Government of Liberia

Integrated Summary Report of Liberia 15 County Climate Change Baseline Reports

Supported by NovaSphere Canada

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1. Executive Summary

This Report is a consolidated summary of the 15 County Climate Change Baseline Reports prepared by experts under the bilateral support for the Nationally Determined Contributions (NDC) implementation and climate governance project initiated by the government of Liberia. The 15 County Climate Change Baseline Reports present baseline for future climate actions in the 15 counties of Liberia. The reports draw on key insights to provide baseline for future policy developments that are unique to the each of the 15 Counties of Liberia. They provide the current climate change contexts at the county-level. The reports also emphasize the significance of understanding how climate change affects development and livelihood conditions at the grassroot level across the 15 political sub-divisions of Liberia. The reports offer a thorough and comprehensive assessment of the climate change situations in Liberia at the county-level. They specifically examined the counties' vulnerabilities to climate change, impacts of climate change in the various counties, the national climate policies, institutional frameworks governing the implementation of Liberia's Nationally Determined Contributions (NDC) sector, and the challenges and opportunities for climate change adaptation and mitigation at the county-level.

The bilateral support for the Nationally Determined Contributions (NDC) implementation and climate governance project that oversaw the production of the reports was supported by government of Canada through NovaSphere to facilitate climate governance at the sub-national level. The principal users of the reports are the government of Liberia through the Environmental Protection Agency (EPA) and line ministries and agencies of the Liberian government and the government of Canada through NovaSphere. This consolidated report is a holistic summary of the 15 reports from the counties. The 15 County Climate Change Baseline Reports draw conclusions from nine sectors of the Liberian government. These sectors include agriculture, coastal zones, energy, fishery, forestry, healthcare, industry, transport, and waste.

The key findings of the reports are informed by qualitative research methodology. Specifically, the reports' findings are informed from data generated from Desk Reviews, Key Informants Interviews, and Focus Group Discussion, and risk assessment instruments including ThinkHazard!. The key findings contained in all of the 15 reports indicate that agriculture, mining, and fishing are principal sources of livelihood income in all of the 15 counties of Liberia, although citizens exploit other sectors to earn their living.

The reports additionally revealed that climate change is adversely affecting livelihood and environmental conditions across Liberia. Climate-induced calamities such as rising temperature, rising sea level, erosion, altered precipitation patterns, flooding, drought occur in all the coastal counties and counties close to the coastal counties. Similarly, the reports gathered that rising temperature, flooding, deforestation, and land degradation are frequent climate-induced occurrences in the landlock counties and some of the coastal counties.

These adverse impacts of climate change contribute to food insecurity, economic challenges, poor farming yields, pollution of water sources, damaging infrastructures, destruction of natural habitats, land degradation and overall poor livelihood condition, thereby influencing high poverty rates in the respective counties. As outlined in the reports, the altercation in rainfall patterns across Liberia has severely affected the country's agriculture sector – necessitating the need to invest in climate-smart agricultural practices – and put the country on the brim of recurring natural disasters such as drought, erosion and flooding. Similarly, the

rising temperature contributes to extreme heat and pollution, which impact health in negative ways. On the other hand, illicit mining activities and shifting cultivation have contributed to environmental degradation and the destruction of natural habitats, which poses serious challenges to the country's biodiversity. The county baseline reports also predict that Liberia remains vulnerable to the impacts of climate change despite the current situations at the county level. These findings of the 15 reports collectively point in the direction of imperative calls for collaborative and concerted efforts across all the nine sectors to take steps to ensure the appropriate climate actions are taken at the county level.

While this summary report provides richer insights of the climate change contexts in the 15 Counties, it is not as exhaustive as the individual county reports. Hence, it is plausible to refer to the county reports in any case where this summary report falls short of providing deeper understanding. Stakeholders across the examined nine sectors highlighted the significance of adopting climate-smart practices, enhancing governance structures, promoting collaborative efforts, and investing in capacity building initiatives to adequately address the situation of climate change at the county-level.

The findings of the baseline reports also suggest that it is crucial to tailor policy efforts, strengthen governance, raise awareness, ensure sustainable practices and institute improved monitoring and evaluation mechanisms to address climate change in Liberia. Across the 15 Counties the reports reveal that stakeholders recommend improved collaboration and partnership among stakeholders in both the public and private sectors. They pointed out that improved collaboration and partnership among government agencies and non-governmental organizations at the county level will facilitate resource mobilization and knowledge sharing to address climate change and its impacts.

In clearer terms the reports recommend reforestation to compensate for lost forests, conservation efforts to preserve existing forests and protect wildlife in a bid to promote biodiversity, and take sterner actions against illegal and unguided mining and logging. The reports also recommend policy reform and investment in renewable energy sources and sustainable development practices.

The reports also emphasize the strengthening of disaster response mechanisms to mitigate the impacts of extreme weather events. In this regard, it is crucial to strengthen national agencies in the sectors at the county level, to improve early warning systems, emergency response planning and infrastructure resilience. The reports further recommend the development and implementation of climate change policies and legal frameworks that integrate adaptation and mitigation measures in development at the county level. Strengthening governance structures will support effective climate change planning and implementation at the local level.

The recommendations contained in this report emulated from stakeholders at the county level. Informed by existing data and empirical experiences, they are proffered based on insights of the county contexts and existing realities in the counties. The recommendations serve as a reference point for building resilience, promoting sustainable practices and holistically addressing climate change in Liberia.

2. Introduction

2.1. Background and objectives

Liberia is Africa's oldest independent republic. The country is located on Africa's west coast. Liberia shares borders with Cote d'Ivoire at its east, Sierra Leone to the west, and Guinea to the north. The Atlantic Ocean lies at the south of the country, stretching from Grand Cape Mount County to Maryland County. Liberia has an area of 111, 369 square kilometers, and the country is divided into 15 political sub-divisions called counties. Liberia's climate is tropical, hot, and humid all year round.

The current realities in Liberia suggest that the country is experiencing climate change and its unfavorable impacts, which has propelled the government to take steps at addressing climate change. Liberia's Nationally Determination Contributions (NDC) plan for sustainable development aim to reduce greenhouse gas emission by 64% by 2030. To achieve this objective, the country relies on its national development plans and donor support. Therefore, the government of Liberia, through the EPA, has decided to study the realities about climate change in Liberia at the local level, as a way of first understanding the situation and its impacts on citizens at the local level. This has necessitated the need for the production of County Climate Change Baseline Reports.

This report is a comprehensive summary of 15 Liberia Climate Change Baseline Reports done to provide a roadmap to address climate change at the county level. The Liberia Climate Change Baseline Reports provide comprehensive assessments of the climate change situations and contexts in each of the 15 counties of Liberia. The reports serve as reference documents for future climate studies and future climate action strategies by the government of Liberia and its partners. The reports base their analyses of the climate change contexts in the counties on nine sectors. Specifically, the reports draw on knowledge from the following sectors: agriculture, coastal zones, energy, fishery, forestry, healthcare, industry, transport, and waste. The reports look at how climate change affect the lives of Liberian residents through each of these sectors.

This summary report provides a succinct analysis of the 15 reports. The objectives of the county baseline reports are to provide a clearer picture of the climate change realities in Liberia at the county level and to inspire policy actions to address the identified impacts of climate change and institute the necessary mitigation and adaptation techniques. The reports also lay the basis for extensive study of the climate change situations in Liberia. In a nutshell, the primary objectives of the reports are to highlight the impacts of climate change at the county level, shed light on national climate policies, and forge informed recommendations to address climate change at the county level.

2.2. Methodology overview

The reports' authors employed qualitative methodology to gather data for the baseline reports. Specifically, desk review, key informants' interviews and focus group discussions were done. Available data were also keyed in computer software (i.e., ThinkHarzd!, Meteoblue; CMIP6) to do risk assessments.

2.3.Desktop Review

A desk review involves studying all the relevant documents from relevant sources including the World Bank and governmental institutions such as the Liberia Institute of Statistics and Geo-Information Services (LISGIS), EPA, and Forestry Development Authority (FDA). Data from these sources were triangulated against other data gathered from the key informants' interviews (KII) and the focus group discussions (FGD). The desk reviews yielded thorough theoretical and policy-informed knowledge that assisted in framing questions for the KIIs and FGDs and making recommendations.

2.4.Stakeholders' Participation

The stakeholders' participation was performed by the conduct of KIIs and FGDs with relevant stakeholders in the nine sectors connected with climate change. The KIIs, particularly, were individual interviews done with subject-matter experts with extensive knowledge of the core issue – climate change. The KIIs were relevant because they yielded data informed by individualized assessments of the climate change situations in the counties. The respondents of the KIIs were all major stakeholders engaged in activities concerning climate change at the level of the nine sectors connected with climate change in Liberia.

The FDGs, on the other hand, similarly involved representatives of governmental and nongovernmental organizations, aligned with Liberia' NDC. The FGDs primarily brought together people with shared knowledge on the subject matter. The FGDs helped to provide a collective assessment of the climate change situations and what is being done at the sectoral level in the counties. To a larger extent the data from the FGDs provided reflections of the efforts being made by policymakers at the sectoral level. They also shed light on the opportunities in the sectors and the challenges in the sectors.

2.5.Climate Information Analysis

The climate information analyses were done using satellite estimates, the World Bank climate knowledge portal, and data from the climate change knowledge portal. The modelled climate data were derived from the Coupled Model Intercomparison Project Phase 6 (CMIP6). The CMIP efforts are overseen by the World Climate Research Program. Scholars relied on the CMIP6 data to share global climate change projections in the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC).

The vulnerability and risk assessments were done using ThinkHazard!, a user-friendly website that considers the effects of disasters on new development projects in an area. ThinkHazard! Evaluates risks of river floods, earthquakes, wildfires, etc.

2.6.Limitations of the Report

The projections presented in the reports did not emulate from primary data collected by the authors. The reliability of the empirical data that informed the analyses on climate change is based on analyses and projections that preceded the existence of the reports. It could be that the assessment indicators on which the reliability of the analyzed data relied were not consistent with the current climate change situations in the counties. Furthermore, while it is true that FDGs and KIIs often provide richer insights about a phenomenon or topic, the generalizability

of conclusions derived from these data collection techniques may be undermined by the usually low number of participants/respondents and in some cases subjective opinions.

2.7.Overview of Liberia's Climate Governance

Liberia's Climate Governance structure comprises a conglomeration of government's agencies and line ministries. The Country's Climate Governance is headed by the National Climate Change Steering Committee (NCCSC). The NCCSC, which oversees the implementation of climate change policies, is chaired by the President of the Republic of Liberia and is supported by the National Climate Change Secretariat at the EPA. The EPA takes leadership on all environment and climate-related responsibilities and has the authority to collaborate with other ministries and agencies to integrate environmental concerns into national development planning.

The EPA also collects and analyzes scientific data related to pollution and environmental quality. It trains and builds capacity in other agencies and works with local authorities on natural resources management. Other members of the NCCSC are the FDA, the Ministry of Finance and Development Planning (MoFDP), the Ministry of Mines and Energy (MME), the Ministry of Agriculture (MOA), the Ministry of Transport (MOT), the Ministry of Gender, Children and Social Protection (MoGSCP), and other relevant stakeholders including the LISGIS and National Disaster Relief Agency of Liberia. The FDA is the leader on forest-related matters, providing leadership for the protection of wildlife, conservation, and biodiversity while the MME leads on energy-related responsibilities. The Ministry of Agriculture is responsible to provide leadership of the country's agriculture sector. The LISGIS is the country's statistics house that provides all the needed data on the population of the country. The National Disaster Relief Agency leads on disaster response.

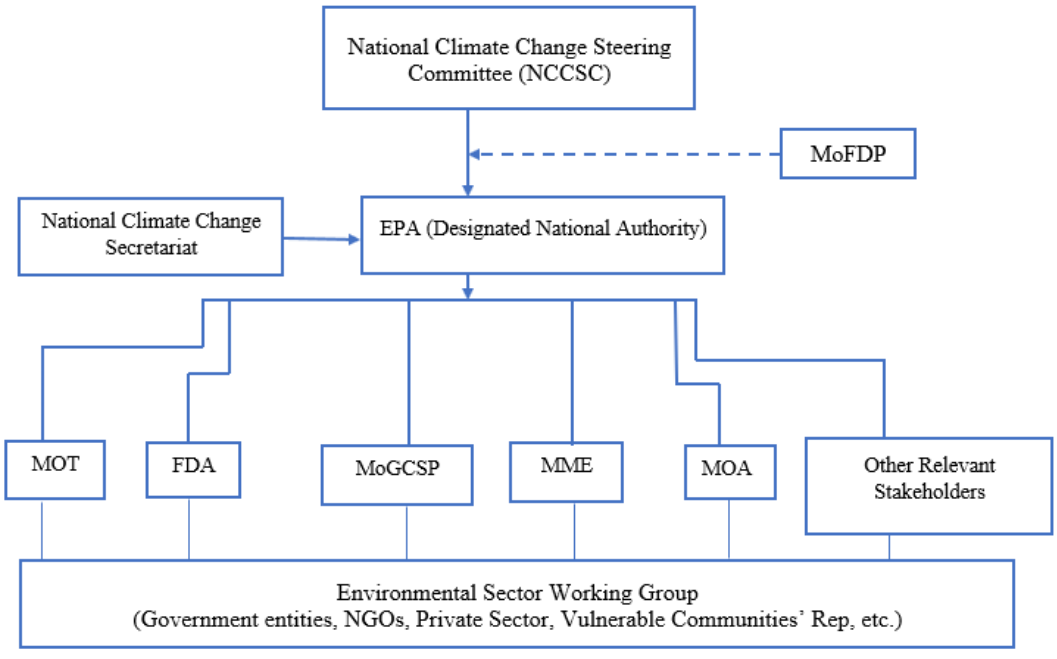


Figure 1: Climate governance or Institutional Arrangement of Liberia: Source: National Policy and Response Strategy on Climate Change

2.8.General Climate of Liberia (main trends)

The World Bank Climate Knowledge Portal reveals that Liberia's average annual rainfall exceeds 2,500 mm. Liberia receives its highest rainfall along the coast, and it decreases towards the country's interior plateaus and low mountains, where average rainfall reaches approximately 2,030 mm. annually. The country's southern areas receive rain all year round while the rest of the country experiences two seasons due the West African Monsoon. The rainy season typically occurs between May and November, with an average temperature of 25°C. The dry season runs from December to April. The dry season is dominated by the harmattan winds with average temperatures between 24 and 27°C. Relative humidity reaches 90%-100% during the rainy season and 60%-90% during the dry season. Liberia's annul temperature is 25.7°C, with observed temperatures ranging between 23.9°C in August and 26.8°C in March. The mean annual precipitation of Liberia is 2,467.07 mm. and the mean monthly precipitation varies from 27 mm. in January to 408 mm. in September. The country experiences rainfall throughout the year, with peak rainfall occurring form June to September, for the latest climatology, 1991-2020.

3. Comparative Analysis of Counties

3.1. Geography and Physical Environment

Founded by repatriated American slaves in 1822, Liberia became an independent republic on July 26, 1847. Liberia has a population of 5.2 million according to its recent national census conducted by LISGIS in 2022. English is the national language but the country's population speaks 16 other local languages. Liberia is situated between latitudes 4°18 and 8°30 north and longitudes 7°30 and 11°30 west on the Atlantic Coast in West Africa. Liberia shares borders with its French-speaking neighbors Côte d'Ivoire and Guinea at its east and north. Sierra Leone lies to its west and the Atlantic Ocean is at the south of the country. Liberia has an area of 111, 369 square kilometers, and the country is divided into 15 political sub-divisions called counties. Liberia's climate is tropical, hot, and humid all year round. Liberia's geography is marked by forests, coastal plains, and highlands (hills and mountains) and water bodies.

3.2.General Relief, Soil Types, Hydrography, and Vegetation

Liberia's relief is characterized by varied elevations and lush vegetation. There are plains, valleys, rolling hills, plateaus, and mountains mostly in counties such as Bomi, Bong, Gbarpolu, (northern) Grand Bassa, Grand Gedeh, (northern) Margibi, (northern) Maryland, Nimba, Lofa, and River Gee. The relief in the coastal counties (i.e., (southern) Grand Bassa, Grand Cape Mount, Grand Kru, (southern) Margibi, (southern) Maryland, (southern) Montserrado, Rivercess, and Sinoe) is characterized by a flat (sometimes narrow) coastal plains extending inland from the seashore. The coastal counties also consist of sandy beaches, mangroves, and estuaries.

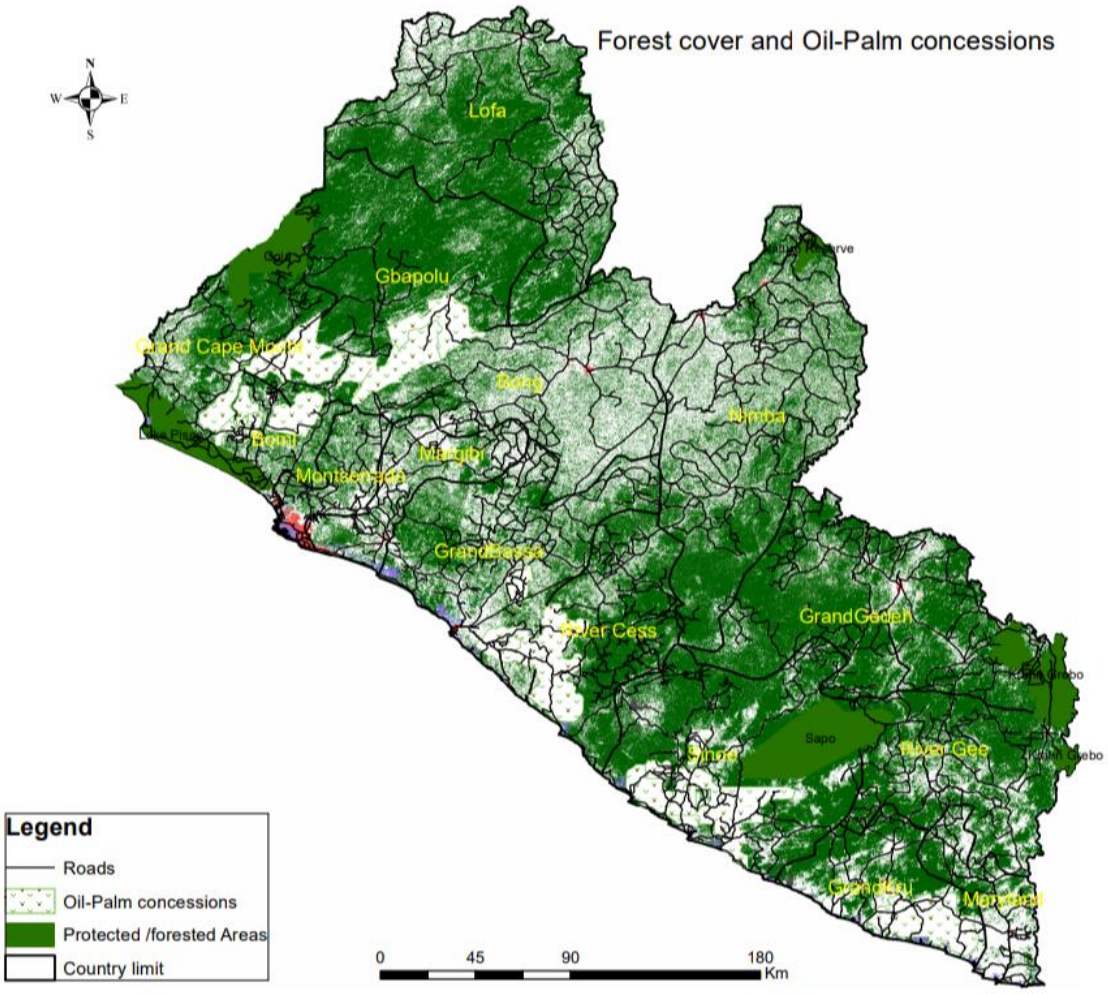


Figure 2: Map of Liberia showing vegetation, protected areas and oil palm concession areas

Generally, Liberia's soil types are varied across the counties, with sandy soils dominating the coastal areas. As indicated in the 15 baseline reports, Liberia's soils are largely arable. For instance, there are laterite soils in nearly all of the counties. There are also alluvial soils in Grand Bassa, Montserrado, Nimba, Rivercess and Sinoe Counties. Clay soils are predominant in Bomi but they are found in other locations as well (e.g., Montserrado, Nimba; Lofa). The soils in Grand Gedeh, Grand Kru, Rivercess, River Gee and most parts of the other counites are arable.

County	Bomi	Bong	Gbarpolu	Grand Bassa	Grand Cape Mount	Grand Gedeh	Grand Kru	Lofa	Margibi	Maryland	Montserrado	Nimba	Rivercess	River Gee	Sinoe
Soil type	Sandy clay	Laterite	Arable soil	Laterite 55%, alluvial 19%, sandy and loamy 26%	Laterite	Arable soil	Arable soil	Clay, sandy clay; loamy	Sandy clay	Reddish brown to black (arable); sandy	Alluvial; clay	Laterite, clay, and sandy	Arable soil	Arable soil	Alluvial; sandy

Figure 3: table showing counties and various soil types

Liberia's hydrography is characterized by a long coastal line and many rivers, creeks, streams, and tributaries. There are tens of water bodies across the country. Principal among these water bodies are the Cavalla River, St. John River, St. Paul River, Cestos River, Mano River, Lofa River, Sinoe River, Dugbe River, Po River and Du River. These rivers along with several others

and creeks traverse the country and they are suitable for the construction of hydroelectric plants. They serve as sources of fishing, agriculture, drinking, and transportation among other livelihood options. In Maryland County, for example, the Cavalla River serves as a major means of transport to neighboring Côte d'Ivoire, facilitating cross-border trade.

Some of these rivers also form natural boundaries between Liberia and its three neighboring countries. Cavalla River constitutes Liberia's borders with Côte d'Ivoire in the east in Grand Gedeh and in the southeast in Maryland county, while St. John River forms Liberia's border with Guinea in Nimba. Cestos River also constitute a natural border between Côte d'Ivoire and Liberia in eastern Nimba County, and the Mano River forms the Liberia's border with Sierra Leone in the western part of Grand Cape Mount County. Additionally, some of these rivers also form boundaries between counties, notably, St. John separating Nimba and Bong and Cestos separating Nimba and Grand Gedeh. Most of these rivers have their origins in mountains and highlands, and they empty in the Atlantic Ocean. In counties such as Grand Bassa, Maryland, Montserrado, and Sinoe, rises in seal level make environments along the coast susceptible to inundation and erosion.

Figure 4: Coastal erosion forced residents out of their shelters in Greenville, Sinoe County. Photo credit: George Y. Sharpe

Liberia's vegetation comprises lush, dense, tropical and evergreen rainforests. The vegetation at the western end of the country in Grand Cape Mount and Bomi is savannah-like along the coast and the dense forests in these two counties stretch northward to Gbarpolu County – Gbarpolu contains significant portions of the Upper Guinea forests. Slightly like Bomi and Grand Cape Mount, Grand Bassa, Grand Kru, and Maryland Counties are predominantly green

forest cover, with pockets of savannah along the coastal areas in these counties. Most of Margibi and Montserrado are contain rubber plantations with small forests northward Bong County. The rest of the counties contain largely lush and dense tropical rainforests, specifically high forest, broken forest, and low bush.

3.3.Socio-economic Trajectories

The socioeconomic trajectories across Liberia are shaped by many sectors. However, the country's largest concessions are in the agriculture sector and its extractive industry. Generally, Liberians in all 15 counties typically engage in subsistence farming, and the country is still struggling to achieve food security. As indicated in the baseline reports of Margibi, Maryland, Montserrado, and Sinoe counties, the largest agricultural investment is in cash crop, rubber precisely. Firestone and Salala Plantations are the leading rubber producers, with their plantations covering huge portions of the land in Margibi and Montserrado counties. Sinoe County has an abandoned rubber concession covering about 600,000 acres and Golden Veroleum operates one of Liberia's largest oil palm plantations in the county. In Bong, Grand Bassa and Nimba, the economy is also driven by mining and agriculture. Iron ore is mined and exported from these counties, and there are agricultural investments there in addition to subsistence farming. Margibi, Montserrado, and Nimba also boast a few decent infrastructures (e.g., hotels) that contribute to the local economies in these counties. Though, illicit and unregulated, the mining of natural resources such as gold also contribute to the socioeconomic dynamics in Grand Gedeh, River Gee, and Sinoe counties. Sinoe and Rivercess are also noted for fishing.

In the west of the country, the local economy is also driven by agriculture and mining. Sime Derby Oil Palm Plantation (now Mano Oil Palm Plantation) and Obasanjo Farms Liberia Inc. located in Grand Cape Mount County are the largest agriculture investments in Liberia's western region. The mining companies in the region include the Western Cluster, an iron ore mining company in Bomi, the Kongba Community Gold Mine in Gbarpolu, and the Madina Rock Crusher in Grand Cape Mount. These investments provide employment opportunities for Liberians residing in these counties. In addition to these investments, subsistence farming, fishing, and illicit mining also contributes to the local economies of these counties. Grand Cape Mount, particularly, is famous for its lake and stunning beaches that also impact its socioeconomic dynamics. Notably, as indicated in the baseline reports of Grand Gedeh, River Gee, and Sinoe, the mining of natural resources in Liberia needs to be properly managed or regulated for the safety of the environment and there is a need to raise awareness against ugly agricultural practices such as shifting cultivation that lead to deforestation and destruction of natural habitats.

Though rich in natural resources, Lofa is a county where the people predominantly engage in agriculture. The county produced rice in commercial quantities prior to Liberia's civil war and continues to rely on agriculture as its major economic activity. Farmers in Lofa also engage in shifting cultivation, producing bulk of its rice from the upland ecology.

County	*Socioeconomic activity*
Bomi	Residents largely engage in subsistence farming and small-scale fishing for livelihood income. There is a mining company which provides employment opportunities as well. Illegal mining and unsustainable farming practices should claim attention for the good of the environment.
Bong	Residents largely engage in subsistence farming and illicit mining for food security and household income. There is a rubber plantation that provides employment opportunities as well. The county serves as a transport route for iron ore export.
Gbarpolu	Residents depend on subsistence farming for food security. There is also a community mining company that provides jobs for few residents.
Grand Bassa	Residents engage in subsistence farming, fishing, and trade for food security and household income. There are rubber plantations, beaches, and a few hotels that contribute to the local economy through employment and other opportunities.
Grand Cape Mount	There are oil palm plantations, a commercial farm, and a rock crusher. Residents also engage in fishing and mining, with illicit mining taking place in some areas, for food security and household income. There are also tourist attractions (i.e., beaches and a lake) that add to the socioeconomic trends.
Grand Gedeh	Residents engage in (illicit) mining and subsistence farming (shifting cultivation) for food security and household income.
Grand Kru	Agriculture and fishery serve as sources of food security and personal and household income. The cultural richness also adds to the socioeconomic dynamics.
Lofa	Although rich in natural resources, agriculture (shifting cultivation) remains the principal source of food security and income generation.
Margibi	Household and livelihood survival depend agriculture, with most of the arable land dominated by rubber plantations. Basic infrastructures such as hotels and beaches also contribute to the local economy through employment.
Maryland	The largest socioeconomic activity is in the agriculture sector, with a rubber plantation providing employment opportunities for locals. Residents also engage into small-scale farming (shifting cultivation) fishing, (illicit) mining, and cross-border trade for food security and income generation.
Montserrado	Most of arable land is dominated by rubber plantation in the interior part of the county, and residents engage in subsistence farming, making agriculture a major economic activity. Small-scale fishing also occurs, and infrastructures such as large markets, beaches, and hotels contribute to the economy.
Nimba	There is a mining company that provides jobs. Rubber and cocoa plantations are also present, and a few infrastructures (i.e., hotels) contribute to the socioeconomic dynamics.
Rivercess	Residents engage in subsistence farming (shifting cultivation as in the rest of the counties), fishing, and trade on a small-scale for food security and income generation.
River Gee	Residents in engage in (sometimes illicit) mining and subsistence farming (shifting cultivation) for food security and income generation.
Sinoe	Residents engage in fishing, mining, and subsistence farming. The county has Liberia's largest rubber plantation but it is abandoned. There is an oil

	palm plantation as well, and farming practices are no different from other counties.

Figure 5: A table with highlights of socioeconomic activities in the counties

3.3.1. Demographic Profiles

Liberia has a population of 5,250,187 with Montserrado being the most populous county at 1,920,965 people according to its 2022 national census report. Nimba, Bong, Lofa, and Margibi are large counties with populations ranging from 301,000 to 500,000 people while Grand Bassa, Grand Gedeh, Grand Cape Mount, and Maryland are medium-sized counties with populations between 150,000 and 300,000. Small counties are those with a population of less than 150,000, such as Bomi, River Gee, Grand Kru, Gbarpolu, and Rivercess. The country has a relatively youthful population, with 74.6% of the country's population under the age of 34. Generally, Liberia's population is male-dominant. There are more males in all of the counties, except Lofa and Montserrado counties where the number of females surpass males. The average household size is 4.4. The household sizes of Grand Kru, River Gee, Sinoe, Grand Gedeh, Nimba, Lofa, and Maryland counties are higher than the national average household size. Liberia has a population growth rate of 3.0 and a dependency ratio of 59, necessitating the need for conducive environment for improved livelihood.

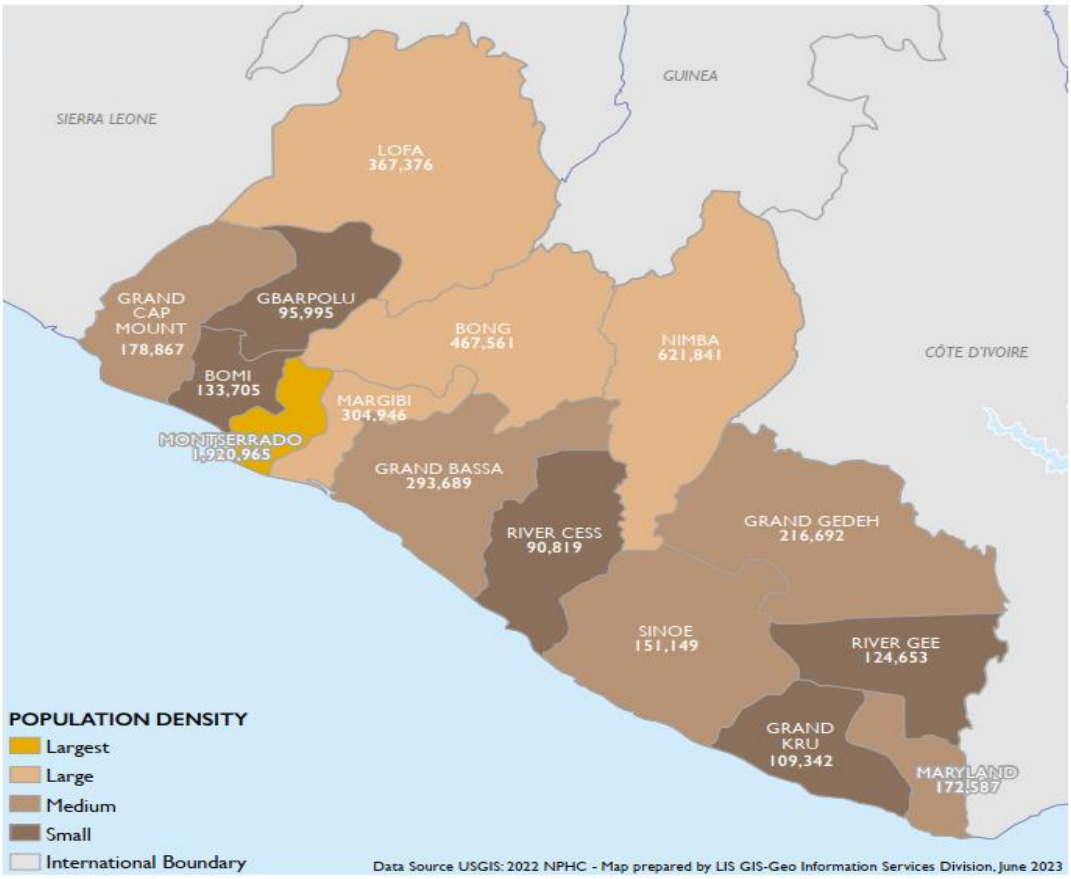


Figure 5: Liberia's with population per county. Source: LISGIS

3.3.2 Livelihoods and Level of Development

The livelihood streams in the 15 counties are principally tied to self-employed initiatives (i.e., farming, fishing, mining, and petit trade) and employment opportunities offered by private corporate firms such as companies operating in the counties (see socioeconomic trends above). In landlock counties like Bong, Lofa, and Nimba, smallholder farmers cultivate crops such as rice, cassava, vegetables, cocoa, and coffee on a subsistence and commercial scale. In the western counties, such as Bomi, Grand Cape Mount and Montserrado, livelihood streams are also determined by livestock rearing in addition to trade and farming.

As discussed earlier, most counties in Liberia are rich in natural resources. The unregulated exploitation of this richness in natural resources to a large extent negatively impact the environment in counties like Bong, Gbarpolu, Grand Gedeh, and River Gee, where artisanal mining serves as a livelihood stream. Most of the counties along the coast engage into fishing both on subsistence and commercial scales to earn their livelihoods (e.g., Grand Bassa, Grand Cape Mount, Grand Kru, Maryland, Rivercess, Sinoe). Consequently, unsustainable fishing and farming practices in these counties poses threat to the environment as well as endanger species.

The level of development across the counties are determined by the International Wealth Index (IWI) and the individual assessments of the county baseline reports authors. Based on the IWI value, counties such as Montserrado, Nimba, and Grand Bassa, and Bong have achieved moderate development compared to other regions of the country. This development trend can be explained by the fact that Montserrado county hosts one-third of the working population and has more improved infrastructure compared to other counties. Similarly, Bong, Lofa and Nimba counties collectively account for another third of the population involved with major economic activities that could foster development in these counties compared to other counties.

3.3.3. Poverty Rates and Urbanization Trends

Liberia remains one of the world's poorest countries, ranking 178th out of 191 countries and territories on the United Nations Human Development Index (UNHDI). The World Food Program estimates that 64 percent of Liberians live below the poverty line, of whom 1.3 million live in extreme poverty. Households headed by elderly persons (age 60+) account for the highest level of poverty. Poverty across the 15 counties has its roots in high unemployment rate, huge disparities in income, high food insecurity, limited healthcare delivery, challenged transportation system, poor infrastructure, and limited or lack of access to basic necessities. Based on the data in the County Climate Change baseline reports, poverty is much higher in Bong, Grand Kru, Lofa, Nimba, and Rivercess Counties. Poverty reduction efforts have been hindered by the lack of diversified economic activities, low production, and slow urbanization in some counties.

Fifty-five percent (55%) of Liberia's population live in urban areas. Based on the 2022 national housing and population census conducted by LISGIS and County Climate Change baseline reports' authors' assessments, urbanization is largely seen in Margibi (55.9%), Maryland (61%), and Montserrado (91.7%) counties. Although Montserrado is almost entirely urbanized, its urbanization comes with challenges such as overcrowding, inadequate housing, unemployment, and income inequality. Economic opportunities are concentrated in the urban areas of Montserrado as is the case in the other counties. This centralization of opportunities in urban areas has resulted in disparities between urban and rural areas within Montserrado county. Grand Kru County is most rural county, with 93.4% of its population living in rural areas. The urban areas have more electricity, improved roads, and higher literacy rate than rural

areas. Dense forests, limited transportation, and lack of infrastructure are indicators behind the lack of urbanization in areas like Rivercess and Gbarpolu counties. Furthermore, low level of urbanization across Liberia is also associated with lack of basic social services such as healthcare, education, and clean water. Subsistence farming, fishing and (sometimes) hunting are the principal livelihood activities in rural areas.

3.3.4. Education and Health Status

Access to education across the 15 counties is largely hindered by lack of adequate school infrastructure, lack of learning resources, shortage of teachers, and financial constraints on the part of the citizens. These facts are highlighted in the baseline reports of Bong, Grand Bassa, and Nimba counties. For Montserrado and Margibi, the dynamic is much better, especially in the urban areas where there are several accessible school infrastructures. Challenges with the educational system are prevalent mostly in rural areas across the 15 counties. Statistically, education is skewed towards urban areas, drop-out rate is higher in rural areas, and the country's literacy rate is higher among its male population. In terms of the educational systems, school enrolment is higher in the early childhood and primary divisions in some counties, Lofa, for example. As indicated in the baseline reports of all the 15 counties, school drop-out rate is higher in the secondary and tertiary divisions. Some of the counties (e.g., Margibi, Montserrado; Bong) are hosts to renowned tertiary learning institutions while others like Rivercess and Gbarpolu lack tertiary learning institutions. Notably, over 50 percent of the populations in Bong, Gbarpolu, Grand Bassa, Grand Cape Mount, and Rivercess counties have never attended school before. This adds to the level of poverty in these counties, and creates the need for simplified climate change messages.

Like the education system, the health sector across the 15 counties faces structural challenges as highlighted in the individual baseline reports of the 15 counties. The challenges with the health systems in the counties include limited health facilities, inaccessibility to available health facilities, lack of healthcare logistics and drugs, low number of healthcare professionals, and high cost of healthcare services. Healthcare delivery is particularly challenging in Bong, Grand Bassa, Grand Kru, and Rivercess compared to the other counties. These challenges underline the rate of maternal mortality in all of the counties of Liberia.

3.3.5. Infrastructure Access and Public Services

Access to infrastructure in the counties is defined by good road network, quality housing, improved access to electricity, and availability of infrastructures such as educational and healthcare facilities. In light of the challenges highlighted in the various baseline reports, some of the counties have witnessed improved infrastructural development over the years. Margibi and Montserrado, for example, have better roads and bridges, which has increased access to schools, health facilities, and other public amenities in these two counties compared to the other counties. These two counties (Margibi and Montserrado) are home to several educational institutions and health facilities, thereby contributing to better living standards in these counties compared to the other counties in the country. Also, Nimba county boasts architectural infrastructure (i.e., decent buildings such as hotels) in its big cities, although poor road network and unreliable electricity also impede growth in Nimba county – especially in rural areas. Similarly, as indicated in the baseline reports for the individual counties, Gbarpolu, Lofa and the counties in the southeast (i.e., Grand Kru, River Gee, Rivercess, Grand Gedeh, and Sinoe) face challenges with road network compared to the other counties. These counites are sometimes cut off from Monrovia by deplorable roads during the raining season.

Figure 6: A deplorable Road impedes transportation to River Gee County during the wet season. Photo credit: J. Negatus Wright, July 2023

Access to electricity is another challenge that is mostly prevalent in Grand Bassa, Grand Kru, and Rivercess counties. Although reliable electricity is elusive in the rural parts of nearly all of the 15 counties, this challenge is loud in Grand Bassa, Grand Kru, and Rivercess counties. Grand Kru, particularly, reported poor quality of housing units for residents. The baseline report for Grand Kru indicates that most households live in housing that are not spacious to accommodate families, and a significant portion of the households cook on wood, straw, grass, dung, or similar materials.

With the exception of Margibi and Montserrado counties, the rest of the counties face structural challenges with accessing public services such as healthcare, education, and rule of law, etc. The major factors contributing to the inaccessibility to public services in the counties include poor road network, inadequate public facilities rendering needed public services, lack of electricity, lack of logistics, and lack of personnel. In Nimba county, for instance, the baseline report pointed out that the residents of the county have to walk long distances to access healthcare service, resulting to delayed or inadequate medical attention particularly in emergency situations. Similarly, in Grand Bassa and Grand Kru, healthcare facilities and transportation options are limited mostly in rural areas, with few health centers catering to the health needs of the population. These sad experiences are not unique to Grand Bassa, Grand Kru, and Nimba counties. In Bong County, for instance, the dynamic is even worse. The

baseline report for Bong County has it that gender inequality creates barriers for women accessing public services such as healthcare, education and rule of law. The scarcity of logistics and manpower (e.g., doctors, nurses, teachers, police officers, equipment) compound these complexities with accessing public services mostly for rural residents across all the 15 counties. These challenges faced by the healthcare centers largely contribute to maternal death and infant mortality, food insecurity, illiteracy, and injustice particularly in rural areas.

3.3.6. Cultural, Ethnic, and Religious Diversity

Liberian live in collective cultures and the country's cultural practices are multifaceted. Cultural practices are unique to specific counties or regions in the country. For instance, Grand Bassa and Lofa have unique naming ceremonies, where children are named after specific circumstances, events, perceived qualities, and according to rank within the family (e.g., 'Saah' is the first boy child of a Kissi family in Lofa). Similarly, traditional marriage rites differ across each of the counties. The same holds for music, dance, storytelling and secret society initiation rites. Generally, two traditional practices permeate the country: the Poro and Sande societies. However, cultural practices by these societies are largely prevalent in the central, north and western regions of the country, although there are pockets of these societies in all other counties or regions of the country. The Poro and Sande are traditional schools where it is believed that young boys and girls learn basic life skills and civic responsibilities. Initiations into these societies vary across the country but they carry the same values. In other words, a man who has gone through the Poro in Maryland county can freely participate in activities of the Poro society in Lofa county and vice versa.

Liberia recognizes 16 ethnic groups. Each of these ethnic groups is attributed a specific county. The Vai, Gola, Mende, Dey, Belle, and Kpelle ethic groups dominate the western counties of Grand Cape Mount, Bomi, Montserrado, and Gbarpolu. The Bassa ethnic groups are predominantly found in Grand Bassa, Rivercess, and Margibi. The Kpelle ethnic group are the dominant tribe in Bong County, although they are also found in Lofa, Gbarpolu, and Margibi counties. Lofa is the most multi-culture county, with the county hosting six of Liberia's 16 ethnic groups: Lorma, Kissi, Gbandi, Mandingo, Kpelle, and Mende. Nimba county is predominantly occupied by the Gio and Mano tribe, although the Krahn tribe occupy a sizable region of the county and there are Mandingo speakers in some areas as well. In the southeast, Krahn is language that is mostly spoken in Grand Gedeh county, followed by Grebo and few other tribes. Sinoe County has a huge Kru population, followed by Sapo and Grebo. Rive Gee and Maryland are dominated by the Grebo ethnic group, with few Kru speakers. In the Grand Kru, the predominant tribes are Kru and Grebo. Although each of the tribes in Liberia points to a county as home, most of the 16 tribes can found in all of the counties due to factors such as intermarriage, trade, and employment opportunities.

Liberia has a large Christian population. According to the country's national census, nearly 85% of the population practice Christianity and around 12% practice Islam. Generally, the Christian majority are found in all of the counties, but the Islamic population dominate in the western counties of Bomi and Grand Cape Mount.

4. Environment and Economic Development

4.1.State of the Environment

The current state of the environment in all of the 15 counties demands critical environmental interventions. Generally, the environments in all of the counties are characterized by natural endowments such as tropical rainforests, rivers, agricultural land and mineral resources. In the southeastern counties of Grand Gedeh, Grand Kru, River Gee, and Sinoe, the environment is resource-rich with evergreen forests and waterbodies. However, these counties face challenges with illicit mining, which gravely contributes to land degradation and the destruction of natural habitats. Additionally, the limited economic opportunities in these counties make residents to rely on the forests for their livelihoods, consequently leading to deforestation – caused by shifting cultivation – and poaching. These challenges have further implications as they make the environment susceptible to climate change and they affect the livelihood and wellbeing of the residents in these counties. The following table summarizes state of the environment in each county, including livelihood options and the need for climate vulnerability assessment.

Figure 7: Illicit mining in River Gee County causes deforestation and land degradation. Photo credit: J. Negatus Wright

Environment and economic development			
County	**State of environment**	**Livelihood option**	**Vulnerability assessment needs**
Bomi	Bomi is one of the closest to Monrovia and it hosts natural features, arable land, and plantations.	Most of the arable land is dominated by oil palm plantations and mining is	Deforestation and land degradation create need for climate vulnerability assessment.

		done at a medium scale	
Bong	Accessible to Monrovia. Hosts tropical rainforests, rivers, and agricultural land. There are also cocoa plantations.	Livelihood activities are dependent on agriculture and mining in rivers and forests	Water pollution, deforestation, and land degradation create need for climate vulnerability assessment.
Gbarpolu	Hosts tropical rainforests, rivers, and agricultural land. There are also cocoa plantations.	Livelihood activities are dependent on agriculture and mining in rivers and forests	Water pollution, deforestation, and land degradation create need for climate vulnerability assessment.
Grand Bassa	Accessible to Monrovia but bad roads persist in the interior parts of the county. There are water bodies and forests.	Economic activities are tied to the forest and water bodies.	Unsustainable farming and fishing practices coupled with sand mining create need for climate vulnerability assessment.
Grand Cape Mount	Accessible to Monrovia but bad roads persist in the interior parts of the county. Most of the arable land is dominated by oil palm farm.	Economic activities are dominated by agriculture and mining.	Unsustainable farming and fishing practices coupled with sand mining create need for climate vulnerability assessment.
Grand Gedeh	Resource-rich with minerals, evergreen forest, and water bodies. Investment-friendly for mining and agriculture.	Limited economic activity creates reliance on forest and forest products	Deforestation, poaching, and destruction of natural habitats create need for vulnerability assessment
Grand Kru	Resource-rich with minerals, evergreen forest, and water bodies. Most of the arable land is dominated by oil palm plantations.	Limited economic activity creates reliance on forest and forest products	Deforestation and destruction of natural habitats create need for vulnerability assessment
Lofa	Agriculture is done on a large scale and improper waste disposal is an issue. Lofa is investment-friendly for mining and agriculture.	Heavy reliance on the forest for agricultural purposes. Bad road condition makes transporting farm produce difficult.	Deforestation and improper waste disposal create need for climate vulnerability assessment.
Margibi	Mostly urban with large population. Hosts some of the nation's best hotels and the only international	The economic activities are dominated by agriculture and	Poor waste management, unsustainable farming and fishing practices

	airport. Most of the arable land is dominated by rubber plantations and has better roads than most counties.	fishing on a commercial scale.	and activities by large populations create needs for climate vulnerability assessment.
Maryland	Most of the arable land dominated by rubber and palm farms. Hosts a large strip of coastal land and tropical forest.	Fishing and agriculture are principal economic activities.	Sand mining along the coast and illegal logging lead to coastal erosion, deforestation and biodiversity loss – creating the need for vulnerability assessment.
Montserrado	Mostly urban with large population. Hosts some of the nation's best hotels and the largest markets. Most of the arable land is dominated by rubber plantations and has better roads than most counties.	The economic activities are dominated by agriculture and fishing on a commercial scale.	Poor waste management, unsustainable farming and fishing practices and activities by large populations create needs for climate vulnerability assessment.
Nimba	The overall geographic location put the county at a disadvantage even though the county hosts forest and wildlife.	Economic activities are largely tied to pit-sawing, mining, farming and charcoal production.	Illegal logging, charcoal production, mining, and agriculture create need for climate vulnerability
Rivercess	The county is located off the national highway and surrounded by the Atlantic Ocean and other water bodies. Hosts plants and animal species.	The economic activities are largely tied to the forest and mining in forest and water bodies.	The use of mercury and dredges for mining and fishing create needs for climate vulnerability assessment.
River Gee	Resource-rich with minerals, evergreen forest, and water bodies. Investment-friendly for mining and agriculture.	Limited economic activity creates reliance on forest and forest products	Illegal mining, deforestation and destruction of natural habitats create needs for vulnerability assessment
Sinoe	Resource-rich with minerals, evergreen forest, and water bodies. Investment can be done in fishery, mining and agriculture.	Limited economic activity creates reliance on forest and forest products	Deforestation, poaching, and destruction of natural habitats create need for vulnerability assessment

Figure 8: Improper waste disposal observed in Cestos City, Rivercess County. Photo credit: Omasco Sren

These challenges can be addressed through the collaborative efforts of the government of Liberia, NGOs, and the community people in ensuring sustainable land management practices. Additionally, as indicated in nearly all of the baseline reports, there is a need to create sustainable livelihood options for local communities that rely on nearby ecosystems for their livelihoods. Also, empowering the communities to sustainably exploit the resources at their disposal will save the environment from hazardous activities.

4.2.Environmental Conditions and Livelihood

The environmental conditions in all of the counties suggest that the impacts of climate change are highly likely. As indicated above in the status of the environment, the environmental conditions in the counties are not favorable due to activities such as unregulated mining, unsustainable agriculture, charcoal burning, shifting cultivation, and unguided constructions in urban areas. These behaviors make the environment vulnerable to climate change impacts such as changing rainfall patterns and extreme heat.

Livelihood options in nearly all of the environments across Liberia are tied to natural resources and other forest-related activities. In Grand Bassa, Grand Cape Mount, Margibi, Montserrado, Maryland, and Sinoe, livelihood income or survivals are linked to fishing, farming, transportation, and employment opportunities in urban areas. This narrative is similar in Grand Gedeh, River Gee, and Gbarpolu counties, where subsistence farming is the major source of livelihood. Hunting is a source of livelihood in some of these counties as well, and this raises the need to promote sustainable land use and conservation of biodiversity. In Grand Kru, the residents also rely on the forest, waterbodies and the healthy ecosystem for their livelihood. Prior to the civil war in Liberia, Lofa produced rice in huge commercial quantities to the point that the county was nicknamed the ‘Bread Basket’ of Liberia. To date, farming is the principal

source of livelihood in Lofa, although the county is rich in natural resources. It is necessary that the agricultural activities in Lofa be guided by sustainable practices to reduce the vulnerability of climate change. In Nimba, livelihood is also dependent on agriculture, mining, and forestry. There are cocoa, coffee, and rubber farms in Nimba as is the case in other counties, necessitating the need to promote sustainable land use to avoid environmental hazards. Like Nimba, Bomi and Bong Counties also rely on agriculture and mining for livelihood and residents in these counties also engage in slash and burn farming practices, which as negative consequences for the environment. The overall air quality in these counties is moderate, with some pollutants causing health problems for pockets of the population. Margibi and Montserrado Counties have more metropolitan environments compared with the rest of the country. The environments are shrouded in various livelihood options such as commercial tree plantations, subsistence farming, fishing, trade, and employment opportunities. However, waste management is a problem in these counties.

Figure 9: Improper disposal of plastic products observed in Paynesville, Montserrado County. Photo credit: George Y. Sharpe

4.3.Poverty and Environmental Vulnerability

Based on the baseline reports, poverty level is high in all of the 15 counties and persistent poverty, low-income levels, and challenges in education and health amplifies the environments vulnerability to climate change-induced effects such as strong wind, changing rainfall patterns, flooding, rising sea level and erosion. In Grand Bassa for County for example, especially in rural areas, impoverished residents are significantly dependent on the natural environment for their survival, which increases the risk of environmental degradation and increases the county's

susceptibility to flooding, sea level rise, and coastal erosion. In Grand Kru, the lack of infrastructure, roads, and limited economic opportunities exacerbate the poverty level among mostly rural residents, pushing the residents into total reliance on the forests and water bodies for survival. This narrative is similar to the poverty and environmental situations in nearby Maryland County. Poor residents lack the resources to reduce their exposure to environmental hazards, heaped on their own activities such as poor waste management, unstainable agricultural practices, illicit mining towards the environment, and inequality in resources allocation.

In Montserrado, the low rate of formal employment also influenced citizens' reliance on the natural environment while at the same time engaging into petit trade for livelihood. Additionally, poverty levels in the counties and the lack of awareness on climate change and its impacts reduce chances of implementing climate-smart environmental activities or adaptation measures. For instance, 62% of the interview respondents in Sinoe County reported that there are no ongoing climate change adaptation practices in their communities, indicating that their environment's vulnerability to the adverse effects of climate change is huge.

Figure 10: Vulnerable housing structure along the coast in Rivercess County. Photo credit: Omasco Sren

4.4.Investments in Environmental Assets

Generally, the nine counties along the coast need investment in coastal defense, and their fishery sectors could be exploited. Contrarily, the six counties off the coast need investment in forest conservation from a general point of view. However, the individual counties are uniquely endowed with other environmental assets that can be invested in. Grand Cape Mount, for example, offers great ocean shores for surfing, and the county accommodates the Lake Piso Reserve, a national protected area. Sinoe County, on the other hand, has its agricultural land being invested in by Golden Veroleum, one of the biggest oil palm plantations in Liberia. Sinoe County also has an abandoned rubber concession covering over 600,000 acres, and the county's fishery and mining sectors offer prospects for huge investment that could provide further livelihood options for the citizens. Like Grand Cape Mount, Sinoe, Grand Gedeh, and River

Gee host the Sapo National Park, a national protected area. Similarly, the environment in Nimba County is resource-rich for investment, and the environmental assets being invested in include the Mount Nimba among other assets. In Margibi and Montserrado, investments are huge in rubber plantations and the counties' labor force.

In Grand Kru and Maryland, the soils offer great potentials for agricultural investments and the counties' fishery sectors are investment-friendly. Additionally, Grand Kru and Maryland Counties mineral and tourism sectors offer potentials for investment that could improve livelihood conditions in these counties. However, the counties' vulnerability to climate change is a challenge that needs to be addressed by any investment. This narrative is synonymous to the environmental situations in Bomi, Grand Cape Mount, Grand Bassa, and Rivercess Counties. Gbarpolu, Grand Gedeh, River Gee reported land suitable for farming, and these counties are also rich in mineral resources, which are being exploited. Lofa is, to some extent, the only county that is endowed with natural resources such as gold, iron ore, and diamond, but these resources are not being exploited. Although illicit mining occurs in Lofa, its Wologizi mountain has not yet being exploited, even though exploitation potentials exist. Lofa, like the counties off the coast, is also rich with tropical rainforests. Investments in these environmental assets have the potential to empower residents in the counties to overcome financial barriers and create long-term sustainability. This also goes with strengthening local institutions and empowering governance at the county level.

4.5.Available Resources and Challenges

County	**Available Resources**			Challenges
	Agriculture resources	Forest & biodiversity	Mineral & water resources	
BOMI	Arable land, oil palm, rubber; cocoa	Forest is a part of upper Guinea forest, hosts wild fauna and flora	Iron ore, diamonds, gold, goethite, hematite, leucophosphite, limonite, magnetite, phosphosiderite, quartz, rockbridgeite; blue lake, Atlantic Ocean, St. Paul River & several water bodies.	Illicit mining, unsustainable farming practices, and charcoal and fuel wood collection contribute to deforestation and environmental degradation while hunting threaten the existence of wildlife.

BONG	Arable land, commercially valuable timber, cocoa, oil palm; rubber	Forest is a part of upper Guinea forest, hosts diverse flora (e.g., ironwood)	Iron ore, gold, diamonds, and base metals, St. John River & several rivers & groundwater	Unsustainable farming practices and poor soil management contribute to deforestation and environmental degradation. Erratic rainfall patterns, low access to market infrastructure, land dispute, and weak law enforcement are other challenges.
GBARPOLU	Arable land; cocoa	Tropical rainforest, biodiversity, ecosystem	Gold, Diamond, Lofa River and several other water bodies	Logging and slash and burn farming practices contribute to deforestation, poaching threatens wildlife, and poor waste management leads to air pollution.

As shown in the table, Liberia is forest-cover and mountains across the country host various mineral resources, including iron ore, gold, and diamond. Besides Montserrado and Margibi Counties, all of the Counties are endowed with dense tropical rainforests, evergreen forests including high forests, broken forests and low bush that are rich in biodiversity. Other environmental assets include infrastructure in urban areas (mostly in Montserrado, Margibi, Nimba, and Grand Bassa Counties), water bodies including rivers, creeks, and streams traversing the entire country. These water bodies along with the Atlantic Ocean offer prospects for investment in fishing and transportation (in Maryland for example).

While these environmental assets have the potential to contribute to improvement in local economy at the county-level, their unregulated exploitation poses serious threat to the environment. For example, areas where unregulated fishing, illicit mining, and shifting cultivation occur are susceptible to disasters such land degradation, flooding and deforestation.

County	**Available Resources**			Challenges
	Agriculture resources	Forest & biodiversity	Mineral & water resources	
GRAND BASSA	Arable land	Atlantic Ocean, St. John River and several	Gold, iron ore, timber, diamonds, crude	Poor soil management contributes to soil erosion.

		other rivers to supply fish	oil, uranium, sand and rock	Unsustainable farming practices and illicit mining lead to deforestation and land degradation. Low value addition/access to market and weak law enforcement are other challenges.
GRAND CAPE MOUNT	Arable land, oil palm; cocoa	Forest, mountain, gold; diamond	Atlantic Ocean, Lake Piso, Mano River & several other water bodies	Poor governance and low infrastructure, compound challenges leading to land/environmental degradation.
GRAND GEDEH	Arable land, cocoa & coffee	Dense forests and wildlife and hosts part of Sapo National Park	Gold, iron ore and water bodies including Cavalla River and many others	Illicit mining and unsustainable farming are major determinants for deforestation and environmental degradation while hunting/poaching pose threats to wildlife
GRAND KRU	Arable land, oil palm, rubber, cocoa	Forest hosts rich biodiversity	Gold, diamond, iron ore, Atlantic Ocean, Dorboh and Norh Rivers, including several other water bodies	Deforestation, illegal mining, and unsustainable agricultural practices are major contributors to environmental degradation

County	**Available Resources**			Challenges
	Agriculture resources	Forest & biodiversity	Mineral & water resources	
LOFA	Arable land, rice, cocoa, oil palm, etc.	Tropical rain forest including high and broken forest and	Mountain, gold, diamond, iron ore, Lofa River, Mano River, & several water bodies	The challenges in exploiting the natural resources lie in governance, economic

		low bush, rich with biodiversity		development and poor infrastructure
MARGIBI	Commercial/cash crops (mainly rubber)	Forest part of the upper Guinea forest & host biodiversity	Atlantic Ocean, Farmington River and several other water bodies	Industrial agricultural practices associated with deforestation and environmental degradation while improper waste disposal is said to cause pollution.
MARYLAND	Arable land, commercial crops,	Dense tropical rainforest with biodiversity	Iron ore, gold, diamond, Cavalla River & several water bodies	Challenges associated with the exploitation of these resources include disruption of ecosystem, land degradation, and pollution due to improper waste management.
MONTSERRADO	Commercial crops (mainly rubber) arable land; infrastructure	Tropical forest covering the interior part of county	Gold, St. Paul River, Mesurado River, Du River and several other water bodies	Industrial agricultural practices associated with deforestation and environmental degradation while improper waste disposal is said to cause pollution.

County	**Available Resources**			Challenges
	Agriculture resources	Forest & biodiversity	Mineral & water resources	
NIMBA	Arable land; cocoa	Forest part of the Upper Guinea forest; timber	Iron ore, gold, diamond, base metals, water bodies	Environmental degradation and deforestation remain challenges due to unsustainable farming and illicit mining. Agriculture expansion and weak law enforcement also

				contribute to biodiversity loss.
RIVERCESS	Arable land, oil palm; cocoa	Dense tropical rainforest, rich in biodiversity	Gold diamond, iron ore, Sinoe River, Cestos River, Timbo River and several other water bodies	Unsustainable farming practices such as slash and burn and improper usage of chemicals contribute to deforestation, environmental degradation and pollution. Hunting and poaching also contribute to biodiversity loss.
RIVER GEE	Arable land; cocoa	Forests and wildlife	Gold, iron ore, River Gee, River Nun, River Gbeh and several other water bodies	Illicit mining and unsustainable farming are major determinants for deforestation and environmental degradation while hunting/poaching pose threats to wildlife
SINOE	Arable land; oil palm	Hosts Sapo National Park and many proposed protected areas, rich in wildlife	Gold, iron ore, Sinoe River, Dugbe River, Sanquin River, and several other water bodies	Illicit mining and unsustainable farming are major determinants for deforestation and environmental degradation while hunting/poaching pose threats to wildlife

Table 1: Available resources in all 15 counties and associated challenges

4.6.Economic Sectors and Climate Vulnerability

4.6.1. Agriculture, Industry, Tourism, Energy, Transport, and Services

The economic dynamics in most of the counties are characterized by rapid urbanization and population growth in urban areas, and low employment level, persistent poverty, low-income level, and challenges in education and health infrastructure in rural areas. The country's economy is driven by many sectors including the agriculture, industry, tourism, energy, transport, and services sectors. How opportunities in these sectors are leveraged at the county-level increases the country's vulnerability to climate change. Liberia's rural population in all of the counties rely on subsistence agriculture, fishing, and mining. These livelihood options have residents engaging in unsustainable farming practices such as slash-and-burn, charcoal burning, pit sawing mercury use in waterbodies, and digging of large pits in search of mineral resources, thereby contributing to deforestation and land degradation, and further increasing the country's vulnerability to climate change and its effects. In Lofa, for instance, the residents

are reliance on the agriculture sector for livelihood coupled with unsustainable farming practices, also increases the county's vulnerability to higher storm intensity.

Montserrado, Nimba, and Margibi, for instance, have large populations mostly in urban areas, and this increases these counties' vulnerability to climate change – in addition to unsustainable forest and land use. Climate-induced altercations in rainfall patterns also increase susceptibility to climate change, and this affects the agriculture and transport sectors. For instance, the counties in the southeast (i.e., Grand Gedeh, Grand Kru, Maryland, River Gee, Rivercess, and Sinoe) can be (to a large extent) cut off from the rest of the country during the raining season due to deplorable roads caused by sometimes unusually heavy down pours. Changing temperature and altered rainfall patterns also negatively affect agricultural production in all of the counties. During the dry season, water availability also drops in counties like Montserrado, Margibi, and Gbarpolu, and energy access decreases across the country.

Liberia is also rich in natural beauties – including pristine beaches, landforms, and wildlife – to attract tourists into the country. Counties along the coast like Bomi, Grand Bassa, Grand Cape Mount, Grand Kru, Margibi, Maryland, Montserrado, Rivercess and Sinoe are homes to pristine beaches and ocean shores. However, rising sea level, increased storm intensity, and coral bleaching could damage the coastal ecosystem and reduce the attractiveness of tourist destinations in these counties. Rising sea level and ocean acidification also make the fishing industry in these counties vulnerable.

5. Climate Information

5.1. Climate Overview for all Counties

Liberia is a very wet country. Liberia's climate is determined by the country's geographic position near the equator and Atlantic Ocean. Based on satellite estimates and global climate models, temperatures in the various counties are warm throughout the year with extremely high humidity. The climate is characterized by seasonal change of temperature and humidity and more marked changes between day and night. Liberia has two seasons (rainy and dry), and these seasons are marked by variation in precipitation across the country. The start and end of each of these seasons, along with the temperature and precipitation trends, vary across the counties.

In Grand Gedeh County, for example, the rainy seasons runs from April to October each year, with the dry season running from October to April. This trend slightly differs from neighboring River Gee where the rainy season runs from April to November and the dry season November to April. In Sinoe the rainy season starts a bit later in May and ends in October. The dry season runs from December to February in Sinoe County, with sporadic sunshine (locally referred to as 'middle dries') in the other months.

Generally, the Liberia is also a warm country, owning its warmness to climate-induced factors. The temperatures across the counties range from 21°C to as high as 33°C, although the temperatures are sometimes higher in the winter months. Liberia receives significant amount of rainfall annually, with Grand Bassa being the wettest county at 4,000 mm of precipitation. Grand Kru (349.46 mm) and Gbarpolu are the counties that see less precipitation (338.17mm) based on the findings of the County Baseline Reports. The below table presents an overview of the climate information for each county, cued from the reports.

County	Rainy season	Dry season	Estimated annual Temperature	Average annual rainfall
Bomi	May to November	December to April	22.3°C to 30°C	558.17mm
Bong	April to October	November to March	25°C to 33°C	2,000 to 3,000 mm
Gbarpolu	April to October	November to March	25°C to 30°C	338.17mm
Grand Bassa	April to October	November to April	26°C to 32°C	4,000 mm
Grand Cape Mount	May to November	December to April	21.75°C to 32.51°C	3,114.90mm
Grand Gedeh	April to October	October to April	25.5ºC on average	76 to 107 inches (2,717.8 mm)
Grand Kru	April to September	October to March	25.5ºC to 31.5°C	287.22 mm to 349.46 mm
Lofa	April to October	November to April	24 ºC to 30 ºC	2,900 mm
Margibi	May to November	December to April	26°C to 30°C	3,255.79 mm
Maryland	April to October	November to March	22.53°C to 29.18°C	101.5 inches (2,578.1 mm)
Montserrado	May to November	December to April	25.13°C to 26.52°C	75 inches (1,905 mm)
Nimba	May to October	December to February	23°C to 30°C	1,800 to 2,200 mm
Rivercess	May to October	December to February	25.7°C on average	2,467.07 mm
River Gee	April to November	November to April	25.5ºC on average	107 inches (2,717.8 mm)
Sinoe	May to October	December to February	26.77ºC to 31.81ºC	2,396.11 mm

Table 2: Summary of the climate information of all counties as indicated in the individual baseline reports

5.2.Historical Climate Data (Temperature and Precipitation Trends)

The historical climate data presented in the county baseline reports record the temperature and precipitation trends of the country from 1901 to 2022. The historical data show that Liberia's temperature remained constant (with minor variation from one year to the other) from 1901 to the 1920s. The 1930s to the 2000s saw fluctuations with gradual temperature increases from 2000 to 2022. In Sinoe, River Gee, and Grand Gedeh, for instance, the minimum temperature remained stable at around 20°C to 22°C from 1901 to the 1920s. From the 1930s to the year 2000, the minimum temperature in these counties fluctuated from around 20°C to 22°C and gradually increased from 2000 to 2022. In Bomi and Grand Cape Mount Counties, the temperature varied each year between 1901 and 2022, notably with no consistent pattern of high and low temperature years. In Grand Cape Mount, notable high minimum temperatures exceeded 25°C between 1901 to 2022 and the low temperatures were slightly above 24°C,

while in Bomi the minimum temperature dropped from slightly above 22°C to over 21°C. During this period (1901-2022), 2020 (26.59°C) was the warmest year in Grand Cape Mount County while 2021 (22.11°C) was the warmest year in Bomi.

The year-to-year variations observed in the minimum temperatures in Bomi and Grand Cape Mount Counties also occurred in Bong County during the period 1901 to 2022. Bong County recorded decline in its minimum temperature between 1903 and 1910 and a further decline between 1924 and 1934, with 1929 (19.43°C) being the coldest year during that period. The County saw relative stability in its temperature throughout the mid-1940s to the 1960s before the return of a cooling trend in the 1970s. from the late 1980s to 2022, Bong County has been recording gradual increases in its minimum temperature, recording 20.98°C in 2016. In Gbarpolu County, the minimum temperature was consistently stable around over 20°C from 1901 to 1909, before it started to decline to hit its lowest temperature (17.97°C) in the late 1920s to 1931. Gbarpolu then recorded a stable temperature pattern (slightly above 20°C) from the 1940s to the 1970s, with noticeable fluctuations between 1971 and 1975 where the temperature decreased before rising from the late 1970s up to 2022. Gbarpolu recorded its highest minimum temperature (20.98°C) in 2021, which indicates a noticeable increase in temperature over the years. Lofa which is next door Gbarpolu shared similar temperature history with Gbarpolu, except that Lofa at some point recorded much lower temperatures (i.e., 16.9°C during the period 1981 to 1990).

In Nimba, the historical data show that the county recorded interannual variations in its temperature in the 1900s onward. The minimum temperature in Nimba decreased between 1903 and 1910 with a further decline in temperature occurring between 1924 and 1934. During this period, Nimba recorded its lowest minimum temperature of 19.23°C in 1929. From the 1940s to the late 1960s, the fluctuations in the temperature in Nimba remained, showing year-to-year variations. From the late 1980s to 2022 saw gradual increase in the temperature in Nimba, with the highest minimum temperature (20.76°C) recorded in 2016. Like most of the other counties, Montserrado and Margibi have over the years recorded variations in their temperatures. The temperatures in these counties fluctuated at around above 20°C from 1901 to 1910 before decreasing in the 1930s. The temperature was relatively stable at above 21°C from the 1940s to the early 1970s. Gradual increases were recorded in the minimum temperatures in Montserrado and Margibi from the 1980s to 2022, the highest minimum temperature being 22.21°C in Montserrado and 21.75°C in Margibi during this period.

In Rivercess and Grand Bassa Counties, the minimum temperatures fluctuated through years from 1901 to 2022. In Rivercess, particularly, the minimum temperature fluctuated between 20.27°C in 1976 and 21.78°C in 2016, with an overall average of 21.03°C. This indicates that temperature levels have not been considerably stable in most of the counties. In Grand Bassa, high degree of year-to-year variation in the minimum temperature level is noticeable during the period 1901 to 2022. The County observed a decreased minimum temperature between 1903 and 1910, followed by a further decline between 1924 and 1934 – the lowest temperature being 19.23°C in 1929. From the 1940s to the 1960s notable higher minimum temperature levels fluctuated within a narrow range in Grand Bassa County. This period was followed by a decreasing trend in the minimum temperature levels throughout the 1970s, 1976 being the coldest year during this period with a minimum temperature of 19.22°C. Since the 1980s to 2022, there has been gradual increase in the minimum temperature level. The highest minimum temperature recorded during the time was 20.76°C in 2016.

In Grand Kru, unlike the other counties, the historical data reveals that the minimum temperature has been increasing throughout the years – with notable fluctuations in between. The minimum temperature in Grand Kru County ranged from 29°C from 1901 to the mid-1960s. This rise in temperature has continued from the late 1960s to 2022. Like Grand Kru, neighboring Maryland has its minimum temperature increasing throughout the years. However, Maryland's temperature increase has been slow, progressing from a minimum temperature of 21.9°C in the 1900s to 22.1°C in modern years. Maryland County recorded its highest annual minimum temperature of 22.6°C in 2016.

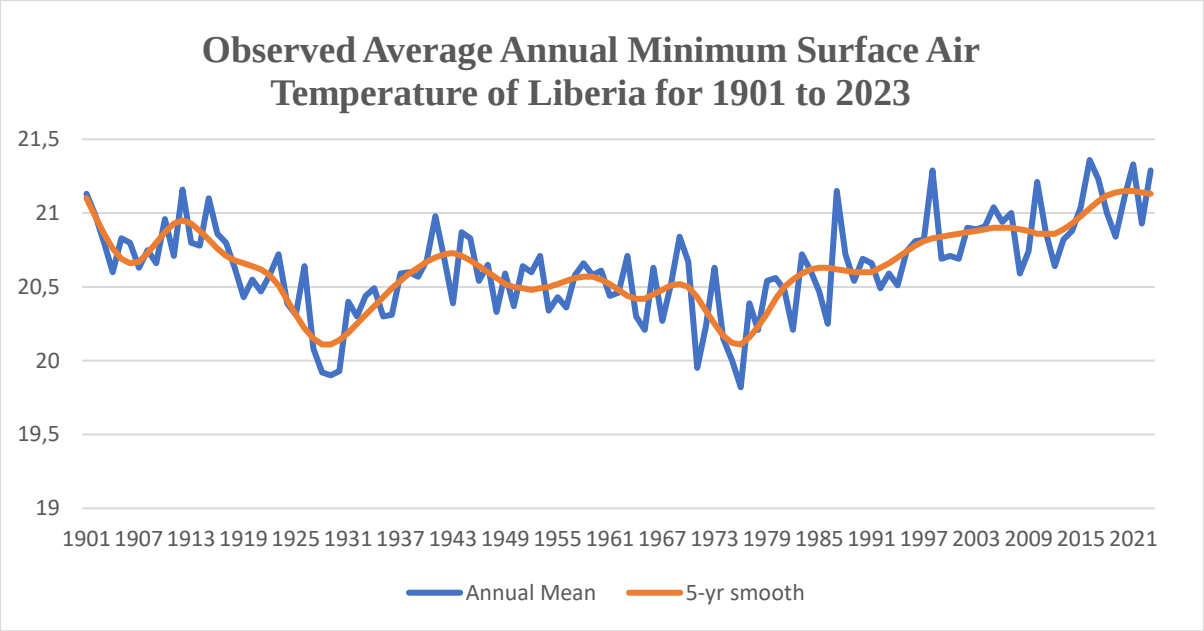


Figure 11: Average annual minimum surface air temperature of Liberia (1901-2023)

Summarily, the historicity of the minimum air surface temperature for all the 15 counties indicate that Liberia's has progressed from a relatively cool country to a much warmer place throughout the years. As indicated in the individual baseline reports, this temperature trend can be owed to many factors including rise in population, urbanization, and various livelihood driven activities. This has also affected the precipitation trend in all of the counties.

Liberia's precipitation pattern was constant between 1901 and 1919 in most of the counties, although there were fluctuations between 1907 to 1909, recording notable reductions in precipitation. Like the temperature, the country's precipitation patterns vary across the counties through the ages. Grand Gedeh, River Gee and Sinoe Counties, for example, received their highest rainfall in September between the period 1991 to 2022, with January receiving the lowest precipitation. May to October has been the wettest months in these counties over the years – during which time the counties and other counties in the region can mostly be hard-to-reach or inaccessible by road. In Grand Kru, which is located in the same region as Grand Gedeh, River Gee and Sinoe, the annual rainfall was minimal in the 1900s, making farming difficult during those years. Grand Kru however saw substantial rainfall throughout the 1920s, 1927 being the wettest year during this period. A noticeable decline in rainfall followed in much of the 1930s – 1931 and 1934 were the only years rainfall peaked in Grand Kru during this decade. Like in other counties, the rainfall followed a zigzag pattern in Grand Kru from the mid-1930s to 2010s. There were gradual increases in rainfall in the 1940s, decline in the 1950s and increase again in the 1960s and so forth up to 2010 when rainfall last peaked. Since

then, Grand Kru has been experiencing slight decline its annual rainfall with noticeable fluctuations in certain years. In Maryland which is next door Grand Kru, rainfall was lower in the 1900s and started gradually increasing in the 1920s, peaking in the 1940s due to potential natural climate variation or human-induced changes. The post 1940s saw gradual decrease in rainfall in Maryland County up to the mid-1960s, creating implications for agriculture and water availability in that part of the country. Maryland County recorded a stable precipitation pattern from the 1970s to the 1990s. Since the early 2000s precipitation has increased in Maryland County, reflecting potential changing climatic patterns

In Bong County, the average annual precipitation was relatively stable from 1901 to 1919, with minor fluctuations in between this period. Rainfall however peaked in 1927, hitting an average 3,287.6 mm, and declined until the 1960s. September has been the month with the highest rainfall and December has been the month with the lowest rainfall in Bong County. In Gbarpolu County, the historicity of the precipitation recorded between 1991 and 2022 shows stable rainfall pattern, with fluctuations between 1991 and 1992, until the early 2000s. September has been the month with the highest rainfall in Gbarpolu County, with January recording the lowest rainfall.

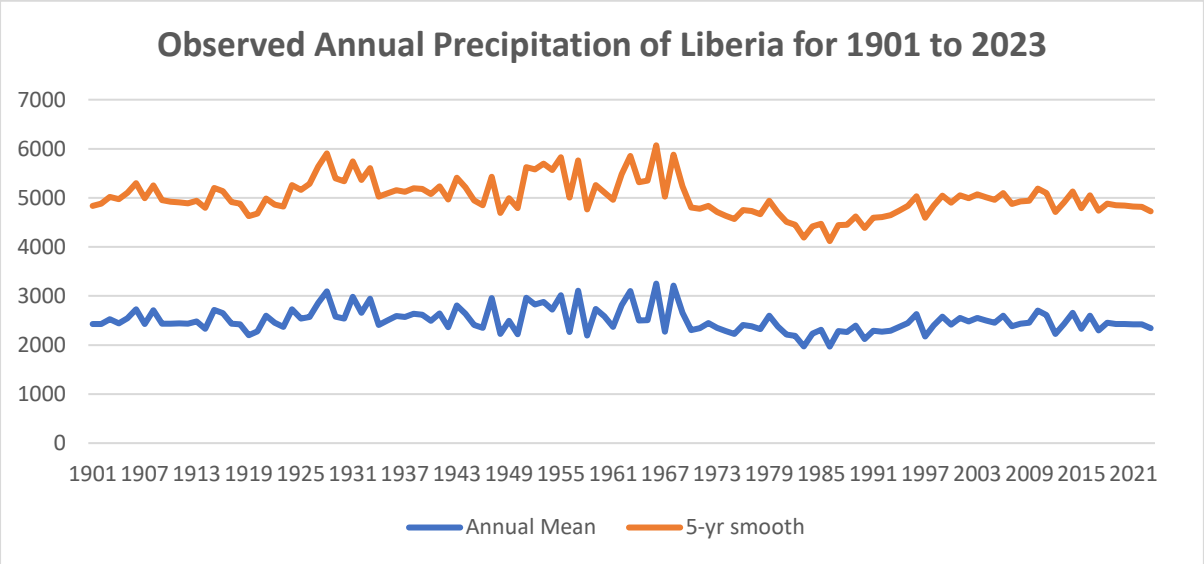


Figure 11: Average annual precipitation of Liberia (1901-2022)

In Lofa County which is next door Gbarpolu County, the precipitation pattern has been in a zigzag manner, peaking and declining in certain years. Notably, the precipitation in Lofa was much higher in the 1900s and it declined throughout the 1960s with fluctuations in between. Lofa received its highest rainfall (31,97.18 mm.) in 1906 and its lowest rainfall (2092.81 mm.) came in 1986.

In Nimba County, the precipitation pattern was consistently stable from 1901 up to 1919, with occasional slight decreases in certain years during this period. In the 1920s rainfall increased in Nimba County, with 1927 (3,025.15 mm.) being the wettest year around that period. This peak in rainfall in the 1920s was followed by decline in rainfall mostly in the 1950s, with the lowest rainfall (14 mm.) coming in 1953. From the 1960s to the 1980s rainfall was high in Nimba County, 1983 being the year with the highest rainfall (2757.57 mm.). The recent precipitation level in Nimba shows (2,044.69 mm) indicating a slight decline compared to the previous years.

In Rivercess which is along the coast like Maryland and Grand Kru, rainfall has been heavy. In 1901 the annual rainfall was 2,55563, which remained relatively consistent for a few years. There were fluctuations in the precipitation level in 1907 and 1909, recording slightly lower values. In the 1920s rainfall increased in Rivercess, peaking at 3,135.94 mm. in 1927 and 3,426.08 in 1928. These two years marked an above-average rainfall period in Rivercess. Rainfall slightly declined between 2384.94 and 2626.97 in the 1930s and the early 1940s before increasing again in 1947 at 3368.82 mm. Throughout the 1950s and 1960s, rainfall remained relatively consistent in Rivercess County. The 1970s saw slight decrease in rainfall and the years of the 2010s recorded a noticeable increase in rainfall. However, the years following this period have seen the precipitation pattern matching that of the 1900s. This same precipitation history in Rivercess county is slightly similar to the precipitation history of next door Grand Bassa County. From 1901 to 1919, the annual mean precipitation in Grand Bassa County remained relatively stable, with a slight decrease observed in some years. However, from 1920 onwards, there was a noticeable increase in annual mean precipitation, reaching its peak in 1928 with a value of 3,696.85 mm. Grand Bassa has had an irregular rainfall pattern over the years. The county has been experiencing rainfall ranging from 2,193.36 to 3,761.29 mm., with its highest coming in 1966 and the lowest in 1983. Throughout the years rainfall has been fluctuating, increasing in certain years and decreasing in the others. However, the recent data from 2022 show a slight decrease in the annual rainfall in Grand Bassa County.

For Bomi County, during the period from 1901 to 2022, the annual precipitation ranged around 3117.15 mm. in 1901 but decreased to 3115.25 mm in 2022. Like in the other counties, the annual mean precipitation varied and fluctuated throughout the years. The lowest Observed Annual Mean Precipitation of Bomi County was in 1986 (2493 mm), while the highest was recorded in 1966 (4276.15 mm). This trend is similar to that of nearby Grand Cape Mount County. The highest observed annual precipitation in Grand Cape Mount County occurred in 1966, recorded at 4180.31mm, while the lowest occurred in 1950 (2679.69mm). The fluctuation patterns in the data can be seen through specific pairings of high and low values over the years. For example, in 1966, the highest precipitation of 4180.31mm was recorded, paired with the lowest value of 2679.69mm in 1950, indicating also a zigzag pattern of rainfall history.

These shifts in the rainfall patterns in the counties represent the irregular climatic condition across Liberia, which is indicative of implications for water management and flooding among other disasters.

5.3.Projections and Variability (Temperature and Precipitation)

Based on the County Climate Change Baseline reports, the variability in the temperature level for Liberia was recorded in 30-year gaps from 1951 to 1980, 1971 to 2000 and from 1991 to 2020 respectively. Generally, the minimum temperature varied between above 20°C and slightly above 24°C, indicating notable increases in temperature levels over these specified periods. There were variations in the temperature level throughout the years, with the months of January, July, and December indicating low temperature and February, March, and April being the months with the highest temperatures in most of the counties.

The precipitation trends indicate that Liberia has two seasons: rainy season and dry season. The period 1951 to 2000 records notable variation in rainfall as the case with temperature levels in

all of the counties. The degree of rainfall in the counties during the period varied between 200 mm. to up to 4,000 mm. The highest rainfall occurred in the months of August, September, and October in the different counties, during which time some of the counties can be hard-to-reach.

Based on the multi-model ensemble data (CIMP6) analyses, precipitation is expected to vary considerably in all shared socioeconomic pathways (SSP) in all of nearly all of the counties, with high emission scenario precipitation averages expected to range between 1463.88-2079.15mm. by 2050 and 1400.58-2359.97mm. by 2100 in Nimba County, for example. Grand Bassa is projected between 2092.42-3089.61mm and 2050.82-3409.22mm during these same periods. Similarly, temperature levels are projected to rise in all of the counties during these same periods if climate change and their impact on the environment are not duly addressed.

5.4.County-specific Highlights

5.4.1 Notable Trends and Variability in Temperature and Precipitation for Select Counties

The temperature variability in all of the counties during the period 1951 to 2020 illustrates an upward trend. In Bomi County, the temperature was 22.75°C with a distribution of 1.37 during the period 1951-1980. In the 1971-2000 period, the temperature was 22.87°C with a distribution of 1.68, and in the 1991-2020 period, it was 23.15°C with a distribution of 1.35. This upward trend is similar in Bong County where the average annual minimum temperature ranged between 21.13°C and 22.52°C during the period 1951-1980. Subsequent periods show an intensified temperature increase, with average minimum temperatures ranging from 21.12°C to 22.67°C from 1971-2000, and 21.31°C to 23.09°C from 1991-2020, indicating a widening temperature range and upward trend.

Similarly, Grand Bassa also recorded an upward trend during the period under consideration. Between 1951-1980, the temperature in Grand Bassa County ranged from 21.74°C to 23.05°C, showing a relatively stable period. However, in the subsequent years, particularly from 1971-2000 and 1991-2020, there is a noticeable increase in temperatures, with averages ranging from 21.79°C to 23.64°C in the latter period. The rate of temperature rise appears to be accelerating, with a more significant increase observed from 1971-2000 to 1991-2020 compared to the earlier periods. In Grand Cape Mount, the minimum temperature was 22.57°C with a distribution of 1.98 during the period 1951-1980, 22.67°C with the distribution of 1.73 from 1971-2000, and 22.94°C with a distribution of 1.44 in 1991-2020. Again, the distribution pattern during those periods was moderately higher, indicating a consistent temperature rise.

In Grand Gedeh County variation of temperature throughout these years was noticed, with the months of March and April indicating higher temperature (above 21°C), while the temperature recorded within the months of January, July and December seem to be relatively stable or constant.

In Grand Kru County, a rising trend in the average minimum surface air temperature over the years was recorded, with a notable acceleration in the rate of increase. The temperature ranged from 22.301°C to 24.142°C in 1951-1980, while it ranged from 23.617°C to 24.142°C in 1991-2020. This consistent increase, despite noticeable fluctuations within periods due to natural variability or meteorological factors, suggests increasing regional challenges.

Lofa County, like the other counties, also recorded an accelerating trend in its minimum temperature during the years. During the period 1951 to 1980, the recorded temperature in Lofa

County was 20.85°C with a distribution of 1.74. From 1971 to 2000, the median temperature was 20.89°C with a distribution of 1.51. Finally, from 1991 to 2020, the temperature was 21.24°C and the distribution was 1.30.

The variability in temperature in Margibi revealed a steadier rise in the minimum temperature during the periods under review. In general, the minimum temperatures ranged from 21.2°C to 24.8°C, with some fluctuations observed within each season during the periods 1951-1980, 1971-2000 and 1991-2020. This steep rise in the minimum temperatures during the years could be attributed to population increase among other phenomenon during the periods under consideration.

In Maryland County, the average minimum temperature pattern also shows increase in the temperature over the years. From 1951 to 1980, the average minimum temperature fluctuated between 21.83°C and 22.26°C. This slightly increased in the 1971-2000 period to 22.46°C. The most substantial rise occurred from 1991-2020, peaking at 23.75°C. However, this increase offers irregular intervals of stability or minor decrease. Accessing the magnitude of change, the shift in temperature from 1951-1980 through 1971-2000 was minimal, with a 0.22°C turn. A significantly larger leap to 1.69°C happened between 1971-2000 and 1991-2020. Alongside growing temperature distribution over time, this suggests an increasing probability of extreme temperatures and intensified fluctuations with Maryland County.

In Nimba, a similar increase in the minimum temperature was recorded. In the initial period of 1951-1980, the minimum temperatures in Nimba County ranged from 20.79°C to 22.24°C. This increased to 20.79°C to 22.43°C in 1971-2000 and 21.05°C to 22.86°C from 1991-2020. The rate of the temperature rise appears to be accelerating. There was a minimal average increase of 0.03°C from 1951-1980 to 1971-2000, but a more pronounced average increase of 0.43°C from 1971-2000 to 1991-2020, indicating a faster warming trend. This accelerated rate of temperature increase may present challenges for the region in terms of adaptation. Despite fluctuations within each period, likely influenced by natural variability and local meteorological factors, the overall trend of rising temperature is evident in Nimba County.

In River Gee, the minimum temperature varied between 22°C and 23°C during the periods under consideration. There was a variation in the temperature throughout these years with the months of February, March and April indicating higher temperature, while the temperature recorded in the rest of the months remained at 22°C with slight variation.

In Rivercess, a similar upward trend is recorded. During the earliest interval (i.e., 1951-1980), the minimum temperature fluctuated between 21.51°C and 21.96°C. The subsequent period (1971-2000) saw a modest increase, with the minimum temperature ranging from 21.56°C to 22.05°C. The most recent timeframe (1991-2020) indicates a more pronounced rise, with the minimum temperature stretching from 21.58°C to 23.46°C.

For Sinoe County, the average minimum air surface temperature was acquired for every 10 years from 1951 up to the time of the writing of baseline report for the County. The report revealed variation of the temperature throughout these years, with the months of March and April indicating significant variation. The temperature recorded within the months of January, July and December seemed to be relatively stable at a minimum temperature of around above 22°C. This seem variation was recorded in the precipitation trend for Sinoe County. The precipitation data of the county was similarly recorded from 1951 to 2022 within a ten-year interval, having a rainy and a dry season as the rest of the country has two seasons. The dry

season is recorded during the month of November to April, while the rainy is from May to October each year. On average, Sinoe County receives between 200 to 300 mm. of rainfall each year. September has been the month with the highest rainfall with an average precipitation of 628.09 mm.

River Gee County which is next door Sinoe County has similar precipitation history as Sinoe. The rainy season occurs in the same period as Sinoe (November to April each year), and the county receives an average rainfall of between 200 to 300mm as well. River Gee County records its highest rainfall in September with an average of 555.65mm., slightly lower than Sinoe which sees its highest rainfall in the same month.

The precipitation variability trend in Grand Gedeh County, which borders both River Gee County and Sinoe County was recorded during the same period (1951-2020). The precipitation variability trend shows that Grand Gedeh like all other counties in Liberia has a rainy season and a dry season, the rainy season occurring in May to October and the dry season occurring in November to April each year. On average, the county receives between 200 and 300 mm. of rainfall each year. Grand Gedeh also receives its highest rainfall in September, averaging 370.82mm., indicating that rainfall in the county is not as high as in the other two counties.

Grand Kru County and Maryland County are also in the same region as Sinoe, River Gee, and Grand Gedeh. The baseline report for Grand Kru reveals a more consistent variation in rainfall during the periods under consideration (1951—2020). From 1951 to 2020, there was no consistent upward or downward trend in the precipitation across the seasonal cycle during the years. Some months consistently experience higher precipitation levels, while others experience more fluctuating patterns, indicating the effects of different climatic factors throughout the years. However, the recent data from 1991-2020 suggest a slight increase in precipitation in the month of July compared to previous decades.

In Maryland County, the monthly precipitation shows considerable variability in January in the 1960s, with decrease in rainfall and subsequent increase in the 1970s. February follows a similar pattern with fluctuations. March, on the other hand, shows a consistent upward trend in precipitation trend, with a slight increase in precipitation. May shows a relatively stable pattern with slight increase in precipitation. However, June experiences a decrease in rainfall and July exhibits significant variations in precipitation levels, decreasing in the 1970s, followed by an overall increase until the 1990s. August follows a similar pattern to July with an overall increase in precipitation and September shows a consistent increase in precipitation over time. October exhibits a mix of patterns, with an increase in the 1970s and subsequent decrease in the 1980s. November shows fluctuation in precipitation levels, while December displays a general decrease in the 1970s, followed by increase in the subsequent decades. From 1951 to 1980, precipitation in Maryland County varied from 1275.88 mm. to 3181.83 mm. with irregular distribution, indicating occasional heavy rainfall events. The following period (1971-2000) saw overall precipitation levels rise between 1381.77mm. and 3075mm. yet, considerable variability remained, alluding to the unpredictable rainfall patterns. The recent interval (1971-2000) mirrored prior fluctuations, with precipitation levels from 1423.12mm. to 3181.83mm. Notably, a slight decline in precipitation suggests potential concerns about the water availability and its impact on local ecosystems and activities.

In Rivercess, the precipitation increased during the periods 1951-1980 and 1971-2000 to 113.76985 mm and this remained constant from 1971-2000 to 1991-2020. In next door Grand Bassa County the precipitation dynamic is different. The baseline report for this county reveals

that Grand Bassa records considerable variations in its rainfall pattern. The County receives higher amount of rainfall in June, July, August and September while November, December, January, and February display more unpredictable rainfall patterns. For example, in 1978, June received the highest rainfall of 657.09 mm. while December recorded the lowest rainfall at 1.97 mm., suggesting that a range of climatic factors influence the variation in the precipitation pattern. Additionally, there were year-to-year fluctuations in the rainfall pattern from the 1950s to the 1970s in Grand Bassa County. Generally, Grand Bassa County recorded an upward trend in precipitation levels throughout the years. From the first interval (1951-1980) to the second interval (1971-2000) there was a decrease in rainfall. There was however a slight increase in the third interval (1991-2020), indicating a potential transition towards a wetter climate in the county.

In Margibi and Montserrado Counties the precipitation variation also followed a zigzag pattern throughout the years, showing stability mostly in September and fluctuations in July from the 1950s through the 1970s. The 1950s to the 1960s also saw increases in rainfall in these counties, recording decline in the decades that followed (i.e., 1970s). The 1980s to the 2010s witnessed increased rainfall in Margibi and Montserrado based on the data in the baseline reports, not without fluctuations, though. Rainfall is much higher in August and September in these two counties, before declining in December and January during the periods under review.

In Nimba County, the precipitation pattern varied between 1593.14 mm. and 2757.14mm., representing the lowest and the highest rainfall amounts recorded in the county in 1983 and 1963 respectively. Certain months, such as June, July, August, and September consistently receive higher amounts of rainfall, while other months like November, December, January, and February receive lower and erratic patterns. June stands out as the month with the highest rainfall (452.22mm.) across all the decades, with December recording the lowest amount of rainfall (0.03mm.) in Nimba County in 1978. Nimba, unlike the other counties, reported consistent decrease in its precipitation levels throughout the years, with the downward trend being more pronounced in the initial timeframe of 1951-1980 to the final one (1991-2020), indicating a possible transition towards a drier climate in the county.

As in Nimba, neighboring Bong County also recorded variation in its precipitation during the periods 1951-2020. The months of June, July, August, and September consistently received higher amounts of rainfall, while November, December, January, and February received lower precipitation. September stands out as the month with the highest recorded rainfall (560.32mm.) across all the decades, while December registered the lowest amount of rainfall in 1978 at 0.01mm.). Overall, there is a general decrease of -15.39mm. per decade in average precipitation levels in Bong County, also indicating a transition towards a drier climate in the area.

In Lofa County which borders Bong, the variability and trends of precipitation across seasonal cycle was experienced in the period 2001-2010 (512.85mm., specifically September 2017), while the lowest was recorded in the period 1971-1980 at 0mm. in December 1978). From the period 1951 to 2020, the highest precipitation (2340.96mm.) was recorded during the period 1951-1980, while the lowest precipitation (2152.14mm.) was from 1971-2000. During the period of 1991-2020, the precipitation was 2290.23mm., and from 1951-2020, it stood at 2282.63mm. In neighboring Gbarpolu, the variation trend is slightly similar, with September being the month with the highest amount of rainfall, peaking at above 300mm. from 2011 to 2020. Rainfall decreases in Gbarpolu in December, January, and February, and starts to increase considerably in May, with some fluctuations.

In the western part of the country in Bomi and Grand Cape Mount, variation in amounts of rainfall is more pronounced as in the rest of the counties. In Bomi, the precipitation variability and trends from 1951 to 2020 shows that all months experienced climatic variability. The lowest precipitation in Bomi was 0.3mm. in December 1978 and the highest was 807.99mm. in August 2010. The dry season is December to March, and the rainy season starts from April, increasing in June and peaking in July. August and September have less rain and October and November have fewer rainy days. December is the driest month, highlighting that Bomi County's distinct dry and wet seasons from 1951 to 2020. Between 1951 and 1980, the value of rainfall in Bomi was 3107.03 mm. with a distribution of 0.00. From 1971 to 2000, the value was 3011.16mm. with a distribution of 0.00. finally, between 1991 and 2020, Bomi registered a rainfall value of 3101.29mm. with a distribution of 0.00. In next door Grand Cape Mount, the recorded precipitation from 1951 to 2020 shows that the highest annual precipitation in Grand Cape Mount County was recorded in August 2019, reaching a remarkable 880.85mm., while the lowest precipitation of 0.4 mm. was observed in December 1978. The period between 1951 and 1980 showed a change in distribution, with a median of 3172.31mm. and a distribution of 0.00. for the period between 1991 and 2020, the median precipitation was 3114.90mm with a distribution of 0.00. The change in precipitation distribution during these periods indicates a moderate fluctuation pattern, not observed in counties in other regions of the country.

5.5.Recommendations for Climate Adaptation

The baseline reports recommend intervention in many areas. Specifically, they recommend the implementation of sustainable water management practices at the county-level, engagement into climate-resilient agriculture, enhancing ecosystem conservation and restoration, strengthening flood resilience and disaster preparedness, promoting climate adaptive infrastructure, improving data collection and monitoring, enhancing community engagement and participation, fostering cross sectoral collaboration, public awareness and education, and the conduct of climate impact assessment in all of the counties. It is also recommended to strengthen climate governance at the county-level.

6. Climate Change Impacts and Vulnerability

The impacts of climate change are being experienced in key sectors connected to the NDC at the county-level. These climate-induced impacts on the local communities have caused altercations in livelihood income generation in some communities – which further increases susceptibility to climate change and its adverse implications. For instance, some farmers in counties such as Grand Gedeh and River Gee have shifted attention to mining and hunting due to irregular precipitation that has affected farm yields. Such a change in livelihood option contributes to land degradation and poaching, thereby contributing to biodiversity loss and further increasing the environments vulnerability to climate change.

6.1.Impacts on Key Sectors

According the baseline reports, all of the counties reported severe impacts of climate change, which affects key sectors connected the NDC at the county-level as shown in the table.

Sector	Impact	Proposed mitigation

Agriculture	Disruption in yearly planting and harvesting schedules as a result of altered rainfall patterns. Crop growth, yields, and overall crop quality also adversely affected by altered precipitation. This sector also faces challenges with drought, soil erosion, waterlogging, and pest infestation.	Build resilience. Ensure sustainable agriculture through policy-informed community awareness and to put in place support mechanism.
Coastal Zone	Rising sea levels results in sea erosion, coastal flooding, marine water intrusion into fresh water, and altercations in the marine ecosystem in the counties along the coast.	Build coastal defense. Support livelihood diversification to reduce dependence on the ocean and other water bodies. Increase stakeholders' engagement to build resilience.
Energy	Rising temperature levels reduce efficiency of thermal power plants. Energy distribution and consumption low during the dry season.	Increase capacity for solar energy. Improve thermal power plants to make it functional all year round. Invest funds in this sector.
Fishery	Increased sea surface temperature, ocean acidification, increased frequency of rainfall contributes to disruption in fish production patterns, migration of fish species, and loss of fishing days.	Include fishery into climate change adaptation mechanisms, strengthen fishery management bodies, and improve monitoring systems.
Forestry	Increase heat waves and forest fires as results of deforestation and slash-and-burn farming practices.	Strengthen forest management bodies at county-level, promote conservation and reforestation. Strengthen partnership in counties and enforce laws on protected areas and species.
Health	Incidences of heat waves, severe rainfall, flood, erosion, tidal abnormalities, tropical storms and rising temperature contribute to cases of diarrhea, cholera, tuberculosis, and dengue.	Strengthen healthcare facilities with adequate logistics and more competent staff. Implement routine disease surveillance and an early warning system, and accelerate public health awareness.
Industry	Erratic rainfall patterns hinder mining and logging activities. Land degradation and deforestation occurs as a result of unregulated mining and logging.	Enhance monitoring and reporting systems. Enforce the legal framework surrounding the sector. Support alternative livelihood options and promote sustainable land use.

Transportation	Severe rainfall worsens unpaved roads to the southeast and other regions of the country. Rising sea level and erosion also make traveling by water difficult.	Upgrade all major roads to asphalt pavements. Promote climate-informed planning and building construction.
Waste	Heavy rainfall and flooding severely affect waste management, mostly in urban areas. Flooding and erosion usually deposit large chunks of waste while also damaging waste management infrastructure. Waste management is problematic largely during the rainy season, contribute to environmental pollution.	Increase the technical and infrastructural capacity of waste management bodies. Increase household awareness on waste management. Enhance monitoring and reporting system, and strengthen the institutional and legal framework surrounding waste management at the county-level.

6.2. Vulnerability

Vulnerability across the counties is shaped by socio-economic factors, infrastructure quality, and adaptive capacity. High socio-economic vulnerability in counties like Grand Cape Mount and River Gee is driven by poverty, limited access to resources, and economic dependency on climate-sensitive sectors. On the other hand, most of the counties, especially those along the coast, have low infrastructure resilience, making them susceptible to climate change impacts like flood and erosion.

Counties such as Grand Gedeh and Maryland face heightened vulnerability due to poor health services and educational infrastructure, which hinders community resilience. Governance plays a crucial role in reducing vulnerability, with weaker governance structures in counties like Grand Gedeh and Rivercess impacting the implementation of adaptive measures.

The overall low adaptive capacity in counties like Grand Kru and Sinoe highlights the need for targeted interventions to improve infrastructure, governance, and community engagement to build resilience against climate change impacts. The following table summarizes the vulnerability of each county:

County	***Socio-Economic***	***Infrastructure***	***Health Services***	***Education***	***Governance***
Bong	Medium	Medium	Low	Medium	Medium
Grand Bassa	Medium	Medium	Medium	Medium	High
Grand Cape Mount	High	Low	Low	Medium	Medium
Grand Gedeh	High	Low	Low	Low	Low
Grand Kru	High	Low	Low	Low	Low
Lofa	Medium	Medium	Low	Medium	Medium
Margibi	Medium	Medium	Medium	Medium	Medium
Maryland	High	Low	Low	Low	Low
Montserrado	Medium	High	High	High	High
Nimba	Medium	Medium	Low	Medium	Medium

River Cess	High	Low	Low	Low	Low
River Gee	High	Low	Low	Low	Low
Sinoe	High	Low	Low	Low	Medium
Bomi	Medium	Low	Low	Medium	Medium
Gbarpolu	High	Low	Low	Low	Low

6.3.Vulnerability and Risk Assessment

The climate hazards affecting Liberia's counties are diverse and include floods, coastal erosion, droughts, and wildfires. These hazards are driven by both natural and anthropogenic factors, such as sea-level rise, increased rainfall variability, and deforestation.

For instance, high risk of river floods is prevalent in many counties, such as Bong, Grand Bassa, and Montserrado, due to excessive rainfall and insufficient drainage infrastructure. Urban flooding is particularly problematic in densely populated counties like Montserrado. Meanwhile, coastal counties like Grand Bassa, Maryland, and Sinoe face significant risks from coastal erosion and storm surges, which threaten infrastructure and human settlements. This is attributed to sea-level rise and frequent storms.

Most of the landlocked counties like Bong, Grand Gedeh, and Lofa counties are prone to wildfires, with risks heightened by deforestation and erratic rainfall patterns. Additionally, the risk of droughts and extreme heat is emerging in counties like Grand Gedeh and Gbarpolu, affecting agriculture and water resources. Extreme heat is a concern in urban areas like Montserrado due to the urban heat island effect. Below is a table summarizing the primary hazards each county faces:

County	***River Floods***	***Urban Floods***	***Coastal Erosion***	***Wildfires***	***Droughts***	***Extreme Heat***
Bong	High	Medium	Low	High	Medium	Medium
Grand Bassa	High	High	Medium	High	Medium	Low
Grand Cape Mount	High	Medium	High	High	Medium	Medium
Grand Gedeh	High	Low	Low	High	High	Medium
Grand Kru	Medium	Low	High	Low	Medium	Low
Lofa	High	Low	Low	High	Low	Low
Margibi	High	High	Medium	Medium	Medium	Medium
Maryland	Medium	Low	High	Low	High	Low
Montserrado	High	High	High	Medium	Low	High
Nimba	High	Medium	Low	Medium	Medium	Low
River Cess	Medium	Medium	High	Low	Medium	Low
River Gee	Medium	Medium	Low	Low	High	Medium
Sinoe	High	Low	High	Low	Medium	Low
Bomi	High	Medium	Low	High	Medium	Medium
Gbarpolu	High	Low	Low	Medium	High	Low

Exposure

Exposure to climate hazards varies across Liberia's counties, influenced by factors such as geography, population density, and economic activities.

High population density in counties like Montserrado and Margibi increases exposure to climate hazards, particularly in urban areas where infrastructure is often inadequate. Counties such as Bong and Nimba, with significant agricultural land, are exposed to climate impacts on crops and livestock, affecting food security.

Coastal exposure is a major concern for counties like Grand Bassa, Grand Kru, and Sinoe, where coastal erosion and storm surges pose significant threats to livelihoods and ecosystems. Similarly, high infrastructure exposure in counties like Grand Bassa and Montserrado highlights the need for resilient construction and improved urban planning to mitigate flood risks.

Meanwhile, Biodiversity and Water Resources are also exposed to the effects of climate change. Counties with rich biodiversity, like Bong and Sinoe, face exposure to climate impacts affecting ecosystems and wildlife. Water resource exposure is critical in Grand Gedeh and Rivercess, where droughts could impact water availability.

The following table illustrates the exposure levels for key sectors in each county:

County	***Population***	***Agriculture***	***Infrastructure***	***Coastal Areas***	***Biodiversity***
Bong	Medium	High	Medium	Low	High
Grand Bassa	Medium	High	High	High	Medium
Grand Cape Mount	Medium	Medium	High	High	High
Grand Gedeh	Low	High	Medium	Low	High
Grand Kru	Low	Medium	Low	High	Medium
Lofa	Medium	High	Low	Low	High
Margibi	High	Medium	High	Medium	Medium
Maryland	Low	Medium	Low	High	Medium
Montserrado	High	High	High	High	Medium
Nimba	Medium	High	Medium	Low	High
River Cess	Low	Medium	Low	High	Medium
River Gee	Low	Medium	Low	Medium	Medium
Sinoe	Low	Medium	Low	High	High
Bomi	Medium	Medium	Medium	Low	Medium
Gbarpolu	Low	High	Low	Low	High

Key Factors Influencing Climate Risk

Climate change risks are influenced by factors such as Geographical Diversity, economic activities, socio-economic conditions, and infrastructure and governance issues. The varied geographical landscape across Liberia results in differential climate risks. Coastal counties face severe threats from erosion and floods, while inland counties are more affected by wildfires and droughts. Also, economic activities are largely dependent on agriculture in counties like Bong and Nimba, and this increases vulnerability to climate change, necessitating the need for climate-smart agricultural practices.

Socio-Economic Conditions are marked by poverty and limited access to resources, which exacerbate vulnerability in counties such as Grand Cape Mount and Maryland – where socio-

economic constraints hinder adaptation efforts. Finally, the quality of infrastructure and governance structures significantly impacts resilience. Montserrado, with relatively better infrastructure, demonstrates higher resilience than counties with inadequate infrastructure like Rivercess.

Summarily, the integrated climate risk assessment for Liberia's 15 counties reveals significant variability in hazards, exposure, and vulnerability. Coastal counties are particularly at risk from erosion and floods, while inland areas face challenges from wildfires and droughts. Socio-economic factors exacerbate vulnerabilities, highlighting the need for targeted adaptation strategies.

6.4.County-specific Vulnerability Highlights

Vulnerability refers to the degree to which a county is prone to experiencing climate-induced disasters like flooding, temperature level rise, drought, wildfires, etc. in the long run – based on projections using data collected analyzed by various climate change models (e.g., ThinkHazard, Meteoblue, etc.). The level at which each of these counties is vulnerable to the impacts of climate change could cause long-term implications for the nine NDC sectors at the county-level. Among other factors, the geography location of some counties and anthropogenic factors support exposure to vulnerability. We summarize the county-specific vulnerability below:

Vulnerability for River Floods is moderately high in Grand Kru, Maryland, Rivercess, and River Gee Counties and very high in the rest of the 11 counties. Potentially damaging and life-threatening River Floods are projected to occur at least once in the next 10 years in counties with higher vulnerability, due to altercations in precipitation patterns.

Vulnerability for urban floods is high in Grand Bassa, Margibi, and Montserrado counties. Bomi, Bong, Grand Cape Mount, Nimba, Rivercess, and River Gee Counties are classified as standing medium level vulnerability to urban floods. The counties classified as standing high vulnerability to urban floods stand at least 20% risk of experiencing damaging floods in the next ten years, due to substantial rainfall. Changes in the environment and land use can influence future hazard levels.

Bomi, Bong, Grand Bassa, Grand Cape Mount, Grand Gedeh, and Lofa Counties stand at higher vulnerability to wildfire, with Gbarpolu, Margibi, Montserrado, and Nimba counties' vulnerability to wildfire classified as medium. Counties with high vulnerability stand greater than 50% risk of weather conditions that could support significant wildfires leading to loss of life and property every year. An increase in the frequency of fire weather due to climate change is likely in these counties.

Grand Cape Mount, Grand Kru, Maryland, Montserrado, Rivercess, and Sinoe Counties reported high vulnerability to coastal erosion, with Grand Bassa and Margibi Counties reporting medium level vulnerability to coastal erosion, due to heavy rains. The Counties that have high vulnerability to coastal floods are very highly susceptible to coastal erosion in the next 10 years while those classified as medium vulnerability stand a 20% risk of potentially damaging coastal flood with the next 10 years. These projected disasters pose threats to homes and infrastructure in these counties within the next 10 years.

Gbarpolu, Grand Gedeh, Maryland, and River Gee reported high vulnerability to drought while Bomi, Bong, Grand Bassa, Grand Cape Mount, Grand Kru, Margibi, Nimba, Rivercess, and Sinoe Counties reported medium vulnerability to drought due to rising temperatures. Drought conditions in these counties have already reduced water availability in these counties during the dry season and it could lead to the drying of major water sources in years to come.

Montserrado County reported high vulnerability to extreme heat due to population density and rising temperatures while counties such as Bomi, Bong, Grand Cape Mount, Grand Gedeh, Margibi, and River Gee reported medium vulnerability to extreme heat conditions. Montserrado's climate is characterized by high temperatures, with an average annual temperature of 25.7°C. Temperature fluctuations, particularly during the Harmattan season from December to March, lead to temperature extremes that can affect both human health and agricultural productivity. The counties classified as standing medium vulnerability to extreme heat are moderately at risk of extreme heat events. Rising temperatures in these counties, which are expected to increase in frequency due to global warming, could lead to health risks for vulnerable populations, stress local ecosystems and agricultural productivity.

The baseline reports for Montserrado and Rivercess Counties indicate these counties have highly susceptible to storm surges and high winds, particularly during intense storm events that accompany heavy rainfall. These projected events have the potential to damage homes, infrastructure, and agricultural lands. They can be prevented by taking climate-smart actions such as reforestation and strengthening infrastructure.

Maryland County and Grand Kru County reported high and medium vulnerability to landslide in the next 10 years due to heavy rains and vulnerable land conditions. This could cause significant disruptions and damage to properties and roads.

The above highlights show that all the 15 counties are vulnerable to various climate-induced incidences in the next 10 years due to outlined factors such as sea-level rise, rising temperatures, and deforestation. These vulnerability levels necessitate improvements in adaptive capacity, accelerating climate-smart livelihood activities such sustainable agriculture, enhancing climate governance, and increasing measurement, reporting and verification, etc. at the county-level.

6.5.Strategies to Address Climate Challenges

The baseline reports recommend several strategies to address climate change at the county level. These strategies are informed by stakeholder's perceptions and experts' opinions. The following are the key recommendations:

1. **Strengthen Infrastructure Resilience:**
    - Improve flood defenses, roads, and energy systems, especially in high-risk areas like Montserrado and Grand Bassa.
    - Implement coastal protection measures in erosion-prone counties like Grand Kru and Sinoe.
2. **Promote Climate-Smart Agriculture:**
    - Encourage sustainable practices to reduce vulnerability in agricultural-dependent counties such as Bong and Nimba.
    - Diversify crops to enhance food security and resilience.
3. **Enhance Governance and Policy Implementation:**

- Strengthen local governance structures to support climate adaptation and resilience-building efforts.
- Develop comprehensive policies addressing climate risk management and sustainable development.

4. **Improve Health and Education Services:**
   - Invest in healthcare and educational infrastructure to reduce vulnerability in counties like Grand Gedeh and Maryland.
   - Promote awareness and education on climate risks and adaptation strategies.
5. **Foster Community Engagement:**
   - Empower local communities through participatory approaches to adaptation planning and decision-making.
   - Enhance social capital to support collective action and resilience.

Implementing these strategies will be crucial for mitigating climate risks and enhancing the resilience of Liberia's counties, safeguarding communities, economies, and ecosystems from the adverse impacts of climate change.

7. Climate Change Perception and Governance

7.1.Perception Index

Informed by FGD and KII, the climate change perception index provides data-driven understanding of the people's awareness of climate change and its impacts in their communities. The perception index is important because it shares experiential insights that political leaders may reference to improve public support for climate action at the county level.

7.1.1. Focus Group Discussions and Key Informant Interviews

The FGD and KII were conducted to gauge public knowledge about climate change and its implications on the nine NDC sectors at the county-level. Specifically, the interview questions were tailored around stakeholders' awareness about climate change and its impacts in the counties, observed impacts of climate change on the NDC sectors, and adaptation and mitigation strategies. The interviews also centered around current governance structure, policy and decision-making processes, capacity building and support, investment in climate change projects, available projects in the county, technological solutions, and monitoring and evaluation processes.

On average the interview respondents across the country reported limited knowledge and low awareness about climate change and its implications on the NDC sectors at the county-level. In Sinoe County, for example, 61% out of 97 interview respondents reported low knowledge about climate change and its implications on the NDC sectors in the county compared to 10% who reported awareness and knowledge of climate change and its implications. Similarly, 67% of the 20 interviewees in River Gee County reported low knowledge about climate change and its implications on the NDC sectors. In Grand Gedeh, the lack of awareness and low knowledge of climate change and its implications are even more pronounced, as 67% out of 90 interviewees reported low awareness and limited knowledge about climate change and its implications. At the western end of the country in Grand Cape Mount County, the climate change knowledge gap is also noticeable. Over 50% of the 41 KII respondents in Grand Cape Mount reported limited or no knowledge at all about climate change and its implications on the NDC sectors. Additionally, 41% out of 141 interviewees in Lofa County indicated they have never even heard about the term 'climate change' while 48 or 34% of the 141 respondents

revealed they have heard about climate change but have no knowledge about what climate change or its implications are. This knowledge gap is prevalent in most of the counties including Margibi that is said to be more urban like Montserrado County.

In other counties either there is some awareness or knowledge about climate change in the agriculture or coastal zone sector or the respondents were unable to link climate change and its implications to any of the NDC sectors. In Maryland County, for example, the interviewees reported some awareness about climate change and its implications, but they could not link climate change and its impacts to the NDC sectors. Next door Grand Kru County which is also in the same region as Maryland, reported some awareness and knowledge about climate change and its implications on the agriculture sector. Similarly, in Nimba and Rivercess Counties, the respondents reported awareness and knowledge about climate change and its implications in NDC sectors such as agriculture, fishery, coastal zone and transport. Notably, they attributed deplorable road conditions, coastal erosion, and altercations in agricultural practices and poor farm yields to climate change impacts such as erratic rainfall patterns.

Alarmingly, the data from the FGDs and KIIs revealed that there are not many ongoing climate change adaptation measures in the counties. In River Gee, for example, 90% of the 20 respondents interviewed reported that there are no ongoing climate change adaptation measures in the county. This result is even louder in Grand Gedeh, where 89% of 90 interviewees indicated that there are no ongoing climate change adaptation measures in the county. In Sinoe County, 62% out of 97 respondents gave similar account that there are no ongoing climate change adaptation measures in their communities. The lack of ongoing adaptation or mitigation measures in the counties' highlights Liberia's vulnerability to the impacts of climate change and calls for proactive and robust actions.

7.1.2. General Perceptions of Climate Change by Sector

The general perception is that climate change and its impacts are more pronounced in the agriculture and coastal zone sectors.

Agriculture: Generally, nearly all of the counties reported that the general perception is that there is sufficient awareness and knowledge about climate change and its impacts on the agricultural sector. With the exception of Gbarpolu and Maryland where awareness is low, the respondents in the rest of the counties attributed changing rainfall patterns, temperature increase and extreme weather events to climate change – which has disrupted farming practices and negatively impacted farm yields.

Coastal zone: In counties such as Grand Bassa, Maryland, Rivercess, and Sinoe, respondents of the FGD and KII expressed sufficient awareness about climate change and its impacts on the coastal zone. For example, 35% of 97 respondents in Sinoe County attributed rising sea levels to climate change. Their perception aligns with global viewpoints that rising sea levels have impacts such as coastal erosion, floods, and salt water intrusion, all of which have devastating consequences on the affected communities.

Energy: Liberia's energy sector is still emerging. The production of energy is shaped by thermal and hydro power plants. The CLSG Transmission lines also contribute to the energy needs of counties along the borders with Côte d'Ivoire, Guinea, and Sierra Leone. Energy supply is low amid demands for high distribution and consumption due to the impacts of climate change. Climate change impacts such as river floods, drought, and strong winds often

cause disruption of energy generation mostly during the dry season. Most of the respondents of the FGD and KII in nearly all of the counties expressed awareness of climate change and its impacts on other sectors, but they do not have the perception that climate change also adversely affects the energy sector.

Fishery: The general perception in most of counties, especially the coastal counites, is that the impacts of climate change are affecting the fishery sectors. Stakeholders in counties such as Grand Bassa, Grand Cape Mount, Grand Kru, Maryland, Rivercess, and Sinoe reported high awareness of altered rainfall patterns, drought, and rising temperatures, and how these affect the fishery sector in their communities. There are similar perceptions in few landlocked counties like Nimba, and Bong. Awareness is however low in Bomi, Margibi, Lofa, Gbarpolu and most of the landlocked counties.

Forestry: This sector is affected by practices such as logging, chainsaw milling, slash-and-burn farming, and charcoal production in counties such as Bomi, Montserrado, and Margibi. These livelihood options contribute to deforestation, biodiversity loss, increased temperature levels among other implications of climate change. The general perception is that there is moderately low awareness about climate change and its impacts on the forestry sector. In counties like Grand Gedeh, River Gee, Gbarpolu, Lofa, Bomi, Grand Cape Mount, Margibi, and Maryland, the stakeholders did not express the perception that climate change is affecting the forestry sector, although there is considerable awareness in Bong, Grand Bassa, Grand Kru, Nimba and Rivercess.

Health: The general perception is that awareness about the implications of climate change on the health sector is low. This perception of low awareness or knowledge is evident – as expressed in the FGDs and KIIs – in counties such as Rivercess, Maryland, Margibi, Lofa, Grand Kru, Grand Cape Mount, and Gbarpolu. Stakeholders in these counties to some extent, have some awareness of climate change but they could not link climate change and its impacts to the health sector in their communities unlike in Nimba and Grand Bassa where the stakeholders noted that it is a general perception that climate change is adversely affecting the health sector.

Industry: The industrial sector is dominated by mining. The mining and agriculture sectors are major contributors to greenhouse gas emission in most of the counties – contributing to biodiversity loss, land degradation, and deforestation. However, stakeholders in most of the counties reported that the general perception is that the communities are not aware that the industrial sector contributes to climate change, and there is also low awareness that the sector is affected by the implications of climate change. Nearly all of the 15 counties need increased awareness about climate change and its implications on the industrial sector.

Transport: The general perception in the counties is that, although the transport sector contributes less to climate change, it is one of the sectors that is mostly affected by the implications of climate change. Besides Bong and Grand Bassa County, the FGDs and KIIs in all the other counties revealed that it is a general perception that climate change and its impacts are felt in the transport sector. Notably, the counties in the southeastern region of Liberia attributed deplorable road conditions, river floods, and sea level rise – all of which make transport to the region difficult during the rainy season – to climate change.

Waste: The FGDs and KIIs revealed that all of the counties lack proper waste management system. Additionally, the interviews indicate that the general perceptions about climate change

in the counties do not link climate change or its impact to the waste sector. The stakeholders revealed that it is not the thought at the county-level that solid waste contributes to climate change or climate change impacts are felt in the waste sector, necessitating the need for increased awareness programs.

In summary, the general perception about climate change and its implications on the NDC sectors is mixed. While stakeholders think that the challenges in some of the sectors (like transport, coastal zone, and agriculture), are results of climate change, they do not hold this view about other sectors. It also justifies feedback from the interviews that there is a need to raise climate change awareness and engage in preparedness activities in the wake of the implications of climate change.

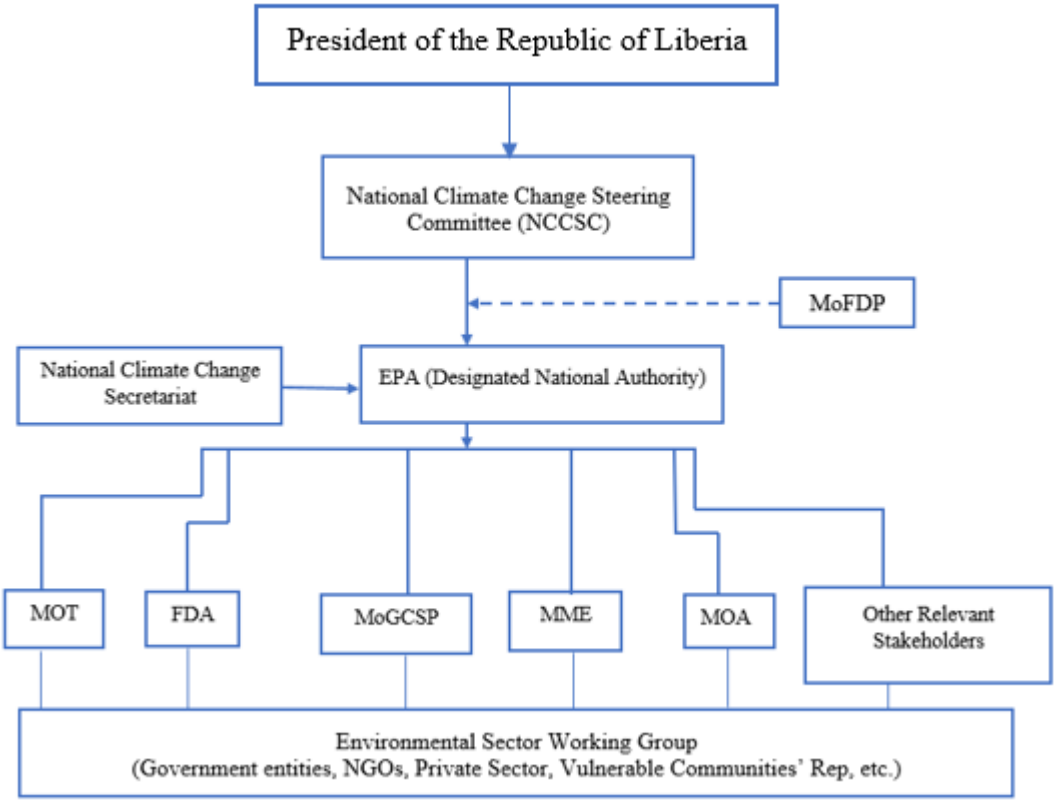
7.2.Governance Structures

At the national level, Liberia's climate governance structures include government's ministries and agencies connected to the NDC sectors. These agencies and ministries of government fall under the umbrella of the National Climate Change Steering Committee (NCCSC), which is supported by the National Climate Change Secretariat at the EPA as discussed earlier (see page 3). The NCCSC is chaired by the President of the Republic of Liberia but its climate-related responsibilities are largely coordinated by the EPA. Other ministries and agencies on the NCCSC are the Forestry Development Authority, Ministry of Transport, Ministry of Mines and Energy, Ministry of Agriculture, Liberia Institute for Statistics and Geo-information Services, Ministry of Finance and Development Planning, Ministry of Gender, Children, and Social Protection, and other relevant government's entities and partners. Each of these constituent members plays specific roles as explained on page 3.

7.2.1. Institutional Arrangements[1]

The institutional arrangement, as earlier explained, is depicted below:

[1] Liberia's climate governance or institutional arrangement was developed by the National Policy and Response Strategy on Climate Change. Read more about it here: https://www.epa.gov.lr/sites/default/files/National%20Policy%20and%20Response%20Strategy%20on%20Climate%20Change%20Final%20Document-min_0.pdf



Climate governance or Institutional Arrangement of Liberia: Source: National Policy and Response Strategy on Climate Change

7.2.2. Coordination Mechanisms at local and national levels

The EPA, sometimes through the National Climate Change Secretariat, collaborates with relevant public and private entities to implement climate actions. The coordination mechanism involves line government ministries such as the Ministry of Finance and Development Planning which oversees the disbursement of funds. Other ministries and agencies include the Ministry of Agriculture, the Ministry of Mines and Energy, the Ministry of Gender, Children, and Social Protection, Ministry of Transport, the Forestry Development Authority, the Liberia Institute of Statistics and Geo-information Services, relevant stakeholders and NGOs working in the sector. These entities collaborate to address climate issues with the EPA leading the coordination in most cases.

At the county-level, Bong and Grand Bassa Counties are the only two counties that have local climate governance structures. The rest of the other counties do not have a governance structure or institutional arrangement to address or discuss climate change at the time of the writing of the county climate change baseline reports. In Bong County, there is a designated Climate Change Focal Point person who serves as the coordinator for all climate change activities. The Climate Change Focal Point person is typically a representative of the local government, appointed by the Superintendent who is the head of the local government. Working alongside the Climate Change Focal Point is the County Climate Change Unit, which comprises a team of experts and staff members responsible for coordinating and implementing climate change activities in collaboration with various stakeholders. The County Climate Change Task Force serves as the multi-stakeholders' platform that brings all the stakeholders from the different sectors together to take climate-related decisions. The body also partners with and coordinates with NGOs and community-based organizations to discuss and address climate matters at the

county-level in consultation with the NCCSC. The structural arrangements and coordination mechanisms in Grand Bassa is similar to that of Bong County.

7.3.Policy and Investment Review

The government of Liberia has committed to tackling the difficulties posed by climate change through the establishment and adoption of various national policies and strategic measures. One of such policies is the National Climate Change Policy and Response Strategy which provides guidance on incorporating climate change concerns into national development planning at different levels. The National Climate Change Policy and Response Strategy also seeks to strengthen coordination for implementation of national climate change policies between the government and all other stakeholders. The government of Liberia through the Environmental Protection Agency has additionally established a National Adaptation Plan (NAP). The NAP provides climate change adaptation options and an adaptation roadmap that communities could follow to reduce climate vulnerabilities[2]. Analysis of adaptation strategies also use the Adaptation Policy Framework (APF). The APF outlines four major principles. These principles include adaptation to short-term climate variability and extreme events to serve as a starting point for reducing vulnerability to long-term climate change, adaptation to different levels in society, including the local level, and adaptation policy and measures have been assessed in a development context, and the adaptation strategy and stakeholder process, which implementation are given equal importance.

8. Strategic Recommendations

8.1.National-level Strategies

Based on the findings of the baseline reports, strategic recommendations in relation to the NDC sectors were put forth for considerations at the national level. These recommendations overlap in the individual county climate change baseline reports. But notably, these recommendations are sector specific, and when taken into considerations, could mitigate the gaps in the various sectors.

General recommendations	**General recommendations**
1. Strengthen climate governance structure at the national level and create dedicated climate governance structures at the local level to ensure localized approach to climate action planning and implementation. 2. Put in place system to regularly assess the vulnerability of each of the NDC sectors. 3. Integrate climate actions into national budget and sectoral funding. 4. Tailor climate policy actions to specific sectors and locations based	7. Support improved collaboration and partnership among stakeholders in both the public and private sectors at the national and local levels to facilitate resource mobilization and knowledge sharing. 8. Promote awareness on climate change and its impact on the country and enhance the skills and institutional capacity of relevant stakeholders 9. Strengthen the capacity of ministries and agencies connected to the NDC sectors at the county-level.

[2] Read more about the NAP at: National Adaptation Plan of Liberia 2020-2030 | PreventionWeb

on affected sectors and communities. 5. Create clear climate change education mechanism to raise awareness at all levels and develop communication strategy to increase awareness of relevant stakeholders. 6. Institute improved Measurement, Reporting, and Verification mechanisms to address climate change in Liberia. [3]	10. Institute and promote adaptation policy and measures and increase climate change adaptation and mitigation awareness at all levels 11. Establish and/or strengthen coordination mechanisms among line ministries and agencies connected to the NDC sectors.
Forest sector	**Forest sector**
1. Strengthen and implement reforestation and afforestation activities to increase vegetation and improve ecosystem services in degraded areas, increase rural income, and improve biodiversity richness. 2. Integrate climate actions (including conservation, mitigation, and adaptation measures) into legal frameworks concerning mining, forestry and logging so as to reduce illegal and unguided mining and logging. 3. Strengthen disaster response mechanisms to mitigate the impacts of extreme weather events. 4. Ensure that development at the national and local levels are environmentally sustainable 5. Promote conservation of Liberia's rich biodiversity and natural endowments so that they can benefit the current generation and posterity. 6. Enhance the management and conservation of forest biodiversity, focused on preventing perturbations such as fire, invasive species, insects and diseases through the adoption of strategic approach to communication that clearly outlines the cost and benefits of various actions affecting forests.	7. Implement sustainable and, where applicable, alternative livelihood initiatives for forest-dependent communities, to empower them to become less reliant on forest resources and to empower them to use the forests in sustainable ways. 8. Promote community forests activities beyond timber extraction as a management tool for sustainable forest management, using indigenous species and knowledge. 9. Identify and map, for proper management, water catchment areas that are valuable to communities in the forests. 10. Promote the consolidation of protected area network by considering landscape approach and ensuring that it consists of a large spectrum of forest types across various environmental gradients to enhance connectivity between habitats and support species migration. 11. Enforce regulation related to illicit mining, logging, hunting and poaching and put in place health facilities for wildlife in hotspot areas.

[3] For more on these recommendations, see the county climate change baseline reports (e.g., Grand Gedeh, Sinoe, Grand Bassa, Maryland)

Energy Sector	Coastal Sector
1. Support policy reform and investment in renewable energy sources and sustainable development practices. 2. Promote and implement energy plantation schemes to minimize pressure on natural forest and reduce energy stress. 3. Promote diversification of energy sources and development and use of affordable energy-efficient sources. 4. Ensure the incorporation of renewable and low carbon energy technology promotion in sectorial and national development planning.	1. Develop management plan for coastal areas to ensure their continuous functioning and availability. 2. Set up early warning systems and educational program, especially for people living along the coast. 3. Promote disaster risk management, especially preparedness, the construction of protective infrastructure (e.g., seawalls and flood reservoirs), coastal erosion control mechanisms to counter rising sea level. 4. Support the rehabilitation and protection of wetlands and mangroves or manage retreat where it occurs for the primary purpose of buffering coastal communities from storm surge, and coastal erosion and promote alternative sources and technologies to enhance water availability. 5. Engage with communities along the coast to participate in actions aimed at protecting the coast and ensuring its continuous viability.
Health Sector	**Health Sector**
1. Increase community awareness of measures against diseases exacerbated by climate change and its impacts. 2. Integrate climate change considerations into existing health policies and strategies, considering gender-differentiated impacts and responses. 3. Strengthen preventive measures to restrict preventable disease transmission and strengthen disease surveillance and response systems in the NDC sectors. 4. Develop early warning systems for climate-driven infectious diseases and improve community-level healthcare and dissemination of information on changing health risks.	5. Conduct periodic health Impact assessments on proposed mitigation and adaptation strategies to determine impacts on vulnerable populations and cumulative health impacts. 6. Build capacity in the Health Sector to increase health protocols in the NDC sectors. 7. Enhance systems to monitor, prevent, and respond to climate related outbreaks of vector borne diseases like malaria and water-borne illnesses such as cholera.

Agriculture Sector

1. Promote climate-smart/sustainable agricultural practices at the community level and build capacity of extension officers to increase the sustainable farming and livestock raring, and encourage farmers to engage in adaptation measures.
2. Improve the effectiveness of pest, disease and weed management practices and improve quarantine capabilities and monitoring programs.
3. Assess and disseminate crop vulnerability and suitability (crop pattern) for different Agro-ecological zones.
4. Enhance climate-proof agro-infrastructural systems (input, output, marketing, post-harvest and technologies and infrastructure including storage) that strengthen the capacity of farmers to increase resilience and productivity.
5. Support communities in livestock and crop sectors with knowledge management and logistics

Agriculture Sector

6. Set up seedbanks to collect and preserve different varieties of crops to strengthen local diversity among farmers
7. Develop and introduce a diverse range of integrated soil fertility management techniques to farmers, and promote crop varieties resilient to drought to increase sustainable agricultural productivity
8. Promote wider use of appropriate technologies, invest in better irrigation system and water management practices, and discourage the burning of organic residues on the soil surface, in order to prevent erosion, waterlogging, and nutrient leaching in increased rainfall scenarios, and to preserve soil moisture in drier rainfall scenarios.
9. Support farmers to diversify their income sources by engaging into other sustainable income generation activities.
10. Adapt planting schedules and diversify cropping systems to mitigate the effects of altered seasonal patterns.

Water Resources

1. Develop a management plan for water resources to ensure their continuous functioning and availability.
2. Support the protection of river catchments and other sources of freshwater, including aquifers, to secure a steady supply of freshwater across all sectors and communities, and to facilitate and promote water recycling, reuse and efficiency for the same purpose.
3. Conduct water resources vulnerability assessment, mapping, documentation and dissemination of necessary information to

Water Resources

relevant stakeholders.

4. Increase urban and rural domestic water supplies and urban sewage services to help combat waterborne diseases and their social and economic impacts.
5. Mainstream climate change in all water resources (coastal water, fresh water sources including aquifers) management plans and program to secure environmental safety and sustainable fresh water supply.

Fishery Sector

1. Promote sustainable fishing techniques to maintain fishing stock and education fishing communities about climate change, its impacts, and adaptation techniques.
2. investment and support for artisanal fishery communities, including protection of mangrove habitats to sustain fish breeding grounds, and promote alternative livelihood income activities.
3. Promote adherence to precautionary cues and information emulating from monitoring practices, and institute early warning and disaster preparedness mechanisms.
4. Conduct research to fully understand fishing pressures and adjust quotas to sustainable levels, as well as into predicting where fish populations will move; finding species resistance to salinity and

Fishery Sector

temperature fluctuations for aquaculture and, where necessary, support selective breeding for increased resilience in aquaculture.

5. Support the protection and restoration of mangroves, recognizing their role as an important habitat for aquatic species, and identify and protect areas valuable for fisheries
6. Put in place or strengthen a system to reduce external stressors on fisheries and to contribute to their sustainable harvesting.
7. Integrate fisheries fully into climate change adaptation and food security policies at the national level to ensure incorporation into broader development planning.
8. Support the diversification of the livelihood portfolio of communities that are fishery dependent.

Transport sector

1. Ensure the mainstreaming of climate change considerations in the national transport policies and programs.
2. Put in place a system for proper urban transport planning to facilitate efficient and low GHG modes of transportation.
3. Promote multiple modes of public transport (e.g., water; rail) and the use of non-motorized transport vehicles like bicycle.
4. Promote fuel switch in transport facilities.

Tourism sector

1. Increase awareness about the tourism sector and promote ecotourism, conservation and payment for Ecosystem Services (PES) that involve local communities targeted at biodiversity conservation, community benefit (pro-poor and gender sensitive), and that minimize illegal poaching.
2. Develop and implementing an environmental 'Code of Ethics' in the tourism sector and build capacity in the tourism sector.
3. Design and implementing efficient and effective disaster management and preparedness plan for tourist sites as well as redirecting clients away from impacted destinations and put in place health facilities for human in touristic areas.

Industrial Sector

1. Put in place a mechanism to ensure new designs and engineering standards to consider the current and future changing climate and periodic review of the design basis for updated climate compatible designs to be in place.
2. Design and implement a procedure to reinforce assets or amend design standards or the frequency of maintenance and monitoring of assets to withstand current and future climate conditions (e. g., storm surge, sea level rise, higher temperatures, and heavy rainfall incidents).
3. Design a procedure to relocate or raise assets and operations outside of high-risk areas (e. g., flood plains, and coastal areas).

Industrial Sector

4. Incorporate biodiversity management programs in mining sector during mining planning so as to enhance ecosystem services like water, which are critical for mining sector.
5. Retain or restore natural buffers in coastal and river environments to increase resilience against flooding, erosion, storm surge and other extreme weather events that may cause damage on infrastructure and assets useful for the mining sector.
6. Put in place a procedure to ensure community engagement, from planning to implementation, of mining sector to overcome and meet growing community concerns over climate change and environmental issues due to the establishment of mining projects

Industrial Sector

7. Design and implement environmental health and safety programs in the mining sector and introduce disaster management and disease prevention policies, procedures, and assessment at national and corporate level.
8. Ensure the incorporation of climate change-related considerations into existing mining sector policies and programs, and monitoring of system components in mining sector.
9. Promote appropriate spatial planning for industrial locations and zoning in the context of climate change.
10. Introduce and promote climate insurance schemes in industrial establishments and promote small-scale energy installations in rural areas.

Waste Sector

1. Embark on solid waste management education at the community level
2. Encourage and promote practices that minimize landfill emission and reduce waste generation.
3. Create or enforce legal frameworks surrounding solid waste management.
4. Invest resources into the waste sectors, particularly in urban areas.

Infrastructure	Infrastructure
1. Ensure climate-resilient infrastructural sector, utilize accurate weather and climate information in infrastructure planning and development, and promote research to build climate-resilient infrastructure. 2. Amidst the increasing wave of sea erosion along the coast, higher tides and more frequent storm surge events, there is a need to redesign the coastal highways, bridges, sewer and water infrastructure so that they are made resilient.	3. Regulations and codes should be revised or developed where necessary to account for climate change impacts. Major infrastructure projects such as roads, airports and sea ports should be subjected to climate risk screening as part of the planning process. 4. Reduce damage to infrastructure and the environment, and lessen the risk to human health and wellbeing by developing land-use policies and emergency response measures that account for sea-level rise when planning and building infrastructure.
Infrastructure	**Urbanization and Settlement**
5. Regulate development in coastal areas; prevent construction in areas of known vulnerability, and protect coastlines at critical sites in order to mitigate the risk to coastal communities. 6. Employ significant investment in building coastal protection including eco-based solutions (planting of trees) and hard structures (groynes, revetments, etc.) in coastal cities like Monrovia, Buchanan, Robertsport, Greenville, Harper, Cestos and Grand Cess. 7. As a last resort, relocate communities that are at extreme risks due to flooding and coastal erosion.	1. Regulate industrial development in urban designated areas through land use planning and ensure an integrated Coastal Zone Management Plan, a National Disaster Risk Management Response Plan and implement the National Environment Action Plan 2. Conduct assessment for hazard mapping, risk reduction and vulnerability of urban settlements in erosion and flood-prone areas and sites of national economic priority. 3. Monitor rural-to-urban migration and develop infrastructure and support facilities in smaller agro-based towns and periphery urban areas in order to reverse rural-urban migration.

8.2.County-specific Recommendations

County-specific recommendations

Grand Gedeh **River Gee** **Sinoe**	**Build institutional capacity**[4]**.** Set up local climate change committee that will take leadership in coordinating the integration of climate change in local development planning and decision-making processes. **Fill Knowledge gap.** Increase awareness and knowledge about climate change and its impact on the NDC sectors and local population among local authorities and the general population. **Reduce vulnerability to climate change impacts.** These three counties, like other counties, are vulnerable to increased frequency and intensity of extreme weather events. Empower the county to implement effective climate adaptation and mitigation strategies. **Build infrastructure and technology to address climate change.** These counties lack adequate infrastructure and technology to support climate mitigation and adaptation efforts. It is recommended to improve in this area. Similarly, there is a need to build climate-resilient roads that connect these counties to the rest of the country throughout the year. **Increase access to climate finance.** As in other counties, these three counties (especially Grand Gedeh) have limited access to climate finance. It is recommended to improve in this area. **Improve coastal defense system.** Sinoe County, particularly, is experiencing coastal erosion, leading to loss of homes. It is recommended that the coastal erosion in Sinoe should be addressed appropriately. **Promote sustainable and farming and fishing practices.** Empower and encourage farmers and fishers (especially in Sinoe County) to adopt climate-smart fishing and farming practices. **Implement climate-smart policies.** Enforce the laws governing protected areas in these counties and ensure that policies against illicit mining and logging and poaching are enforced to the letter in these counties.

County-specific recommendations

[4] These recommendations are further justified in the baseline reports of the specific counties. Additionally, it must be noted that the recommendations across counties overlap, given that the scenarios are nearly matched in counties with close proximity. You can read more about this in the individual county baseline reports.

Grand Kru **Maryland** **Rivercess**	Grand Kru, Maryland and Rivercess are coastal counties that are largely confronted with climate change impacts such as temperature levels, sea erosion, and inundation. While these counties demonstrate considerable knowledge about climate change and its impacts on the coastal zone, transport, and agriculture sectors, there are considerable knowledge gaps in other sectors such as the health sector, the industrial sector, the energy sector, and waste management sector. It is recommended that climate change knowledge management programs in these counties should target increasing awareness among stakeholders and the general population in these sectors. Awareness raising for sustainable livelihood activities and climate adaptation measure is also crucial. The reports also recommend that authorities in these counties should undertake beach nourishment projects to mitigate coastal erosion and safeguard coastal lands in addition to promoting sustainable fishing practices. Additionally, the county climate change baseline reports from these counties recommend strengthening institutional capacity and building climate-resilient infrastructure. There is also a need to build or improve coastal defense mechanisms in these counties. It is also recommended to develop advanced water collection and storage infrastructures and reinforce road networks against climate change impacts.

County-specific recommendations	
Grand Bassa **Margibi** **Montserrado**	**Fill knowledge gaps.** While these counties demonstrate considerable knowledge in climate change and its impact on the coastal zone and agriculture, knowledge about the impacts of climate change on other sectors is lacking, necessitating the need for increased climate change awareness raising. **Integrate climate change considerations into county development planning.** Incorporate climate change mitigation and adaptation measures into development plans, policies and regulations. Additionally, integrate climate change adaptation and mitigation measures across all sectors at the county-level. **Invest in climate-resilient infrastructure.** Sea level rise, coastal erosion, and inundation have contributed to loss of homes in these counties. Hence, their baseline reports recommend the construction of climate-resilient infrastructure, the construction of coastal defense structures like seawalls, and upgrading in water supply system. **Promote sustainable and farming and fishing practices.** Empower and encourage farmers and fishers to adopt climate-smart fishing and farming practices.

	Strengthen disaster risk reduction and early warning systems. Empower communities to forecast disaster risk and empower them to provide residents with early warning in a bid to reduce their susceptibility to disasters. **Strengthen climate-resilient health system.** Empower the health systems to work all year round with the requisite technologies, and improve climate-resilient waste management practices through awareness raising and logistical empowerment with local governments. **Invest in renewable energy.** Promote the use of renewable energy sources such as solar and wind power to reduce the use of fossil fuels and GHG emissions. **Enhance governance and multi-stakeholders' collaboration.** Bring stakeholders from the public and private sectors together at the county level to facilitate climate change adaptation and mitigation efforts. **Take steps to control urbanization and improve waste management.** Support local community by improving livelihood condition to reduce migration to urban settlements. Similarly, embark on awareness raising initiatives mostly in urban settlement to improve solid waste management and let communities aware of how the waste sector is connected to climate change.

County-specific recommendations	
Bong **Lofa** **Nimba**	**Enhance climate-governance structures.** Strengthen governance sector with knowledge management and capacity development. Secure funding to support county-level climate actions across the NDC sectors. **Enhance data collection and research.** Invest on gathering empirical data on climate change indicators at the county-level and create a database system that stores climate change information for future reference. Additionally, develop and implement enhanced monitoring and evaluation mechanisms and promote capacity building programs for stakeholders at the county-level. **Enhance climate change education and awareness.** Develop and implement educational programs to increase awareness and understanding of climate change and its impacts on the NDC sectors in the communities in these three counties. **Promote climate-smart agricultural practices.** Empower and encourage farmers with knowledge to adopt climate-smart farming practices and institute policies that promote sustainable agriculture at the county-level. **Promote the adoption of climate-smart energy system.** Encourage the adoption and implementation of more efficient, cost-effective, and

	environmentally sustainable energy systems. Lead communities towards alternative renewable energy sources. **Improve healthcare system.** Build resilience in the healthcare sectors to support the delivery of healthcare services all year round. Strengthen the capacity of governance in the health sector to make the sector climate-resilient. **Strengthen forestry management.** Promote the implementation of climate-smart forestry management plans through improved stakeholders' engagements, resource allocation, and governance empowerment. Additionally, build resilience in the industrial sector, which is dominated by mining activities. Ensure that protected forest areas are well protected and that the laws concerning forestry and mining are enforced to the letter.

County-specific recommendations	
Bomi **Gbarpolu** **Grand Cape Mount**	**Policy and governance:** Develop and implement climate change policies and legislation that integrate adaptation and mitigation measures. Strengthen governance structures to support effective climate change planning and implementation at the local level. **Engage communities and build capacity.** Establish and strengthen local governance structures to take leadership in climate actions at the county-level. Promote collaboration among stakeholders connected with the NDC sectors to engage into sectoral-level climate-smart actions in the counties. **Build climate resilience and sustainability in NDC sectors.** The baseline reports from these western counties recommend the construction of climate-resilient roads and the promotion of climate-smart agricultural practices. **Promote climate-smart agricultural practices.** Empower and encourage farmers and fishers with knowledge to adopt climate-smart farming and fishing practices and institute policies that promote sustainable agriculture and aquaculture at the county-level. **Promote forest conservation and reforestation.** Stakeholders in these counties (especially Gbarpolu) recommended the sterner enforcement of

	conservation and forest management laws and reforestation initiatives at the county level. **Enhance climate change education and awareness.** Increase climate change awareness and its impacts on the NDC sectors in local communities. While stakeholders in these western counties demonstrate knowledge in climate change and its impacts on agriculture, coastal zone and transport, they show lack of knowledge in the impacts of climate change on other NDC sectors such as waste, industry, and health, etc. **Erect coastal defense system.** Grand Cape Mount and Bomi Counties, particularly, are prone to experiencing coastal erosion, which may lead to loss of homes and biodiversity loss. It is recommended that measures should be put in place to appropriately address or avert coastal erosion in these counties.

9. Conclusion

This integrated summary report of the 15 County Climate Change Baseline Reports sheds lights on the details and key findings of the county reports. Generally, the reports indicated that Liberia (all of the 15 Counties) is experiencing climate change and its impacts on key sectors. These sectors include the agriculture, coastal zone, energy, fishery, forestry, health, industry, transport, and waste – which are connected to Liberia's Nationally Determined Contributions.

Based on the findings contained in the individual reports, climate change is adversely affecting each of these sectors and livelihood activities in the counties are said to be the driving forces behind climate change. For instance, farmers in Bong, Lofa, Grand Gedeh, and River Gee Counties largely engage into shifting cultivation and slash-and-burn farming practices, and these livelihood activities contribute to land degradation and deforestation, leading to rising temperature levels, extreme heat conditions, drought, wildfires and other implications of climate change.

The reports also outline and noted the absence of climate governance structures in all of the counties excluding Bong and Grand Bassa Counties. The absence of climate governance structures at the county-level undermines the effort of the National Climate Change Steering Committee such that there is no leader for climate actions at the local level and community ownership of climate actions may also be jeopardized.

The absence of climate governance structure at the local level also makes it difficult to integrate climate change into county development plans and to implement climate action plan at the local level.

The reports also outline substantial knowledge gaps about climate change and its implications on key sectors connected to the NDC of Liberia. Based on the reports, local communities are aware of climate change and its impacts in the agriculture, coastal zone, and transport sectors compared to other key sectors connected to the NDC. The FDGs and KIIs conducted in these

counties revealed that stakeholders were aware and able to attribute difficulties in traveling to the counties to very high precipitation patterns during the rainy months. At certain months of the year, traveling to the southeast, for example, can be nearly impossible by road – which locals in this part of the country believe could be as a result of altered rainfall patterns resulting from climate change over the years. The local communities through their stakeholders could also attribute poor farm yields to climate change impacts such as drought, erosion and inundation. Delayed planting due to severe rainfall is another notable observation by stakeholders in the agriculture sector.

In the counties along the coast, the stakeholders also demonstrate considerable knowledge and awareness of the impact of climate change on the coastal zone, noting that rising sea levels, inundation, and coastal erosion result from climate change, and have contributed to loss of homes and biodiversity loss.

Despite the stakeholders' demonstrated knowledge and awareness of climate change and its impacts on the agriculture sector, coastal zone and transport, there is a pronounced knowledge gap in other sectors, necessitating the need to place emphasis on climate change education and awareness raising among county-level stakeholders and local communities.

The reports call for actions among key stakeholders at all levels of the Liberian government. There need to integrate climate change into legal framework and academic curricular has been pointed out by the report authors. Additionally, the conclusion of the county baseline reports points in the direction of improved monitoring and evaluation mechanisms to gather county-level climate data that will guide future county-level climate actions.

Furthermore, the reports concluded that climate change considerations must permeate government decision-making at the local level. It calls for improved partnerships among stakeholders in the private and public sectors to mobilize climate finance to reduce the impacts of climate change in the counties. Based on the reports, the conclusion is that forest-fringe communities continue to rely on forests (including protected areas) for livelihood activities, indicating the necessity to lead local communities into selecting livelihood options that will not get them engaging into unsustainable practices. Similarly, counties along the coast continue to grapple with land degradation and rising sea level due to unsustainable fishing practices and sand mining along the coast. These conclusions indicate that local frameworks that protect biodiversity and wildlife need to be elucidated within local communities to the fullest, and decision-makers at the county level need more trainings in climate change.

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