COUNTRY OVERVIEW

Liberia has made significant economic and development progress since emerging from civil war in 2003. But the country remains in a fragile situation, confronting widespread poverty, high inequality and unemployment, and limited access to basic services (water, sanitation, energy). Agriculture, fisheries and forestry are instrumental to Liberia’s inclusive economic growth and poverty reduction goal. 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. Agricultural productivity, which already suffers from land degradation and extreme weather events, is even more vulnerable to a changing climate given its reliance on climate-sensitive staple crops such as rice and the rising incidence of pests and disease. Saltwater and freshwater fisheries, a key economic and nutritional resource, are likely to suffer as sea temperatures increase and coastal ecosystems (mangroves and wetlands) are damaged. Coastal zones, home to the majority of the population, infrastructure, and economic activity, are at risk from flooding and erosion associated with sea level rise, which will lead to salinization of coastal agricultural fields.

CLIMATE PROJECTIONS

- 0.9°–2.6°C increase in temperature by 2060
- Increase in frequency and intensity of extreme weather events
- 0.13–0.56 m increase in sea levels by 2100

KEY CLIMATE IMPACTS

- **Agriculture Production**
  - Increased crop loss/failure due to extreme weather events
  - Increased pests, weeds, pathogens

- **Water Resources**
  - Diminished water quality
  - Insufficient water levels for basic sanitation infrastructure

- **Coastal Zones**
  - Coastal flooding and erosion
  - Damage to houses and infrastructure
  - Salinization of land and aquifers

- **Fisheries**
  - Shift in distribution of species
  - Biodiversity loss
  - Loss of livelihoods

- **Human Health**
  - Increased risk of vector-, air- and waterborne diseases
  - Increased food insecurity
CLIMATE SUMMARY

Liberia has a predominantly equatorial climate with four distinct elevation zones: the coastal belt, rolling hills, plateaus and northern highlands. Rainfall is highest along the coast (4,770 mm/year) and decreases toward the interior plateaus and low mountains, where the average annual rainfall level is 2,030 mm. With the exception of the southernmost parts of the country, which receive rainfall year-round, most of Liberia experiences two seasons, a function of the West African Monsoon: a wet season (“summer”) between May and November, when temperatures hover around 25°C; and a dry season (“winter”) between December and April, when the dry and dusty harmattan winds blow off the Sahara Desert and temperatures fluctuate between 24°–27°C. (2, 3, 6, 7)

HISTORICAL CLIMATE

Key climate trends since the 1960s include:

- Increased average annual temperatures of 0.8°C throughout the country.
- An additional 57 “hot” nights per year on average (a 15.7 percent increase).
- Decline in mean annual rainfall (difficult to determine whether this is part of a long-term trend because of the variable nature of rainfall in the region).
- Increased frequency and unpredictability of intense rainfall events.
- Rising sea level.

FUTURE CLIMATE

Projected climate changes include:

- Increase in annual temperatures between 0.9°–2.6°C by the 2060s, with rate of warming most rapid in the northern inland regions.
- Substantial increase in the frequency of “hot” days and nights.
- No consistent projections for rainfall exist but trends suggest an overall increase in average annual rainfall, with an increase in wet season rainfall of 3 percent by 2050. Dry season rainfall in the south will decline by 2050.
- Rise in sea level of 0.13–0.56 meters by 2100.

SECTOR IMPACTS AND VULNERABILITIES

AGRICULTURE

Agriculture has been an important source of economic growth since the collapse of the formal economy during the civil war. The sector contributes 35.2 percent of GDP and provides livelihoods to 67 percent of the population. Rice is the country’s primary staple crop, cultivated by 74 percent 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 suitable for rice production where it previously was not. 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. Cassava, Liberia’s second most important staple crop, is far more resilient to climate changes (particularly higher temperatures) and may provide an alternative food source in an increasingly erratic climate. Liberia’s major agricultural exports (rubber, cacao, and coffee) are also sensitive to changing weather conditions. 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 levels that may come under pressure as rising temperatures reduce moisture levels and exacerbate pest and diseases that thrive in hot conditions. (1, 3, 8, 9)

Climate Stressors and Climate Risks

<table>
<thead>
<tr>
<th>Stressors</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased temperatures</td>
<td>Yield reductions; crop loss</td>
</tr>
<tr>
<td>Increased frequency of intense precipitation</td>
<td>Increased incidence of pests (e.g., grasshoppers) and diseases (e.g., black pod and coffee rust)</td>
</tr>
<tr>
<td></td>
<td>Increased heat stress on coffee and cacao trees, particularly during dry season</td>
</tr>
<tr>
<td></td>
<td>Reduced growing season, maturation and drying period for crops as a result of an overall increase in average annual rainfall</td>
</tr>
<tr>
<td></td>
<td>Accelerated erosion of topsoil</td>
</tr>
<tr>
<td></td>
<td>Waterlogging of rubber plantations</td>
</tr>
</tbody>
</table>
WATER RESOURCES
Liberia has one of the highest rates of water resources per capita in Africa. Changes in seasonal rainfall patterns and rising temperatures, however, will negatively impact the water balance by either decreasing total water levels or degrading water quality through contamination. Runoff in the St. Paul River Basin is projected to decrease 0.7–25 percent by the 2020s due to precipitation and temperature changes, impacting potential hydropower production at the Mount Coffee plant and the water supply for Monrovia, the capital. In rural areas, water is largely supplied from shallow wells whose levels fluctuate with rainfall variability, particularly during the dry season (December – April). Reduced water levels further stress water quality as pollutants are concentrated. 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, which was severely damaged due to fighting and vandalism sustained over 14 years of civil war.

COASTAL ZONES
Sea level rise, and associated coastal flooding and erosion, are putting increasing stress on Liberia’s extensive and productive coastal zone. In addition to supporting key agriculture and fishing activities, the coast is home to almost 60 percent of the population, much of which resides in areas already at risk from inundation. Liberia’s Environmental Protection Agency is concerned that 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. Areas of Monrovia such as the West Point Slums have had to be evacuated because of storm surges. If sea levels rise one meter, areas of major cities such as Monrovia, New Kru Town, River Cess, Buchanan and Robertsport will be submerged, incurring losses of land and infrastructure worth $250 million. In addition, rapid coastal erosion (both from sea level rise and sand mining) already puts settlements and infrastructure at risk in areas like Buchanan, Greenville, Harper and Robertsport. 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.

Only 16.9 percent of the total population has access to an improved sanitation facility, causing many communities to resort to basic pit latrines and open defecation. Poor waste management practices, which contaminate water sources, are even more problematic during flooding and heavy rainfall. (3, 9)

These factors will also negatively impact fish and other marine species that rely on mangroves as a habitat and food source. (2, 5, 7, 8)
FISHERIES
Fish are an important component of the Liberian diet and the primary source of protein in coastal areas. Liberia’s fisheries include: coastal marine fisheries, involving industrial and artisanal activities; inland river and lake fisheries, which are underdeveloped and artisanal; and aquaculture, which consists of small, freshwater ponds producing tilapia in rural areas of non-coastal communities. The fisheries sector suffered during the civil war, and now faces risks from climate change and climate variability. Rising sea surface temperatures are reducing biodiversity and overall stocks as a result of death, diminished reproductive cycles and migration to cooler waters. Changing rainfall patterns, particularly during the dry season when inland river and pond levels are low, are causing significant numbers of fish to die. Those that survive are often confronted with waters contaminated from pesticide runoff and other pollutants. (2, 4, 8)

Climate Stressors and Climate Risks

<table>
<thead>
<tr>
<th>Stressors</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased temperatures</td>
<td>Disruption to reproductive patterns and migratory routes</td>
</tr>
<tr>
<td>Increased frequency of intense precipitation</td>
<td>Reduced aquatic biodiversity and productivity</td>
</tr>
<tr>
<td></td>
<td>More frequent loss of fishing days due to bad weather</td>
</tr>
<tr>
<td></td>
<td>Loss of income and livelihoods</td>
</tr>
<tr>
<td></td>
<td>Reduced protein intake and nutrition deficits for human population</td>
</tr>
</tbody>
</table>

HUMAN HEALTH
Liberia’s population already suffers from a range of environmental problems that will likely be intensified by climate change. Malaria is one of the leading causes of morbidity and mortality, accounting for 38 percent of all hospital visits. Increased rainfall and flooding are likely to cause outbreaks of malaria, cholera (expected to increase 10 percent by 2100) and diarrheal diseases of epidemic proportions. The incidence of Lassa Virus (LASV), the third highest cause of morbidity, is also expected to rise as heavy rainfall increases. Cases of LASV, carried by the multimammate rat, double or triple during the rainy season when rat populations grow rapidly. Dengue fever, already present in neighboring Côte d’Ivoire, could expand into Liberia as temperatures rise. Respiratory diseases may be exacerbated by heat stress and increased rainfall levels.

Climate Stressors and Climate Risks

<table>
<thead>
<tr>
<th>Stressors</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased temperatures</td>
<td>Increased incidence of vector-borne diseases (e.g., malaria, dengue fever and yellow fever) due to extended breeding range to higher elevations</td>
</tr>
<tr>
<td>Increased frequency of intense precipitation</td>
<td>Increased incidence of food- and waterborne diseases (e.g., cholera, typhoid and diarrhea)</td>
</tr>
<tr>
<td></td>
<td>Exacerbation of respiratory diseases (e.g., asthma)</td>
</tr>
</tbody>
</table>

FOREST ECOSYSTEMS
Liberia is home to 40 percent of West Africa’s forest cover, which is used for food (non-timber forest products and wildlife), fuelwood, medicinal products and energy. Rainfall projections are too inconclusive to predict with certainty if climate change will significantly impact tropical forests. However, substantial evidence shows that increased duration and intensity of rainfall leads to slower tree growth and, in more severe cases, rotting because of waterlogged tree roots. Increased runoff due to heavy rain, combined with root loss may cause greater siltation of surrounding reservoirs and rivers. Rising temperatures have also created environments where pests, including the pine caterpillar (Dendrolimus punctatu), can thrive. (2, 7, 8)
POLICY CONTEXT

INSTITUTIONAL FRAMEWORK
The Environmental Protection Agency (EPA) of Liberia 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. Last but not least, the National Climate Change Steering Committee and Secretariat, established in 2010, are charged with creating an intergovernmental framework for combatting climate change in Liberia.

NATIONAL STRATEGIES AND PLANS
Liberia joined the UNFCCC in 2002. It drafted its second Poverty Reduction Strategy Paper, which outlines an approach toward graduating to middle-income status by 2030. Liberia is one of the first recipients of the Green Climate Fund and a signatory to the 2015 Paris Climate Change Agreement. The 2017 National Policy and Response Strategy on Climate Change will guide the country’s efforts to mitigate the risks of climate change and reduce vulnerability. This document, in addition to those below, addresses climate change as a major obstacle to long-term development and growth:

- Initial National Communication (2013)
- Environmental Protection and Management Law (2002)

KEY RESOURCES
1. CGIAR. 2015. Climate vulnerability and adaptation of the smallholder cocoa and coffee value chains in Liberia.
3. EPA. 2013. Initial National Communication to the UNFCCC.

Map Sources:
### SELECTED ONGOING EXPERIENCES

<table>
<thead>
<tr>
<th>Selected Program</th>
<th>Amount</th>
<th>Donor</th>
<th>Year</th>
<th>Implementer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liberia Energy Efficiency and Access Project (LEEAP)</td>
<td>$29.75 million</td>
<td>African Development Bank Group (AfDB)</td>
<td>N/A</td>
<td>Liberia Water-Sewerage Corporation</td>
</tr>
<tr>
<td>Strengthening Liberia’s Capability to Provide Climate Information and Services to</td>
<td>$18.7 million</td>
<td>GEF (Least Developed Countries Fund)</td>
<td>TBD</td>
<td>UNDP, Liberia Environmental Protection Agency (EPA), Ministry of Land, Mines and Energy</td>
</tr>
<tr>
<td>Enhance Climate Resilient Development and Adaptation to Climate Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Africa Regional Fisheries Program in Liberia - ACGF</td>
<td>$4.19 million</td>
<td>World Bank</td>
<td>N/A</td>
<td>Ministry of Agriculture, Bureau of National Fisheries</td>
</tr>
<tr>
<td>Fostering Innovative Sanitation and Hygiene in Monrovia</td>
<td>€1.13 million</td>
<td>AfDB</td>
<td>N/A</td>
<td>Monrovia City Corporation</td>
</tr>
<tr>
<td>Enhancing Resilience of Vulnerable Coastal Areas to</td>
<td>$9.65 million</td>
<td>GEF (Least Developed Countries Fund)</td>
<td>2010–2014</td>
<td>EPA</td>
</tr>
<tr>
<td>Climate Change Risks in Liberia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhancing Resilience to Climate Change by</td>
<td>$6.35 million</td>
<td>GEF (Least Developed Countries Fund)</td>
<td>2011–2016</td>
<td>Ministry of Agriculture, UNDP</td>
</tr>
<tr>
<td>Mainstreaming Adaptation Concerns into Agricultural sector Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Governance Advocacy and Leadership for Water, Sanitation and Hygiene (GoAL WASH)</td>
<td>N/A (Multi-</td>
<td>UNDP: SIDA, Basque Water Agency</td>
<td>2012–2015</td>
<td>Ministry of Lands, Mines and Energy</td>
</tr>
<tr>
<td>Installation of Multipurpose Mini-Hydro Infrastructure (for energy and irrigation)</td>
<td>$5.76 million</td>
<td>GEF: Trust Fund</td>
<td>2011–2014</td>
<td>Liberia Electricity Corporation, MLME, EPA, UNIDO</td>
</tr>
<tr>
<td>Agriculture Sector Rehabilitation Project (ASRP)</td>
<td>$26.9 million</td>
<td>IFAD, AfDB, ADF</td>
<td>2009–2017</td>
<td></td>
</tr>
<tr>
<td>Post-Ebola Health System Strengthening and Epidemic Prevention</td>
<td>€7 million</td>
<td>GIZ</td>
<td>2016–2019</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>West Africa Biodiversity and Climate Change (WA BiCC)</td>
<td>$49 million</td>
<td>USAID/West Africa</td>
<td>2015 – 2020</td>
<td>Tetratech, EPA</td>
</tr>
</tbody>
</table>