Plates. This fault has been responsible for several major earthquakes in historic times, including a 7.5 magnitude tremor on February 4, 1976, which killed 23,000 people.³⁴ Even though earthquakes and volcanic eruptions are not climate-related, these events present serious threats and compound vulnerability for an already at-risk population:³⁵

- The 1976 Earthquake, which resulted in more than 23,000 deaths, caused damages estimated at 17.9% of GDP.
- The explosive eruption of Guatemala's Santa Maria volcano in 1902 was one of the world's largest 20th-century eruptions.
- In 2010, two consecutive natural disasters, Tropical Storm Agatha and the eruption of the Pacaya volcano, caused an estimated US \$1.55 billion in damages and losses, which account for 4.1 percent of the nation's GDP.

Implications for Disaster Risk Management (DRM)

- ➔ An increase in temperature and precipitation under future climate trends might increase tropical disease vectors, thus requiring improvements to the health care institutional framework.
- ➔ 40% of the rural population does not have household water connection, making these groups especially vulnerable to future climate-induced droughts.
- ➔ Urban and rural growth patterns hinder risk reduction due to the lack of DRR- specific measures in local land use plans and construction codes. Under future possible trends of increased flooding and landslides, these populations may be unable to respond quickly and effectively to curtail risk.
- ➔ Future climate projections showing increased precipitation trends might drastically affect areas already prone to flooding and landslides, as many of these areas have inadequate road construction infrastructure and inappropriate land use.
- ➔ Future climate variability could endanger food security, especially for those in the central highlands who already must rely on lands with low productivity.
- ➔ A possible increase in tropical cyclones and extreme weather events brought on by an increase in the El Niño and La Niña cycles threatens agricultural production, human settlements, coastal fisheries, and infrastructure.

³⁴ USGS: <http://earthquake.usgs.gov/earthquakes/world/index.php?regionID=41>

³⁵Relief Web: <http://reliefweb.int/node/232433>

SECTORAL CLIMATE RISK REDUCTION RECOMMENDATIONS

AGRICULTURE

Forty-three percent of Guatemala's land is used for agriculture, pasture accounts for 30 percent, cultivation 13 percent, and forestry 36 percent.³⁶ The primary agricultural products include maize, rice, wheat, sorghum and beans. Commercial production includes coffee, bananas, rubber, sugarcane, and livestock. Agriculture remains a major contributor to Guatemala's economy, accounting for 22 percent of the country's GDP, more than half the country's total export earnings, and 39 percent of total employment.³⁷

Climate variability and weather extremes such as increased temperature outside of the adapted range of crops adversely affect the duration and seasonality of crop cycles, often leading to crop failure. Water shortage and increased desertification due to droughts also hinder crop productivity.³⁸ Indirectly, climate change will affect the incidence of pests and diseases, the cycling and availability of nutrients in the soil, and will lead to increased propensity for fires.

Table 1: Projected Change in Crop Yields across Guatemala

Crop	Baseline Yield (1961 - 1990)	Projected Yield	Change %	Period
Wheat	846	814	-3.78	2020s
Wheat	846	738	-12.77	2050s
Wheat	846	326	-61.47	2080s
Maize	1357	1384	1.99	2020s
Maize	1357	1230	-9.36	2050s
Maize	1357	1182	-12.90	2080s
Sorghum	526	530	0.76	2020s
Sorghum	526	620	17.87	2050s
Sorghum	526	592	12.55	2080s
Best Cereal	1377	1501	9.01	2020s
Best Cereal	1377	1643	19.32	2050s
Best Cereal	1377	1685	22.37	2080s

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

According to the discussion on the effects of climate change on agriculture in Guatemala's First National Communication to the UNFCCC, the following are possible climate change-induced vulnerabilities of staple crops for the year 2030:³⁹

- ➔ Precipitation variations ranging from a 6 percent average increase to an 18 percent decrease for corn, beans, and rice.
- ➔ Depending on the region, yield increases for corn of up to 15 percent or yield decreases of up to 34 percent.
- ➔ Dramatic yield decreases of up to 66 percent for beans in the valleys of Asuncion, Mita Jutiapa, and Monjas Jalapa, or modest yield increases of up to 3 percent for the farmlands of Amatitlán, San José Pinula, Palencia, and Villa Nueva.
- ➔ Yield decreases of up to 27 percent for the lower areas of the Polochic river basin.

³⁶ Ibid note 19.

³⁷ Rural Poverty Portal: <http://www.ruralpovertyportal.org/web/guest/country/home/tags/guatemala>

³⁸ CEPAL. Guatemala: Efectos Del Cambio Climático Sobre la Agricultura, 2010.

³⁹ Ibid note 6.

- ➔ Implications of adverse weather events on agricultural production are as follows:
- ➔ Hurricane Stan damaged an agricultural area of 720,000 hectares. The crop losses were estimated to be 50 percent in the case of yellow maize, 80 percent for black beans, 30 percent for white maize, 90 percent for bananas, sorghum and sesame and 5 percent for sugar cane. In some areas in the west of the country 100 percent of small livestock were affected.
- ➔ The drought of 2009 resulted in overall losses of 40,757 ha of maize and bean production.
- ➔ El Niño and La Niña cycles have already been noted as contributing to extreme variations in coffee production. For example, in 2005 coffee production in the Pacific region was seriously affected by the floods and destruction from Hurricane Stan. About 20 percent of the harvest was lost, which was estimated to amount to US \$40 million.⁴⁰
- ➔ Crop failure due to adverse weather and climate change disproportionately affect poor indigenous children who already face food shortages. Malnutrition rates run around 70 percent in these groups, which is double the rate for non-indigenous children.⁴¹
- ➔ Priority adaptation measures in the agriculture sector include the following:
- ➔ Considering that many people in rural areas already face malnutrition, crop diversification and alternative food sources should be developed to ensure food security.
- ➔ Rotation of cultivations should be encouraged to replenish soil nutrients and avoid soil degradation, erosion, and desertification.
- ➔ Since different varieties of the same cultivation can adapt to different conditions of temperature and water and humidity, policies and programs should be implemented that encourage genetic diversity in the cultivation of basic grains.
- ➔ Government programs should be created for seed banks to preserve native varieties that could be used during future climate variability.
- ➔ ENSO-based climate forecasts should be used as a tool for agricultural planning strategies and adaptive measures.
- ➔ Special management plans for agricultural ecosystems in dry zones should be developed to include information on water resources and forecasts on El Niño events.
- ➔ An analysis of the climatic variability and yields for intensive crops should be undertaken to determine vulnerability.

WATER RESOURCES

Many areas of Guatemala face serious water-supply problems. Some areas have water deficiencies for drinking water, which has led to conflicts between large and small irrigation users in the highland regions and in the coastal areas.⁴² Moreover, of the ten leading causes of morbidity in the country, 50 percent are water-related diseases, and diarrheal illness causes 43 percent of infant mortality.

Even though water access has improved, with access for 95 percent of the population in urban areas and 61 percent with improved sanitation, water quality is often poor and only 15 out of 331 municipalities have treatment plants that are in working condition. Wastewater from urban areas is often untreated—of the 329 municipalities in the interior, only 15 employ water treatment, while the remaining discharge goes into streams and rivers. In rural villages and settlements in the interior of the country the conditions are far worse,

⁴⁰ CATIE. Impact of Climate Change on coffee farming households in Central America and steps for adaptation, 2008.

⁴¹ Ibid note 23.

⁴² Ibid note 21.

with only 54 percent receiving piped water, which is often untreated. 60.3 percent of rural families use water from rivers, lakes, and springs, which are generally contaminated.⁴³

Future trends in water quality and quantity are worrisome, considering that there are already shortages in many areas of Guatemala due to mismanagement, lack of infrastructure, and drought events.⁴⁴

By 2030:

- ➔ Future probable reduction in the superficial water flow of between 10 and 50 percent for some areas is expected. This reduction in the water flow, along with the predicted temperature increases and precipitation reduction will result in lower water supply for population use, human development, and irrigation in agriculture.
- ➔ The probable increase in intense rainfall may overwhelm sewer systems in cities, where storm sewers are not separated from sanitary sewers.
- ➔ A probable future increase in droughts combined with a decrease in precipitation, will greatly increase Guatemala's vulnerability to water scarcity, especially in the drier and warmer regions in the east and coastal areas. Serious water shortages are expected on the plains, the Motagua Valley, and the Pacific coast of Guatemala. Vulnerabilities will be further magnified by the negative interaction between anticipated increases in demand for water for domestic use and irrigation.
- ➔ In severe drought conditions, unsound agricultural practices (deforestation, soil erosion, and excessive pesticide use) will also degrade the quality and quantity of surface and ground water.

The First National Communication recognizes the need for more stringent review and treatment of both urban and rural water supplies. The following adaptation measures would help meet this goal:

- ➔ Encourage research and monitoring programs to quantify the local surface energy balance and requirements;
- ➔ Enact integral water management and watershed policies that are region-specific;
- ➔ Develop water catchment and storage through the use of reservoirs that could also be used for hydroelectric generation, irrigation, and water supply.

HUMAN HEALTH

The main illnesses associated with climatic variability in Guatemala are respiratory infections, malaria, and diarrheal diseases. Currently, acute respiratory infections rank in the top ten causes of premature death and mortality, and the incidence of death among children under 5 years of age is 67 per thousand due to respiratory illnesses, diarrhea, and malnutrition. The lack of water treatment and piped water, especially in urban and rural areas, and marginalized access to health care and education among the poor compound human health vulnerabilities.⁴⁵

Demographic and social factors such as urban development and human migration due to droughts, growing poverty in urban areas, and environmental degradation could promote new forms of disease vectors and expanded dispersal under future climate trends. Overall, higher incidences of vector-transmitted diseases (dengue and its hemorrhagic variety, malaria, leishmaniasis, and yellow fever) are expected. It is well known that dengue is commonly transmitted in areas with temperatures above 20°C, which is well below the expected future temperature range for some parts of Guatemala. A probable increase in the incidence of droughts and floods is also a major danger: Leishmaniasis is a disease associated with prolonged droughts,

⁴³ Ibid note 6.

⁴⁴ CEPAL. Guatemala: Efectos Del Cambio Climático Sobre la Agricultura, 2010.

⁴⁵ Ibid note 5.

while leptospirosis is related to floods and the prevalence of stagnant water. Outbreaks of hantavirus have already been reported after prolonged droughts.

Due to climate variability such as increases in temperature and adverse weather events, the following trends may occur by 2030:

- ➔ Diarrheal illness and malaria may increase at the beginning of the rainy season (June and September), with higher values in the months of June and July due to increases in flooding.
- ➔ Malaria cases may decrease in the south west region of the country.
- ➔ Respiratory infections may increase in frequency in the month of June and July due to intensification of drought events.

The following recommendations would help reduce vulnerability to both current and anticipated human health concerns:

- ➔ Improved response measures, early warning systems, and increased municipality expenditures for water treatment and access and health care services;
- ➔ Risk management policies to mitigate the effects of drought and flooding, especially in rural areas;
- ➔ Health education programs to foster better sanitation practices for those relying on river or secondary water sources.

FORESTS

Deforestation and land degradation simultaneously threaten biodiversity, increase the incidence of flooding and sedimentation, and reduce water quality. Due to a lack of protection policies and poor land use programs, the rate of deforestation around the country in the last decade ranged from 54,000 ha to 90,000 ha a year, which is relatively high when compared with countries like Brazil and Mexico and is more than three times the average for Latin America and the Caribbean. Land degradation in Guatemala stands at 32.47 percent, very close to the Latin America average of 35 percent. Farm activities, along with cattle ranching, are responsible for 89 percent of land-use change in the country. Migratory agriculture, through the practice of slash and burn, accounts for 78.5 percent of deforestation activities in the country, livestock accounts for 10 percent, and commercial agriculture accounts for 0.5 percent. At the current rate of deforestation and land degradation forest cover may decrease by 1.6 percent by 2030.

Guatemala contains the greatest concentration of upland coniferous forests in Central America, and they contribute nearly 80 percent of the forest-related goods. They also provide erosion protection, which helps mitigate against landslides, as well as watershed protection to one of the most utilized watersheds in Guatemala. Coniferous forests are highly intolerant to changes in climatic conditions, leaving them especially vulnerable to future climate variability.

To mitigate improper land use and deforestation, agroforestry should be integrated into land use policies, the benefits of which are as follows:⁴⁶

- ➔ Provides food in the form of fruits and nuts which would reduce food insecurity and malnutrition;
- ➔ Prevents erosion and thus land degradation while also protecting vital watersheds;
- ➔ When coupled with sustainable logging and certification, agroforestry can provide economic value and thus improve the living conditions among poor and marginalized groups;

⁴⁶ World Bank. Costs, Benefits, and Farmer Adoption of Agroforestry: Project Experience in Central America and the Caribbean, 1995.

- ➔ Because trees produce water as a byproduct of photosynthesis and also cool surrounding areas, agroforestry could reduce the severity of droughts.

EXISTING ADAPTATION FRAMEWORK/STRATEGY/POLICY AND INSTITUTIONAL SETUP

Based on the 2004 “Climate Change Studies in Guatemala with Emphasis on Adaptation” project, conducted by the Ministry of Environment and Natural Resources (MARN) in collaboration with the Netherlands Climate Assistance Program, the Government of Guatemala developed a **National Climate Change Programme** in 2006. It studied adaptation to climate change in the dry regions of the country and assessed the ability of local, regional, and national players to respond to the impacts of climate variability and change. Other focal areas include supporting forestry and agroforestry projects, implementing adaptation requirements in the human health, water resources, and agriculture sectors, and incorporating the subject of climate change into municipal and institutional agendas.⁴⁷

Over the last decade, the Government of Guatemala has moved towards a more proactive disaster risk management approach to address vulnerability in the region. Among the numerous policies and programs, the following target adaptation and vulnerability to climate change and climate-related events:

- ➔ Following Hurricane Stan in 2005, the Government of Guatemala enacted a **National Program for Disaster Prevention and Reduction (PNPMD)**, which focuses on improving and expanding risk monitoring and assessment, reducing risk, strengthening institutions, and developing risk financing strategies. The PNPMD includes four action areas:⁴⁸
 - improving risk identification and monitoring;
 - investing to reduce risk;
 - strengthening institutional and planning capacity for risk management; and
 - developing risk financing strategies.
- ➔ **The Social Development Law (Decree 42-2001) and the Law of Housing and Human Settlements (Decree 120-96)**. Both of these laws include the concept of disaster vulnerability reduction in development planning.

Government agencies that deal with DRR and climate adaptation include:

- ➔ **The Ministry of Environment and Natural Resources (MARN)** is the national authority on environment in the country and is the designated national authority on climate change. The Ministry includes a **Climate Change Unit (UCC)** created in September 2001, whose main activities are the analysis of climate change, carbon sequestration studies, to offer technical and scientific support to institutions in charge of areas affected by climate change (forests, water, basic grains), and participation in risk and early warning activities related to climate variability and global warming.
- ➔ **The National Council on Climate Change (CNCC)** was created in July 1997 and its purpose is to be a national consultation entity between the Ministry of Environment and Natural Resources and the rest of the Guatemalan society and sectors of the economy on all issues related to climate change. The Commission comprises officials from the various Ministries, including the **Ministry of Agriculture, Livestock and Food (MAGA)** and the **National Environmental Commission (CONAMA)**.
- ➔ **The National Commission on Joint Implementation**, also known as the **Guatemalan Office in Joint Implementation (OGIC)**, was created in June 1997 and is responsible for the technical follow-up on projects of Joint Implementation.

⁴⁷ Ibid note 27.

⁴⁸ HFA-PEDIA ISDR Country Profile: <http://www.eird.org/wikien/index.php/Guatemala>.

Ongoing Efforts—At a Glance

Vulnerability Reduction

- A Natural Disaster Risk Mitigation program and Catastrophic Risk Deferred Draw-Down operation totaling US \$85 million as part of the Country Partnership Strategy with the World Bank for 2008
- A risk management strategy and National Program for Disaster Risk through Guatemala's 2008 Country Partnership Strategy with the International Finance Corporation.
- The Inter-American Development Bank's Country Strategy for Guatemala for 2008- - 2011, which includes expanding a disaster risk management plan
- Modernizing the meteorological system in Guatemala with support from the Central American Development Bank (BCIE)
- EU's Program for the Reduction of Vulnerability and Environmental Degradation Guatemala (PREVDA)
- Development of disaster risk management at the local level with the support of the Japan International Corporation Agency
- Inter-American Development Bank and Spanish funded 2010 project to improve water and sanitation, funded by the Inter-American Development Bank and Spain

GFDRR Interventions (in effect or under consideration)

- Development of territorial planning and design off mitigation measures for critical infrastructure
- Development of scientific information to promote municipal planning to reduce disaster risks
- Support for the development of territorial planning that integrates disaster risk considerations at the municipal level
- Technical assistance to support and mainstream the national program for disaster risk reduction
- Support for the development of a Risk Assessment Platform for Guatemala

The **Community Based Adaption** Program (CBA), carried out in partnership with the United Nations Development Programme, includes the *Rio Tojguech Project: Micro-Basin Level Adaption to Climate Change through Tree Nurseries for Hydrological and Soil Management Project*. This project, which is expected to be completed in 2012, focuses on integrating climate change risk management into activities within the water and agriculture sectors in Western Guatemala through:

- ➔ Reforestation, agroforestry, and capacity building for improved agricultural practices to reduce climate change-driven erosion, flood, and landslide risks;
- ➔ Capacity building in local communities for the integration of climate change risk management into coastal ecosystem management;
- ➔ Integration of climate change risk management into watershed-level ecosystem management institutions, including environmental service markets.

RESEARCH, DATA, AND INFORMATION GAPS

Climate change and climate-related extreme weather events disproportionately affect Guatemala and endanger agricultural production, human life and development, biodiversity, and infrastructure. To meet the long-term goals of providing effective risk management and climate adaption to the Guatemalan population the following knowledge gaps should be addressed:

➔ **Monitoring of Climate Data**

- With only 5 climate stations used for Guatemala's First National Communication to the UNFCCC (San Marcos, Catarina, Retalhuleu, Río San José, Ipala, and the Mita Station), the

weather and climate monitoring capacity of the department of Seismology, Volcanology, Meteorology and Hydrology's (INSIVUMEH) is clearly lacking. In addition, the density and number of weather stations are very limited. It has been noted that the number of weather stations in Guatemala has declined in recent years in part due to fiscal constraints in the maintenance of equipment and trained personnel.¹¹⁴⁹

- In the first communication it was also noted that some of the climate data was found to be incomplete or inaccurate and needed to be re-recorded.

➔ Use of Climate Data

- The country does not have effective mechanisms for disseminating weather information to communities and various sectors of society. This hinders risk management and preparation and adaptation measures.

➔ Impact Studies

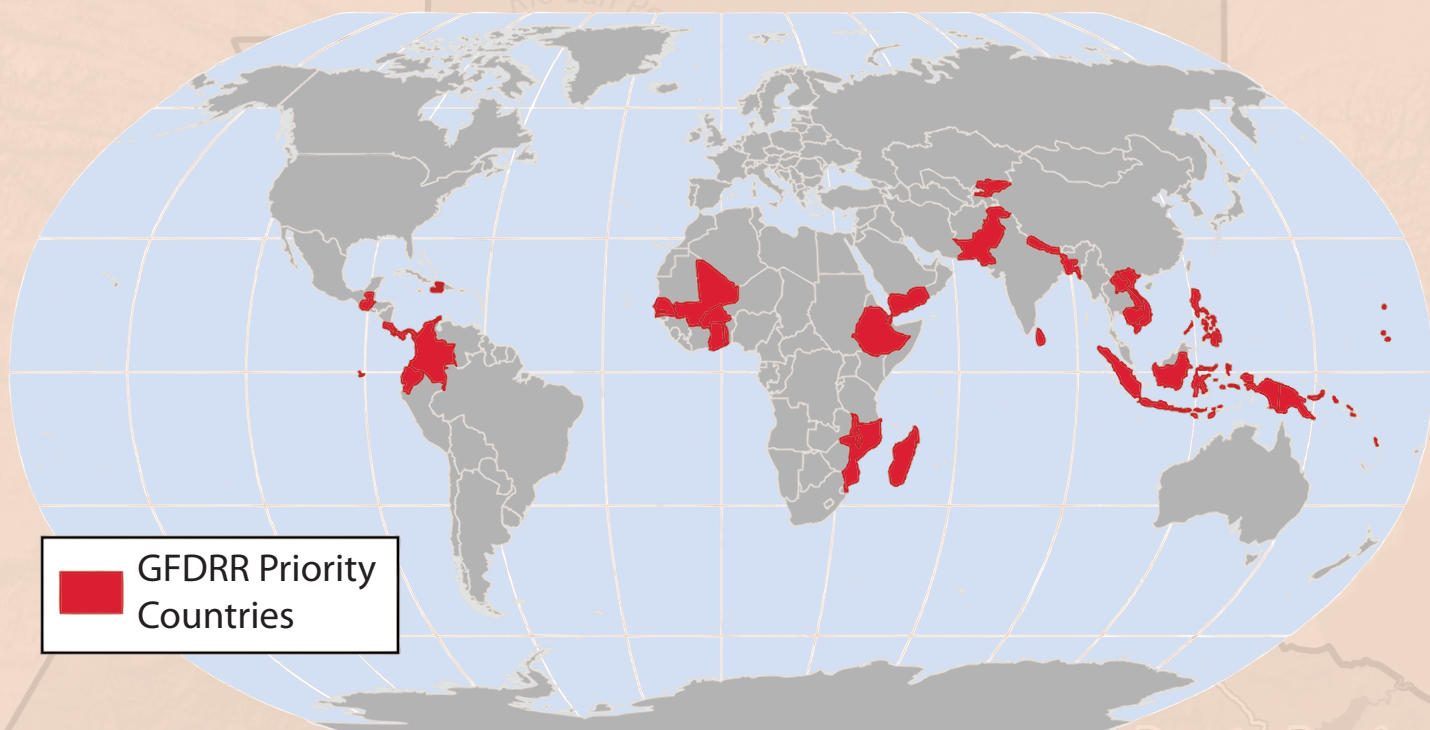
- Vulnerability and impact assessments need to be performed in the dry corridor to better adapt risk management and land use practices.
- Strategic environmental impact assessments, including zoning plans, are needed to improve infrastructure planning.
- During a European Union Humanitarian Aid and Civil Protection (DG ECHO) needs assessment mission, partners reported that some populations in the more remote areas were not been taken into account in the government assessment, which is especially troubling as these groups are the most impacted by adverse weather events and climate change.
- Impact studies need to be performed on water quality and quantity as there is a discrepancy in how many households actually receive piped water and its level of quality. Also no government entity is responsible for controlling and monitoring national water quality and thus there is no accurate data on levels and types of pollution.⁵⁰
- Impact studies are needed on the temperature and precipitation threshold of staple crops as well as on their duration and seasonality, so the population can plant crops that are more adept at dealing with reduced soil moisture. In addition, studies on crops that are resistant to pests and diseases and that are fire resistant should be performed.

⁴⁹ Ibid note 6.

⁵⁰ <http://www.fao.org/nr/water/aquastat/countries/guatemala/indexesp.stm>

Climate Risk and Adaptation Country Profile

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



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