

CLIMATE RISK COUNTRY PROFILE

LIBERIA



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Graphic Design: [Circle Graphics, Inc.](#), Reisterstown, MD.

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

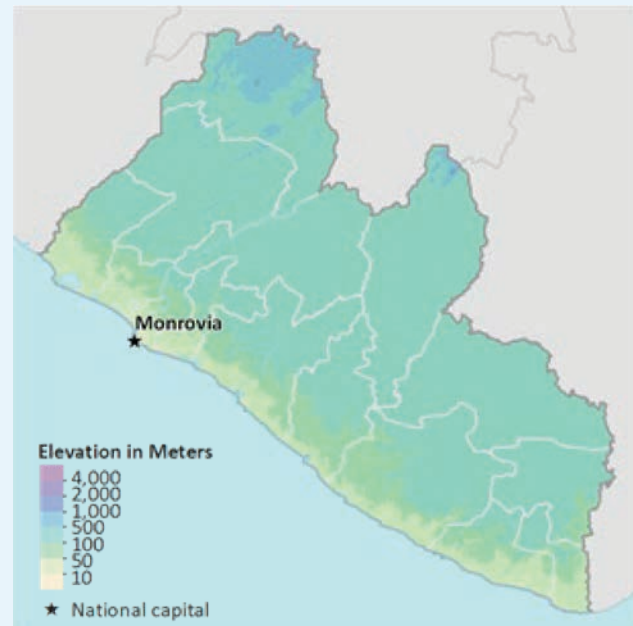
The World Bank Group (WBG)

COUNTRY OVERVIEW

Liberia is situated in the center of the Upper Guinea Rainforest Region along the West Coast of Africa. This region is one of the most biologically diverse and was originally covered by continuous, dense tropical rainforest, ranging from Guinea, south through to Ghana. Liberia has a predominantly equatorial climate, with three distinct topographical belts. The low coastal belt is about 40 kilometer (km) wide, and constitutes tidal creeks, shallow lagoons, and mangrove marshes. Moving inward, the second belt includes rolling hills that reach elevations of 60–150 meter (m) (200–500 feet) (**Figure 1**). The third belt, comprises the bulk of Liberia, is marked by abrupt changes of elevation in a series of low mountains and plateaus, which are less densely forested.¹

Liberia has made significant economic and development progress since the end of its civil war in 2003. However, the country remains fragile and highly vulnerable due to high levels of inequality, unemployment and poverty, with limited access to basic services such as water, sanitation and energy (**Table 1**).³ Liberia has a population of 5.06 million people (2020) with a current population growth rate at of 2.4% (2020).⁴ Approximately 51.6% of the population currently live in urban areas and this is projected to increase to 57.3% and 68.2% of the population by 2030 and 2050, respectively.⁵ The country has a Gross Domestic Product (GDP) of \$2.95 billion (2020), growing at a rate of –2.3% in 2019 and –2.9% in 2020. The country has experienced highly volatile, yet positive growth rates since the early 2000s. According to 2020 data, the country's GDP is dominated by the agriculture sector (inclusive of fishing and forestry), which accounts for 42.6% of GDP and the industry sector (including mining, construction, electricity, water and gas), which contributes 11.7% of GDP and services comprising 49.7% of GDP. Liberia is highly vulnerable to adverse effects of climate change. Liberia is also highly vulnerable to environmental instability due to its extreme poverty and high dependence on 'climate sensitive' sectors such as agriculture, forestry, fisheries, and energy and mining.⁶ As the rural economy is largely dependent on rain fed subsistence farming, forest produce and fishing.⁷

FIGURE 1. Topography of Liberia²



¹ Environmental Protection Agency of Liberia (2013). Liberia: Initial National Communication 2013. URL: <https://unfccc.int/sites/default/files/resource/lbrnc1.pdf>

² World Bank (2019). Internal Climate Migration Profile – Liberia

³ USAID (2017). Liberia: Climate change risk profile. Country Fact Sheet. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

⁴ World Bank Open Data (2021). World Development Indicators. Liberia. URL: <https://databank.worldbank.org/source/world-development-indicators>

⁵ World Bank Data Bank (2021). Population estimates and projections, Liberia. URL: <https://databank.worldbank.org/source/population-estimates-and-projections>

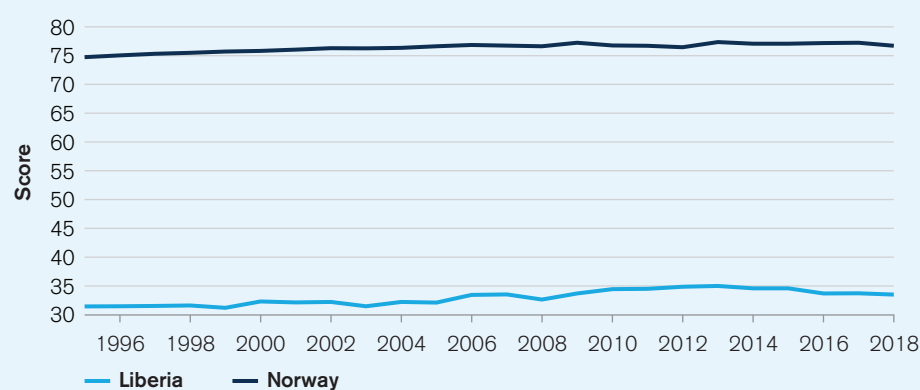
⁶ Environmental Protection Agency of Liberia (2008). Liberia National Adaptation Programme of Action (NAPA). URL: <https://unfccc.int/resource/docs/napa/lbr01.pdf>

⁷ IUCN (2012). Climate Change Gender Action Plan for the Government of Liberia. URL: https://portals.iucn.org/union/sites/union/files/doc/liberia_0.pdf

TABLE 1. Data Snapshot: Key Development Indicators⁸

Indicator	
Life Expectancy at Birth, Total (Years) (2019)	64.7
Population Density (People per sq. km Land Area) (2018)	50.0
% of Population with Access to Electricity (2019)	27.6%
GDP per Capita (Current US\$) (2020)	\$583.30

The ND-GAIN Index⁹ 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, Liberia is recognized as highly vulnerable to climate change impacts, ranked 171 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 Liberia's progress in comparison to Norway's.

FIGURE 2. ND-GAIN Index for Liberia

Liberia submitted its [Nationally-Determined Contribution \(NDC\)](#) to the UNFCCC in 2016 and its [Second National Communication](#) to the UNFCCC in 2021. These documents provide the platform to integrate its Low Carbon Development Strategy into the country's long-term sustainable development Vision by 2030.¹⁰ Agriculture, fisheries and forestry are instrumental to Liberia's inclusive economic growth and poverty reduction goals. High reliance on climate-sensitive activities renders Liberia vulnerable to climate variability and change, expected to manifest in higher temperatures, more extreme weather events such as heavy rains, and rising sea levels. The country has identified urban and coastal development, sea level rise, and potential salinization of coastal areas as key areas for climate change adaptation portfolios.

⁸ World Bank (2021). DataBank – World Development Indicators. URL: <https://databank.worldbank.org/source/world-development-indicators>

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

¹⁰ Republic of Liberia (2016). Nationally Determined Contributions. <http://www4.unfccc.int/ndcregistry/PublishedDocuments/Liberia%20First/INDC%20Final%20Submission%20Sept%2030%202015%20Liberia.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

Liberia is one of the wettest countries in the world, with the heaviest rainfall occurring from May to October.¹¹ The country's average annual rainfall is relatively high, nearly exceeding 2,500 millimeters (mm). Rainfall is highest along the coast, but decreases towards Liberia's interior plateaus and low mountains, where average rainfall reaches approximately 2,030 mm per year.¹² Southern areas of the country receive rain year-round, while the rest of the country experiences two seasons due to the West African Monsoon.¹³ The wet season typically occurs in the summer months between May and November, with average temperatures of 25°C. The dry season typically occurs in the winter months, December to April. The dry season is dominated by the harmattan winds with average temperatures between 24 to 27°C. Relative humidity reaches 90%–100% during the rainy season and 60%–90% during the dry season.¹⁴

¹¹ Environmental Protection Agency of Liberia (2013). Liberia: Initial National Communication 2013. <https://unfccc.int/sites/default/files/resource/lbrnc1.pdf>

¹² Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

¹³ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

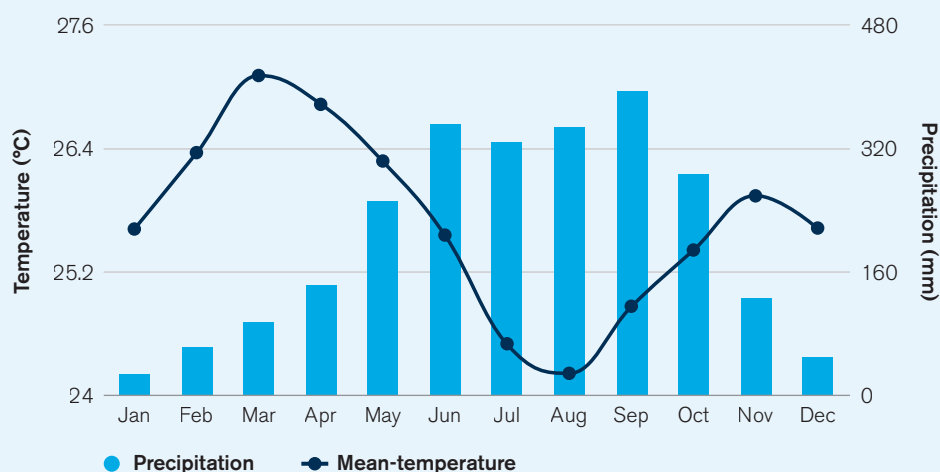
¹⁴ Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

Analysis from the Climate Change Knowledge Portal (CCKP) (**Table 2**), presents the latest climatologies, mean annual temperature for the country is 25.7°C, with observed monthly temperatures ranging between 23.9°C (August) and 26.8°C (March). Mean annual precipitation is 2,467.07 mm, and mean monthly precipitation of the country varies from 27 mm in January to 408 mm in September.¹⁵ Rainfall occurs throughout the year, with peak rainfall occurring from June to September, for the latest climatology, 1991–2020 (**Figure 3**). **Figure 4** shows the spatial variation of the observed average annual precipitation and temperature across Liberia.

TABLE 2. Data Snapshot: Summary Statistics

Climate Variables	1991–2020
Mean Annual Temperature (°C)	25.7°C
Mean Annual Precipitation (mm)	2,467.07 mm
Mean Maximum Annual Temperature (°C)	31.2°C
Mean Minimum Annual Temperature (°C)	20.3°C

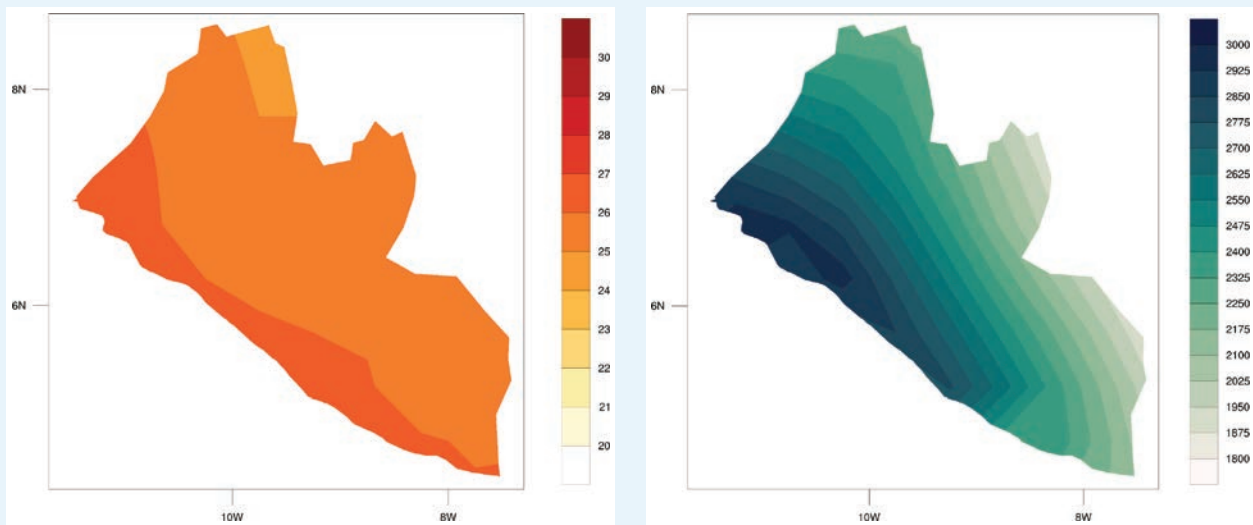
FIGURE 3. Average Monthly Temperature and Rainfall for Liberia, 1991–2020¹⁶



¹⁵ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-data-historical>

¹⁶ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-data-historical>

FIGURE 4. Map of Average Annual Temperature (°C) (left); Annual Precipitation (mm) (right) of Liberia, 1991–2020¹⁷

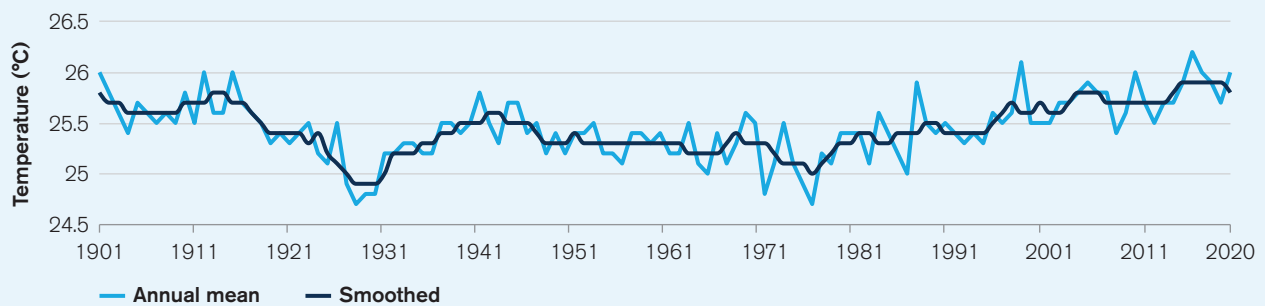


Key Trends

Temperature

In Liberia, the mean annual temperature has increased by 0.8°C between 1960 and 2006 (**Figure 5**), an average rate of 0.18°C per decade. While there is insufficient data to determine trends in daily temperature extremes for all seasons, the available data does show that the average number of ‘hot nights’ per year increased by 57 between 1960 and 2003. There has also been a significant decrease in the annual frequency of ‘cold nights’, which have decreased by 18 days per year. This rate of decrease has been observed to be most rapid in March to May period.¹⁸

FIGURE 5. Observed Temperature for Liberia, 1901–2020¹⁹



¹⁷ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia, Historical Climate. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-data-historical>

¹⁸ McSweeney, C., New, M., and Ligano, G. (2012). Liberia. UNDP Climate Change Country Profiles. URL: https://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Liberia/Liberia.hires.report.pdf

¹⁹ WB Climate Change Knowledge Portal (CCKP, 2021). Liberia URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-data-historical>

Precipitation

Mean annual rainfall over Liberia has decreased since 1960, however, it remains unclear if this is a long-term trend or due to the variability in rainfall for the region. However increased frequency of intense rainfall is expected and these event occurrences are also expected to increase in unpredictability. Increasing sea levels may also result in additional vulnerability to coastal areas during heavy rainfall.²⁰

Climate Future

Summary Statistics

The main data source for the World Bank Group's Climate Change Knowledge Portal (CCKP) is the CMIP5 (Coupled Model Inter-comparison Project Phase 5) data ensemble, which builds the database for the global climate change projections presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. The RCP2.6 for example represents a very strong mitigation scenario, whereas the RCP8.5 assumes business-as-usual scenario. For more information, please refer to the [RCP Database](#). For simplification, these scenarios are referred to as a low (RCP2.6); a medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile. **Table 3** provides CMIP5 projections for essential climate variables under high emission scenario (RCP8.5) 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.

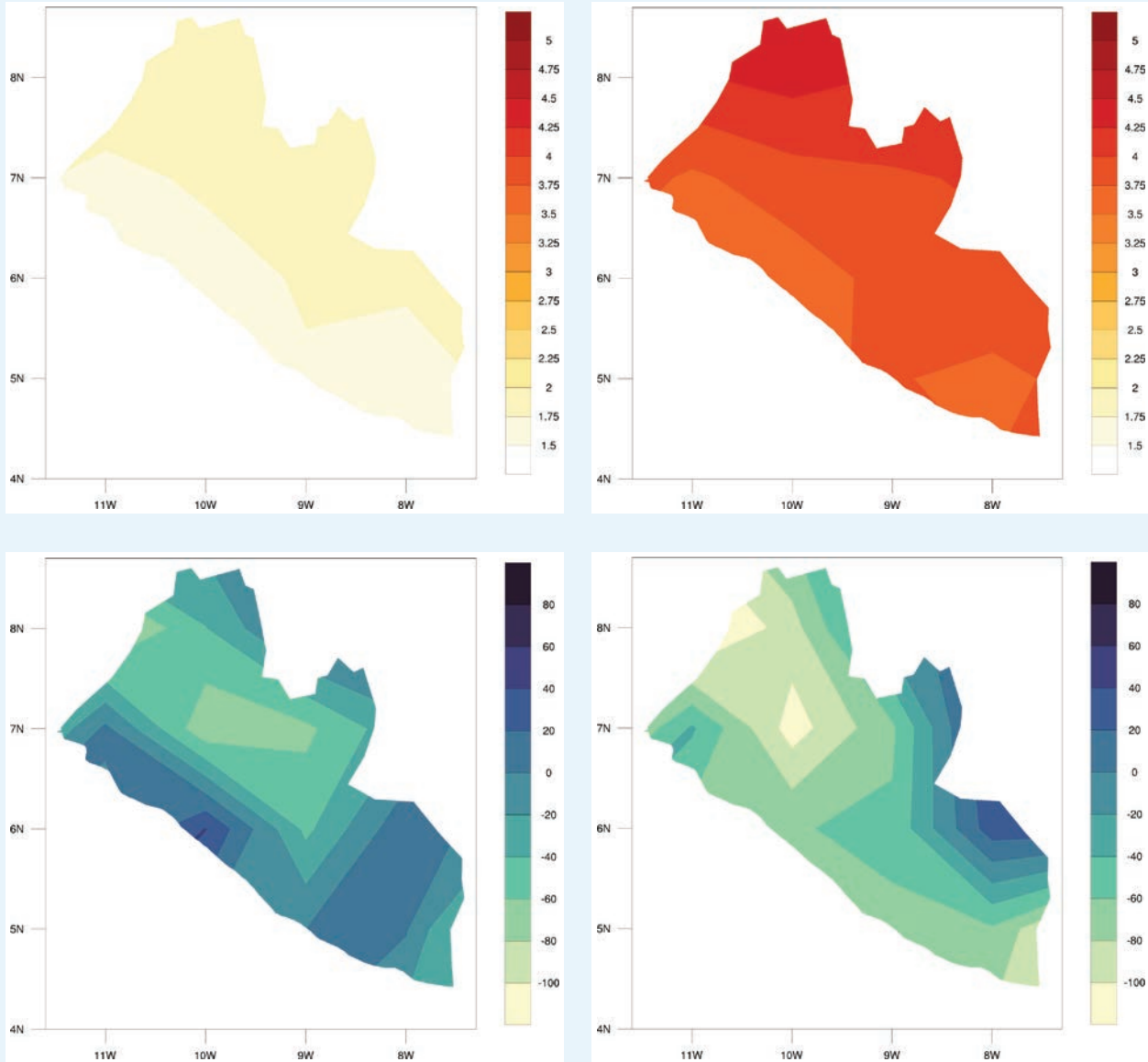
TABLE 3. Data Snapshot: CMIP5 Ensemble Projections

Cmip5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	+0.6 to +1.3 (+0.9°C)	+1.2 to +2.4 (+1.6°C)	+1.7 to +3.6 (+2.4°C)	+2.1 to +4.8 (+3.2°C)
Annual Precipitation Anomaly (mm)	–28.9 to +32.5 (–1.17 mm)	–37.1 to +33.8 (–1.3 mm)	–40.5 to +51.5 (+4.4 mm)	–47.9 to +63.0 (+4.7 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).

²⁰ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

FIGURE 6. CMIP5 Ensemble Projected Change (32 GCMs) in Annual Temperature (top) and Precipitation (bottom) by 2040–2059 (left) and by 2080–2099 (right), Relative to 1986–2005 Baseline Under RCP8.5²¹



²¹ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia Projected Future Climate. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-data-projections>

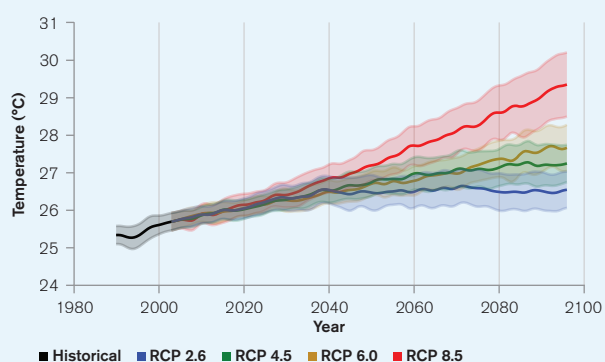
Key Trends

Temperature

Climate change is projected to increase temperatures and impact water availability across Liberia; some areas may also experience flooding due to increased intensity of rainfall, coastal erosion and sea-level rise. Liberia as well as the West African Region are at high risk to projected climate trends of increased temperatures, high variability of precipitation with potential for increased heavy rainfall events.²² Under a high-emission scenario, projections show a likely increase of monthly temperatures of 3.2°C for 2080s, with a possible increase of more than 4.8°C by the end of the century. While mean annual temperatures for the country are expected to increase, warming rates are expected to be higher and most rapid in the

northern inland regions as opposed to coastal zones. Under a high emission scenario, it is anticipated that 'hot' days will occur in 24–65% of all days by mid-century and by 29–90% of all days by the end of the century. Most rapid increase will be in July, August and September, however the 'hot season' is expected to start earlier and last later. Hot nights are also expected to increase by 37–89% and 49–95% of all nights for mid and end century, respectively.²³ Temperature rise, as shown in **Figure 7**, are projected to increase across all emission scenarios throughout the end of the century. Increased heat and extreme heat conditions will result in significant implications for human and animal health, agriculture, and ecosystems.

FIGURE 7. Projected Average Temperature for Liberia (Reference Period, 1986–2005)²⁴



²² Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

²³ McSweeney, C., New, M., and Ligcano, G. (2012). Liberia. UNDP Climate Change Country Profiles. URL: https://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Liberia/Liberia.hires.report.pdf

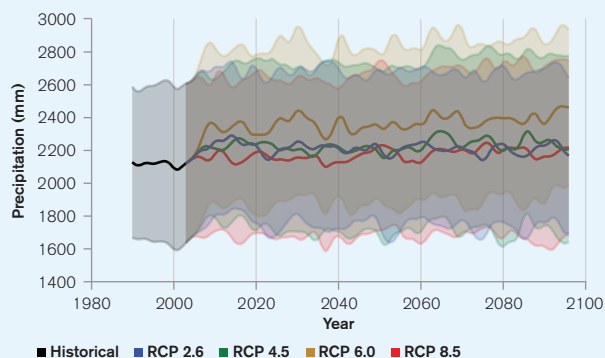
²⁴ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia Agriculture Dashboard. URL: <https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=LBR&period=2080-2099>

Precipitation

The amount and distribution of precipitation is projected to change across the region, with high variability expected for Liberia. Despite significant inter-annual variability, under a high-emission scenario, precipitation at a nationally aggregated is projected to stay largely the same through the 2090s. Despite variability, there is an expected increase in extreme rainfall intensity and an expected reduction in dry season rainfall in the southern regions, by mid-century.²⁵ Projected changes to variable rainfall will adversely impact Liberia's coastal, forestry and agricultural sectors. This is likely to result in potential flooding for lowland areas, as demonstrated by

Figure 8. According to Liberia's First National Communication (2013), increasing temperatures and high variability of rainfall will impact the country's water balance, specifically for the Cavalla River, St John River²⁶ and St Paul River Basin and will create a more difficult agricultural scenario due to soil runoff and intense rain.²⁷

FIGURE 8. Projected Annual Average Precipitation for Liberia (Reference Period, 1986–2005)²⁸



CLIMATE RELATED NATURAL HAZARDS

Overview

Liberia is at high risk to natural hazards. Vulnerability is exacerbated due to the country's high level of poverty and high dependence on climate change sensitive sectors, such as agriculture, fisheries, mining and forestry. Additional contributing factors to the country's vulnerability to climate change conditions include mal-adapted agricultural activities, unsustainable logging practices, unregulated coastal sand mining, an overdependence on biomass leading to high levels of deforestation, inadequate infrastructure, low level of socio-economic development, low institutional capacity and inadequate meteorological and hydrological data and data gathering capabilities.²⁹ National capacity

²⁵ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

²⁶ Drakenberg, O., Andersson, F. and Wingqvist, G. (2014). Liberia-environmental and Climate Change Policy Brief. URL: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2014/01/Liberia_EnvCC-PolicyBrief-2013-Final-Draft.pdf

²⁷ Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

²⁸ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia Water Dashboard. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-sector-water>

²⁹ Environmental Protection Agency of Liberia (2008). Liberia National Adaptation Programme of Action (NAPA). URL: <https://unfccc.int/resource/docs/napa/lbr01.pdf>

to handle predicted climate changes is also weak; increasing vulnerability. Climate change is expected to result in more extreme weather situations such as heavy rains and drought in West Africa. Liberia continues to have a high degree of urbanization, primarily to Greater Monrovia. Climate change may reduce land area along the Mesurado river delta and along the coastline exposed to erosion and sea level rise.³⁰

While Liberia is prone to flooding but not drought, human displacement in neighboring countries may become an additional future challenge. Heavy rains, storm surges, sea level rise and increased erosion, puts both urban and rural infrastructure at risk.³¹ Furthermore, heavily populated parts of the coast would be affected by frequent waterlogging, increased coastal erosion, and sea-level rise. This is likely to result in significant economic losses, damage to agricultural lands, infrastructure as well as human casualties.³² Climate change is also expected to increase risks and severity of natural disasters in Liberia, through more intense temperatures as well as rainfall patterns, increased temperatures and prolonged heat waves.

Key Trends

In Liberia, environmental degradation, climate change, lack of infrastructure impacts water quality and basic sanitation, and the loss of biodiversity and ecosystem services constitute serious obstacles to development and poverty reduction efforts, which further increases vulnerability and risks to hazards.³³

With the country's high number of rivers, catchments and aquifers as well as its low-lying coastal zone, changes to precipitation is likely to result in high-risk flooding scenarios. In Liberia, river flood hazard is classified as high, with potential for damaging and life-threatening river floods occurring throughout the country. As shown in the maps below, the country is also highly at risk for urban floods as well as coastal flooding.³⁴ Coastal flooding is also impacted by projected sea-level rise. As shown in **Figure 9**, population densities, i.e. capital city of Monrovia, the urban area of Greater Monrovia, and coastal urban areas, also overlap with key flood zones and areas of high vulnerability.³⁵

³⁰ World Bank (2020). Greater Monrovia Urban Review. A spatial analysis investigating constraints and opportunities. URL: <http://documents1.worldbank.org/curated/en/649581593487174497/pdf/Main-Report.pdf>

³¹ Drakenberg, O., Andersson, F. and Wingqvist, G. (2014). Liberia-environmental and Climate Change Policy Brief. URL: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2014/01/Liberia_EnvCC-PolicyBrief-2013-Final-Draft.pdf

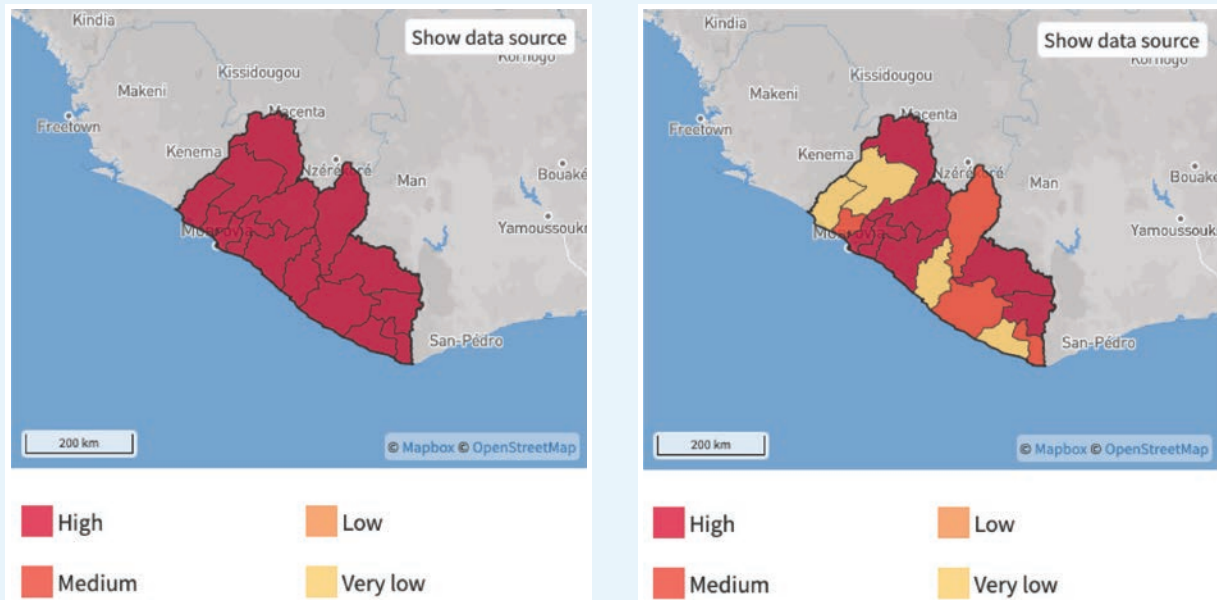
³² Neugarten, R., Honzak, M., Alam, M. and Juhn, D. (2017). Natural Capital Mapping and Accounting in Liberia: Understanding the contribution of biodiversity and ecosystem services to Liberia's sustainable development. Technical Report, Conservation International. May 2017. DOI: 10.13140/RG.2.2.33270.70725. P 22. URL: https://www.researchgate.net/publication/321304599_Liberia_Mapping_Natural_Capital

³³ Drakenberg, O., Andersson, F. and Wingqvist, G. (2014). Liberia-environmental and Climate Change Policy Brief. URL: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2014/01/Liberia_EnvCC-PolicyBrief-2013-Final-Draft.pdf

³⁴ ThinkHazard! (2020). Liberia Flood Hazards. URL: <http://thinkhazard.org/en/report/144-liberia/UF>

³⁵ Neugarten, R., Honzak, M., Alam, M. and Juhn, D. (2017). Natural Capital Mapping and Accounting in Liberia: Understanding the contribution of biodiversity and ecosystem services to Liberia's sustainable development. Technical Report, Conservation International. May 2017. DOI: 10.13140/RG.2.2.33270.70725. P 22. URL: https://www.researchgate.net/publication/321304599_Liberia_Mapping_Natural_Capital

FIGURE 9. Risk of River Flood (left); Risk of Urban Flood (right)³⁶



Implications for DRM

Climate change is projected to exacerbate existing flood related disaster risks and impact water availability in Liberia. A rise in extreme weather events is expected with higher frequency over the coming decades. In addition, climate change is expected to precipitate a rise in sea level, coastal flooding, and erosion; already, 0.8 square km of land has been lost in recent decades due to coastal erosion, impacting infrastructure and nearby population centers. In the Greater Monrovia area alone, a predicted 16 cm sea level rise by 2030 would put at risk 675,000 people and 9,500 hectares of land. The high degree of informal settlements, which historically have been associated with disaster risk, and continued urbanization has further exacerbated vulnerabilities to pandemics and disasters throughout the country's urban areas, especially to floods. Within these areas, a significant amount of infrastructure is located in flood zones. These informal settlements are physically vulnerable due to precarious siting, especially to potential damage to critical infrastructure. Livelihoods are also expected to be negatively impacted for those settlers working in sensitive sectors of the economy. Already, since 2013, sea level rise and coastal erosion have displaced more than 6,500 and destroyed 800 houses in the West Point slum of Monrovia. In addition, increasing rainfall and flooding events would exacerbate risk of malaria, cholera, and diarrheal diseases.³⁷

³⁶ ThinkHazard! (2020). Liberia. URL: <https://thinkhazard.org/en/report/144-liberia/FL>

³⁷ Hommann, K., and Rajashekar, A.V. (2016). Greater Monrovia Urban Review: A Spatial Analysis investigating Constraints and Opportunities. World Bank Group. URL: <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/399551593487350119/main-document-review>

Liberia is guided by its National Disaster Management Policy(2012) to ensure the reduction of natural and man-made disaster risks through coordinated efforts across agencies. Liberia is working to reduce vulnerability to climate change by reducing exposures to risk and increasing adaptive capacities and national resilience strategies. Specifically, the country is looking to improve its resilience to increased risk of natural hazards, extreme events, and to reduce vulnerability of local communities and institutions in order to better prepare for, mitigate and respond to natural hazards and increased threats from climate change.³⁸

CLIMATE CHANGE IMPACTS TO KEY SECTORS

Liberia is recognized as highly vulnerable to climate change, particularly for water, agriculture, coastal areas and public health sectors. Impacts of climate change are already being experienced in the region.³⁹ Temperature increases have been identified for autumn and summer warming. In the coastal zone the number of hot days and warm nights will continue to increase, which affects human health, fisheries and the continued development of coastal zones. Heavy rains, storm surges, sea level rise and increased erosion, puts both urban and rural infrastructure at risk, particularly for poor and vulnerable groups. Furthermore, heavily populated parts of the coast would be affected by frequent inundations, increased coastal erosion, and sea-level rise.⁴⁰ Financial constraints and limited institutional capacities have limited adaptation capabilities and effective response to climatic hazards. This further threatens future adaptive responses, economic sustainability as well as rural development in the country.⁴¹ For Liberia, environmental degradation, climate change, lack of water and basic sanitation, and loss of biodiversity and ecosystem services constitute serious obstacles to the country's development and poverty reduction efforts, increasing vulnerability to risks and hazards, increasing the importance for sustainable adaptation measures.

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.⁴²

³⁸ National Disaster Management Agency (2012). National Disaster Management Policy. URL: <http://www.mia.gov.lr/doc/Web%20National%20Disaster%20Risk%20Management%20Policy-clean-12102012.pdf>

³⁹ ThinkHazard! (2020). Liberia River Flood Hazards. URL: <http://thinkhazard.org/en/report/144-liberia/FL>

⁴⁰ Drakenberg, O., Andersson, F. and Wingqvist, G. (2014). Liberia: Environmental and Climate Change Policy Brief. URL: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2014/01/Liberia_EnvCC-PolicyBrief-2013-Final-Draft.pdf

⁴¹ ECOWAS (2013). Policy Brief. West Africa Coastal Climate Change National Adaptation Planning Workshop. URL: <https://www.usaid.gov/sites/default/files/documents/1860/NAP%20Policy%20brief.pdf>

⁴² 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

The agricultural sector plays a critical role in Liberia's food security situation and economic prosperity.⁴³ Rice, cassava and vegetable production account for 85% of cultivated land⁴⁴ and 80% of Liberia's agriculture sector is made up of subsistence farming dependant upon rain-fed agriculture.⁴⁵ Agriculture has been an important source of economic growth since the collapse of the formal economy during the civil war. Decline in agriculture productivity in recent years has been attributed to unpredictable rainfall patterns and increasing temperatures due to climate change, which has affected soil moisture and water availability for food production. Pre-and post-harvest losses due to pests and diseases and insufficient storage are also high, averaging about 40% for food crops annually. Liberia relies heavily on importation of food products, particularly, rice, livestock and fish, to meet local consumption demands.⁴⁶

Climate Change Impacts

Rice is the primary staple crop, cultivated by 74% of farmers. Rice is highly sensitive to increased humidity temperatures and intense rainfall, and to the pests that thrive in these conditions. However rising temperatures may render areas in the north more suitable for rice production where it previously has not been suitable. Intense rainfall and associated flooding and erosion of sowed fields may counteract these gains depleting nutrient-rich topsoil and reducing the total arable land area.⁴⁷ The country's major agricultural exports, rubber, cacao and coffee, are also highly susceptible to changing weather conditions and higher temperatures. Increasing intensity of rainfall events could damage rubber production and increase costs to maintain proper drainage on plantations. Cacao and coffee (both Arabica and Robusta) have specific climatic requirements for optimal productivity and may come under pressure as rising temperatures reduce moisture levels and exacerbate pest and diseases that thrive in hot conditions. Due to the high cost of rehabilitating cocoa and coffee farms affected by the war, as of 2013, 61% of the cocoa farms and 71% of the coffee farms have not been rehabilitated. This has hindered cocoa and coffee production and export.⁴⁸

In Liberia, increasing heat trends for much of the country's agricultural areas are also expected to be impacted by increasing number of consecutive days with heavy precipitation.⁴⁹ The trend towards greater wet days and higher temperatures will increase water logging and add stress to limited water infrastructure and sanitation. Additionally,

⁴³ Drakenberg, O., Andersson, F. and Wingqvist, G. (2014). Liberia: Environmental and Climate Change Policy Brief. URL: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2014/01/Liberia_EnvCC-PolicyBrief-2013-Final-Draft.pdf

⁴⁴ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁴⁵ Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

⁴⁶ IUCN (2012). Climate Change Gender Action Plan for the Government of Liberia. URL: <http://genderandenvironment.org/resource/liberia-climate-change-gender-action-plan-ccgap-report/>

⁴⁷ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

⁴⁸ Environmental Protection Agency of Liberia (2013). Liberia: Initial National Communication 2013. URL: <https://unfccc.int/sites/default/files/resource/lbrnc1.pdf>

⁴⁹ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia Agriculture Dashboard. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-sector-agriculture>

as temperatures rise, local trends in daily maximum temperatures may offer insights on these upper thresholds for specific crops, translating these potentially into changing yields (**Figure 10**).

Adaptation Options

Both the sensitivity of the agricultural sector to the climate and the high reliance of this sector on rain-fed agriculture have important implications for Liberia. Cassava is the country's second most important staple, and is more resilient to climate changes (particularly higher temperatures). Increased cassava production may provide a key alternative food source.

Expanded areas of cultivation should be considered and trialed in the central and northern agricultural zones of the country.⁵¹ Investments in research and extension services can enhance the capacity and delivery of information to the agricultural sector, with particular reference to climate change and the implementation of adaptation options.

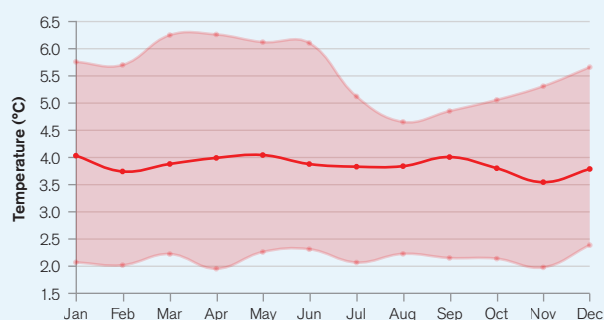
Although Liberia possesses abundant land and water resources that can sustain crop-area expansion, these resources have to be harnessed in an appropriate policy, legal, and investment environment. Issues regarding property rights (e.g., access to land, security of tenure, and utilization) and land administration is weak, and the country continues to lack a land-use policy.⁵² Improvements should also be made to the weather monitoring network and associated weather information systems, including the publication and distribution of agriculture-specific weather forecasts on a frequent basis (e.g. short-term and seasonal forecasts, the monitoring of heavy rainfall, etc.).⁵³

Water Resources and Sanitation

Overview

Liberia has one of the highest rates of water resources per capita in Africa, however water quality and sanitation remain a significant problem, particularly for major urban zones such as the capital city, Monrovia. Approximately, 70% of the population has access to improved water sources though Liberia has an abundant water supply (from both surface and groundwater). However, water quality remains poor in some areas due to mining (e.g. iron ore pollutants), farming (e.g. agrochemical runoff) and industrial activities (e.g. discharge from rubber processing).⁵⁴

FIGURE 10. Projected Average Daily Max Temperature for Liberia (RCP8.5, Reference Period, 1986–2005)⁵⁰



⁵⁰ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia Agriculture Dashboard. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-sector-agriculture>

⁵¹ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatechange.gov/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

⁵² Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

⁵³ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

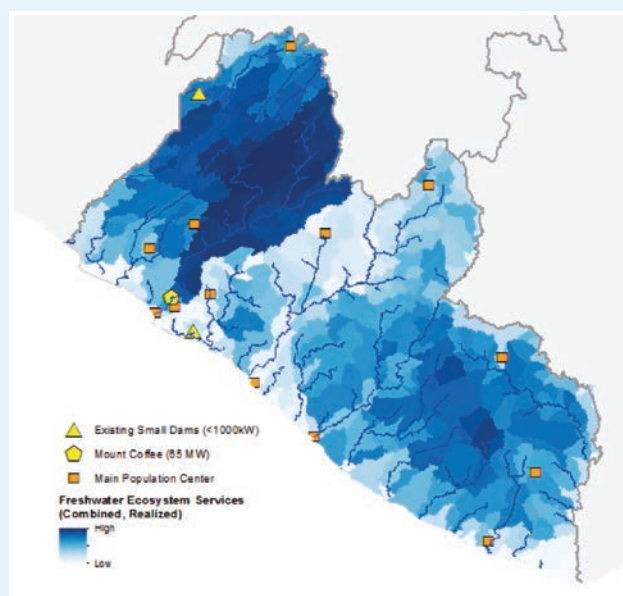
⁵⁴ USAID (2017). Climate risks in food for peace geographies – Liberia. Climate Risk Profile. https://www.climatechange.gov/sites/default/files/asset/document/20170227_USAID%20ATLAS_Climate%20Risks%20in%20FFP%20Geographies_Liberia.pdf

Climate Change Impacts

Changes in seasonal rainfall patterns and rising temperatures, will negatively impact the water balance by decreasing total water levels and/or degrading water quality through contamination. Runoff in the St. Paul River Basin is projected to decrease 0.7–25% by the 2020s due to precipitation and temperature changes, impacting potential hydropower production at the Mount Coffee plant as well as the water supply for Monrovia.⁵⁵ Access to water and sanitation declined substantially during the civil war, however improvements have been made in the last 10 years.

In rural areas, water is largely supplied from shallow wells whose levels fluctuate with rainfall variability, particularly during the dry season (December–April). Approximately 73% of the population has access to improved water sources, however just 7% of rural populations and 29% of urban populations have access to improved sanitation facilities. In urban areas, intense precipitation is likely to impact the water infrastructure, as the increased volumes of water overwhelm sewer systems and water treatment plants. This could also lead to an increase in the amount of runoff into rivers and lakes, washing sediment, nutrients, pollutants, trash, animal waste, and other materials into water supplies making them unusable, unsafe, or in need of water treatment and increasing cost for water purification to supply potable water to communities.⁵⁶ **Figure 11** shows areas of Liberia's freshwater services (quantity, quality, and flow regulation) inclusive of population areas and existing hydropower dams.

FIGURE 11. Spatial Mapping of Liberia's Important Zones for Freshwater Services (2017)⁵⁷



Nearly half of Liberia's population practice open defecation. Increased rainfall, flooding and increased heat are expected to increase sanitation vulnerabilities by further increasing the prevalence of water and vector-borne diseases such as cholera and diarrheal diseases.⁵⁸ Decreased availability and compromised quality of surface water supply will heighten the vulnerability of populations depending on these sources for daily activities; more intense and frequent storms and flooding may cause storm water flows, which increase the likelihood of water contamination of

⁵⁵ ECOWAS (2013). Policy Brief. West Africa Coastal Climate Change National Adaptation Planning Workshop. <https://www.usaid.gov/sites/default/files/documents/1860/NAP%20Policy%20brief.pdf>

⁵⁶ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. http://www.epa.gov/lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁵⁷ Neugarten, R. et al. (2017). Natural Capital Mapping and Accounting in Liberia. Understanding the contribution of biodiversity and ecosystem services to Liberia's sustainable development. Conservation International. May (2017). p. 59. URL: https://www.researchgate.net/publication/321304662_Natural_Capital_Mapping_and_Accounting_in_Liberia_Understanding_the_contribution_of_biodiversity_and_ecosystem_services_to_Liberia%27s_sustainable_development

⁵⁸ Drakenberg, O., Andersson, F. and Wingqvist, G. (2014). Liberia: Environmental and Climate Change Policy Brief. URL: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2014/01/Liberia_EnvCC-PolicyBrief-2013-Final-Draft.pdf

both surface sources and shallow wells.⁵⁹ This is a particularly serious potential adverse impact as people rely heavily on surface water when wells dry up. Increased temperatures and intense rainfall are putting greater pressure on the water and sanitation sector, with potential to further impact development gains.

Adaptation Options

Investment needs to be made in Liberia to support structural adaptation changes in the country's water management infrastructure, planning for urban expansion, and sanitation and quality drinking water requirements. Planning and adaptation strategies for water resources in Liberia are also important to include within development strategies for agriculture and energy sectors. Improvements to the country's water and sanitation infrastructure should be a priority. There is critical need to support the protection of river catchments and other sources of freshwater (including aquifers) in order to secure a steady supply of freshwater across all sectors and communities. A Vulnerability Assessment should be conducted on Liberia's Water Resources sector, inclusive of the mapping, documentation and dissemination of necessary information to stakeholders. An increase in urban and rural domestic water supplies and urban sewage services are necessary to help combat sanitation vulnerabilities, water-borne diseases and their social and economic impacts. Climate change impacts in Liberia should be mainstreamed in all water resources management plans and programs to secure environmental safety and sustainable fresh water supply for the country in the immediate, near and long-term future⁶⁰.

Energy

Overview and Climate Change Impacts

Liberia is endowed with significant primary energy sources, including biomass, hydroelectricity, petroleum and renewable energy resources and these plays a crucial role in the development of Liberia's economy. It is also a major component of Liberia's infrastructure and supports economic activities and social development.⁶¹ Much of Liberia's infrastructure is damaged and outdated and this includes the country's energy sector; energy generation was partially recovered to Monrovia in mid 2006. As of 2012, approximately 95% of the population relied on biomass for energy needs. This has also led to an uncontrolled production of charcoal, causing significant deforestation and biodiversity degradation. The country's electricity generation is through portable generators and hydro-power plants.⁶² Projected threats of climate change on the energy sector in Liberia can be explained in terms of its potential for infrastructural damage on power stations and power transmissions, as well as barrier to access biomass fuel sources which can be caused by sea level rise and flooding. This can also be explained in terms or the rise in temperature, particularly given that energy source in Liberia is less diversified and dominated by fossil fuel, charcoal and wood.⁶³

⁵⁹ USAID (2017). Climate risks in food for peace geographies – Liberia. Climate Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/20170227_USAID%20ATLAS_Climate%20Risks%20in%20FFP%20Geographies_Liberia.pdf

⁶⁰ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁶¹ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

⁶² IUCN (2012). Climate Change Gender Action Plan for the Government of Liberia. URL: https://portals.iucn.org/union/sites/union/files/doc/liberia_0.pdf

⁶³ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

Adaptation Options

Liberia is under pressure to scale its energy generating capabilities in order to become more resilient to climate change and also to meet the country's development goals. This can be achieved through the implementation of research programs to inform priorities and action between the country's National Energy Policy, its Low Carbon Economy and the National Vision for development goals through 2030. Strengthened institutions and individual capacity needs to be built in renewable energy technology and management and policies should be designed to promote private investment in renewable energies such as increased hydro-power capacity and solar. The country's six main rivers: Mano, St. Paul, Lofa, St. John, Cestos and Cavalla, have considerable potential for hydro-power generation.⁶⁴ The rehabilitation of existing hydro-power plans remains a priority with great incentive for the country to build new hydro-power plants for increased production capacity⁶⁵.

Health

Overview

Liberia is expected to have significant health effects caused by climate change, mainly in relation to the expected increasing incidence of rising temperatures, heat waves, and floods. Liberia has some of the highest rates of diseases that are caused or exacerbated by environmental factors and will likely be further intensified by climate change. Increased/ excessive rainfall and flooding and higher temperatures will increase the incidence of vector- and waterborne diseases such as cholera, malaria, diarrheal diseases, yellow fever and schistosomiasis. In Liberia, malaria is one of the leading causes of morbidity and mortality in Liberia, and the number one cause of death for children under age five.⁶⁶

Liberia ranks low on nutrition indicators due to persistent food insecurity from low agricultural output, high reliance on food imports, and weak infrastructure, all of which are impacted by climate variability and change. In the country, food insecurity is widespread, with approximately 20% of households considered food insecure. The highest rates of food insecurity are found in Bomi (55%), Grand Kru (4%) and River Cess (45%) counties. Rates of chronic and acute undernutrition decreased in the past six years, but almost one-third of children under five remain stunted and micronutrient deficiencies are highly prevalent. Agricultural yields of subsistence crops (rice and maize) are some of the lowest in the region; these yields will be further threatened by higher temperatures and increased rainfall variability. Liberia imports 73% of its food needs and interruptions in transport conduits in the regional market due to a more variable climate, coupled with higher food prices, threaten the country's food security.⁶⁷ Weak infrastructure undermines income-earning opportunities, limits access to health and education facilities, and raises the price of goods and services. Areas with the poorest road networks are the most food insecure as roads, particularly in rural areas, often become impassible during the rainy season (June–October), contributing to

⁶⁴ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁶⁵ Republic of Liberia (2015). Nationally Determined Contributions. URL: <http://www4.unfccc.int/ndcregistry/PublishedDocuments/Liberia%20First/INDC%20Final%20Submission%20Sept%2030%202015%20Liberia.pdf>

⁶⁶ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

⁶⁷ Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

reduced economic productivity and exacerbating lean season malnutrition. With projected trends of more intense precipitation and floods, Liberia's road network will be further stressed impacting food distribution networks and as well as employment opportunities.⁶⁸

Climate Change Impacts

Increased temperatures will also be a problem, resulting in physiological stress and resulting impacts to productivity and epidemiological implications. Dengue fever is already present in neighboring Cote d'Ivoire and is likely to expand into Liberia as temperatures increase. Yellow fever is also likely to increase in wet weather; meningitis, prevalent in hot, dry months may expand in the country's inland zones. Respiratory diseases may be exacerbated by heat stress and inhalation of pollutants from stagnant air.⁶⁹ For Liberia, the annual distribution of days with a high heat index provides insight into the health hazard of heat. While high temperature alone can be compensated for by evaporative cooling such as from transpiration, if the air is nearly saturated with moisture (humidity), then cooling potential is reduced and the apparent temperature increases. Increased health threats can be projected and monitored through the frequency of tropical nights (>20°C). Tropical Nights (**Figure 12**) represents the projected increase in tropical nights across different emission scenarios (CMIP5 ensemble). As seen, increased nighttime temperatures are projected to be minimally increased, except for the sharp increase expected under the high emission scenario. The Warm Spell Duration Index (**Figure 13**) shows the cumulative nature of a sequence of multiple days with high temperatures, which can raise the impact on the human body and lead to health issues in broad segments of the population. As seen, the warm spells are projected to rapidly increase across all emission scenarios by mid-century.

FIGURE 12. Projected Number of Tropical Nights (Tmin >20°C) (Reference Period, 1986–2005)⁷⁰

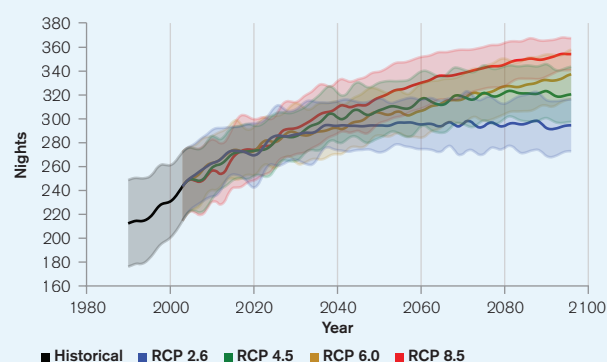
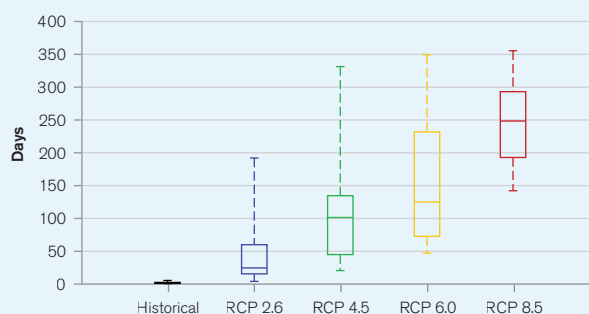


FIGURE 13. Projected Warm Spell Duration Index in Liberia for the Period 2040–2059 (Reference Period, 1986–2005)⁷¹



⁶⁸ USAID (2017). Climate risks in food for peace geographies – Liberia. Climate Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/20170227_USAID%20ATLAS_Climate%20Risks%20in%20FFP%20Geographies_Liberia.pdf

⁶⁹ USAID (2017). Climate risks in food for peace geographies – Liberia. Climate Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/20170227_USAID%20ATLAS_Climate%20Risks%20in%20FFP%20Geographies_Liberia.pdf

⁷⁰ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia Health Sector. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-sector-health>

⁷¹ WBG Climate Change Knowledge Portal (CCKP, 2021). Liberia Health Sector. URL: <https://climateknowledgeportal.worldbank.org/country/liberia/climate-sector-health>

Adaptation Options

Liberia's health-care infrastructure needs to be upgraded to support more systemic climate change resilience. Capacity needs to be built to support the adaptation to extreme weather events and support the necessary response capacities.⁷² Health care system personnel are not fully aware of the relationship between climate change and variability and health impacts. To date, there has been no specific training of the personnel in regard to adaptation to climate change and mitigating its negative health impacts. Increases in training and capacity can improve the level of knowledge and skills to prevent diseases connected with climatic factors, however this knowledge remains relatively limited among the general population. Additionally, improved monitoring and surveillance systems are not conducted at the right geographical and temporal scale that would allow observations of trends and make advance forecasts to direct interventions against climate sensitive diseases. Increased investment, coupled with a targeted climate-health-adaptation research agenda can support the identification and analysis of trends and develop indicators to improve health sector capacity to react. The development of Health Early Warning systems is needed, specifically for heat wave warnings and flooding.

Fisheries

Overview

Liberia's fishery sector is an important component to the food security situation and household livelihood structures of coastal as well as inland communities. Fishing provides 65% of the animal protein needs of the country and contributes around 3.2% to Liberia's GDP and is a key primary source of protein for children in many coastal areas. Liberia has three types of fisheries: 1) coastal marine fisheries, involving industrial and artisanal activities; 2) inland river and lake fisheries, which are underdeveloped and largely artisanal; and 3) aquaculture, which consists of small, freshwater ponds producing tilapia in rural areas of noncoastal communities. The sector remains largely underdeveloped in Liberia and is considered to be severely at-risk to climate change and variability. Within coastal areas, mangroves provide critical breeding grounds for important fish species and rising seas pose a risk to these ecosystems, along with other pressures such as the need for fuel and firewood and land for road building.⁷³

Climate Change Impacts

Rising sea surface temperatures are reducing biodiversity and overall stocks as a result of death, diminished reproductive cycles and migration to cooler waters. Climate induced changes in the biophysical characteristics in Liberia, along with extreme events, will have significant effects on the ecosystems which support fish (especially inland). This is projected to significantly affect food security and key livelihoods.⁷⁴ Changing rainfall patterns, particularly during the dry season when inland river and pond levels are low, are causing significant numbers of fish die off. Coastal fish resources are believed to be fully exploited and illegal fishing is rampant. Breeding grounds for fish are threatened by further destruction of coastal wetlands, water pollution and agricultural run-off. Damage to habitat, breeding grounds and the further depletion of fish stocks is expected with storm surges and coastal erosion as well as a lacking regulatory and legal framework to enforce habitat conservation.⁷⁵ Changing water temperatures

⁷² Liberia (2021). Liberia's Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/SNC.pdf>

⁷³ USAID (2017). Climate risks in food for peace geographies – Liberia. Climate Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/20170227_USAID%20ATLAS_Climate%20Risks%20in%20FFP%20Geographies_Liberia.pdf

⁷⁴ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁷⁵ Drakenberg, O., Andersson, F. and Wingqvist, G. (2014). Liberia: Environmental and Climate Change Policy Brief. URL: http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2014/01/Liberia_EnvCC-PolicyBrief-2013-Final-Draft.pdf

and rainfall patterns are also expected to affect fish stocks in rivers and coastal zones.⁷⁶ It is also possible that some fish production may increase in West African coastal waters, including Liberia, however for coastal communities to benefit, an improvement to fisheries governance is necessary to prevent non-Liberian fishing in Liberia's marine Exclusive Economic Zones and to maintain the value of these fish populations.⁷⁷ More research is required.

Adaptation Options

It is critical that Liberia recognizing the importance of the country's fishing sector as a major contributor to the country's food supply, food security and livelihoods. Policies should be developed and adopted to reflect this priority accounting for climate change impacts. Robust monitoring, reporting and verification system should be established to capture and report changes in the stock, productivity, and pressure on fisheries. Significant research is required both to fully understand the fishing pressures of projected climate change on Liberia's coasts and to more fully understand potential impacts on fishing communities. Findings can inform requirements to adjust sustainable quotas, predict fish population movement and support selective breeding for aquaculture. Investment should be made in order to support the protection and restoration of mangroves, recognizing their role as an important habitat for aquatic species, which contributes to biodiversity and increased food product availability for consumption and livelihoods. Recognizing the potential impacts to local communities, support should be directed to the diversification of the livelihood portfolio of communities that are fishery dependent.⁷⁸

Coastal Zones and Sea Level Rise

Overview

Sea level rise (SLR), coastal flooding and erosion are adding additional strain to Liberia's extensive and productive coastal zones. Currently Liberia's infrastructure capacity for basic social services is low and highly vulnerable to climate change. Flooding is considered a major and immediate threat to the country's economic growth, energy supply, roads and transport, food and agriculture, education, health, water and sanitation and social protection.⁷⁹ In addition to supporting key agriculture and fishing activities, the coast is home to nearly 60% of the population, much of which resides in areas already at risk from water inundation. Settlements in coastal lowlands of Liberia are especially vulnerable to risks resulting from climate change; yet these lowlands are densely settled and growing rapidly. SLR has resulted in increased rates of inundation, storm surges, erosion and other coastal hazards that are threatening coastal settlement, resulting in loss in infrastructure and involuntary migration in communities like West Point and Buchanan. Increased urban slum settlements in low-lying coastal areas has aggravated existing urban problems such as problem of waste management, shortage of social services such as water, sanitation, education, health, etc. as the case is in West Point, Buchanan and other areas.⁸⁰

⁷⁶ Liberia (2012). Liberia: National Adaptation Programme of Action. URL: <https://unfccc.int/resource/docs/napa/lbr01.pdf>

⁷⁷ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁷⁸ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁷⁹ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

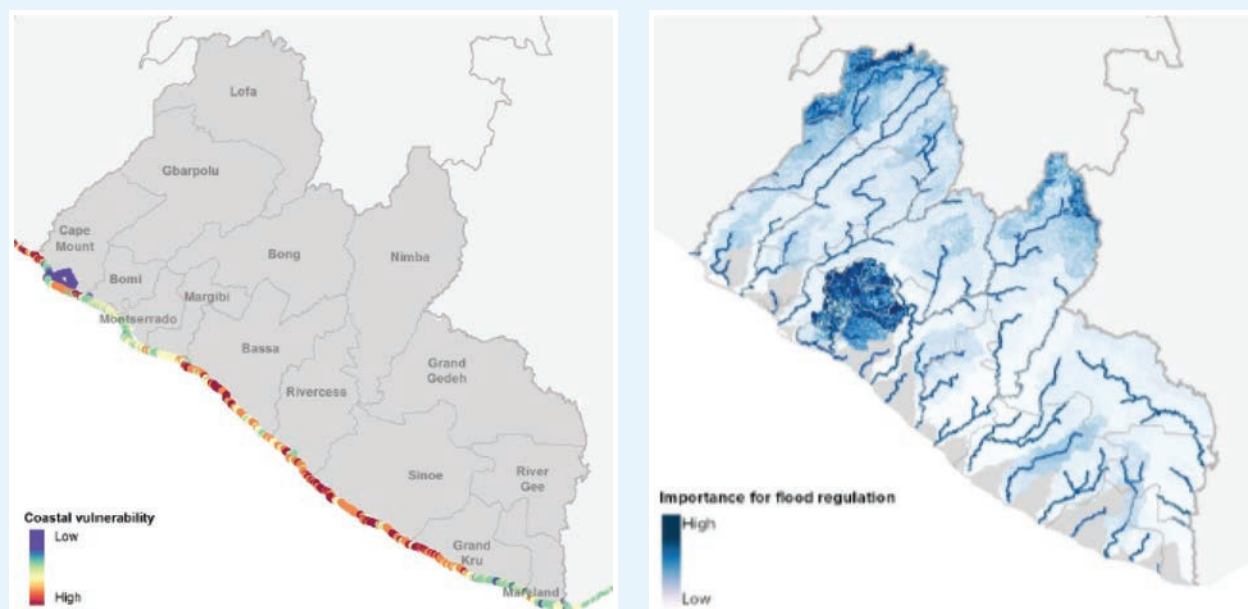
⁸⁰ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

Climate Change Impacts

It is projected that approximately 95 km² of land in the coastal zone of Liberia will be inundated as a result of one-meter sea level rise, with about 50% (48 km²) of the total land loss due to inundation on the sheltered coast and shoreline retreat.⁸¹ Estimates suggest that 230,000+ people are at risk and 2,150km² will be lost with a one-meter sea level rise by the end of the century. Damages and loss (infrastructure and land) for major cities such as Monrovia, New Kru Town, River Cess, Buchanan and Robertsport are estimated at \$250 million (2017 estimates).⁸² Rapid coastal erosion (both from sea level rise and sand mining) already puts settlements and infrastructure at risk, specifically for Buchanan, Greenville, Harper and Robertsport communities.

Currently, sea level rise and coastal erosion has heavily impacted on communities like West Point, New Kru Town, Sinkor and Virginia, putting major infrastructures such as the JFK Kennedy Hospital, D. Tweh High School and the Hotel Africa at risk. Low-lying areas of Monrovia, such as West Point Slums, have had to be evacuated due to storm surges. The rise in sea level will increase migration to higher lands and/or result in shock waves of migration to the interior when coastal inhabitants seek refuge from flooding. **Figure 14** presents areas for flood regulation around specific natural capital and degrees of coastal vulnerability.

FIGURE 14. Spatial Representation of Coastal Vulnerability and Zones of Natural Capital Requiring Flood Regulations (2017)⁸³



⁸¹ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁸² Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

⁸³ Neugarten, R. et al. (2017). Natural Capital Mapping and Accounting in Liberia. Understanding the contribution of biodiversity and ecosystem services to Liberia's sustainable development. Conservation International. May (2017). URL: https://www.researchgate.net/publication/321304662_Natural_Capital_Mapping_and_Accounting_in_Liberia_Understanding_the_contribution_of_biodiversity_and_ecosystem_services_to_Liberia's_sustainable_development. pp. 56, 63.

Rising sea temperatures and intense rainfall levels will impact unique mangrove ecosystems through erosion, leaving the coast even more exposed to storms and wave damage.⁸⁴ Much of the country's coast is protected by mangroves, which also provide nurseries for fish habitats, however this is increasingly under threat by road and infrastructure construction and population pressures. The country's most vulnerable coastal areas to erosion are in Bassa, Rivercess, Sinoe, and Grand Kru counties. Coastal protection provided by mangroves is relatively high in Bassa and Rivercess counties, and to a lesser extent in Sinoe county.⁸⁵ Increased precipitation will impact vulnerable zones of forests and biodiversity and may see increased incidence of flooding and erosion due to deforestation and habitat degradation.

Adaptation Options

Adaptation and improved coastal zone management should focus on reducing the environmental and socio-economic impact from catastrophic floods, coastal erosion, and sea level rise; specifically, in settled areas. Policies for aquaculture, urban infrastructure, integrated coastal management as well as flood-related disaster risk responses need to be developed and implemented and related physical planning and building control measures and regulations should be instituted to ensure the protection of Liberia's 350-mile coastline, seaports and capital city. Allocation of land in flood prone areas such as the dry swamp areas around Monrovia that have experienced flooding during the rainy seasons, should be avoided. Building of coastal infrastructure such as roads, seaports, fish landing and hotel and residential buildings must be put in place to ensure that marginal increase in the height of the structures for sea level rise (SLR) can be mitigated. People located in high-risk areas should be offered incentives to relocate.⁸⁶

Liberia should promote disaster risk management, disaster preparedness, and protective infrastructure (e.g. seawalls and flood reservoirs) to protect against rising sea level. Support should be directed towards the rehabilitation, management, and protection of wetlands and mangroves in order to buffer coastal communities from storm surge and coastal erosion. Efforts should be made to establish mechanisms for coastal erosion control and promote alternative sources and technologies to enhance water availability with a focus on identifying and mitigating potential salinization of drinking water. Coastal Defense Strategies should be implemented for Monrovia, Buchanan, and Robertsport in order to reduce the vulnerability of coastal urban areas to erosion, floods, siltation, and degraded landscapes.⁸⁷

⁸⁴ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

⁸⁵ Neugarten, R. et al. (2017). Natural Capital Mapping and Accounting in Liberia. Understanding the contribution of biodiversity and ecosystem services to Liberia's sustainable development. Conservation International. May (2017). URL: https://www.researchgate.net/publication/321304662_Natural_Capital_Mapping_and_Accounting_in_Liberia_Understanding_the_contribution_of_biodiversity_and_ecosystem_services_to_Liberia's_sustainable_development

⁸⁶ USAID (2017). Liberia Fact Sheet. Climate Change Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Risk%20Profile_Liberia.pdf

⁸⁷ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov/lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

Institutional Framework for Adaptation

Liberia's Environmental Protection Agency (EPA) is the primary agency responsible for preparing the National Communication under the United Nations Framework Convention on Climate Change (UNFCCC) and the National Adaptation Programme of Action (NAPA). In coordination with its partners, the EPA is focused on integrating climate change across government ministries including the Ministry of Agriculture and the Ministry of Land, Mines and Energy. The National Environmental Policy Council shapes priorities for environmental targets and objectives. The country's National Climate Change Steering Committee and Secretariat, established in 2010, are responsible for creating an intergovernmental framework for combatting climate change in Liberia.

Policy Framework for Adaptation

Liberia submitted its First National Communication in 2013, its Second National Communication in 2021, and Nationally-Determined Contribution (NDC) to the UNFCCC in 2016, which provides the platform to integrate its Low Carbon Development Strategy into the country's long-term sustainable development Vision by 2030. The country also implemented its Initial National Communication in 2013 and National Adaptation Program of Action (NAPA) in 2008. Current climate change mitigation and adaptation activities are guided by the National Policy and Response Strategy on Climate Change (2018). Liberia is one of the first recipients of the Green Climate Fund and a signatory to the 2015 Paris Climate Change Agreement.

Liberia's NAPA process identified several projects and urgent adaptation needs in which three projects have been selected to address the most urgent priority needs of the country. These projects, given by priority rank within the NAPA, are described below:

- *Agriculture adaptation*: enhancing resilience to increasing rainfall variability through the diversification of crop cultivation and small ruminants rearing.
- *A National Meteorological and Hydrological Monitoring System*: enhance adaptive capacity through the rebuilding of the national hydro-meteorological monitoring system and improved networking for the measurement of climate parameters.
- *Coastal Defense*: reducing the vulnerability of coastal urban areas (Monrovia, Buchanan, and Robertsport) to erosion, floods, siltation, and degraded landscape.⁸⁸

⁸⁸ Environmental Protection Agency (2018). National Policy and Response Strategy on Climate Change. URL: http://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf

National Frameworks and Plans

- [Second National Communication](#) (2021)
- [National Policy and Response Strategy on Climate Change](#) (2018)
- [Natural Capital Mapping and Accounting in Liberia](#) (2017)
- [Initial National Communication](#) (2013)
- [National Disaster Management Policy](#) (2012)
- [National Adaptation Programme of Action \(NAPA\)](#) (2008)
- [Environmental Protection and Management Law](#) (2002)

Recommendations

Research Gaps

- Improve the understanding of the occurrence and magnitude of key climate change trends, as well as the key vulnerabilities, development impact, and possible adaptation responses
- Widen the participation of the public, scientific institutions, women and local communities in planning and management, accounting for approaches and methods of gender equity
- Strengthen environmental monitoring capabilities for strengthened and more effective environmental management
- Enhance Liberia's adaptive capacity through the rebuilding of the national hydro-meteorological monitoring system and improved networking for the measurement of climate parameters
- Strengthening of technical capacity to integrate climate change risk management into farmer level agricultural capacity
- A detailed analysis of the economic and social implications of climate change, including an assessment of geographic risks and the role of gender in vulnerability and resilience, should be undertaken to provide the basis for an effective national climate change adaptation strategy for the country⁸⁹
- Additional research should be undertaken to estimate the cost of implementing Liberia's Nationally Determined Contribution under the Paris Climate Accord⁹⁰

Data and Information Gaps

- Improve observational data through the additional of weather stations and hydro-meteorological instrumentation
- Improve technical capacity to analyze hydro-met data and project impacts across sectors
- Establish institutional capacity for providing timely early warning systems
- Development of early warning systems about dangerous hydrometeorological phenomena and climate risk management for extreme events
- Increase data on urbanization and information settlements for Greater Monrovia to determine settlements located in disaster areas or flood zones

⁸⁹ World Bank (2020). Greater Monrovia Urban Review. A spatial analysis investigating constraints and opportunities. URL: <http://documents1.worldbank.org/curated/en/649581593487174497/pdf/Main-Report.pdf>

⁹⁰ World Bank Group (2018). From Growth to Development: Priorities for Sustainably Reducing Poverty and Achieving Middle-Income Status by 2030. Systematic Country Diagnostic. URL: <https://openknowledge.worldbank.org/handle/10986/29880>

Institutional Gaps

- Ensure integration of NDC goals and climate change adaptation efforts are included in sectoral and regional plans as well as with City governments, land authorities, and DRM agencies
- Ensure the involvement of disaster first-responder agencies are involved in long-term spatial planning in urban zones to adapt to projected disaster and climate change impacts
- Implementation of cross-sectoral climate-smart solutions at national and subnational levels
- Implement regional-scale cooperation among countries in West Africa and to emphasize the benefits of collaboration and institution building in the region
- Establish a National Steering Committee on Climate Change to ensure the integration of low-carbon, climate-resilient considerations into development planning by providing overall guidance, political support, and leadership, ensuring adequate resource allocation and monitoring the results related to the national efforts to address and adapt to climate change
- Integrate climate change concerns into relevant policies and planning processes at the state and national levels
- Policy actions should be designed to create a more enabling environment for agriculture, improve education quality and expand education access, as well as extend the reach of water, sanitation, and sewage services
- Systems should be development to more appropriately manage the country's natural resources and to resolve disputes over natural resources and land, which contributed to ongoing social and economic tensions⁹¹

⁹¹ World Bank Group (2018). From Growth to Development: Priorities for Sustainably Reducing Poverty and Achieving Middle-Income Status by 2030. Systematic Country Diagnostic. URL: <https://openknowledge.worldbank.org/handle/10986/29880>

CLIMATE RISK COUNTRY PROFILE

LIBERIA



WORLD BANK GROUP