STATE OF THE ENVIRONMENT REPORT FOR LIBERIA

2007-2018

Environmental Protection Agency of Liberia
Tubman Blvd.
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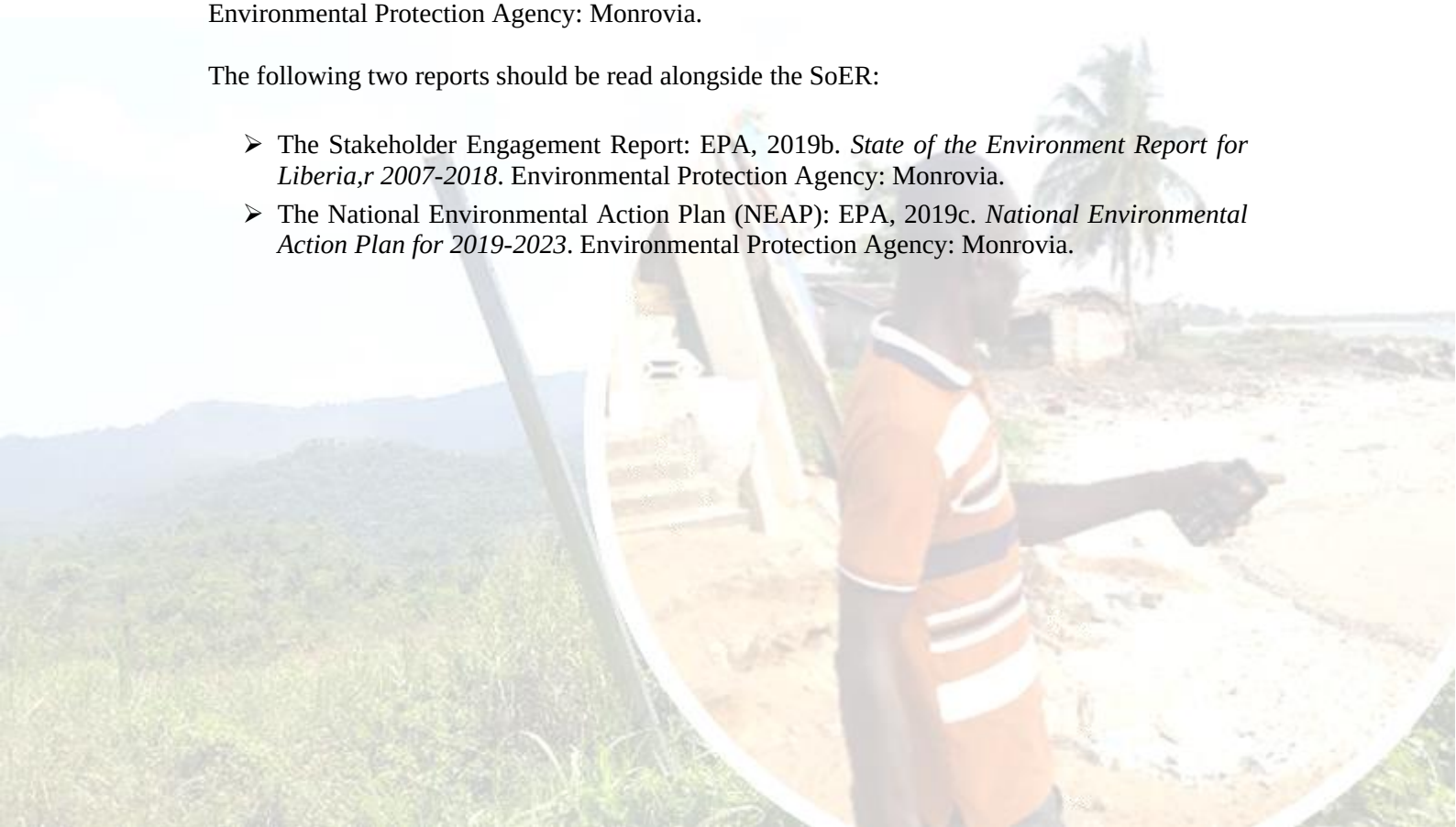
The following two reports should be read alongside the SoER:

- The Stakeholder Engagement Report: EPA, 2019b. *State of the Environment Report for Liberia,r 2007-2018*. Environmental Protection Agency: Monrovia.
- The National Environmental Action Plan (NEAP): EPA, 2019c. *National Environmental Action Plan for 2019-2023*. Environmental Protection Agency: Monrovia.



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FOREWORD

Liberia is a country with exceptional environmental and cultural wealth. The need for developing the country and utilising its environment to the best interest of the country's economy is stressed by Liberia's current focus on creating an enabling climate, particularly for the business sector. This point was underscored by President George M. Weah during his first address to the 73rd Session of the United Nations General Assembly (UNGA) in September 2018. The President emphasized that after years of war and violence hampering socio-economic development, and the end of the United Nations Mission in Liberia (UNMIL) peacekeeping operations in the country, rebuilding the economy was essential for Liberia (World Bank, 2018). This marks a positive turning point for the country's socio-economic development.

Through various initiatives, such as the Gaborone Declaration for Sustainability in Africa, Liberia is making strides in fostering sustainable economic development. At a Business Climate Forum held on 1st February 2019, Finance and Development Planning Minister, Samuel D. Tweah Jr, expressed the need for the country to boost economic growth and development in line with the Pro-poor Agenda for Prosperity and Development (PAPD)[1]. Thus highlighting the need to mainstream climate change and environment into the country development plans at both the sectoral nd national levels. The Minister statements underscore the predicament of sustainable development and the question it ultimately poses: How to develop a country economically whilst mitigating possible negative socio-environmental effects often associated with any kind of development?

As with many other countries, Liberia faces a plethora of environmental challenges associated with climate change, including general pollution, water, sanitation, and waste management (particularly industrial waste). Often, challenges posed to the environment are influenced by, and to a greater extend fuelled by population growth. Developing strategies to balance development against the socio-economic needs of the country's people cannot be over-emphasized.

The State of the Environment Report (SoER) for 2007-2018 and its associated National Environmental Action Plan (NEAP) for 2019-2023 have been developed for Liberia's Environmental Protection Agency (EPA).

This report portrays the condition of the environment in Liberia. The report presents an overview of the country, the state of the environment and trends under various themes: agriculture, water, forestry and biodiversity, atmospheric, geology and soils, terrestrial and aquatic ecology, climate change etc., as well as the important linkages between environment and poverty, health and the potential value of ecosystems services.

It is evident from the information contained in this report that despite Liberia's positive endowments of a rich forest reserve and biodiversity, the country faces environmental challenges and that improving the state of our environment is critical for promoting prosperity for current and future generations. Unsustainable exploitation of our natural resources is increasingly causing environmental degradation and resulting to reduced ecosystem services and disasters. The

[1] GOL 2019

reduction in ecosystem services is in turn contributing to poverty and other socio-economic issues. The associated action plans presented in the NEAP points to concrete action required to address these challenges.

As we embark on a renewed effort to promote social equity and economic prosperity, there is a need to step up awareness at all levels and enhance our ability to improve the state of the environment through adequate planning and budget support for managing our environment. It is my hope that this report will inform the people of Liberia and our partners about the state of our environment and natural resources. Beyond that, it is my hope that the information contained in this report will influence national and sectoral planning and contribute to decision making for the betterment of the general citizenry.

In conclusion, Liberia's environmental challenges are real and strong management solutions to avoid undermining sustainable development and growth. We must continue to listen to the voices of the specialists and recommendations in the NEAP for 2019-2023 to save our country's fragile environment. The Government and people of Liberia are determined to ensuring a strong, green environment that will drive sustainable economic and social development.

Prof. Wilson K. Tarpeh
Executive Director & Chief Executive Officer
Environmental Protection Agency

EXECUTIVE SUMMARY

INTRODUCTION

This State of the Environment Report (SoER), drafted by Green Consultancy Inc. (Greencons), considers three essential country resources (or themes) which can be used for assessing Liberia's environmental state and trends. They are: Terrestrial Resources (forestry, soil, etc.); Aquatic Resources; and Cross-Sectional Resources and Environmental Linkages. Towards the end of the report, additional emerging environmental issues and concerns are also discussed. These include, for example, human trafficking, climate change, Invasive Alien Species (IAS), illegal fishing, the usage of chemicals and solid waste management. The methodology for drafting the report largely involved a public notification period, a questionnaire which was administered by Greencons to a range of stakeholders across Liberia, site assessments and strategic sampling, Focus Group Discussions (FGDs), and Key Informant Interviews (KIIs).

TERRESTRIAL RESOURCES

Land

Liberia's land is a vital resource for human livelihoods and food security. Yet, findings point to the devastating effect these activities have had on the environment when not managed and controlled. Several issues affect the management of land resources in Liberia. These include land degradation and soil erosion from activities, such as unregulated mining and forestry practices and poor agricultural practices. Another issue affecting Liberia's savannah ecosystems is fire. Moreover, it is estimated that 2% (19,432 ha) of the land area of Liberia is lost to deforestation annually. Much of the forest losses are driven by the dependence on forest resources for subsistence and income generation. This makes deforestation another major issue.

Soil

Most soils in Liberia are oxisols and ultisols and contain oxides of aluminium and iron which are very acidic. This provides much of the foundation for agriculture, mining, the forestry sector, and all the produce that these sectors yield. Soils also make the greatest contribution to terrestrial carbon storage, shapes natural heritage landscapes, and enhances its green spaces. Yet, soil is being polluted by both natural and man-made factors. The latter include human-induced pressures through agricultural practices and contaminant inputs from waste application. Slash-and-burn agriculture is widely practised by the majority of the rural population depending on this activity for their livelihood. However, deforestation is on the increase in Liberia, increasing soil erosion.

Agriculture

Agriculture is the main livelihood across Liberia, as most rural communities depend wholly on agriculture. Most agriculture is carried out on smallholdings, many of which are still cultivated in the traditional ways of bush fallowing or shifting cultivation. Mostly, agricultural crop production is rain-dependent, particularly in the uplands. Crops grown mainly include rice, cassava, potatoes, maize, okra, pepper, oil palm and rubber. In terms

of commercial agriculture, there are also larger plantations producing rubber, coffee, cocoa, palm kernel, and other export crops. The largest commercial agricultural systems are rubber and oil palm plantations. Livestock production is still in its infancy.

Forestry and Woodland

Dominated by forests, Liberia has at least 2200 species of vascular plants, 4.7% of which are endemic to its forests, boasting flora and fauna (like pygmy hippos) that are both rare and at risk of extinction. Throughout history, the country has depended almost exclusively on its natural forests to meet the needs of its population, as forest plantations have never truly been established for timber and wood products. Today, however, the threats to forest loss are existential. Such threats include logging, uncontrolled hunting and mining, the expansion of unregulated and unsustainable farming and agro-industrial crop plantations; all of which have replaced forested landscapes with open land. The annual deforestation (tree cover loss) rate in Liberia is approximately 0.31%. What is often observed is large areas of natural forest land being converted by concessionaires into monocrops of oil palm or rubber estates, the act of which poses a threat to the natural balance of the forest.

Wildlife Resources

In November 2005, Conservation International (CI) led a survey to assess Liberia`s remaining biodiversity. At last count, the country was home to 2,200 species of plants, 193 mammals, and 576 bird species. The pressures on Liberia's wildlife resources include shifting agriculture, deforestation, hunting and poaching for both the illegal wildlife trade market, as well as the bush meat market. The loss of natural habitats through increased forest degradation due to mining, clearing, afforestation and other agricultural activities add to the pressures on Liberia's wildlife resources. Surveys in the forests of the Cestos and Senkwehn rivers showed a significant decline in the density of wildlife.

Mineral Resource Extraction and Pollution

Mining production affects fresh water through heavy water usage in processing ore, and through water pollution from discharged mine effluent and seepage from tailings and waste rock impoundments (such as leachate generation/presence of sulphide minerals, etc.). In the absence of adequate prevention and control strategies (such as rehabilitation), erosion may carry substantial amounts of sediment into nearby waters. Excessive residue can clog riverbeds and smother watershed vegetation, wildlife habitat, and aquatic organisms.

AQUATIC RESOURCES

Wetlands

In Liberia, wetlands are typically characterised by a high diversity of plant and animal species, supporting both terrestrial and aquatic vegetation and providing important habitats for many animals, including fish species. They play an important role in the hydrological cycle by providing important ecosystem services and acting as buffers of intense meteorological events. Resources gained from wetlands are vital to the livelihood of people living in the surrounding areas. Wetlands also consist of large stands of

mangroves which support substantial fish populations. The country's landscape and biodiversity, including that of its wetlands, have a great potential for attracting tourists. Wetlands are under significant pressure from human activities. The latter include mining of sand for construction, inadequate provision of basic water and sanitation services (leading to these wetlands being used as sanitation, washing and ablution areas), waste, large-scale pollution and chemicals emanating from oil refineries, paint factories and rubber plants. Wetlands are, furthermore, under threat from clearing for firewood and farming.

Ground and Surface Water Resources

Ground and surface water in Liberia mainly come from rainfall which feeds its two major lakes (both of which lie along the Atlantic coastline) and rivers. Liberia has an abundance of good quality groundwater throughout the country, recharged by the country's tropical rain and watersheds. The primary source of water used by its people is surface and groundwater. Groundwater is usually obtained by means of boreholes with hand pumps and hand-dug wells.

Fisheries

Liberians have been involved in fishing activities for centuries. Fishing is carried out mainly with nets, traps, hooks and lines, and canoes. The fisheries sector of Liberia can be divided into small-scale fishery (artisanal and semi-industrial), recreational fishery, industrial fishery (pelagic and demersal), and aquaculture. Industrial fishing in Liberia was introduced in the 1970s when the Mesurado Group of Company operated industrial fishing vessels targeting shrimps. Whilst the aquaculture sector in Liberia is not well developed and consists mainly of fishponds for subsistence, it does contribute to the livelihood and survival of the rural communities.

ATMOSPHERIC RESOURCES

The atmosphere is one of the most important layers of the earth's outer layers. It contains many gases, including oxygen which humans and other living things inhale from the air to aid in several body functions. Human beings need a continuous supply of air to exist. The requirement for air is relatively constant about 10-20m^3 per day. Air is a mechanical mixture of gases. The normal composition of external air by volume is approximately as follows: Nitrogen 78.1%, Oxygen 20.93%, and Carbon dioxide 0.03%. The balance is made up of other gases which occur in traces, e.g. argon, neon, krypton, xenon and helium. In addition to these gases, air also contains water vapor, traces of ammonia and suspended particulate matter, such as dust bacteria, spores and vegetable debris.

CROSS-SECTIONAL RESOURCES AND ENVIRONMENTAL LINKAGES

Biodiversity

Biological heritage is important to mankind in many ways. It provides us with ecosystem services like clean water, contributing directly to the economy through industries like fishing and tourism. This indirectly supports livelihoods by providing food, medicine and building materials, and generally, improves people's health and well-being. Liberia has

been regarded as one of the biodiversity hotspots in the world, and one which contains the highest remaining portion (42%) of the Upper Guinea Massif, including plants with high endemism. The country boasts over 2,000 vascular plant species, 600 bird species, 75 reptile species, and 150 mammal species.

Cultural Heritage

Liberia has a diverse cultural and traditional belief systems that includes various ethnic groups and religions. The right to culture is embedded in the constitution as a fundamental right. Various religions and practices have given birth to a plethora of different festivals and practices. History has also shaped, and continues to shape, such practices, especially the way in which enslaved Liberians from North America could return with new American traditions picked up during the slavery period. In this way, Liberia's history has also given birth to unique cultural celebrations. Along festivals and public holidays, Liberia also boasts unique music styles which have and continue to be shaped by its different cultures.

Tourism

Liberia's endowment includes a rich natural resources base with a potential tourism and hospitality market, including forests, rivers, seas, waterfalls, hills, mountains, lagoons, lakes, wetlands, and deltas. The country prides itself on an extensive and unique biodiversity, including the largest remaining tract of the Upper-Guinean Forest (UGF) in West Africa and an impressively diverse range of wildlife and plant species. Liberia's biodiversity, its rich cultural landscape, and beaches offer natural attractions for tourists and international visitors seeking new adventures. Still, this sector has remained largely underdeveloped.

Energy

Biomass is reported to dominate energy consumption in Liberia with a share of more than 80% of the used primary energy sources. This includes woody biomass used for domestic cooking and heating. In the year 2000, it was estimated that over 95% of the population depend on firewood and charcoal for cooking and heating and palm oil for lighting. According to the most recent Census (2008), 70% of the urban population use charcoal for cooking compared with 5% of the rural population; 91% of the rural population use firewood for cooking against21% of the urban population. In Monrovia, the percentage of households using charcoal is higher at 85%. Around 2% of the population have access to clean fuels and technologies for cooking. For most households, the use of modern energy services consists mainly of kerosene, electricity, and liquefied petroleum gas for lighting, cooking, and entertainment. These are used predominantly by higher income households in urban areas. Electricity and petroleum-based modern type of energy services are used mostly for economic production and transportation.

Food Insecurity

Food security is a complex and multifaceted concept for which a specific assessment is often required. There are several components to measure food security, including food availability, accessibility to food sources, food stability, food utilisation and food

consumption, together with a list of indicators for each component. In Liberia, the World Food Programme (WFP) estimates that food insecurity affects around 640,000 people, which correspond to 16% of its entire population.

EMMERGING ISSUES AND OUTLOOKS

Human Trafficking

Human trafficking is the forced trading of humans for a specific purpose. This might include sexual slavery (prostitution), or commercial exploitation. In Liberia, human trafficking exists and is a phenomenon which is well-known by the government, Civil Society Organisations (CSOs) and Non-Governmental Organisations (NGOs). In essence, there are two types of trafficking in Liberia. The one involves victims being trafficked from and between rural and urban areas (i.e. in-country), whilst the second type is known as trans-national trafficking.

Climate Change

Recent studies, including the latest climate vulnerability and risk assessment done in 2018, indicate that climate change is expected to increase vulnerability to natural disasters (floods and storms), whilst sea level rise can be expected to primarily affect the large coastal population. The effects of climate change are likely to affect the productivity of key economic sectors, including agriculture, forestry, and fisheries and their associated supply chains, thus impacting on their contributions to national Gross Domestic Product (GDP) and the country's effort to alleviate poverty in line with its Pro-Poor Agenda for Prosperity and Development (PAPD). Many stakeholders acknowledged the environmental and public health risk of air pollution, including respiratory disorders, cancer, etc.

Invasive Alien Species

IAS are non-native to a particular ecosystem and whose introduction and spread cause, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health. Invasive species are considered as one of the biggest environmental challenges of the 21st century. There are many flora and fauna species that have invaded Liberia over the last several decades. Invasion here means accidental and unplanned introduction of plant and animal species. IAS are a concern in the fisheries, forestry and agricultural sectors. Invasive species are recognised as one of the leading threats to biodiversity conservation, and pose economic costs on agriculture, forestry, fisheries and other human enterprises.

Chemicals

The Liberian Government, through the Environmental Protection Agency (EPA), has made considerable gains in the fight against chemicals by: (1) crafting laws and policy on the use of chemicals in Liberia, and (2) recruiting signatories to the Multilateral Environmental Agreement in the combat against chemical importation and usage. The government, through its partners, has identified some used chemicals in Liberia as banned chemicals. Challenges posed to the chemical industry in Liberia are: (1) the importation,

and (2) irrational use. With our most porous border, undocumented chemicals and banned substances may sometimes enter the country for use. Therefore, the EPA, working together with the immigration and commerce office, could assist to mitigate the transportation of banned chemicals in the country.

Waste Management

Waste is defined as the range of garbage arising from animal and human activities that are discarded as unwanted and useless but may be recyclable and reusable or compositing and renewable through several technological processes. There are several types of waste discussed in this SoER: domestic waste and hazardous waste. The EPA, as an autonomous agency, is charged with the responsibility to regulate environmental protection and management. The Act mandates the right to a clean and healthy environment for all within the territorial borders of Liberia. Such mandate includes but is not limited to solid waste management and sanitation. The "agency" as referred, is vested with the regulatory power to ensure solid waste management and liveable sanitary conditions.

Disaster Management

Environmental degradation is affecting some parts of the country significantly. The result of activities such as farming, plantations and mining (amongst others), compounded by population expansions (especially in Monrovia) is that large swathes of land are being degraded significantly to a point where these can no longer support plant life as a result of soil erosion and deforestation. Coastal erosion also has become a major problem in the coastal areas in Liberia, leading to an increasing number of displaced households and damaging property and infrastructure. Such erosion further increases due to changing weather conditions and human activities.

Conclusion and Recommendations

Environment and Economics

The pro-poor agenda recognizes the importance of environmental sustainability in the multi-sectoral approach towards national development. However, in this light, Liberia's long-term development blueprint which is the vision 2030 framework is underpinned by the principle of sustainable development and the recommendations set forth below should ensure the actualization of the principle:

- Adopt an integrated approach that addresses access to and management of natural resource, mainly land, water and forest, building infrastructures and access to markets, access to production inputs, and the development of livestock and fisheries sub-sectors. More attention has to be paid to public investment in the sector as well as to reinforcement of technical capacities of Ministry of Agriculture (MoA) to be able to deliver services aimed at improving sustainable agriculture for food and nutrition security. There is also a limited private investment for food crops production (low agriculture).
- It is recommended that policies need to incorporate intangible cultural heritage or symbolic cultural values into their conceptualization of local cultural valuation, along with better tangible cultural heritage or utilitarian cultural values.

- Given the potential of the tourism sector to spur socio-economic growth and development, the government needs to conduct a Strategic Environmental Assessment to determine the magnitude and scope of environmental and social impacts resulting from the development of the tourism industry in Liberia. Based upon the findings of such an assessment, an Environmental and Social Management Framework (ESMF) can be developed to safeguard environmental and social values from the negative impacts that could emerge from tourism development and management. Such a framework can strongly inform land-use planning and building regulations to guide sprawling developments along coastlines, valleys and protected areas in support of development of tourism facilities.
- The national government should institute varieties of fiscal measures to compensate environment-friendly initiative including the green infrastructure or technology, green financing and discourage undertakings that are infamous for degrading the environment by accurately meting out penalties based on the "polluter pays" principle.
- Encourage customers to make eco-responsible lifestyle choices and buying decisions. It will increase public attention on the environment friendliness of manufacturing practices and product ecological effects and inspire companies to follow environmentally sustainable standards.

Socioeconomic Status, Poverty, Gender, and the Environment

There are complex relationships between socioeconomic status, deprivation, and gender on the one hand, and climate on the other hand. Because of these variables the various exclusions many Liberians experience exacerbate their marginalization and their tendency to degrade the setting. The following guidelines should be put in place to tackle these exclusions and avoid degradation of the country's environment.

- Gender mainstreaming is the systematic process of institutionalizing gender analysis and equity values in issues recognising preparation and implementation of development strategies and legislation for the development strategies and legislation for the benefit of children, boys, women, men and other marginalized groups with a view to achieving gender equality and equity (GoK *et al.*, 2005).
- Mainstream poverty-environment interconnects with national and county growth planning, policy making, budgeting, programme execution and monitoring through financial and technical assistance (Drakenberg *et al.*, 2009) and strengthens public institutions' capacity to tackle negative nexus manifestations between the two variables. An important vehicle for this would be to finalize the formulation of a national environment policy on which all sectoral environmental laws would be anchored.
- Educating young, socio-economic marginalized children and providing equal educational opportunities for the socio-economically disadvantaged, the disabled, and the girl child in Liberia is important. Other issues such as Free Primary Education (FPE) and Free Tuition Secondary Education (FTSE) should be the necessary first steps although other issues such as onerous household duties and cultural practices, e.g. the Female Genital Mutilation (FGM) and early childhood marriage tend to scheme to keep girls out of school. Particular focus should be put

on drafting in minority communities when promoting girl child education. However, if the socio-cultural impediments tend to militate against girls' education, affirmative measures should be taken to address these injustices.

- Sensitise men and women in matters of gender and the environment. Women's exploitation is so deeply rooted in our cultures and psyches, that it remains invisible. Stereotypical gender roles are imposed by hierarchical family, social, economic, and educational institutions. Consequently, both men and women need to be more mindful of the need to create a more equal society as true development suffers where half the population is shut out of the formal economy. Training in environmental and gender sensitivity for women and men, especially lawmakers, politicians and institutional, would enable them to discard their stereotypical views of the environment and women, as well as retrogressive cultural practices involving environmental degradation and the consignment of parts of society.

Climate Change and Variability

Liberia, like the rest of the world, has been adversely impacted by climate change and weather. These elements have intensified environmental degradation; decreased agricultural production and food security; increased flooding incidences, landslides, droughts, disease epidemics; damaged physical infrastructure; and reduced the risk of competing natural resources. Even though the susceptibility to such impacts is discrete and context-specific, it has the potential to contribute to substantial economic costs that could impede the achievement of the pro-poor agenda for development and prosperity.

The national adaptation plan offers a broad coordinated, structured mechanism for government, private sector, civil society, and other stakeholders to incorporate climate change and variability considerations into national development planning and implementation at different levels. While the trajectories of future climate change and the impacts of variability in Liberia are uncertain, concrete actions are required to prepare for uncertainty by implementing proactive approaches to plan for the uncertain future. The following guidelines need to be adopted in order to formulate a national climate change strategy and enacting climate change law:

- Identify and capitalize on future opportunities posed by climate change and uncertainty (such as carbon trading).
- Establish specialized institutions and centres of excellence that will allow Liberia to enunciate study feasibility strategies for mitigation and adaptation.
- Develop early warning systems and connect climate change with reduced risk of disasters at all rates.
- Increase coordination of climate change adaptation strategies and mitigation initiatives at the state, city and community level to increase monitoring and reporting.

Geographical and Biological Environment

Liberia is blessed with enormous biodiversity and wildlife diversity. These natural resources are a source of livelihood for Liberians. They are also important to the Liberian economy and are critical for achieving the goals outline in the culture, social, and political pillars of the pro-poor agenda. The forests and woodlands are equally contributing to the Liberian economy and human development. Nevertheless, there have been initiatives by the government to fight this pressure. Despite the policies and laws adopted, there are still challenges afflicting the sector. Considering the above mentioned, the following recommendations are proposed:

- The national biodiversity policy should be formulated, and a biodiversity law implemented to provide a comprehensive regulatory structure that combines biodiversity conservation with the need to exploit the immense resources of the country's biodiversity for the pro-poor agenda.
- Sharing of mechanisms and exchange of biodiversity records among Liberia's ministries must be designed to ensure strategic control and planning of all-important biodiversity areas.
- The initiation of a technical economic value approach to evaluate the forests and woodland which are currently undervalued is paramount to the acquisition of comprehensive data that should be gathered by relevant authorities in order to ensure that informed decisions on the country's forest and woodlands resources can be made.
- The government should also start considering planting trees outside the gazetted forests and areas affected by logging.

Emerging Environmental Issues

If not managed properly, Liberia's economic development trajectory, envisaged in the PAPD 2023 plan, will likely generate considerable pressure on the environment. Moreover, Liberia's growing population is expected to accelerate this pressure. Provided that this situation occurs, the emerging issues that are discussed in this chapter could worsen. Consequently, new pressures may emerge while the already existing pressure may take a new turn. However, to address the new expected environmental issues that may emerge, the following recommendations should be considered and developed for implementation:

- The government should promote the recovery and re-use of electronic equipment in order to reduce the electronic waste load.
- In order to increase the access of incinerators by all health care facilities in the country, policy measures that encourage such investment should be developed and implemented.
- Green economy should be the core of the Liberian government's national economic development priorities; and
- Establishment of a regional food bank around the country to respond rapidly to disasters.
- To improve solid waste management, a properly corresponding and integrated

management approach should be developed, hence implementation in order to reduce pollution loading of water systems and project the risks of surface water eutrophication, water quality degradation and lower the high costs of waste management; and

- The appropriate quantification and documentation of waste, including electronic waste should be promoted in order to ensure better risk management, appropriate disposal and better allocation of management responsibilities.

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AEW	Africa Environmental Watch
AfDB	African Development Bank
AFL	Armed Forces of Liberia
AfT	Agenda for Transformation
AID	Agency for International Development
AOGCMs	Atmosphere-Ocean Global Climate Models
ASRP/IFAD	Agricultural Sector Rehabilitation Project/International Fund for Agricultural Development
AU	African Union
AWOS	Automatic Weather Observation Station
AWS	Automatic Weather Station
BID	Background Information Document
BIF	Banded Iron Formations
BNF	Bureau of National Fisheries
CA	City Alliance
CAC	Country Agriculture Coordinator
CARI	Central Agriculture Research Institute
CARI	Consolidated Approach for Reporting Indicators (of Food Security)
CBD	Convention on Biological Diversity
CBE	Community-Based Enterprise
CBO	Community-Based Organisation
CBL	Central Bank of Liberia
CCC	Community Care Centres
CCCD	Cross-Cutting Capacity Development
CCD	Colony Collapsed Disorder
CCVI	Climate Change Vulnerability Index
CDCP	Centre for Disease Control and Prevention
CEDAW	Convention on the Elimination of all forms of Discrimination Against Women
CFMA	Community Forest Management Agreement
CH_4	Methane
CI	Conservation International
CIL	Carbon-in-Leach
CITES	Convention on International Trade in Endangered Species
CLSG	Côte d'Ivoire, Liberia, Sierra Leone & Guinea
CLTS	Community-Led Total Sanitation
CLUS	Cheesemanburg Landfill Urban Sanitation
CNDRA	Centre for National Documents and Records Agency
CR	Critically Endangered
CRC	Cavalla Rubber Corporation
CRL	Community Rights Law
CSO	Civil Society Organisation
CWIQ	Core Welfare Indicator Questionnaire
DAI	Development Alternatives Inc.
DAO	District Agriculture Officer
DALY	Disability-Adjusted Life Years
DEFRA	Department for Environment, Food and Rural Affairs
DFD	Deforestation and Forest Degradation
DFID	Department for International Development
DHS	Demographic and Health Survey
DLSC	Department of Lands, Surveys and Cartography
DO	Dissolved Oxygen
DoA	Department of Agriculture
DRM	Disaster Risk Management
ECOWAS	Economic Community of West African States
EEZ	Exclusive Economic Zone

EIA	Environmental Impact Assessment
EITI	Liberia Extractive Industries Transparency Initiative
EIU	Economist Intelligence Unit
ELWA	Eternal Love Winning Africa
ELWA-RIA	Eternal Love Winning Africa-Roberts International Airport
EM-DAT	Emergency Events Database
EMP	Environmental Management Plan
EN	Endangered
EPA	Environmental Protection Agency
EPO	Equatorial Palm Oil
EPPO	European and Mediterranean Plant Protection Organisation
ERB	Energy Regulatory Board
EU	European Union
EVD	Ebola Virus Disease
ESMF	Environmental and Social Management Framework
ETU	Ebola Treatment Unit
EWS	Early Warning System
FAO	Food and Agriculture Organisation
FAPS	Food and Aquiculture Policy and Strategy
FCL	Forest Cry Liberia
FCRC	Forest Concessions Review Committee
FCS	Food Consumption Score
FDA	Forestry Development Authority
FFI	Fauna and Flora International
FGD	Focus Group Discussion
FGM	Female Genital Mutilation
FIFES	Forest Incomes for Environmental Sustainability
FLEGT	Forest Law and Enforcement, Governance and Trade
FMC	Forest Management Contract
FPA	Front Page Africa
FPE	Free Primary Education
FPS	Fisheries and Aquaculture Policy and Strategy
FTSE	Free Tuition Secondary Education
GAP	Good Agronomic Practices
GBIF	Global Biodiversity Information Facility
GCBF/ARP	Green Cross Burkina Faso/Africa Regional Programme
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility/Fund
GHG	Greenhouse Gas
GFPs	Gender Focal Points
GIS	Geographical Information Systems
GoL	Government of Liberia
Greencons	Green Consultancy Inc.
GVL	Golden Veroleum Liberia
HAB	Harmful Algal Blooms
HDI	Human Development Index
HFC	Hydrofluorocarbons
HFO	Heavy Fuel Oil
HDPE	High Density Polyethylene
HIES	Household Income and Expenditure Survey
IAS	Invasive Alien Species
IBA	Important Bird Area
IDA	International Development Association
IDLO	International Development Law Organisation
IDP	Internally Displaced Person/People
IDSR	Integrated Disease Surveillance and Response
IFC	International Finance Corporation

ILO	International Labour Organisation
IMF	International Monetary Fund
INC	Initial National Communication
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
ITC	International Trade Centre
IUCN	International Union for Conservation of Nature
IUU	Illegal Unregulated Unreported
IWRMS	International Water Resource Management System
KII	Key Informant Interview
LAC	Liberia Agriculture Company
LACEEP	Liberian Accelerated Electricity Expansion Programme
LACEEP-AF	Liberia Accelerated Electricity Expansion Project – Additional Financing
LASIP	Liberia Agriculture Sector Investment Plan
LASV	Lassa Virus
LCD	Least Developed Country
LDHS	Liberian Demographic and Health Survey
LDN	Land Degradation Neutrality
LDNTSP	Liberia Land Degradation Neutrality Target Setting Programme
LEC	Liberia Electricity Company
LEEAP	Liberia Energy Efficiency and Access Project
LFI	Liberia Forest Initiative
LFS	Labour Force Survey
LFSP	Liberian Forest Sector Project
LGS	Liberian Geological Survey
LHS	Liberia Hydrological Services
LINTA	Liberian National Tourism Association
LIS	Liberian Immigration Service
LISGIS	Liberia Institute of Statistics and Geo-Information Services
LLA	Liberia Land Authority
LMA	Liberia Maritime Authority
LNFS	Liberia National Fire Security
LNP	Liberian National Police
LNRCS	Liberia National Red Cross Society
LPD	Land Productivity Dynamic
LRCFP	Land Rights and Community Forestry Project
LULUCF	Land-Use, Land-Use Change and Forestry
LWPA	Liberia Water Producers Association
LWSC	Liberia Water and Sewer Corporation
MAC	Ministries, State Agencies and National Commissions
MCC	Monrovia City Corporation
MCS	Monitoring, Control and Surveillance
MDA	Mineral Development Agreement
MDG	Millennium Development Goal
MIA	Ministry of Internal Affairs
MICAT	Ministry of Information, Cultural Affairs and Tourism
MLME	Ministry of Land, Mines and Energy
MME	Ministry of Mines and Energy
MNS	Ministry of National Security
MNS	Ministry of National Security
MoA	Ministry of Agriculture
MoCI	Ministry of Commerce and Industry
MoH	Ministry of Health
MoJ	Ministry of Justice
MOPP	Maryland Oil Palm Plantation
MoPW	Ministry of Public Works
MoT	Ministry of Transport
MRU	Mano River Union

MUS	Monrovia Urban Sanitation
MW	Megawatt
NaFAA	National Fisheries and Aquaculture Authority
NAIDAL	National Agro-Input Dealers Association of Liberia
NAPA	National Adaptation Programme of Action
NAPHS	National Action Plan for Health Security
NBSAP	National Biodiversity Strategy and Action Plans
NCCS	National Climate Change Secretariat
NDC	Nationally Determined Contributions
NDMA	National Disaster Management Agency
NDMTC	National Disaster Management Technical Committee
NDRMA	National Disaster Risk Management Agency
NDRMP	National Disaster Risk Management Plan
NEAP	National Environmental Action Plan
NEP	National Energy Policy
NEPAD	New Partnership for Africa's Development
NERICA	New Rice for Africa
NFA	National Fisheries Authority
NFI	National Forestry Inventory
NFRL	National Forest Reform Law
NFSNS	National Food Security and Nutritional Strategy
NGO	Non-Governmental Organisation
NGP	National Gender Policy
NIP	National Implementation Plan
NLP	National Livestock Plan
NO_2	Nitrogen Oxide
NOAA	National Oceanic and Atmospheric Authority
NoI	Notice of Intent
NORAD	Norwegian Agency for Development Cooperation
NPA	National Port Authority
NPHIL	National Public Health Institute of Liberia
NRDP	National Reconstruction and Development Plan
NREL	National Renewable Energy Laboratory
NSA	National Security Agency
NTAT	National Technical Advisory Team
NTFPs	Non-timber Forest Products
NTGL	National Transitional Government of Liberia
NTPS	National Transport Policy and Strategy
NVE	Norwegian Government
OECD	Organisation for Economic Cooperation and Development
PAPD	Pro-Poor Agenda for Prosperity and Development
PCC	Paynesville City Corporation
PES	Payment for Ecosystem Services
PFCs	Perfluorocarbons
PFE	Permanent Forest Estate
PIH	Partners in Health
POPs	Persistent Organic Pollutants
PPA	Proposed Protected Area
PROSPER	People, Rules and Organisations Supporting Ecosystem Resources
PRS	Poverty Reduction Strategy
PSC	Productions Sharing Contract
PSMP	Pesticide Stock Management System
RAP	Resettlement Action Plan
RCFI	Rural Community Finance Institution
REDD+	Reducing Emissions from Deforestation and Degradation
RF	Radio Frequency
RIU	REDD+ Implementation Unit
RREA	Rural and Renewable Energy Agency

SAICM	Strategic Approach to International Chemicals Management
SAMFU	Save My Future Foundations
SAPEC	Smallholder Agricultural Productivity Enhancement and Commercialisation Project
SCNL	Society for the Conservation of Nature of Liberia
SDI	Sustainable Development Institute
SFM	Sustainable Forest Management
SF_6	Sulphur Hexafluoride
SGBV	Sexual and Gender Based Violence
SGS	Society of General Surveillance
SHF	Super High Frequency
SNP	Sapo National Park
SOC	Soil Organic Carbon
SoER	State of the Environment Report
SSA	Sub-Sahara Africa
STCRSP/IFAD	Smallholder Tree Crop Revitalisation Support Project
SWM	Solid Waste Management
TA	Traditional Authority
TAL	Tourism Association of Liberia
TDS	Total Dissolved Solids
TEEB	The Economics of Ecosystems and Biodiversity
TFZ	Tropical Forest Zone
TGS	Tai-Grebs-Sapo
ToR	Terms of Reference
TRC	Truth and Reconciliation Commission
TSC	Timber Sales Contract
TSF	Tailings Storage Facility
TST	Technical Support Team
UGF	Upper-Guinean Forest
UL	University of Liberia
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children Education Fund
UNMIL	United Nations Mission in Liberia
UNSC	United Nations Security Council
USA	United States of America
USAID	United States Agency for International Development
USGS	United States Geological Survey
VoA	Voice of America
VPA	Voluntary Partnership Agreement
VSLA	Village Savings and Loan Associations
VU	Vulnerable
WAAPP	West Africa Agricultural Productivity Project
WABiCC	West Africa Biodiversity and Climate Change
WACPS	Women and Children Protection Section
WAPP	West African Power Pool
WARDA	West African Rice Development Association
WASH	Water, Sanitation and Hygiene
WB	World Bank
WCMC	World Conservation Monitoring Centre
WFP	World Food Programme
WHO	World Health Organisation
WPWT	White Plains Water Treatment
WQM	Water Quality Monitoring
WRI	World Resources Institute

WWAP	World Water Assessment Programme
WWF	World-Wide Fund for Nature

PART ONE: OVERVIEW OF THE STATE OF ENVIRONMENT REPORT

CHAPTER ONE: BACKGROUND TO THE STATE OF THE ENVIRONMENT REPORT

1.1 INTRODUCTION AND CHAPTER OVERVIEW

The EPA contracted Green Consultancy Inc. (Greencons) in 2018 to draft the second State of the Environment Report (SoER) for Liberia for 2007-2018. Out of this SoER, a separate document, the NEAP, has been compiled to guide environmental resource management for 2019-2023. The current SoER was preceded by the first SoER for Liberia published in 2006.

This chapter describes the SoER process and briefly touches on the methodology which was employed by the specialists to conduct the various assessments upon which the data and recommendations in this report are based.

1.2 AIMS AND OBJECTIVES OF THE NATIONAL STATE OF THE ENVIRONMENT REPORT

The SoER provides an assessment of the status and trends of the environment and natural resources, and their effect on the wellbeing of the country's population. Once in every five years, there is a nationwide study carried out to establish the state of the environment, as well as to develop a five-year NEAP to guide the Government of Liberia (GoL) in managing its environmental resources. The preparation of the SoER and NEAP is largely participatory, drawing knowledge and resources from lead agencies, development partners, research institutions and Civil Society Organisations (CSOs) (amongst others). Although an SoER technical committee is responsible for overall quality control, the preparation of these reports is outsourced to ensure transparency and quality data from environmental specialists.

The SoER process essentially assesses the country's current environmental state, but also finds key trends and indicators to evaluate how particular environmental resources affect the country's economy and the livelihoods of its citizens. The term "'environment" is used holistically to include biophysical, social and economic indicators. In overall terms, the SoER provides a comprehensive assessment of environmental issues in the country, by looking back at the experiences in environmental management (2005-2015). The NEAP, on the other hand, will identify key priority areas of intervention for the government to take forward.

The objectives of the SoER can be summarised as:

1. Identifying plans and programmes that have been developed and implemented (and that may still be current) since the completion of the last SoER in 2006;
2. Ascertaining the status and achievements of the above-mentioned plans and programmes; and

3. Acquiring any readily available data and information arising from the plans and programmes. Data and information acquired will ascertain what progress has been made against the recommendations provided in the 2006 SoER. Conclusions drawn from the review will, in effect, constitute a surrogate measure of the state of the environment in Liberia as reported in the 2006 SoER. Where significant and tangible progress has been made, it will be considered as an improvement to the environment. Conversely, where no progress can be identified, it will be considered that there has been no, or at least very limited, improvement.

The aims and objectives of the SoER process is guided by the following six key questions:

I. How and why is the environment important to the people of Liberia?
II. How is the environment of Liberia changing (if at all)?
III. What challenges and opportunities do such changes hold for the country?
IV. Are there special issues which affect the environment and the development of the country that require attention and new management approaches?
V. How will different policy choices/strategies affect the future of the country and its citizens?
VI. What can be done to ensure that environmental value is retained/enhanced so as to ensure that the lives of the population are improved?

Answering these questions, the SoER considers four essential country resources (or themes) which can be used for assessing Liberia's environmental state and trends. These resources are:

- **Terrestrial Resources** (forestry, soil, etc.);
- **Aquatic Resources**;
- **Atmospheric Resources;** and
- **Cross-Sectional Resources and Environmental Linkages**.

Towards the end of the report, additional emerging (or new) environmental issues and concerns are also discussed. These include, for example, human trafficking, climate change, Invasive Alien Species (IAS), illegal fishing, the usage of chemicals and solid waste management (SWM). The last type of resources considered are referred to also as cross-sectional resources and environmental linkages, as these resources "link", and bear reference to, various of the resources already discussed. Themes such as biodiversity, culture and heritage, energy and food security are explored thereunder. The word "cross-sectional" is also used, as these resources have an influence on, and are affected by, other resources. These include, for example:

- Noise;
- Biodiversity;
- Land-use practices;
- Energy;
- Chemicals;
- Solid waste management; and
- Climate change and natural disasters.

Throughout various sections of the report, such as the first chapter which provides a country brief, socio-economic resources are also considered. These include demographics, education, markets, economy and jobs, agriculture and fisheries, food security, communication, transport, recreation, health, culture and traditional practices.

The EPA is responsible for managing the SoER process. Following the publication of the first SoER for Liberia in 2006, this current (second) SoER commenced in June 2018 following a publication of a Notice of Intent (NoI) in two national newspapers for the purpose of informing the general public and soliciting public input. On the 10th of September 2018, an inception workshop was held in Monrovia to initiate the reporting process and to identify all the relevant stakeholders involved. The latter was attended by representatives from various government ministries, agencies and commissions; from representatives of CSOs, Non-Governmental Organisations (NGOs), and international organisations. During the inception meeting, the consulting team presented the approach and methodology for the preparation of the SoER and considered stakeholder input and recommendations.

1.3 METHODOLOGY

1.3.1 Overview

The methodology for drafting the SoER and NEAP involved the following steps which are briefly discussed below:

I. Literature review;
II. Primary data collection;
III. Data analysis;
IV. Data validation workshop; and
V. Report and plan finalisation.

1.3.2 Literature Review

The specialists contracted by Greencons to serve the following purposes conducted the literature review:

- Provide the required foundation of knowledge for the various themes;
- Identify areas of previous research under each of the themes explored (i.e. secondary data);
- Identify data inconsistencies, such as gaps in research, contradictions in previous studies, or open questions left from other research;
- Identify the need for further research; and
- Place the SoER within the context of existing available literature and, consequently, reason as to why further investigations are needed in specific identified fields.

1.3.3 Primary Data Collection through Stakeholder Consultation

A range of stakeholders was consulted as part of the data gathering process. A stakeholder can herewith be defined as an individual and/or organisation who/which is actively involved in the project, or whose interests may be positively or negatively affected as a

result of project execution or successful project completion. This, therefore, ranges from all government institutions, CSOs and NGOs to the private sector and academia. Included would also be any community, individual or group which has a shared interest in, or contribution to, the findings or outcomes of the SoER and NEAP.

A questionnaire was used as the principal instrument for data gathering. Stakeholder-specific questionnaires were constructed to guide the general discourse for each stakeholder type across the five environmental resources under scrutiny. The questionnaires were constructed subsequent to a thematic literature review covering multidisciplinary backgrounds of each stakeholder's area of focus, which was narrowed down during the inception workshop into a set of questions for each stakeholder. Collecting the data by means of a structured questionnaire allowed the team the opportunity to thoroughly and rigorously explore the themes which emerged from the literature review phase and to dissect further some of the gaps that will be incorporated in the SoER.

The questionnaires all consisted of a set of questions aimed at facilitating discussion with stakeholders in addressing the key objectives of the SoER. Each discussion covered a basic understanding of the stakeholder's area of focus, resource management tools and views on the risks and/or decision-making tools and methods.

In so doing, the basic outline for each questionnaire consisted of:

- Developing a general understanding of the policies and other legal instruments around a stakeholder's area of focus. This included, for example, collecting data on the various legal instruments: i.e. policies, laws, regulations, etc.;
- Assessing the current status of a resource against the set of management policies and regulations;
- Gathering expectations from stakeholders in their respective fields regarding the current resource management tools that they use and how this can be improved; and
- Identifying areas of vulnerability (understanding limitations and barriers) and listing stakeholders' required needs.

The prepared questionnaires were circulated amongst key identified stakeholders across the nation through email and hard copy distributions. These were accompanied by an informed consent form, together with a Background Information Document (BID) on the SoER project issued by EPA. The questionnaires were distributed by Greencons during February and March of 2019. Thereafter, the stakeholders were interviewed face-to-face to review the contents of the data and solicit more discussion around topics. Interviewing stakeholders in such a manner allowed them time to reflect on key questions and have a discussion around certain topics. In some cases, several stakeholders were grouped and interviewed in Focus Group Discussion (FGD) settings. The FGDs were particularly useful in rural and remote settings with illiterate stakeholders to ensure that people could be engaged with in their local dialects.

Participation in the FGDs varied from county to county, involving participants from all over different groups at different levels in their respective communities. The consultations

were conducted in 13 of the 15 counties of Liberia within selected communities. Refer to Table 1.1.

Table 1.1: *List of Counties and Communities where Focus Group Discussion Meetings were Held*

Nr	County	Community
1	Rivercess County	Iti
2	Sinoe County	Butaw
3	Rivergee County	Sarbo-Sweken
4	Grand Gedeh County	Zleh Town
5	Nimba County	Zolowee
6	Bong County	Fokorleh
7	Lofa County	Zigida
8	Margibi County	Kpanyan
9	Grand Cape Mount Co.	Kinjor
10	Bomi County	Klay
11	Montserrado	Westpoint
12	Maryland	Pleebo
13	Grand Bassa	Buchanan

Obtaining a broad stakeholder representation was of critical importance in the consultation process. Still, time and funds only permitted the inclusion of a limited number of participants, as each location visited by the data gathering team was divided into four key sectors of the society, namely:

- Government (national regulators and local government);
- Private sector;
- NGOs; and
- Civil society and communities.

At government-level, the data gathering team met government departments and authorities in several counties where the capitals were also visited. Apart from engagements with national government departments in Montserrado, the team also engaged county authority structures, of which included county superintendents, for example. For the private sector, respondents largely included individual organisations within the mining and agricultural sectors. As public and private institutions, local universities were also consulted. Concerning NGOs, certain development partners were notified and requested by Greencons to provide input. The partners included agencies such as:

- United States Agency for International Development (USAID);
- UNDP (United Nations Development Programme);
- World Bank (WB);
- Food and Agriculture Organisation (FAO) of the United Nations (UN);
- Conservation International (CI); and
- Fauna and Flora International.

At the community level, the teams requested the involvement of different categories of people to ensure equal representation across age and gender. This included the youth, women, elders, community leaders, as well as traditional groups.

The interviews and FGDs commenced in February 2019 with the last set of interviews conducted in Montserrado County on the 22nd of March 2019. Interviews and FGDs within the various sectors/thematic areas were carried out in parallel. Attendance varied between sectors and depended on the schedules of stakeholders and the time they could afford to the project. Generally, the team found that sectors were well-represented, such as, for example, stakeholders working in the water sector. It should be noted that stakeholders were not expected to reply to all the questions prepared for a specific topic. Instead, discussions were entirely guided by the respondent's experience and relevance to the subject matter.

Additionally, a series of consultative meetings were held with key informants and sector experts from various government ministries and agencies, as well as academics and independent experts. Consultations involved conducting a series of in-depth, semi-formal interviews with practitioners and other key stakeholders within the relevant sectors. Feedback from these interviews bordered around the current state of the environment with respect to various sectors, the challenges, threats and risks and recommendations on the way forward. Whilst some of the input generated during this exercise is useful for this report, a significant amount of the information generated will feed directly into the SoER and NEAP reports.

Table 1.2 provides the names of all the stakeholders identified and engaged with by Greencons' specialists. In the table, the stakeholders are not grouped into each environmental resource, as the interests and mandates of most stakeholders touched on more than one particular environmental resource. Most stakeholders were engaged on more than one occasion, as the field team had to pressurise several stakeholders repeatedly to obtain needed information. The "date of consultations" refers to the physical face-to-face interactions with the stakeholders.

Table 1.2: *Stakeholder Identification and Consultation*

Stakeholder	Date of Consultations	Themes of Investigation	Key Data Sources Provided
Government			
Environmental Protection Agency (EPA)	Ongoing, but primarily from 14 to 23 March 2019	Food security Land-use planning and human settlements Health Socio-economic development Economy and employment	None specifically, apart from key pieces of legislation and related documents obtained by means of a literature study
Ministry of Transport	14-23 March 2019		
Liberia Land Authority (LLA)			
Ministry of Gender and Child Social Protection Agency			
Ministry of Finance and Development Planning			
National Public Health Institute of Liberia (NPHIL)			
Ministry of Health			
University of Liberia Agricultural College			
Ministry of Public Works			
Ministry of Commerce and Industry			
Liberia Institute of Statistics and Geo-Information Service			
Ministry of Information, Cultural Affairs and Tourism			
National Housing Authority			
John F. Kennedy Medical Hospital			
Ministry of Youth and Sports			
Ministry of Agriculture			
Ministry of Gender and Children Social Protection Agency			
Ministry of Health (MoH)			
Ministry of Mines and Energy			

Stakeholder	Date of Consultations	Themes of Investigation	Key Data Sources Provided
Ministry of Information, Cultural Affairs and Tourism (MICAT)			
Forestry Development Authority (FDA)	14-23 March 2019	Ecology Forestry Conservation	
Department of Conservation	16 February to 5 March 2019	Ecology Land-use planning Conservation	The department provided several documents for review, such as Management Plans of National Parks (Sapo, FFI 2017; Gola SCNL 2018) and documented conservation research reports of the FDA
Department of Community Forestry	18 February to 5 March 2019		The department provided several documents for review, such as the FDA Annual Reports and Global Witness Reports on Community Forestry in Liberia (GW 2017)
National Forestry Inventory (NFI)	5 March 2019		None specifically, apart from key pieces of legislation and related documents obtained by means of a literature study
Liberia Forest Sector Project/REDD+	21 February 2019		The department provided several documents for review, such as various write-ups and reports by the REDD+ Implementation Unit (RIU) of the FDA, World Bank 2016
Paynesville City Corporation (PCC)	17 March 17 2019	Food security Land-use planning and human settlements Health Socio-economic development Economy and employment	None specifically, apart from key pieces of legislation and related documents obtained by means of a literature study
Monrovia City Corporation (MCC)	19 March 2019		
William R. Tolbert College of Agriculture and Forestry, University of Liberia	5 February 2019	Soil	The college provided several of their reports and research work

Stakeholder	Date of Consultations	Themes of Investigation	Key Data Sources Provided
Cuttington University, Suakoko, Bong County			
Non-Government Organisations or Initiatives			
USAID	14-22 March 2019 & 1-8 April 2019	Food security Land-use planning and human settlements Health Socio-economic development Economy and employment	None specifically, apart from key pieces of legislation and related documents obtained by means of a literature study
UNDP			
World Bank Group			
Cities Alliance			
Food and Agriculture Organisation (FAO)	16 February 2019		The department provided several documents for review, such: FAO, 2011, Global Forest Assessment Report
Fauna and Flora International (FFI)	12 March 2019	Ecology Land-use planning Conservation	FII provided for review a selected FFI Leaflet on a Transboundary Landscape (FFI 2018)
IDH The Sustainable Trade Initiative	22 February 2019	Ecology Land-use planning Conservation Aquatic resource management	The initiate directed to the team to various forestry land-use options of a proposed land-use plan for Foya District (Koffa 2019)
Land Rights and Community Forestry Project (LRCFP)	12 February 2019		The project referred the team to the LRCFP Mid-Term Assessment Report (Russell 2009)
People, Rules and Organisations Supporting Ecosystem Resources (PROSPER)	12 February 2019		PROSPER referred the team to the Annual Work Plan (PROSPER 2014)
Forest Incomes for Environmental Sustainability (FIFES)	12 February 2019		FIFES referred the team to the FIFES Report (FIFES 2019)
West Africa Biodiversity and Climate Change (WABiCC)	11 February 2019		WABiCC referred the team to a selected WABiCC publication on climate change, wildlife trafficking and forest depletion (2016)
Safe My Future Foundations (SAMFU)	03 March 2019		None specifically, apart from key pieces of legislation and related documents obtained by means of a literature study
Society for the Conservation of Nature of Liberia (SCNL)	12 March 2019		

Stakeholder	Date of Consultations	Themes of Investigation	Key Data Sources Provided
Sustainable Development Institute (SDI)	14 February 2019		SDI referred the team to the Impacts of Sime Darby on Communities in Liberia (Siakor 2012) (Also see Rhein 2014)
Forest Cry Liberia (FCL)	05 March 2019		None specifically, apart from key pieces of legislation and related documents obtained by means of a literature study
Conservation International (CI)	12 March 2019		
Wild Chimpanzee Foundation	12 March 2019		
National Biodiversity Strategy and Action Plans (NBSAP)	18 February 2019		Referred the team to The National Biodiversity Strategy and Action Plan Report (EPA 2017)
The Economics of Ecosystems and Biodiversity (TEEB)			Referred the team to the EPA Report (2018) on the Biophysical and Socioeconomic Assessment of Mangroves, a TEEB study
Central Agriculture Research Institute (CARI)	5 March 2019	Soil	The institute provided several of their reports and research work
Private Sector			
MNG Gold	9 March 2019	Socio-economic development Socio-political and governance	None specifically, apart from key pieces of legislation and related documents obtained by means of a literature study
EPO	14 February 2019		
Golden Veroleum Liberia (GVL)	17 February 2019		
Maryland Oil Palm Plantation (MOPP)/Cavalla Rubber Corporation (CRC)	19 February 2019		
Arcelor Mittal Liberia	27 February 2019		
Firestone Liberia	PENDING		
Aureus Mining Company	10 March 2019		
Sime Darby Plantation	12 March 2019		
Paynesville City Corporation (PCC)	17 March 17 2019		
Monrovia City Corporation (MCC)	19 March 2019		
Communities			
Grand Bassa County Community Representatives	13 February to 12 March 2019	Food security Land-use planning and human settlements	None specifically
Sinoe County Community Representatives			

Stakeholder	Date of Consultations	Themes of Investigation	Key Data Sources Provided
Rivergee County Community Representatives		Health Socio-economic development Economy and employment	
Grand Gedeh County Community Representatives			
Nimba County Community Representatives			
Bong County Community Representatives			
Rivercess County Community Representatives			
Sinoe County Community Representatives			
River Gee County Community Representatives			
Grand Gedeh County Community Representatives			
Nimba County Community Representatives			
Bong County Community Representatives			
Lofa County Community Representatives			
Margibi County Community Representatives			
Grand Cape Mount County Community Representatives			
Bomi County Community Representatives			

The purpose of the stakeholder consultation process for the current SoER/NEAP programme was to assist the GoL through its EPA to assess the current state of the Liberian environment and draft action plans for enhancing environmental management.

Consulting key stakeholders is essential in order to harness valuable knowledge directly from the primary source; data which is not always available in a literature search (secondary data). Often, stakeholders might apply principles and strategies to their work which are not well-documented, but which could have profound outcomes for developing the SoER and NEAP. Engaging with a government department on its own understanding of the department's role, for example, could offer insight into possible limitations or areas for improvement not reflected in any secondary data. Stakeholders' expectations of their own departments/institutions and roles and responsibilities could also affect profoundly the management tools to develop. The stakeholder engagement process is not only essential in order to obtain data for the report and plan, but also to create awareness to all stakeholders about the functions of both the SoER and NEAP.

In summary, the objectives of these consultations were as follows:

- Identifying key stakeholders and their interests and concerns in relation to the management of the environment;
- Ensuring that stakeholders understood the importance of the SoER and received information thereof;
- Informing and involving affected and interested individuals and organisational stakeholders in the development of the SoER and incorporating their concerns in the preparation of a NEAP;
- Collecting baseline data on a range of environmental resources, related to (but not limited to) air quality, soil, agriculture, socio-economy, waste and sanitation, ecology, forestry, etc.;
- Allowing for meaningful stakeholder input in the design of the NEAP including concrete measures for addressing environmental issues in various sectors; and
- Ensuring that stakeholders have access to information on the SoER/NEAP process.

The methodology used to solicit stakeholders' views, input, and recommendations regarding Liberia's environmental state principally revolved around a stakeholder engagement exercise. The stakeholder consultation was conducted across 14 of the 15 counties and in 11 strategic communities in Liberia. Topics discussed with each stakeholder centred on the essential issues relevant to the country. In collecting the data, Greencons dispatched a team of specialists across Liberia to undertake a comprehensive stakeholder engagement programme. The team was authorised by the GoL to conduct a series of engagement consultations with various stakeholders; from local government authorities, concessionaires to the general public. The engagement meetings were aimed at soliciting the views and concerns of government and the wider public on a couple of issues. Such issues ranged from the status of the country's biodiversity, socio-economy to other relevant drivers influencing environmental change.

The methodology encompassed the following phases:

- Public notifications;

- Administering a questionnaire to key stakeholders;
- Site assessments;
- Key Informant Interviews (KIIs); and
- Focus Group Discussions (FGDs).

Plate 1.1: *Community consultation held by Greencons in Zleh, Grand Gedeh County (February, 2019)*

The most important objective of the consultation process encompass mere identification of key stakeholders to provide needed data for the SoER and NEAP, but also to provided them with an opportunity to discuss their concerns related to Liberia's environment. For example, stakeholders were identified in their specific fields of interest and work to provide in-depth knowledge of the challenges and opportunities related to a specific environmental resource. It offered an opportunity for such stakeholders to be part of any possible solutions by having been able to provide recommendations and mitigation measures. The data gathering process can, therefore, be a form of capacity building, which allowed representatives across several sectors and fields to have contributed to environmental solutions. The latter has been captured in the NEAP.

1.3.4 Data Analysis

Drafting the SoER and NEAP consisted of analysing the reviewed secondary and primary data and reporting this in a concise and structured manner across different environmental themes. Part of this process was also to identify gaps in literature or data received from stakeholders, and to present different management options for various environmental challenges faced by the country. By considering and incorporating all the data sourced from the various specialists on the team, the final structure of the SoER deviates in many ways from what the team envisaged the structure to look like in the beginning of the data gathering process. For example, initially, our team envisaged that there should be a section on cross-section resources, and one on "environmental linkages". After having reviewed and incorporated the data obtained into the report, we realised that these two

sections can be merged. Other sections, such as atmospheric resources, were taken out as sufficient data could not be obtained.

1.3.5 Data Validation Workshop

SoER and NEAP validation workshop: Subsequent to submitting this report, a validation workshop was organised on Zoom Media Platform due to the COVID-19 (Corona Virus) Pandemic. The attendance register and comments and response trail of the workshop are attached under the annexures of this report.

1.3.6 Report and Plan Finalisation

Final SoER and NEAP: This phase involved incorporating all the comments received on the drafts and finalising the documents for submission to the EPA. Given the volume of the report, it is recommended for the EPA to prepare a number of policy briefs for distribution to policy makers. Particularly important constituencies, which often miss out on important environmental messages, include those people of the population who are illiterate, and school-going children. Therefore, it is recommended for the EPA to produce English leaflets of the SoER and NEAP. These should cover a wide range of thematic areas to spread key recommendations and messages regarding the environmental challenges faced by Liberia.

1.3.7 Challenges

As is the case with any research project, several challenges were experienced by the Consultants' data gathering team during the assessment period.

Foremost, although Consultants provided prior notice of the assessment to all its stakeholders through public notices and EPA letters, many claimed that they were still ill-informed about the study. Some local government departments and community members even went on record stating that they had not received any form of notification about the SoER process. This, unfortunately, led to many stakeholders feeling uncomfortable sharing information about their departments or own portfolios, opinions and concerns. Many were hesitant to speak openly to the team and to provide required documentations.

Poor participation in the study was especially prevalent in the private sector and in particular, concession areas. In fact, most concession companies did not allow the team access to their datasets. Although the team was given some form of acknowledgement by many, some stakeholders remained rather sceptic of the study. Instead, Greencons was repeatedly told by various entities that important requested documentation would be delivered to the team *via* email or after they had consulted with their senior management. In many cases, such data had never been received.

Other challenges included conflicting schedules for stakeholder appointments. Often, stakeholders could not be reached or were out of the office at the time of study. Many also failed to deliver on their commitments to submit required information to Greencons electronically, or simply disregarded the reporting deadlines set by the teams. Despite

these challenges, Greencons consistently followed up with stakeholders through phone calls and face-to-face meetings. Such persistency enabled the team to gather sufficient data to develop the SoER and NEAP.

In conclusion, Greencons has observed that much of the data required to draft the SoER and NEAP is, in fact, in the possession of larger international or local NGOs and in the individual possession and not central data storage of some government functionaries who were hesitant to disclose such data to the team. Greencons, therefore, strongly recommends for the draft SoER to be presented to these organisations in an open workshop where their expertise can be gauged to further enhance the reports.

1.4 REPORT STRUCTURE

The report commences with an overview of the SoER (**CHAPTER 1**) and the country profile (**CHAPTER 2**). The country profile section provides a concise background of Liberia with particular reference to its socio-economic context. These include governance, demographics, social service delivery and an overview of the country's economy.

The second environmental state and trend which is considered under **CHAPTER 3** is Agriculture. Under this theme, the report looks at the Liberian Agriculture Sector with an emphasis on policies, practices and production trends. **CHAPTER 4** looks at the nexus between socio-economic development and the environment. The first section of the chapter deals with education and presents an overview of the literacy rate per age group and gender. The second part presents empirical data on the economy of Liberia. The third section deals with the relationship between health and environment. The chapter concludes with a look at the link between gender and environment. **CHAPTER 5** details Liberia's perspective of climate change with emphasis on projections and impacts. An overview is provided of the impact of different sectors (transportation, waste, agriculture, industry, mining, infrastructure, and forestry) on the emission of greenhouse gases and the corresponding impacts on human health and the environment. The chapter concludes by highlighting priority challenges and constraints for addressing climate change issues and capacity needs in Liberia. In **CHAPTER 6**, biodiversity is discussed, focusing on terrestrial and aquatic resources, current trends and implementation strategies. The chapter concludes by discussing challenges faced in the sector and highlights key responses by the Government of Liberia to develop improved forest management policies and regulations and to accost a host of related challenges in the forest sector. **CHAPTER 7** looks at aquatic resources with focus on surface water, ground water and coastal resources. Major forcers on water quality are discussed and key management strategies are outlined. **CHAPTER 8** presents information on the soil and geology of Liberia with focus on the mineral potential of Liberia, current mining trends and potential impact to the environment. The latter section of the SoER, **CHAPTER 9**, looks at emerging trends in the environmental sector of Liberia. These include, for example, human trafficking, climate change and Invasive Alien Species (IAS). Major challenges are highlighted, and key government responses are elaborated upon.

The report concludes with recommendations pertaining to each theme discussed. These recommendations are only brief, as they are elaborated upon in the NEAP.

CHAPTER TWO: COUNTRY PROFILE

2.1 INTRODUCTION

This chapter provides a socio-economic overview of Liberia. The intention of the chapter is to highlight the country's current socio-economic status in order to measure sustainable development initiatives against. Following an overview of Liberia, the chapter commences with a demographic snapshot of the country, providing estimated population figures, mortality rates, ethnicity, religion, literacy, and unemployment levels. This is followed by a brief analysis of the country's basic social service provisions. These include the provision of water and sanitation, electricity, schools, policing, transport, and communication. Next, the chapter delves into the country's economy with the last section highlighting current economic outlooks and development agendas.

2.2. LOCATION, CLIMATE AND RAINFALL

Liberia is situated on the West Coast of Africa. The country's approximate land mass is 37,000 square miles (GoL, 2018). It also lays claim to an economic zone of 13 nautical miles (nm) and a territorial zone of 200 nm. Liberia borders Cote D'Ivoire to on its eastern flank, Sierra Leone to the west, and to its north is Guinea. Its coastline is vast and covers approximately 560 kilometres (km) which stretches all along the Atlantic Ocean to its south. The land of the country stretches south to north from its coastal plains through a region of rolling hills and inundated plateaus with mountains reaching around 644 metres (GoL, 2013).

Plate 2.1: *Map of Liberia (Source: Liberia DHS[2], 2013: p. xxiv)*

The climate is tropical and humid, with little change in temperature throughout the year. The mean is 27°C (81°F), with temperatures rarely exceeding 36°C (97°F) or falling below 20°C (68°F). Along the coast, the heat is tempered by an almost constant breeze.

2.3 GOVERNANCE, ADMINISTRATIVE STRUCTURES AND LAND

In terms of its governance, the country is divided into 15 counties classified as first-order administration divisions. Two of 15 counties, Rivergee and Gbarpolu, were created as recently as 2000 and 2001. Each of these counties are further divided into districts and

[2] Demographic and Health Survey

clans at second-order divisions (GoL, 2013). There are a total of 136 districts, several of which have been created in the last 70 years. In fact, only Grand Cape Mount and Margibi counties have not formed any new districts since 2004. Monrovia, in Montserrado County, serves as the country's administrative capital.

The country is governed by a democratic leadership regime which consists of an elected legislature and an executive and independent judiciary. Powers within government are vested in different bodies, such as the legislative, executive and judicial powers of the government. Currently, there are 19 functional ministries and some autonomous agencies and commissions which have been created to address specific development issues (UN, 2017). Table 2.1 lists Liberia's institutional arrangements according to its ministries and agencies.

Table 2.1: *Liberia Ministries and Agencies*

Ministry of Internal Affairs	Civil Service Agency
Ministry of Agriculture	National Disaster Management Agency
Ministry of Commerce and Industry	Environmental Protection Agency
Ministry of Education	General Services Agency
Ministry of Finance and Development Planning	Liberia National Fire Service
Ministry of Foreign Affairs	Centre for National Documentation and Records
Ministry of Gender, Children and Social Protection	Liberia Institute of Statistics and Geo-Information Services
Ministry of Health (MoH)	Liberia Airport Authority
Ministry of Information, Cultural Affairs and Tourism	Liberia National Port Authority
Ministry of Justice	Liberia Telecommunication Authority
Ministry of Labour	Liberia Maritime Authority (LMA)
Ministry of Mines and Energy	Liberia Petroleum Regulatory Authority
Ministry of National Defence	Forestry Development Authority (FDA)
Ministry of Post and Telecommunication	Water, Sanitation and Hygiene (WASH) Commission
Ministry of Public Works	National Commission on Higher Education
Ministry of State	University of Liberia (UL)
Ministry of Transport	National Fisheries and Aquaculture Authority
Ministry of Youth and Sports	Liberia Petroleum Refining Company
Ministry of National Security	Liberia Water and Sewer Corporation
	Liberia Energy Regulatory Agency
	Rural Renewable Energy Agency
	Liberia National Commission on Small Arms
	National Investment Commission
	Liberia Electricity Corporation
	Liberia Refugee Repatriation and Resettlement Commission
	Corporative Development Agency
	Central Agriculture Research Institute
	National Public Health Institute of Liberia

The government has also been transforming and decentralising its powers to respond to specific issues of the 21st century. For example, dealing with issues such as urbanisation (explained shortly), the current focus of the government is on empowering municipalities to work collaboratively to enable sustainable development. Decentralising governance has a lot of merit in Liberia, as this will allow more administrative autonomy at county-level. In a similar vein, this raises questions as to the capacities of municipalities to take over such responsibilities and deliver the required results.

Land is partly governed by Liberia's Land Authority, with the creation of the Land Authority Act of 2016. Imbedded in Liberia's system of administration is an appreciation for, and hence great allowance for, traditional authorities in any development. This is manifested in its land policies. Land in Liberia is still largely held under a dual land tenure system, whereby both customary and statutory land systems are recognised. Land tenure remains, as some scholars have written, a complex system in sub-Saharan Africa, with a great deal of overlap between a number of traditional systems and state control. In essence, land in Liberia is categorised into four categories in accordance with the Land Rights Bill of 2014. These categories are public land, government land, customary land, and private land. The fundamental principle under the latter bill is that anyone in the country who does not have any formal title to land can enjoy the right to, or possess, land pursuant to an agreement of a lease, easement or license. Most of the land around the studied area comprise of private family land or communal land. According to the Land Rights Bill of 2014, which has recently been superseded by the Land Rights Act of 2018, such land is usually held by indigenous Liberians under a traditional land tenure system (FAO, 2018). The government provides legal title to land, which can protect landowners from land insecurity. Community members can obtain land from traditional leaders, although such documentation can only be given by the government. Traditional Authorities (TAs), on the other hand, can be granted land or can purchase land from a private landowner.

Land ownership and land/house plots held largely under community land are obtained through consultation with the competent leadership structure (often the village/town leader, or chief) on a free-of-charge basis. This is particularly prevalent in rural areas, In terms of private family land, land can be obtained by means of land purchases from family representatives.

2.4 DEMOGRAPHICS

2.4.1 Population

Foremost, it should be mentioned that Liberia's statistical system was severely affected during the civil war (1989-1996 and 1999-2003), during which there was a low capacity for statistical monitoring, education and training [Liberia Institute of Statistics and Geo-Information Services (LISGIS), 2017]. Most of the country's demographic data was lost during the years of war, leading to a generally poor record-keeping and archiving culture (*ibid*.). Much of the data is also outdated, as the last formal census was undertaken in 2008. However, more recent country wide surveys, such as the Demographic and Health Survey (DHS) of 2013, and the HIES of 2016, shed more light on the recent data trends. Therefore, the following section provides data from a range of different sources. These

range from data obtained directly from LISGIS, to reports and plans either from the GoL, the World Bank (WB) or UN.

As mentioned, the country's population is estimated just over 4.2 million (LISGIS, 2017). The following table provides the country's population growth rate between 1962 and 2008 (*ibid*).

Table 2.2: *Liberia Population Growth (Source: LIGIS, 2017: p.6)*

Index	1962	1974	1984	2008
Population	1,016,443	1,503,368	2,101,628	3,476,608
Population change	-	486,925	598,260	1,374,980
Average annual increase	-	40,577	59,826	57,291
Percentage increase	-	48	40	65.4
Annual rate of growth	-	3.3	3.4	2.1

Liberia calls itself home to just under 1 million households, with a mean household size of 4.3 persons per households (LISGIS, 2017). According to LISGIS (*ibid*.) the largest household sizes can be found in Maryland County (with an average of 4.9 people per household), whilst Gbarpolu County has the smallest household sizes (average 3.7 people per household). Table 2.3 portrays the mean household sizes in Liberia, cross-classified by rural, urban, region and county.

Table 2.3: *Liberia Mean Household Sizes [Source: Liberia Core Welfare Indicator Questionnaire (CWIQ) Survey, LISGIS /2010]*

People		**1-2**	**3-4**	**5-6**	**7+**	**Mean Household Size**
LIBERIA	741,771	12.8	33.2	30.9	23.1	4.98
Rural	402,242	11.8	33.6	32.1	22.5	4.99
Urban	339,530	13.9	32.7	29.4	23.9	4.98
Greater	*208,560*	*15.4*	*34.7*	*28.5*	*21.4*	*4.82*
North Central	*219,846*	*10.8*	*32.6*	*31.0*	*25.6*	*5.14*
Bong	70,450	7.5	30.5	35.6	26.4	5.39
Lofa	60,233	11.9	40.6	29.4	18.2	4.73
Nimba	89,163	12.8	28.9	28.4	29.9	5.21
North Western	*68,406*	*12.8*	*38.5*	*30.2*	*18.5*	*4.73*
Bomi	21,165	16.9	30.6	24.5	28.0	4.99
Grand Cape	25,796	11.1	32.3	35.8	20.8	5.01
Gbarpolu	21,445	10.9	53.7	29.0	6.4	4.13
South Central	*134,056*	*12.0*	*35.7*	*31.8*	*20.5*	*4.87*
Grand Bassa	55,550	14.7	43.8	28.6	13.0	4.31
Margibi	46,105	11.4	29.9	39.1	19.5	4.91
Montserrado	32,401	8.3	30.1	26.9	34.7	5.79
South Eastern A	*60,787*	*14.9*	*27.2*	*31.9*	*26.0*	*5.11*
Grand Gedeh	27,078	19.3	30.9	29.9	19.9	4.67
Rivercess	15,659	12.0	29.9	37.6	20.5	4.94
Sinoe	18,050	10.7	19.3	29.9	40.1	5.91
South Eastern B	*50,116*	*9.5*	*22.9*	*37.8*	*29.8*	*5.47*
Grand Kru	9,870	4.2	19.5	36.8	39.5	6.08
Maryland	27,233	11.9	25.9	39.6	22.6	5.04
Rivergee	13,013	8.5	19.5	34.6	37.5	

There are several ethnic affiliations across Liberia. The largest ethnic groups are the Kpelle (around 20% of the Liberian population are affiliated to this group), Bassa (13%), Gio (8%), Mano (8%) and Kru (6%) (LISGIS, 2009: p. 87). There seems to be little variation between urban and rural household sizes. The country appears to be experiencing growth in its population. To put this in perspective, the 2008 census pin-pointed the population at around 3.5 million: up from 2.1 million in 1984 (GoL, 2013).

Refer to Table 2.4, which was taken from the 2008 Census Report (LISGIS, 2008: p. 8).

Table 2.4: *Liberia Population Growth Rates (Source: LISGIS, 2008: p.8)*

	Population		2008			Growth Rate	Average Household Size	
County	1984*	2008	*No. of Households*	*Household Population*	*Special Population*	1984-2008	1984	2008
Bomi	66,420	84,119	20,508	83,033	1,086	0.9	4.0	4.0
Bong	255,813	333,481	69,810	328,668	4,813	1.0	4.9	4.7
Gbarpolu	48,399	83,388	47,440	80,186	3,302	2.3	4.6	5.5
Grand Bassa	159,648	221,693	23,950	217,230	4,463	1.4	4.0	4.6
Grand Cape Mount	79,322	127,076	18,143	124,777	2,299	2.0	4.5	5.2
Grand Gedeh	63,028	125,258	8,969	122,913	2,345	2.9	5.2	6.8
Grand kru	62,791	57,913	49,642	57,650	263	-0.4	4.9	6.4
Lofa	199,242	276,863	45,095	273,990	2,873	1.3	5.2	5.5
Margibi	151,792	209,923	19,254	207,146	2,777	1.1	4.5	4.6
Maryland	69,267	135,938	13,981	134,279	1,659	2.8	5.8	7.0
Montserrado	491,078	1,118,241	232,585	1,105,246	12,995	3.5	5.4	4.8
Nimba	313,050	462,026	80,734	454,881	7,145	1.7	5.8	5.6
Rivercess	37,849	71,509	15,829	69,844	1,665	2.3	5.9	5.0
Rivergee	39,782	66,789	9,822	64,330	2,459	2.2	5.4	6.5
Sinoe	64,147	102,391	14,533	101,068	1,323	2.1	6.6	6.4
TOTAL	**2,101,628**	**3,476,608**	**670,295**	**3,425,241**	**51,467**	**2.1**	**6.1**	**5.1**

Table 2.5 portrays the same data per district and gender.

Table 2.5: *Population Distribution per Sex and County (Source: LISGIS, 2008)*

Name of county	Sex		Total
	Male	Female	
Bomi	42940	41179	84119
Bong	164859	168622	333481
Gbarpolu	43906	39482	83388
Grand Bassa	110913	110780	221693
Grand Cape Mount	65679	61397	127076
Grand Gedeh	64994	60264	125258
Grand Kru	29648	28265	57913
Lofa	133611	143252	276863
Margibi	105840	104083	209923
Maryland	70855	65083	135938
Montserrado	549733	568508	1118241
Nimba	230113	231913	462026
Rivercess	37224	34285	71509
Rivergee	34863	31926	66789
Sinoe	54767	47624	102391
Total	1739945	1736663	3476608

Figure 2.1 illustrates the country's population figures as a percentage of each county.

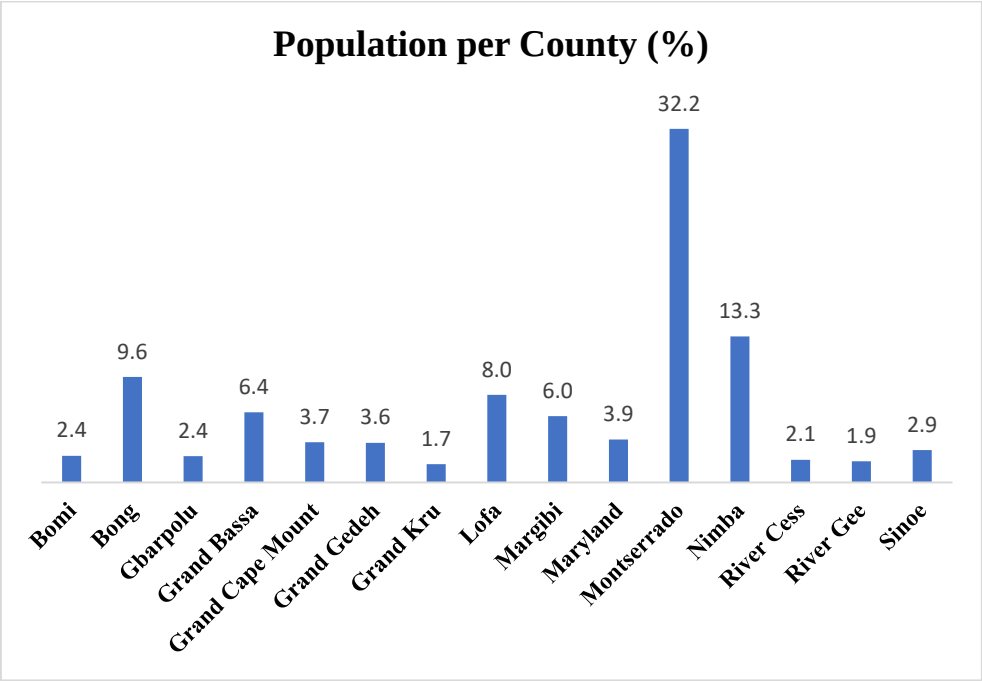


Figure 2.1: *Liberia's Population as a Percentage of Each County (Source: LISGIS, 2008)*

According to the government, much of this growth can be explained by the country's high fertility rate and declining mortality (GoL, 2018). Albeit this growth, there is also a negative net migration rate of 5.7 migrants for every 1,000 population (*ibid.*). In terms of a gender breakdown, females represent 51.1% of the population (LISGIS, 2017).

The largest county by population is Montserrado (classified as its own separate region) holding approximately 32.2% of the country's population (GoL, 2018). This is followed by Nimba (13.3% of the country's population) and Bong (9.6%) (*ibid.*). The smallest populated county is Grand Kru with a population of just over 70,000 (1.7% of the total population). In terms of the largest cities, Monrovia is the country's capital and most heavily populated city with just over one million residents (LISGIS, 2017). Each county also has its own capital, such as Bensonville in Montserrado County, Sanniquellie in Nimba, Gbarnga in Bong and Buchanan in Grand Bassa (to name some of the largest capitals in terms of population figures).

The statistical data points to a disparity between the urban and rural population. For example, the rural population stands at around 53.9% of the total population (LISGIS, 2017). The government estimates that the average population density for the country is 93 persons per square mile: from 1,500 per square mile in the Greater Monrovia Region to only 22-40 per square mile in Eastern Liberia (*ibid.*).

As part of defining a country's population, understanding which age cohorts comprise the most and least of the country's population is critical for several reasons. One reason is to determine unemployment rates (as percentages of the working-age population), or to plan for the provision of social services (especially for the poor or youth). Figure 2.2 below provides a pyramid for the population of Liberia according to age categories.

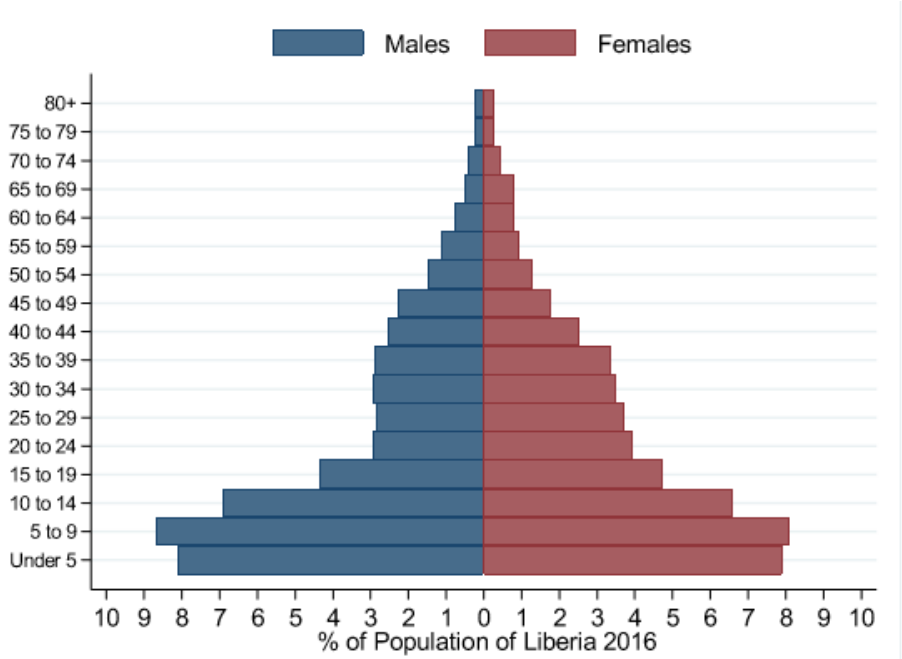


Figure 2.2: *Population of Liberia in Age Categories (Source: LISGIS, 2017: p.11)*

Considering age, the largest section of the population (52.6%) seems to be within the standard working-age population of 15-65 years of age (LISGIS, 2017). This is closely followed by residents who are 18 years or older (49.1%) and between 0-14 (44.5%). Very few residents are 65 years or older (2.9%) (*ibid.*). In summary, considering a pyramid of the population makeup, the country has a very youthful population. Moreover, the general life expectancy for men and women is around 53 years (GoL, 2013).

2.4.2 Urbanisation

Urbanisation is a trend experienced in Liberia. The following figure illustrates urbanisation in Liberia between 2007 and 2017.

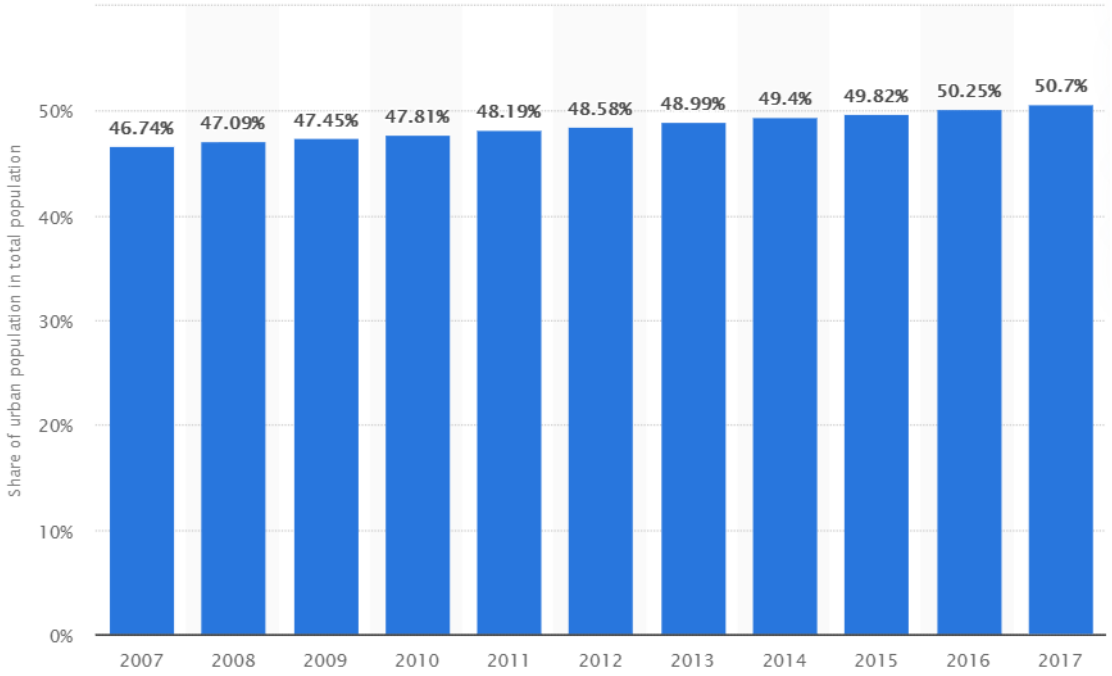


Figure 2.3: *Urbanisation in Liberia between 2007 and 2017 (Source: Statista, 2018)*

Urbanisation is hardly surprising, as there are more social services and economic opportunities in larger urban centres. The government acknowledges that urbanisation has been rapid and contributed to overcrowding conditions, inadequate infrastructure, youth unemployment and slum developments in urban areas (GoL, 2018).

As already referred to, Liberia's largest city is Monrovia, where most of the country's economic sectors reside. With a rural-to-urban in-migration to Monrovia, coupled with general inter-urban migration trends, there is an increasing disparity in infrastructure, employment opportunities and basic social service provisions between the rural areas of the country and the largest cities, such as Monrovia (Eros, 2019). Much of the urbanisation trends in Monrovia can be traced to rural citizens fleeing to the city during the years of civil war when Monrovia was controlled by peacekeeping forces held by interim governments. As the city grew, slumps sprang up on its fringes as it became ever more difficult to keep up with the growing population. Today, it is estimated that as of 2008, around 49% of households in Liberia live in urban areas (UN, 2017).

Urbanisation carries along some challenges. For example, migration towards the larger coastal towns and cities is reshaping the economic and social environment. Such population movements pressurise the country's existing natural resources and further degrades the environment subsequent to what was done by the years of war. One of the most obvious challenges to urbanisation in particular is service delivery and infrastructural development in high density areas, but also in particular in rural areas which are far from service delivery points. Service delivery infrastructure (in both urban and rural areas), remain poor and not well-developed after the war. The rehabilitation of such social infrastructure is simply made more urgent by the fast growth of the urban population.

Another challenge with urbanisation is the increasing disparities brought along with such development between the urban and rural population. For example, in rural areas, higher fertility rates are observed, possibly in light of poor educational upbringing. This intensifies the need to provide social services and infrastructure in rural areas. Such disparities are also noticeable in terms of employment opportunities. There are more economic sectors in larger cities such as in Monrovia, which, together with poor social services and a lack of basic infrastructure, pulls people from rural areas to the cities. As explained by some scholars, one can argue, therefore, that much of the current urbanisation trends in Liberia is due to pull factors. This stands in contrast to the past, when people were forced to move to the city due to the war.

2.4.3 Displacement and Involuntary Resettlement

Liberia's population dynamics are heavily influenced by population displacement and involuntary resettlement. This largely resulted from years of civil war where it is estimated that nearly half of the country's population experienced displacement (*cf.* Dabo, 2012). During the civil warfare, Internally Displaced People (IDP) were forced to flee from their homes with massive human rights abuses and violations in the wake of the evictions. Violations included massacres, arbitrary killings, targeting of civilians, psychological torture, forced abduction, the use of especially women and children as sexual slaves, and also massive forced displacement.

Figure 2.4 illustrates the scale of displacement per county as per the 2008 Population and Housing Census (LISGIS).

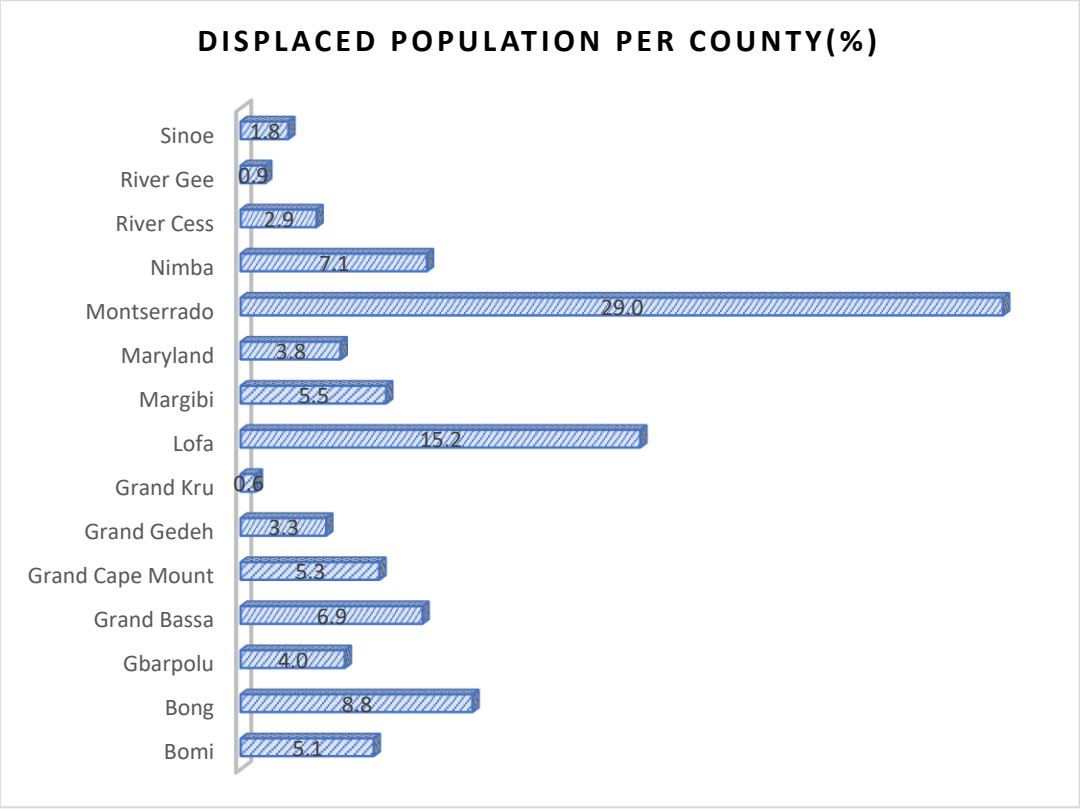


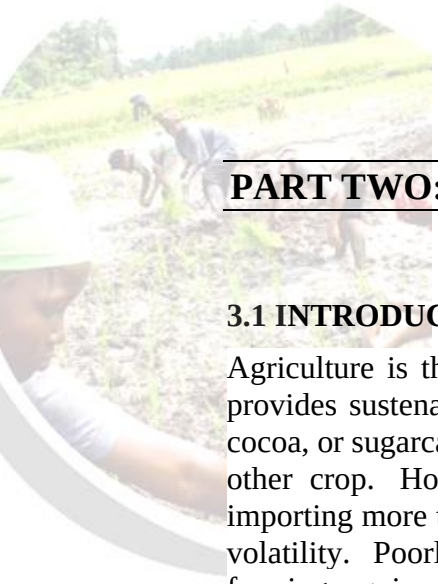
Figure 2.4: *Displacement per County (Source: LISGIS 2008 Population & Housing Census)*

Some reports, such as narratives from Liberia's Truth and Reconciliation Commission (TRC) also refer to such displacement as the defining feature of Liberia's conflict (ibid.). According to the United Nations High Commissioner for Refugees (UNHCR) (2007), it is estimated that around 500,000 to 600,000 people were internally displaced, whilst 780,000 had been made refugees by the time the war ended. It is also claimed by the TRC that forced displacement was used as a deliberate military strategy for rebel groups to claim their territory (*ibid.*). Such displacements saw huge numbers of villagers fleeing amidst gunshots and attacks, and often affected women disproportionately to men. Many women also suffered sexual abuses.

In order to deal with the aftermath of displacements, the TRC was established and started with public hearings in Monrovia in early 2008 (UNHCR, 2017). As part of the hearings, victims and perpetrators had an opportunity to voice their experiences. The impacts of forced displacement were profound, and included not only psychological stress, but also the loss of property.

Another aspect of displacement is involuntary physical and/or economic resettlement as a result of projects needing land for development. Resettlement is often required for the development and construction of hydroelectric dams, large-scale (commercial) agriculture (irrigation schemes), road works (the construction of highways, for example), mines, or urban development projects. Liberia has had a fair share of such resettlement projects. Many of these have been for road construction projects, such as a 180.36 km road construction project from Monrovia to Gbarnga in Bong County for which a Resettlement Action Plan (RAP) was prepared and submitted to the government in 2012. Similar projects included the construction and rehabilitation of the Somalia Drive Road, which is envisaged to be completed in 2021. A more recent and ongoing resettlement project is the proposed Greenville-Barclayville road. This project, upon completion, envisages to bring about improvement in transportation and trade along this corridor.

Involuntary resettlement, although much different than forced displacement, can also have a significant negative impact on people and communities, if not planned properly. The most recent example which requires significant resettlement planning is a lingering debate over the future of West Point in Monrovia. In 2017, an article by UrbanAfrica.net (2017) pointed out that this community houses around 75,000 people and claims the title of being Liberia's largest urban slum. As residents have built their homes up to the water's edge, many structures are vulnerable to tides, currents and storm surges. Coastal erosion is both perpetuated by such development, but also intensifies the need for the government to resettle this slum. The article largely points to an ongoing debate as to whether this slum should be resettled. Attempts by the government to relocate the community to more peripheral suburbs in the past have failed due to a lack of alternative livelihood opportunities (*ibid.*). The article further notes that relocation has become a favoured option for the GoL, especially amidst factors such as climate change and believed rising sea levels. This illustrates how environmental degradation is very often linked to forced (or involuntary) displacement. The same slum was affected by flooding in July 2019 when 72 residential houses were swept away in a massive storm. Sea erosion, coupled with poor settlement development and/or planning, significantly affected the country's urban population and safety.



PART TWO: ENVIRONMENT AND ECONOMIC DEVELOPMENT

CHAPTER THREE: AGRICULTURE

3.1 INTRODUCTION

Agriculture is the primary livelihood for more than 60% of Liberia's population and provides sustenance for many households engaging in cassava, rubber, rice, oil palm, cocoa, or sugarcane production. More households engage in cassava production than any other crop. However, overall agricultural productivity is low, resulting in Liberia importing more than 80% of its rice, making the country vulnerable to global food price volatility. Poorly integrated, the sector lacks basic infrastructure such as machines, farming equipment/tools, farm-to-market roads, fertilisers and pesticides, and food storage capacity. Cassava and rice are the primary staple food crops. The main cash crops and foreign exchange earners are rubber, cocoa, oil palm and timber. Rubber is one of the dominant generators of state revenues, accounting for 17.5% of the total export receipts in 2017. Commercial rubber farms employ an estimated 30,000 people and up to 60,000 smallholder households are involved in growing rubber trees (CBL, 2017). Firestone Rubber Plantation, covering almost 200 mi^2 (square miles), is the largest single natural rubber operation in the world and the biggest private sector employer in Liberia.

For oil palm production, there has been considerable interest from both smallholders and large investors in expanding its export and production. However, uncertainty with regard to land tenure is a significant challenge for potential oil palm farmers and investors. Stakeholders in the oil palm sector include smallholder farmer cooperatives, individual farmers, large multinational corporations and concessionaires, as well as individuals playing various intermediary roles and support services. Another obstacle to investment in the sector is the lack of capital and professional expertise to increase productivity.

Liberia has favourable climate and fertile soil for cocoa production and there is increased investment in the rehabilitation of cooperative and smallholder farms for cocoa production in the country. Although the production of cocoa is basically on a small-scale, it is expected to increase as farmers continue to reclaim and rehabilitate their farms. As with the agriculture sector in general, smallholder cocoa farmers and local cooperatives are challenged by inadequate farm-to-market roads; lack of familiarity with measurement and quality standards; lack of storage facilities; and limited access to updated price and market information. Beside the cash crops, there are market opportunities and potential for agribusiness investment, which focuses on developing the value chain of the available food crops such as rice, cassava, vegetables, fruit, poultry and fish.

Liberia has a suitable climate for horticulture, such as production of peppers, okra, onions, tomatoes, squash, eggplants, etc., which are in high demand throughout the country all year round. Lowland cultivation and low-cost irrigation would give smallholders an opportunity to increase productivity and expand market share of this valuable crop. Liberia has an Atlantic coastline spanning about 580 km endowed with abundant marine fish stocks. The coastline and abundant freshwater resources provide breeding

ground varieties of marine species, including crab, lobster, shrimp, tilapia, tuna, shark, croaker, and barracuda.

The Agriculture sector of Liberia is regulated by the Ministry of Agriculture (MoA). The MoA was established by an Act of the Liberia Legislature on 11 May 1972. The 1972 Act repealed the 1964 law created by the then Department of Agriculture (DoA) and assigned specific responsibilities to develop the Liberian agriculture sector (www.moa.gov.lr). The core general areas of responsibility of MoA consist of, agriculture, both smallholder and commercial, plantation crops, fisheries and livestock.

This chapter looks at the Liberian Agriculture Sector with an emphasis on policies, practices and production trends.

3.2 POLICY CONTEXT

In 2002, both the National Environmental Policy and the Environmental Protection and Management Law of Liberia were developed and approved to enhance environmental protection, including soils, within the territorial limits of Liberia. In 2013, the Land Rights Policy of Liberia was developed and approved, followed by the Land Rights Act of 2018. Essentially, both the land rights policy and legislation strongly emphasise the principle of environmental protection, which also emphasises conservation of soils in the nation.

Key soil-related issues specifically addressed by the environmental protection policy and law of Liberia include the maintenance of soil productivity, control of erosion in environments such as caused by surface mining localities, and the control of soil pollution that could potentially arise from the disposal of wastes and hazardous chemicals on lands in the country. The policy and law further provide for the conduct of environmental impact assessments, audits, and monitoring to curtail any adverse impact of industrial activities on lands (soils) in Liberia. The establishment of more protected areas (of which soil conservation is inclusive) and regulations/guidelines for other risk factors that could potentially impact the soil negatively are also considered in the environmental policy and law. Enforcement of these and other policies and regulations, however, has remained a key challenge.

Licenses and permits are also issued to industries, agriculture importers and dealers, including agriculture companies to operate in the country. The licenses and permits are given by the EPA, MoA and the MoH. Inspections, monitoring and evaluations by the agency and ministries are challenges to the MoA. Poor coordination amongst the institutions and low budgetary constraint are factors challenging these institutions. However, some level of coordination has been initiated for example the Environmental Sector Working Group which brings together different institutions of GoL, CSOs and NGOs to discuss trending environmental and social issues and serves as a platform for information dissemination.

The MoA has adopted the Economic Community of West African States (ECOWAS) regulations on pesticide, fertiliser and seeds in 2016, but has not taken effect in Liberia as yet. There is also the absence of a national legal and regulatory instrument on seeds, fertiliser and pesticide. In an effort to manage all plant activities, the MoA developed a

National Plant Protection Policy and regulatory service. The document was validated in 2010, but is yet to have cabinet approval and legislation.

3.3 AGRICULTURAL PRACTICES IN LIBERIA

3.3.1 Overview

Agriculture is the main livelihood across Liberia (MoA, 2007; 2008). Basically, the landscapes of Liberia range from coastal lowlands and plains to rolling hills and plateaus further inland, and mountains rising to a maximum height of 1,380 m around the north and northeast of the country (CILSS, 2016). Amidst these landscapes, up to five agro-ecologies have been identified and described by the Government of Liberia, based on their potentials for agricultural use (CAAS-Lib, 2007ab). These five agro-ecologies include coastal beach plains, flood plains, tidal swamps, valley swamps, and hills.

Table 3.1: *Descriptions of the Various Agro-Ecologies of Liberia (CAAS-Lib, 2007ab)*

Agro-ecology	Drainage	Recommendation crops	Production Constraints	Recommended Improvement Measures
Costal beach plains	Poor to well drained	Unsuitable for most crops except cassava, coconut, oil palm,	Low fertility, low organic matter	Fertility management
Tidal swamps	Poor	Intensive lowland rice	High tide destroys crop	Adequate drainage
Valley swamps	Poor	Lowland rice	Water logging, low nutrients, low organic matter	Adequate drainage, fertility management
Low and high hills	Well drained; foot slopes poorly drained	Upland rice, vegetables, cassava, tree crops	Low fertility, erosion	Fertility management, adequate fallow

Thirty percent (30%) of the land area is arable while 2.5% is pastureland. Most of the upland soils are lateritic, acidic, infertile, and low in humus. The swamp soils are comparatively better in nutrients and humus but are mostly waterlogged from May to October.

It is estimated that less than 10% of the 4.6 million hectares of arable land in Liberia are cultivated; in fact, most rural communities depend wholly on agriculture. More than 70% of the population is rural and depends principally on biological resources for livelihoods. Agriculture plays an important role in Liberia's economy, which is also evident by the number of farming fields across the countryside, with farm households accounting for at least 80% of the population in those parts of Liberia (CAAS-Lib, 2007b), and those engaged in agricultural activities accounting for 65% of the economically active population of the country in 2014 (FAO, 2005). About 46% of the total land area of 9.8 million hectares is available for agriculture (FAO, 2005). Most agricultural activities are carried out on smallholdings, with staple food crops produced mainly for subsistence. The food crops are produced by traditional methods, which are characterised by bush fallowing or shifting cultivation. Vegetables and tree crops are produced mainly for commercialisation. The latter traditional/subsistence system of production (the shifting

cultivation or slash-and-burn method) is characterised by low productivity, long fallow periods of 6-10 years and relatively short cultivation periods of 1 or 2 years.

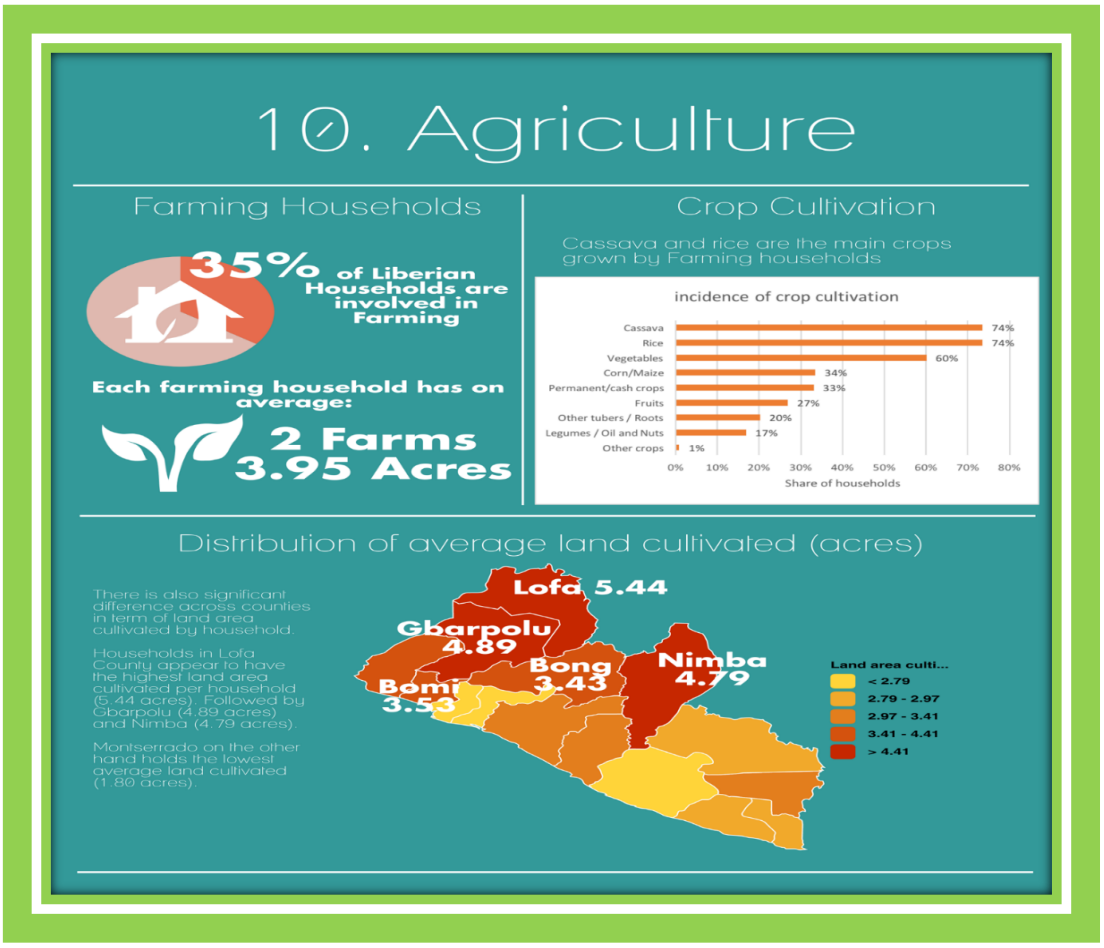


Figure 3.1: *Agriculture by Farming Households, Crops Cultivated and Distribution of Average Land Cultivated (Source: LISGIS/HIES 2014 & 2016)*

Table 3.2 below provides the land under cultivation by county in hectares.

Table 3.2: *Land Area Cultivated by County in Hectares (Source: LISGIS/HIES, 2016)*

County	Male-headed households	Female-headed Households	All households	Land cultivated per capita
Bomi	1.5	1.3	1.4	0.4
Bong	1.5	1.1	1.4	0.4
Grand Bassa	1.4	1.2	1.4	0.4
Grand Cape Mount	1.8	1.4	1.8	0.5
Grand Gedeh	1.2	1.1	1.2	0.3
Grand Kru	1.2	1.0	1.2	0.3
Lofa	2.4	1.6	2.2	0.5
Margibi	1.2	0.8	1.1	0.3
Maryland	1.2	0.9	1.1	0.2
Montserrado	0.7	0.7	0.7	0.2
Nimba	2.1	1.5	1.9	0.5

County	Male-headed households	Female-headed Households	All households	Land cultivated per capita
Rivercess	1.4	0.8	1.3	0.3
Sinoe	1.1	0.9	1.1	0.3
River Gee	1.3	1.1	1.2	0.3
Gbarpolu	2.1	1.6	2.0	0.5
National	1.7	1.3	1.6	0.4

There is also significant difference across counties in terms of land area cultivated as shown in Table 3.2. Households in Lofa County appear to have the largest land area cultivated per household. Moreover, male-headed households cultivate more area of land than female-headed households across counties.

Mostly, agricultural production in Liberia is dependent on the rain or is in most instances rain fed, particularly in the uplands. The lowlands, on the other hand, support short duration crops, especially during the dry season. Major crops cultivated in Liberia are listed in Figure 3.2:

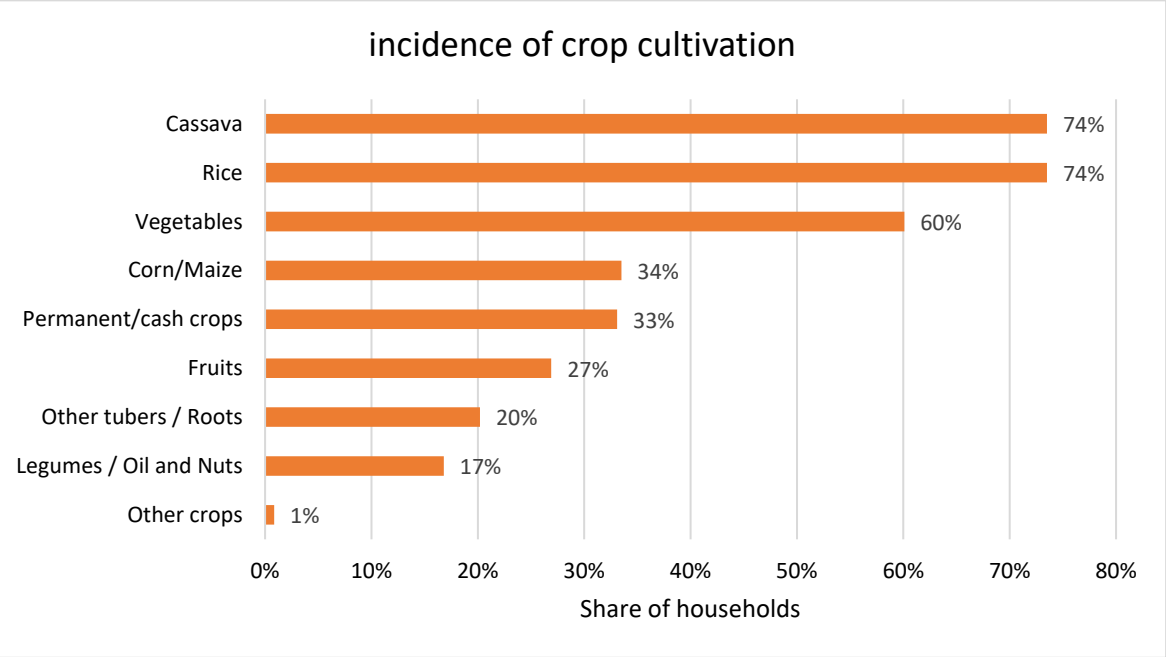


Figure 3.2: *Incidence of Crop Cultivation (Source: LISGIS/HIES, 2016)*

There is a prevalence of smallholder farmers in Liberia. Most households in Liberia own an average of 2 farms. The average size of land cultivated per household is 1.6 ha. The distribution of land cultivated illustrated in Table 3.2 shows the prevalence of smallholder farmers in the country. Less than 3% of farming households cultivate more than 5 ha of land; even in the top land quintile, average land cultivation is smaller than 4 ha.

Table 3.3: *Average Land Area (ha) Cultivated by Quintiles (Source: LISGIS/HIES 2016)*

Quintiles of land cultivated	Household land area cultivated			Household land area cultivated per capita		Number of observations[3]
	Mean	SD		Mean	SD	
Quintile 1 (Smallest farm)	0.34	0.17		0.11	0.10	826
Quintile 2	0.83	0.13		0.23	0.15	1005
Quintile 3	1.25	0.12		0.34	0.24	809
Quintile 4	1.88	0.25		0.51	0.32	772
Quintile 5 (Largest farm)	3.60	1.07		0.84	0.58	636
Total	1.58	1.23		0.40	0.41	4048

Cassava and rice are the main crops grown by farming households (they account for 74% of households' crop portfolio each). Vegetables growing are also important (60% of the crop portfolio). The share of households growing corn is 34%. Permanent cash crops are grown by 33% of households while only 27% of households grow fruits (banana, papaw/papaya, pineapple, plantain, etc.) and 20% grow other tuber or roots (eddoes, ginger, Irish potatoes, onions, sweet potatoes and yams). These figures vary minimally across.

Rice and cassava are the main crops, although as many as 8-10 different crops can be planted in a mixed cropping system. Average Cassava yields are estimated at 5.28 metric ton per hectare.

Table 3.4: *Estimated Production of Cassava (Based on Farmer Estimates) (Source: LISGIS, 2016)*

County	Number of farming households	Average area per household (Ha)	Average yield / ha (MT)	Average yield/ household (MT)	Production (MT)
Bomi	12 498	0.39	5.68	2.23	27 916
Bong	53 885	0.39	5.68	2.23	120 361
Grand Bassa	22 294	0.39	5.68	2.23	49 797
Grand Cape Mount	23 444	0.39	5.68	2.23	52 366
Grand Gedeh	8 956	0.39	5.68	2.23	20 005
Grand Kru	7 725	0.39	5.68	2.23	17 255
Lofa	38 883	0.39	5.68	2.23	86 852
Margibi	15 668	0.39	5.68	2.23	34 997
Maryland	5 677	0.39	5.68	2.23	12 681
Montserrado	17 061	0.39	5.68	2.23	38 109
Nimba	74 658	0.39	5.68	2.23	166 761
Rivercess	8 491	0.39	5.68	2.23	18 966
Sinoe	9 874	0.39	5.68	2.23	22 055
River Gee	5 741	0.39	5.68	2.23	12 823
Gbarpolu	7 459	0.39	5.68	2.23	16 661

[3] The figures in the table are weighted. However, the number of observations reflect the number of farming households in the sample.

County	Number of farming households	Average area per household (Ha)	Average yield / ha (MT)	Average yield/ household (MT)	Production (MT)
Total	**312 314**				**697 604**

Two species of rice are grown, an Asian rice species (*Oryza sativa*) and an African species (*O. glaberrima*), that has become rare. Other species of rice include 22 aquatic varieties (19 exotic and 3 indigenous) and 32 terrestrial (25 exotic and 7 indigenous). Nearly all the exotic varieties were brought in by AfricaRice, formerly refered to as "West African Rice Development Association" (WARDA).

The next table provides the trends of rice and cassava grown in Liberia, whilst the figure illustrates the trends of rice and cassava production in metric tons.

Table 3.5: *Trends of Rice and Cassava Hectares, Yields and Production 2012 (Source: LISGIS/HIES, 2016)*

Description	Unit	Year					Percent Change	
		2012	2011	2010	2009	2008	Average (010-011)	Average (09-08)
PRODUCTION								
Paddy Rice	MT	297,190	290,650	296,090	293,000	279,000	1.3	3.9
Fresh Cassava	MT	485,190	489,270	493,000	495,300	496,290	-1.2	-2.1
Total	**MT**	**782,380**	**779,920**	**789,090**	**788,300**	**775,290**	**-0.3**	**0.1**
AREA HARVESTED								
Rice	HA.	246,380	238,780	251,230	247,580	222,760	0.6	4.8
Cassava	HA,	61,050	61,040	61,470	63,210	57,360	-0.3	1.3
Total	**HA.**	**307,430**	**299,820**	**312,700**	**310,790**	**280,120**	**0.4**	**4.1**

Yield per ha								
Rice	KG	1,206	1,217	1,179	1,183	1,253	0.7	-1.0
Cassava	KG	7,947	8,016	8,020	7,835	8,652	-0.9	-3.6
FARMS								
Rice	NUM	**241,750**	242,800	241,310	245,840	231,650	-0.1	1.3
Cassava	NUM	**120,710**	122,520	119,370	120,560	117,730	-0.2	1.3
Total		**362,460**	**365,320**	**360,680**	**366,400**	**349,380**	**-0.1**	**1.3**

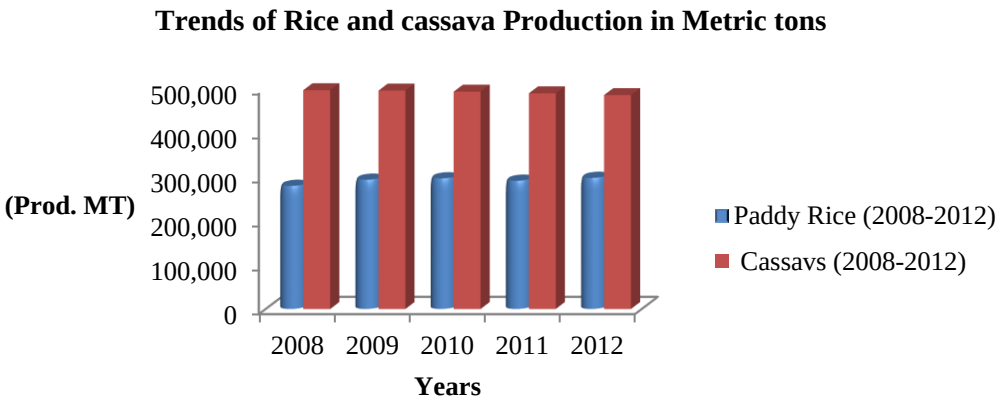


Figure 3.3: *Trends of Rice and Cassava Production in Metric Tons (Source: LISGIS/HIES, 2016)*

Other cash crops and/or crop trees of economic importance are rubber (*Hevea brasiliensis*), coffee, yam (*Dioscorea spp*), ground nuts (*Arachis hypogeae*), cow peas (*Vigna unguiculata*), cabbage (*Brassica oleracea*), oil palm (*Elaeis guineensis*), coconut (*Cocos nucifera*), papaya (*Carica papaya*), banana (*Musa sapientum*), avocado/butter pearl (*Persea americana*), sweet orange (*Citrus sinensis*), and mango/plum (*Mangifera indica*).

Table 3.6: *Number of Farming Households Engaged in Cash Crops Production by County (Source: LISGIS/HIES 2016)*

County	Total number of farming households	Cocoa	Coffee	Oil Palm	Rubber	Sugar Cane
Bomi	12 498	137	-	307	1 187	204
Bong	53 885	1 304	-	164	8 083	5 265
Grand Bassa	22 294	829	-	-	2 631	3 567
Grand Cape Mount	23 444	237	86	1 620	1 744	326
Grand Gedeh	8 956	1 281	39	76	134	18
Grand Kru	7 725	96	-	18	462	125
Lofa	38 883	10 421	10 965	1 485	278	1 170
Margibi	15 668	-	-	-	1 141	1 598
Maryland	5 677	-	-	36	642	999
Montserrado	17 061	363	-	998	-	2 423
Nimba	74 658	17 097	3 151	7 690	21 875	8 660
Rivercess	8 491	276	-	132	709	194
Sinoe	9 874	-	-	115	101	227
River Gee	5 741	855	-	41	185	175
Gbarpolu	7 459	454	-	38	449	174
Total	**312 314**	**33 350**	**14 240**	**12 719**	**39 620**	**25 125**

Figure 3.4: *Export Volume and Value of Rubber, Cocoa and Coffee Beans 2014-2016*

Table 3.7: *Evolution of Livestock and Poultry Production (Source: LISGIS/HIES 2016)*

		Year				Percent Change		
Description	**Unit**	**2012**	**2011**	**2010**	**2009**	**2011**	**2010**	**2009**
LIVESTOCK								
Cattle	Head	10,440	7,000	10,650	8,370	49.1	-2.0	24.7
Goats	Head	96,400	100,000	96,750	75,330	-3.6	-0.4	28.0
Sheep	Head	46,680	47,200	48,450	43,470	-1.1	-3.7	7.4
Pigs	Head	61,210	65,200	64,990	68,000	-6.1	-5.8	-10.0
TOTAL	**Head**	**214,730**	**219,400**	**220,840**	**195,170**	**-2.1**	**-2.8**	**10.0**
POULTRY								
Chickens	Head	924,700	951,260	800,780	774,960	-2.8	15.5	19.3
Ducks	Head	53,000	53,350	48,580	39,210	-0.7	9.1	35.2
TOTAL	**Head**	**977,700**	**1,004,610**	**849,360**	**814,170**	**-2.7**	**15.1**	**20.1**

In 2011, there were more poultry product (chickens) than other livestock. Cattle are the least in terms of production by farmers in Liberia.

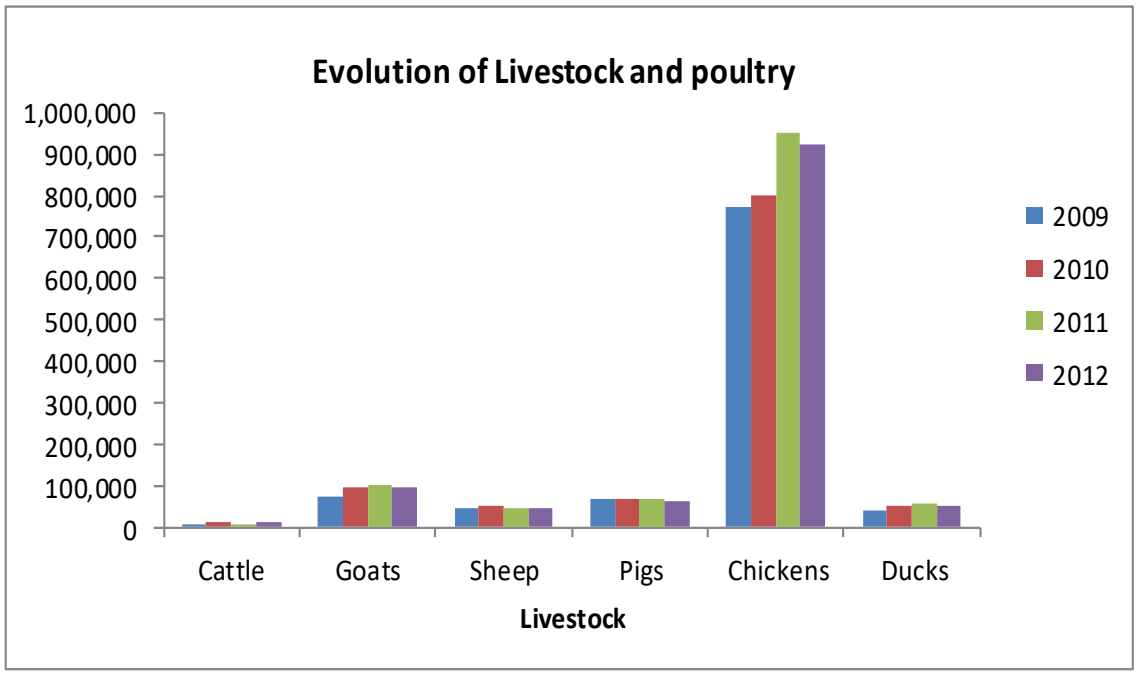


Figure 3.5: *Evolution of Livestock and Poultry (Source: LISGIS/HIES 2011)*

3.3.2 Pastured Land

Permanent pastures accounted for two million hectares in terms of land-use in 1998 (FAO Report, 2001). Such areas remain largely unexploited as livestock production is still in its infancy. To develop this industry, the GoL had established up to seven major pasturelands intended to enhance and maximise livestock production, with specific focus on N'Dama cattle multiplication (Rhissa, 2007). The locations of the pasturelands are indicated in Table 3.8.

Table 3.8: *Distribution of N'Dama Cattle Ranches in Pre-War Liberia (Source: Rhissa, 2017)*

Pasture	Location	Size (ha)	Initial stocking (head)
Foyah Cattle Ranch	Lofa County	1000	500
Todee Cattle Ranch	Montserrado County	100	100
Panama Cattle Ranch	Bong County	25	25
CARI Cattle Ranch	Bong County	300	100
Kpain Cattle Ranch	Nimba County	50	50
Parta Cattle Ranch	Bong County	500	500
Sanghai Cattle Ranch	Montserrado County	50	50
Total		**2025**	**1825**

Unfortunately, most of these ranches are now colonised by weeds, as there are no more livestock - a condition created by the war. Consequently, most livestock and livestock products are still being imported. By 2007, however, the Central Agriculture Research Institute (CARI) Ranch was occupied by a cattle breeding programme led and undertaken by M.D. Sow Associates, and that programme later relocated to Meleke (adjacent Gbarnga, Bong County) in 2011, while CARI has partially resumed operating its cattle breeding ranch. Today, there are approximately 15 pastoral landscapes in Liberia located

in Montserrado, Bong, Nimba, Grand Gedeh, Sinoe, Grand Bassa, Lofa, Grand Kru and Maryland. Pastureland in the mentioned locations include: Montserrado (Ricks Institute, Todee Ranch, and the University of Liberia College of Agriculture and Forestry); Bong (CARI, Bong Mines, and Cuttington University); Nimba (J.T. Philips); Grand Gedeh (Karweaken and Jaoudi); Sinoe (James Greene Agriculture Training Institute); Grand Bassa [Liberia Agriculture Company (LAC) and David Moore farm]; Lofa (Foya); Maryland (Maryland Three Ranches); and Grand Kru (Grand Kru) (LNBSAP, 2004). These are used to raise cattle and small ruminants, such as goats and sheep.

In general, meadows and pastures in Liberia are largely without fencing and shelter facilities for the cattle are poorly enclosed. Hence, animals roaming and destroying the crops of neighbouring farmers have become a key issue surrounding animal husbandry in Liberia, as it has regularly led to conflicts between the pastoralists and other farmers, with the former often required to settle payments for the loss of the latter.

3.3.3 Commercial Agriculture

There are also large individual and corporate commercial plantations that utilise state-of-the-art technology to produce rubber, coffee, cocoa, oil palm, and other export crops. The largest commercial agricultural systems are rubber and oil palm plantations. In terms of rubber, there are eight large-scale rubber plantations in Liberia, owned and operated by foreign business interests. These are:

- Firestone Plantations Company in Harbel, Margibi County;
- Cavalla Rubber Corporation (CRC) in Maryland County;
- Cocopa Rubber Plantation, Nimba County;
- Sinoe Rubber Corporation in Sinoe County;
- Gutrich Rubber Plantation in Bomi County;
- Salala Rubber Corporation, Bong County;
- Weala Rubber Corporation, Margibi County; and
- Liberian Agriculture Company in Grand Bassa County.

These concessions convert large tracts of land into rubber and oil palm plantations. These plantations are owned and operated mainly by foreign multi-national corporations. State-owned enterprises are also engaged in coffee and cocoa cultivation. The land development process for rubber and oil palm plantation involves the use of heavy earth-moving equipment. Natural vegetation of mixed species is cleared in favour of a monoculture. The common practice is to first clear the undergrowth, and then fell large trees and set these ablaze. Rice and cassava are the main/staple food crops in Liberia, although as many as 8-10 different other crops can be planted in a mixed cropping system.

Plate 3.1: *NERICA[4]-L-19 field at CARI (Source: Crops Programme, CARI)*

The New Rice for Africa (NERICA) was developed from a cross between the African rice (*Oryza glaberrima* Steud.) and the Asian rice (*O. sativa* L.). These varieties have shown great potential in both upland and lowland ecosystems in Africa and are already disseminated on an estimated more than 300,000 ha (Aliou *et al*., 2010). Additionally, they provide a new and unique opportunity for sustainable agricultural development in the environments where most of Africa's rice farmers earn a living. Among several varieties of NERICA tested at CARI, NERIACA-L-19 was best adapted for the lowland ecology and several upland varieties were identified as suitable/adapted varieties for the upland ecology. The yield of the lowland NERICA in Liberia is 3.5-4.5 t/ha and for the upland is its 2.5-3.5t/ha based on the management practices used for cultivation. Other crops and/or crop trees of economic importance are rubber (*Hevea brasiliensis*), coffee, yam (*Dioscorea spp*), ground nuts (*Arachis hypogeae*), cow peas (*Vigna unguiculata*), cabbage (*Brassica oleracea*), oil palm (*Elaeis guineensis*), coconut (*Cocos nucifera*) and horticultural crops such as papaya (*Carica papaya*), banana (*Musa sapientum*), avocado/butter pearl (*Persea americana*), sweet orange (*Citrus sinensis*), and mango/plum (*Mangifera indica*).

Table 3.9: *Production Trends of Cassava, Cocoa, Coffee, Rice and Rubber in Liberia between 2009 and 2018 (LISGIS, 2019; FAO, 2019)*

Year	Crop (Metric ton / annum)				
	Cassava	**Cocoa**	**Coffee**	**Rice (paddy)**	**Rubber**
2009	496,290	4,600	1,800	293,000	59,500
2010	493,000	6,700	600	296,250	62,100
2011	489,270	11,700	652	290,650	63,000

[4] The New Rice for Africa

Year	Crop (Metric ton / annum)				
	Cassava	**Cocoa**	**Coffee**	**Rice (paddy)**	**Rubber**
2012	485,190	12,000	700	297,720	63,000
2013	491,810	8,400	680	281,226	63,000
2014	453,377	7500	644	264312	75190
2015	453,378	7000	645	176,521	75636
2016	697,608	6707	606	335,180	73297
2017	538,000	8552	594	247,495	71185
2018	578,760	-	-	257,995	-

Animal husbandry and aquaculture (inland fish production) are also essential features of Liberia's agriculture. Both extensive and intensive management systems are applied by different farmers in the rearing of livestock in Liberia. Animals produced include goats, sheep, poultry, pigs and cows, and are reared chiefly for meat production. The dominant fish species farmed in Liberia are the Nile tilapia and African catfish (*Clarias spp*.); however, the African bonytongue (*Heterotis niloticus)* is becoming increasingly popular.

Table 3.10: *Major Rubber Concessions in Liberia from 1926-2019*

Plantation	Previous name	Date of concession agreement	Export potential (ton)	Location of plantation	Size of plantation
Bridgestone/ Firestone	Firestone Plantation Company	1926	60 000ton/year	Harbel Margibi	1, 000, 000 acres
SIFCA	Cavalla Rubber Corporation		3000-4000 tons/month	Maryland	25,000ha
SIFCA	Maryland Oil Palm Plantation (MOPP)			Maryland	15,200ha
Cocopa		2008		Nimba	
Salala Rubber Corporation	Weala Rubber Corporation	1959		Margibi	4, 500 ha
Liberia Agriculture Company (LAC)		1966	21,000 ton/year	Grand Bassa	7, 000 ha
Golden SIFCA	Maryland Oil Palm Mill-	2019		Maryland	10 ha

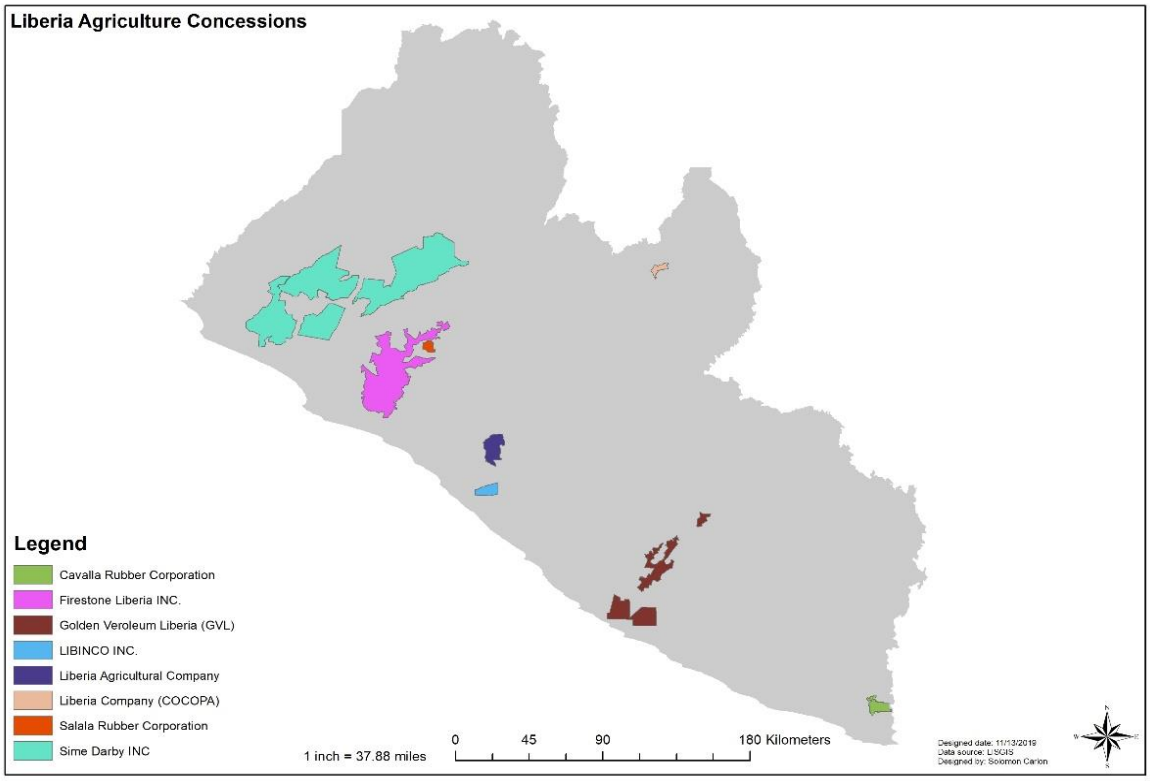


Figure 3.6: *Agriculture Concession Locations in Liberia (Source: LISGIS)*

3.3.4 Challenges with Agricultural Practices

As indicated by several stakeholders in the agricultural field, agricultural production in Liberia is at an all-time low. Although there are several reasons for this, one relates to the type of farming practised, coupled with an increase in pest infestation. Farming is also labour-intensive and time-consuming. This finding is not only limited to agriculture, but also to the fishing industry.

Besides the technological challenges limiting agricultural production in Liberia, the inadequacy of finance has remained a key problem. Currently, there is a remarkable lack of financial institutions dedicated to addressing the funding needs of farmers in Liberia, as it was prior to the Liberian civil wars. When available, interest rates charged by micro and other lenders tend to be excessive and, thereby, discourage farmers from seeking loans as a means of enhancing their farming ventures. Despite the lack of financial institutions to provide substantial credit to farmers, hope remains high that in the not-too-distant future, an agriculture bank will be re-established in the country to serve the needs of farmers willing to increase their investments in agribusiness.

Apart from the interventions and progress made in the sector, funding from the Government of Liberia towards agriculture in comparison to other sectors has been low. The GoL has been challenged in fulfilling the commitment of member countries of the African Union (the Malabo Declaration of 2015) in designating 10% of national budgets on agriculture.

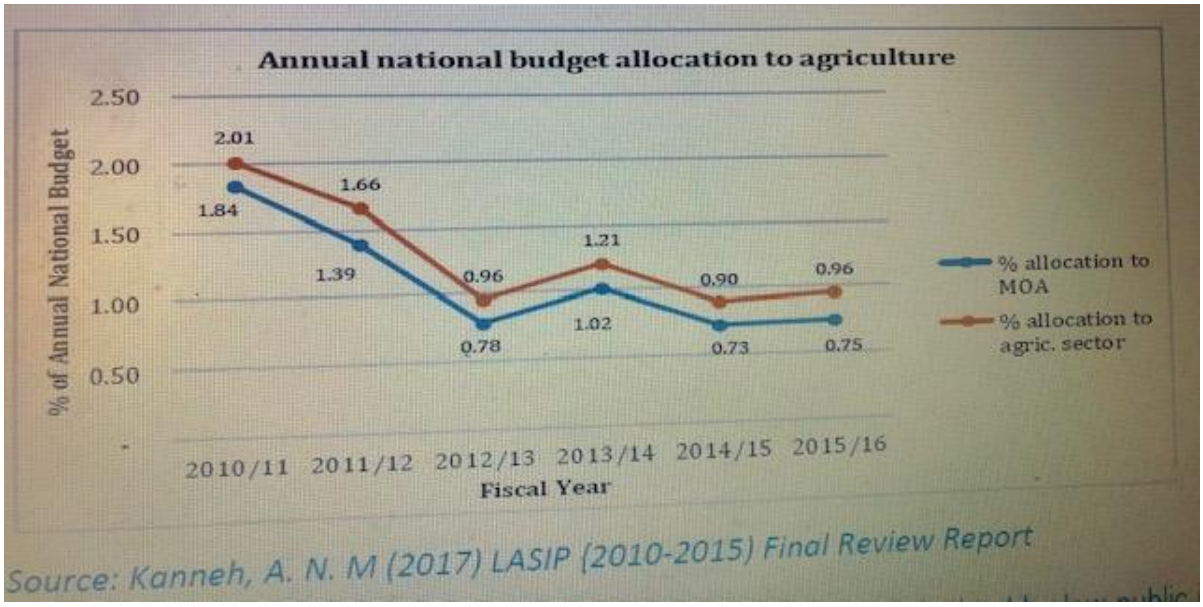


Figure 3.7: *Annual National Budgetary Allocation to the Agriculture Sector*

3.3.5 Interventions in Agriculture Sector

The critical need of the agriculture sector is the continued development of the sector to promote/contribute to the economic growth of the country and improve the livelihood of all farmers (smallholders and commercial farmers). The development of this sector depends on available adequate funds to address the financial gaps and to develop the human capital needed to sustain a developed sector. The government, through its partners, has launched several interventions geared towards the development of the agriculture sector.

These interventions are, but not limited to:

a. Agricultural Sector Rehabilitation Project (ASRP/IFAD[5]) (2010 - 2015): The project contributed towards improving basic access and revitalising rural economies in previously isolated counties, especially addressing beneficiaries' needs by funding and supporting infrastructure development (farm-to-market roads, irrigated rice paddy development, human resource capacity development, etc.) and supporting yield increases for rice, maize and cassava by promoting the introduction and extension of new technologies to farmers;

b. The West Africa Agricultural Productivity Project (WAAPP) (July 2011 - June 2016): Funded by the World Bank credit and Japanese Trust Fund grant. The main focus of the project was:

1. *To enhance food security, reduce importation of rice and increase incomes of smallholder rice producers, and*
2. *To generate and accelerate the adoption of improved technologies in priority crops of Liberia including rice. This project was implemented in eight of the fifteen counties of Liberia.*

[5] International Fund for Agricultural Development

c. The Smallholder Agricultural Productivity Enhancement and Commercialisation Project (SAPEC) (2013). This project is aimed at the improvement of the productivity, income and nutritional status of farmers in 12 of Liberia's 15 counties, with a special focus on youth and women. The project has been supporting crop production, intensification and marketing activities of farmers and processors, and supporting human resource capacity building and institutional strengthening by supporting CARI, Tubman University and the University of Liberia; and

d. Smallholder Tree Crop Revitalisation Support Project (STCRSP/IFAD[6]) (July l 2012 – December 2017): The project was expected to support up to 15,000 smallholder farmers' use of improved cocoa and coffee planting materials and enhance their access to drying, storage and packing facilities; rehabilitate up to 315 km of farm to market roads, and help legally institute cooperatives, and support their access to technical advice.

In reference to Climate Change Adaptation Agriculture Project, the MoA, representing GoL, and UNDP signed the Global Environment Facility/Fund (GEF) Agreement to implement the LDC Facility (LDCF) Project titled: Enhancing Resilience of Climate Change by mainstreaming adaptation concerns into the agriculture sector development in Liberia. The programme is a U$2.5 million GEF-funded Project, launched in August 2012 and is piloted in Bong and Grand Gedeh Counties. The CCAAP is serving as a vehicle for implementation of one of the priority actions coming from the Liberia National Adaptation Programme of Action (NAPA). The project is aimed at increasing the resilience of poor, agriculturally dependent communities and decreasing the vulnerability of the agricultural sector to climate change in Liberia. It has two basic components: (1) Capacity Development for Climate Change Management in Agriculture Sector, and (2) Piloting Adaptation Strategies at Community Level. The targeted beneficiaries of the project include 60 Technical staff (30 males and 30 females) of the sector, 30 sector field staff (15 males and 15 females), 100 university students (50 males and 50 females), 200 farmers (100 males and 100 females), NGOs/CSOs and Policy makers (MoA 2014 annual report).

Bureau of National Fisheries at the MoA has the statutory responsibility to monitor, supervise, and coordinate all fishing activities in the Republic of Liberia. The Bureau of National Fisheries (BNF) has somehow succeeded in combating Illegal Unregulated Unreported (IUU) fishing. Over the years significant steps towards the development of the fisheries sector have been realised through the following projects: WARFP, ACP-Fish Project, EAF-Nansen, TCP/FAO Project, GoL Inland Fishery Development Project, and APDRA/IFIDEP Inland Fish Farming Development.

Table 3.11: *Fishery Farmers Recorded in Liberia*

County	Marine	Fresh Water	Fishery per County
Bomi	0	6	6
Bong	0	15	15
Gbarpolu	0	23	23
Grand Bassa	45	20	65

[6] International Fund for Agricultural Development

County	Marine	Fresh Water	Fishery per County
Grand Cape Mount	573	77	650
Grand Gedeh	0	35	35
Grand Kru	340	10	350
Lofa	0	17	17
Margibi	43	22	65
Maryland	52	22	74
Montserrado	110	12	122
Nimba	0	286	286
Rivercess	26	13	39
River Gee	0	6	6
Sinoe	35	5	40
Total	**1224**	**569**	**1793**

Source: (2015 MoA Annual Report) - The complete listing and location of the farmers are available in the Department.

3.4 TRANSPORT AND COMMUNICATION

Liberia is known to have poor road and transport network systems. Very limited road transport connectivity has been seen in the last 10 years, with around 60% of Liberia's roads in poor condition (Primson Management Services, 2018). The greatest challenge with the road infrastructure is heavy rain, during which gravel roads, in particular, become impassable for weeks at a time. According to the Liberia Common Country Assessment Report (Primson Management Services, 2018), a survey of the country's roads was undertaken by the World Bank in 2016, during which 11,562 km of roads were mapped. The study found that of the 578 km of paved roads, 86% were in good, and even excellent, condition. Of the unpaved roads (10,984 km mapped), 57% were in poor, or even very poor, condition. Transport is also challenging in rural areas. Limited road access or deplorable road conditions make it nearly impassable for cars. As a result, motorcycles are often the only available means of transportation in most areas, especially where there is no paved road access.

Considering railway transport, there is no particular regulatory authority for railways. Therefore, the Ministry of Transport shares the responsibility of regulating the rail sector with the Ministry of Mines and Energy. Rail infrastructure and services are traditionally closely related to the mining sector. The current limited railway network was not in operation between 1988 and 2008. Liberia's railroads are all owned by the country's mining companies, and their 480 km of tracks were used primarily to transport iron ore to the ports of Monrovia and Buchanan. In 1989, Liberia had three rail systems owned and operated by foreign steel and financial interests, in conjunction with the Liberian Government. One of these, the Lamco Railroad, closed in 1989 after iron ore production ceased. The other two were shut down by the civil war, during which large sections of the rail lines had been dismantled. Approximately 60 km of railroad track was exported for scrap in 2001[7].

[7] *Track machine exports". Railway Gazette International. 2010-08-31. Retrieved 2010-10-25.* Railways in Liberia, http://sinfin.net/railways/world/liberia.html

Railways in Liberia are comprised of two lines. One line runs from the port of Monrovia in the northeast, with a second line running from the port of Buchanan in the center of the country. The principal usage of the railways is (or rather, was) for iron ore. In 2010, only the Bong Mine Railway was operational. Although the Lamco Railway was at least partially rebuilt by Arcelor Mittal and put back into service in 2011.

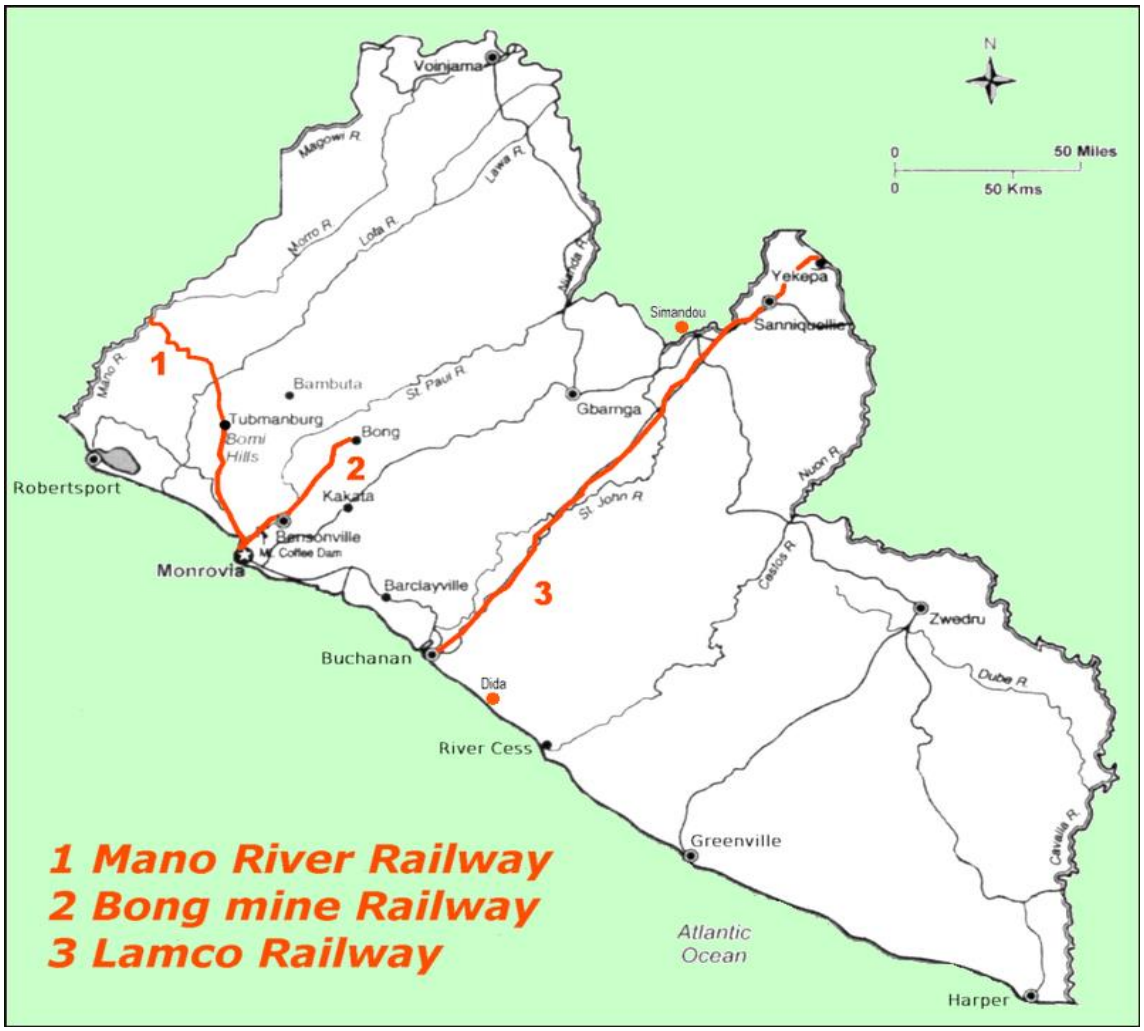


Figure 3.8: *Railway Lines of Liberia*

1N - 3' 6" (1067 mm) gauge
2C - 4' 8.5" (1435 mm) gauge
3S - 4' 8.5" (1435 mm) gauge

Table 3.12: *Standard Railway Route Information*

	Monrovia to Bong or Jenje & Buchanan to Nimba	**Connects the mine at Mano River with the Bomi Hill line (62 km from the Port of Monrovia)**	**Yekepa to the Port of Buchanan to ship iron ore**	**Bong Mine Range in Bong County to Monrovia**
Track gauge	Standard: 345 km 1,435 mm Narrow: 145 km 1,067 mm	1,067 mm gauge	standard gauge 1,435 mm	standard gauge line
Ruling gradient	n/a	n/a	n/a	n/a
Total track distance (single and/or double)	490 km (328 km single track)	84 km	266 km	77 km
Type of rail (weight and if welded or not)	n/a	n/a	n/a	n/a
Type of sleeper and fastenings	n/a	n/a	n/a	n/a
Total track travel time	n/a	n/a	n/a	n/a
Maintenance (Good, marginal, bad)	n/a	Built in 1960	Built in 1963	Built in 1964
Companies-consortiums operating on line	n/a	National Iron Ore Company of Liberia (NIOC) Rail Road	The Liberian American – Swedish Mineral Company (LAMCO) Rail Road	The Bong Mining Company (BMC) Rail Road
Traffic frequency (monthly/weekly/daily)	n/a	n/a	n/a	n/a
Security (Good, marginal, bad)	n/a	n/a	n/a	n/a
Main stations (Add details below)	n/a	n/a	n/a	n/a

n/a - Not Available

It should be noted, however, that these railways are currently not operational, although the BMC Railway is partially being operated by Geoservices, a Liberian company which transports goods (such as scrap metal) from the Bong Mine to Monrovia. Still, the existing rail tracks offer future benefits to Liberia. To illustrate this, the former LAMCO Railroad dissects the country in half and hence makes it a potential distribution artery joining the country's southeast and northeast, as well as holding the potential to foster needed development in leeward parts of Liberia.

There are three key railway lines in Liberia, namely System A, System B, and System C.

System A

- Gauge: 1,067 mm
- Total Length: 145 km (cCurrently not in operation)
- Route: Monrovia, Brewerville, Vonzuahn, Tubmanburg, Mano River and Jenje (railhead)

System B

- Gauge: 1,435 mm
- Total Length: 78 km (currently the only functional line)
- Route: Monrovia (port and national capital) – Careysburg - Bong (railhead and mine)

The Bong Mines line runs 80 km from the Bong Mines in Lower Bong County to the freeport of Monrovia. The line was used to transport iron ore during the company's operation prior to the war. The railroad now serves as a major route for transporting goods, particularly farm produce and charcoal, from the Bong Mines to and from over a hundred towns and villages along the line to Monrovia. There are no roads following these routes, so the railway is well-used[8].

System C

- Gauge: 1,435 mm
- Total length: 250 km (currently not operational)
- Routes: Buchanan Port, Mehla, Yela, Sanokwelle, Sanniquellie, Yekepa and Nimba (railhead and Lamco mine)

The government has no plans to construct or rehabilitate railways using its own funds, and the costs of reinvestment or new investment are expected to be borne by private investors. The government is retaining ownership of the railway, but granting the right to develop, use, and operate the railways through concessionaire(s). There is no legal framework for the construction and operation of railways, and "Concession Agreements" (contract law) form the only legal basis. However, the concessions do include open access "clauses" and the National Transport Policy and Strategy 2009 (NTPS) aims to improve and expand the rail network through integrating the railways into the overall national transport infrastructure. The Mineral Development Agreement (MDA), with ArcelorMittal, gives the government the right to use any spare capacity on the rail lines for "other" traffic, providing it pays the concessionaire a reasonable compensation. The

[8] Source: www.frontpageafrica.com/newsmanager/anmviewer.asp?a=10048 accessed 23rd November 2009

MDA, with China-Union, requires the rehabilitation for a transportation capacity of 12 mtpa of concessionaire ore traffic, plus common carrier freight and passenger services.

Communication in Liberia has improved with the expansion of GSM service providers, such as Lonestar, MTN and Orange. Although more needs to be done, most of the areas visited by the field team have access to communication, most notably the Lonestar Network. Aside from cellular phones, there is also radio coverage in some of the communities (mainly local radio stations). According to several villagers, news from Monrovia, or other parts of Liberia, can be received in many rural areas. Still, whilst it is true that access to communication is readily available, it is also clear that some communities, such as the southeast, are completely excluded from formal communication channels of Liberia. Many also do not have access to any local radio broadcasting stations, except for the Ivorian stations. This is worsened by the lack of mobile phone services in very remote areas. In many rural areas, villagers' means of information dissemination is rather primitive, involving having to walk from home-to-home to get important news across.

3.5 RECREATION, CULTURAL HERITAGE AND TOURISM

3.5.1 Recreation

Compared to the urban and semi-urban communities where there is a wide range of recreational activities to select from, most of the rural communities have limited access to such facilities. For example, in urban or semi-urban areas, more people have access to electricity and, hence, enjoy recreational activities such as television, watching sports, music, dancing or clubbing, for example. However, many rural villagers' lives are so revolved around subsistence farming or fishing, that recreational activities are rarely distinguished from main household chores. Yet, soccer fields can often be seen in many villages, whilst there are also entertainment centres (video clubs or stores) in several villages which have access to electricity (either from the grid, or generators). In coastal or areas close to rivers, water-based activities are also common, such as swimming or bathing. The data obtained through village transect walks (i.e. walking through the visited villages and noting important infrastructure or community groups) indicate that there are various organisations in the villages focusing on the general welfare of the people. For instance, there are saving and financial clubs, youth groups, women groups, as well as traditional assemblies in most of the places visited. Community life in most villages, and the needed support provided by social structures and family ties, are of vital importance to the livelihoods of the rural people.

3.5.2 Culture Heritage

Foremost, much of Liberia's cultural heritage is shaped by its various ethnic groups and religions, speaking volumes about the country's rich cultural diversity . As an illustration, the largest ethnic group is the Kpelle, of which around 20.3% of the population belong to (LISGIS, 2009). This is tailed by the Bassa (13.4%) and Grebo (10%). Other smaller ethnic groups include the Gio, Mano, Kru and Lorma (to name a few). In addition to these, there are also various American-Liberians who still have ancestors who once migrated to Liberia from the Unites States of America during the eighteenth century [International Trade Centre (ITC), 2015]. In fact, the country is home to an astounding sixteen different major tribes. Amongst many of these different ethnic groups is a unique language which culturally binds people from different villages and areas.

In terms of religion, the Liberian Constitution protects individuals' freedom to practise any religion as long as this confines to the general laws of the country. This marks a stark contrast to the past, where there have been religious persecutions at an unprecedented scale during the long civil war. The widest percentage of people belong to the Christian faith (85.6%), whilst around 12.2% are of the Islamic religion. The remaining population fall under traditional religions (LISGIS, 2009). Liberia is known to have diverse cultural and traditional belief systems. Such systems are rather unique to different communities and regions. However, the introduction of religion, especially the Christianity and Islamic faiths, is said to have placed a dark cloud over the existence of traditional spiritual practices. As asserted by members of some communities, their traditional beliefs are often seen as demonic in the eyes of their people. Whilst many acknowledge the existence of some form of God or western belief, traditional beliefs still persist. This, according to some, stirs conflict in certain communities. Many believe there is a need for a peaceful existence and acceptance of different belief systems to move the country forward. Tolerance is called for, which could be realised through the introduction of relevant laws, for example.

Brought along by different cultures and embedded in the Constitution as a key right, various religions and practices have given birth to a plethora of different festivals and practices. As one example, Monrovia hosts annually the Monrovia Children's Day, attracting the youth with performances, games and contests. The 26th of July marks Independence Day, which is an important national holiday in Liberia. In addition, Christmas, Easter and *Eid al Fitr* (an Islamic tradition) are celebrated across the country. History also shaped and continues to shape such practices, especially the way in which enslaved Liberians from North America could return with new American traditions picked up during the slavery period (World Atlas, 2019). Therefore, there also continues to be a strong relationship between Liberia and the United States of America, celebrated by days such as 'Thanksgiving Day in Liberia', which is celebrated annually on the 4th of November. In this way, Liberia's history has also given birth to unique cultural celebrations.

Among festivals and public holidays, Liberia also boasts unique music styles which have and continue to be shaped by its different cultures. Albeit traditional (village) music, which is still enjoyed, the country is known for its highlife music (a combination of American, West African and Latin American style music), which can be traced back to the 1950s (World Atlas, 2019). The youth of the country have also embraced more

western-style music genres, such as classic hip-hop, with roots going back to the 1980s. Hip-hop (or Hipco) in Liberia is unique in the sense that it borrows much of its roots from local languages. It, therefore, makes sense that a musical genre such as Hipco has been used by activists as a tool for opposition against the government and/or oppressive regimes, music which often speaks out against a moral decay in society (*ibid*.).

As the country is culturally diverse, it makes sense that much of its cultural heritage is embedded in buildings and structures, shaped by its history. For example, one well-known historical and cultural asset is Harper, the capital city of Maryland County. The area is historically highly significant due to several abandoned buildings. Another place, such as Providence Island, also leverages significant historical attraction as the first place where American slaves first arrived in Liberia in 1822 (ITC, 2015). Additional culturally and historically significant areas also include the Executive Mansion, the Masonic Temple, the Centre of Behsao, the Centennial Pavilion, the Firestone Rubber Plantation and the Liberian Museum (*ibid.*). The Firestone Rubber Plantation, for example, is one of the most valuable historical areas of Liberia. This, and many other similar plantations, continue to provide a source of employment to many Liberians as smallholder rubber farmers who sell their rubber harvests for exporting.
Many people seem to argue that cultural heritage protection is not a priority of the GoL. An example of this is Plate 5.2, which is the remaining ruins of the ancient Kpaiyea fortification wall in Yealleh, Zorzor District, Lofa County (Daily Observer, 2018).

In addition to buildings and structures, the Liberia landscape and, more notably, its forests, have shaped cultural traditions and practices over centuries. It is often referred to in literature that the indigenous populations of Liberia have been "builders of forests" (*cf*. Fraser *et al*., 2016). This meaning encapsulates how some of the forest landscapes in the country have been shaped by the presence of human settlements and farmers. For example, walking across Liberia (especially northwest Liberia) and through its forested areas and traditional villages, one often comes across dense forest patches which have become known as anthropogenic forests. Such forests are either former cultivated land, or disturbed land, which has been left as unmanaged successions for years. Many of these forests have become exemplars of mature or primary rainforests. It is in this historical-ecological phenomenon where biodiversity and culture intertwine. Rightfully so, such a bio-cultural relationship between tropical forests and cultural values has been recognised by ecologists and conservationists. Today, many of these anthropogenic forests have sacred areas known as "sacred groves". Many of such groves harbour traditional practices and have become sacred areas where culturally significant trees are protected. Many of the trees are believed to be endowed with metaphysical powers. The cutting and burning of many tree species are, therefore, prohibited in several rural areas of Liberia.

Rightfully, some scholars have referred to some of these forests in Liberia as "sacred agro-forests", where there are often also artefacts of ruined towns from the years of war (Fraser *et al*., 2016). Amongst these agro-forests are ancestral burial grounds (gravestones), alongside old ritual artefacts such as shrines, masks, divinatory media, fetish objects and herbal medicines. Much of the sacredness of these agro-forests is, therefore, related to the symbolic presence of ancestors, who truly shaped the earth with their fresh organic material and food processing means. Such lifestyles shaped forests with a considerable amount of organic carbon which is also referred to as "African dark

earth" (*ibid*.). It is, therefore, not surprising that culturally significant mature rainforest trees are intersected with native and exotic fruit trees. Cocoa and kola are trees which do very well in these soils. An interesting fact is that a tree such as the kola tree is often planted in these agro-forests to commemorate the birth of an individual.

Fraser and his colleagues in 2016 have written about the Loma, descendants of the Mande macro-language speaking group of rural Liberia who have occupied the region for more than 500 years. The Loma, as with many other tribal affiliations, celebrate and live through their ancestors in sacred agro-forests. Land tenure systems are strictly defined by ancestral relationships and ownership defined by gender-specific initiation societies. The latter include the *Poro* for men, and *Sande* for women, for example (Fraser *et al*., 2016). In many of these societies, the cutting and burning of some of these sacred forested areas and trees are forbidden. This creates a clear contrast to often adjacent surrounding, natural old fallow land where cultural laws do not prohibit the cutting of trees for shifting cultivation.

Sacred agro-forest patches are widespread in Liberia, and often hides cultural heritage in unique ways. Research conducted by Fraser *et al.* (2016) reveals that many of such forest patches are actually old towns which were abandoned by its residents as certain tree species, forbidden to be cut by ancestors, started creating too much shade. Today, these areas reveal ruined towns where native and exotic fruit trees have been planted and continue to grow undisturbed with primary forest in a mosaic of building ruins and ancestral graves. Such areas are often visited for ceremonies or rituals.

In light of bio-cultural landscapes, of pressing concern and to relevance to the status of the Liberian environment is the unprecedented speed at which culturally important landscapes are being transformed by development, logging, or industry. Rapid land-use changes have clearly become of the biggest threats not only to biodiversity conservation, but also cultural preservation. To put this in perspective, some scholars' recon that, since the beginning of the 19th century, up to 470,000 km^2 of tropical forest has been cleared (*cf.* Fraser *et al*., citing Sayer et al., 1992 and Poorter *et al.*, 2004). Unmanaged deforestation, therefore, presents a real threat to Liberia from a biodiversity, cultural, but also tourism perspective. Another troublesome concern is shifting cultural practices, such as youth violating and/or challenging traditional beliefs of sacred agroforests and bans on cutting certain trees or slashing and burning particular areas for farming. Fraser *et al.* (2016) found this to be particularly acute in Nimba County, where the youth once had the greatest participation in armed conflict.

3.5.3 Tourism

3.5.3.1 Overview

In order to discuss the state of tourism in Liberia, it is important to understand the state and potential of this critical sector at a global level, including its potential for socio-economic transformation, investment, and job creation. In 2011, the World Travel and Tourism Council reported that the world's tourism sector was globally responsible for 8.8% of the world's jobs (258 million); 9.1% of the world's GDP (US$6 trillion); 5.8% of the world's exports (US$1.1 trillion); and 4.5% of the world's investment (US$652

billion) (Indexmundi, 2019). The report also estimated that 3.8 million jobs (including 2.4 million indirect jobs) could be created by the tourism industry in Sub-Saharan Africa over the next 10 years.

The World Travel and Tourism Council reported that the tourism industry globally generated US$2,364.8 billion directly in 2014 and is expected to grow at an annual rate of 3.3% until 2025.

World	2014 USD bn[1]	2014 % of total	2015 Growth[2]	USD bn[1]	2015 % of total	Growth[3]
Direct contribution to GDP	2,364.8	3.1	3.7	3,533.2	3.3	3.9
Total contribution to GDP	7,580.9	9.8	3.7	11,381.9	10.5	3.8
Direct contribution to employment[4]	105,408	3.6	2.0	130,694	3.9	2.0
Total contribution to employment[4]	276,845	9.4	2.6	356,911	10.7	2.3
Visitor exports	1,383.8	5.7	2.8	2,140.1	5.6	4.2
Domestic spending	3,642.1	4.7	3.7	5,465.0	4.1	3.8
Leisure spending	3,850.2	2.3	3.3	5,928.8	2.5	4.1
Business spending	1,175.7	0.7	4.0	1,679.0	0.7	3.2
Capital investment	814.4	4.3	4.8	1,336.4	4.9	4.6

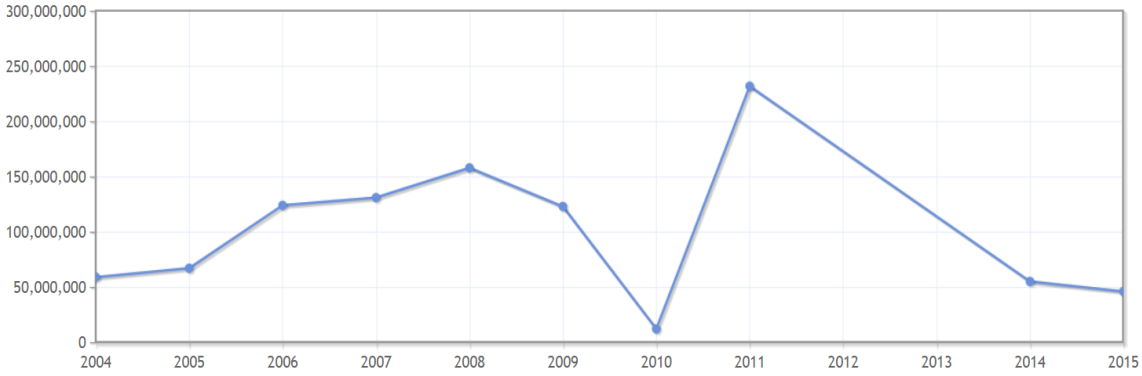
[1]2014 constant prices & exchange rates; [2]2015 real growth adjusted for inflation (%); [3]2015-2025 annualised real growth adjusted for inflation (%); [4]'000 jobs

Figure 3.9: *Global Performance of the Tourism Sector (Source: Indexmundi, 2019)*

The tourism sector in Liberia has remained largely underdeveloped. Despite its potential to diversify the domestic economy away from a heavy reliance on extractive industries, the sector has not received a high level of attention from the public or private sectors. The country has not been able to achieve a recognition of its scenic attractions to draw international tourists, unlike some of its regional neighbours who have had a vibrant influx of tourists from Europe and America. Although the Ministry of Information, Culture and Tourism (MICAT) has drafted a list of 80 potential attractions nationwide, Liberia has essentially no international tourism industry. This, in some measure, is due to the country's insufficient transportation network, limited electricity connectivity, inadequate accommodation facilities and other relevant tourism infrastructure. In fact, quite a few tourist destinations have attractions and facilities that cater to tourists. The deficit in infrastructure represents one of the major constraints impeding the flourishing of this sector. Another major constraint lies in the deficient policy and regulatory framework; both which are required to enable the development of the sector.

The Ministry of Information, Culture and Tourism was established by law on the 11th of May 1972 as a statutory government body, charged with the responsibility of developing and disseminating factual information about Liberia at home and abroad. The ministry is also tasked with promoting national cultural and tourism values through various cultural groups and tourism centres. At the core of the ministry's budget for 2019/20 is the regulation and enhancement of Liberia's cultural and tourism programmes locally and internationally. For the 2017/18 budget year, the ministry spent $66,328 on the tourism sector and foresees to spend $133,237 for the year 2020/21. The same amount is envisaged to be spent for the year 2021/2022, which is insufficient for the requirements for developing the sector. The ministry has so far not been able to institute a system for tracking and reporting on tourism arrivals or revenues. Thus, the contribution of tourism to the Liberian economy is not well-documented. For example, reports obtained from the FDA on tourists visiting the Sapo National Park over the period 2018-2019 record just 26

tourists, with 13 in 2018, and 13 in 2019; most of whom were Europeans and Americans (pers. comm, Sakui[9], November 2019). Additionally, Liberia's current visa system does not provide for the issuance of visas specifically for the purpose of tourism. This imposes a challenge to comprehensively documenting the number of tourist arrivals coming into Liberia. Based on statistics from the World Tourism Organisation's Yearbook of Tourism Statistics, Liberia's income[10] from international tourism was $46,000,000 in 2015. This figure is lower than the average $232,000,000 in 2011 and $12,000,000 in 2010.



Year	Value
2004	$59,000,000
2005	$67,000,000
2006	$124,000,000
2007	$131,000,000
2008	$158,000,000
2009	$123,000,000
2010	$12,000,000
2011	$232,000,000
2014	$55,000,000
2015	$46,000,000

Figure 3.10: *Liberia Tourism Statistics (Source: World Tourism Organisation, Yearbook of Tourism Statistics, Compendium of Tourism Statistics and data files-2015 - Indexmundi, 2019)*

3.5.3.2 Liberia's Tourist Attractions and Potential

Liberia's endowment includes a rich natural resource base with a potential tourism and hospitality market, including forests, rivers, seas, waterfalls, hills, mountains, lagoons, lakes, wetlands, and deltas. The country prides itself on an extensive and unique biodiversity, including the largest remaining tract of the Upper Guinea Forest in West Africa and an impressively diverse range of wildlife and plant species. This includes over 2000 different vascular plants (including 225 tree species); 600 bird species; 150 mammal species, and 75 reptile species. Liberia's forests also produce a wide range of other environmental goods and services that benefit Liberia and the rest of the world. Liberia's biodiversity, its rich cultural landscape, and beaches offer natural attractions for tourists and international visitors seeking new adventures.

[9] Manager of Awareness and Ecotourism, FDA

[10] These are expenditures by international inbound visitors, including payments to national carriers for international transport. These receipts include any other pre-payment made for goods or services received in the destination country. They also may include receipts from same-day visitors, except when these are important enough to justify separate classification. Some countries do not include receipts for passenger transport items.

Some known tourist attractions that Liberia possess include the following:

The 700-square mile Sapo National Park in south-eastern Liberia (protected area)

The Sapo National Park (SNP), located in south east Sinoe County, is Liberia's first national park. The largest remaining part of the Upper Guinea Forest, it is the second largest area of primary tropical rainforest in West Africa. The SNP was formally designated in 1983, and then extended in 2003 at the end of civil war, to its current size of 697 square miles. The park is relatively flat and marshy, comprising of lowland swamps and rainforest, making it an ideal habitat for pygmy hippos to flourish. It has a tropical climate, with temperatures between 22-28°C and a wet season from May to October. The SNP remains relatively inaccessible to outside visitors. There are no roads or trails within the park, and there are almost no facilities for visitors. Consequently, this significant and environmentally rich area remains somewhat unpenetrated by researchers and tourists.

Plate 3.2: *Sapo National Park, Lowland rain forest (Source: Stephen van der Mark, 2007)*

The 40-square mile Lake Piso near the Liberia-Sierra Leone border

Lake Piso is an oblong tidal lagoon in Grand Cape Mount County in western Liberia, near the town of Robertsport. Its name originates from a local varnacular meaning "pigeon's hole" - a reference to the flocks of pigeons that once came to Lake Piso for water. It is the largest lake in Liberia. During the rainy season, Lake Piso has more freshwater as rivers drain into its basin. During the dry season, the lake is more dependent on the salty tides of the Atlantic Ocean. The lake offers opportunities that include fishing and water sports, such as swimming, canoeing and water skiing. Prior to the outbreak of the First Liberian Civil War, it was a popular travel destination for tourists.

The surfing beaches at Robertsport along the Atlantic Ocean

Robertsport, the provincial capital of Grand Cape Mount County, is a town located in western Liberia, about 10 miles from the Sierra Leone border. It is named after Joseph Jenkins Roberts, the first president of Liberia. The town lies on Cape Mount Peninsula, a spit of land separating the brackish lagoon Lake Piso from the Atlantic Ocean,[2] 50 mi (80 km) north-west of Monrovia. Apart from the ecologically rich Lake Piso and beautiful cape mountain overlooking the city of Robertsport, the city offers one of the best surfing locations Liberia can boast of owing to the exciting waves. In fact, the surf movie, Sliding Liberia, which put Liberia on the surfers' map, was filmed at Robertsport Beach.

Plate 3.3: *Surfing at Robertsport Beach (Source: Cooper, 2010)*

Cape Palmas and Lake Shepherd

Cape Palmas is located in the extreme southeast end of the coast of Liberia. The cape itself consists of a small, rocky peninsula connected to the mainland by a sandy isthmus. Immediately to the west of the peninsula is the estuary of the Hoffman River. Approximately 21 km (15 mi) further along the coast to the east, the Cavalla River empties into the sea, marking the border between Liberia and Côte d'Ivoire. Cape Palmas in Maryland has a very rich history in the slave trade and the establishment of Liberia. Maryland as a colony was granted statehood on the 2nd of February 1841 and then independence on the 29th of May 1854. On the 18th of March 1857, the state of Maryland was annexed as a part of the Republic of Liberia. Tourist attractions in the city include settlers' homes, slave trading depots, beaches and, of course, Lake Shepherd, one of Liberia's most breath-taking lakes. The lake presents an astonishing view with its calm waters and trees. Its studded coast offers the kind of relaxation that a visitor would gladly enjoy.

The Kpatawee Waterfalls in Central Liberia

Liberia is endowed with some interesting wetlands of international significance. Some of these include, but are not limited to, the following Ramsar sites:

I. Lake Piso Multiple-Use Reserve Coastal Lacustrine;

II. Marshall Inland Riverine;
III. Mesurado Coastal Area;
IV. Gbedin Inland Swamp; and
V. Kpatawee Inland Riverine.

Adding to the list above will soon be the Cestos-Senkwehn Inland Riverine, which is still a proposed nature reserve. These wetlands are important areas for birds and mangroves, making these an interesting attraction for visitors. The Kpatawee Waterfalls is an outstanding feature of the Kpatawee Wetlands. It falls within the rainforest zone of Liberia, as a branch of the St. John River, one of the six major rivers in the country. Whilst the river erodes the valley in its upper sections, it accumulates sand and gravel downstream, leaving patches of bare land along its course, which provide wintering grounds for large numbers of important birds and other animals. The villagers value this area as a cultural and entertainment area. It offers enormous ecotourism potentials but lacks the infrastructures to support it.

East Nimba Nature Reserve Bordering Liberia, Guinea, and Ivory Coast (protected area)

The East Nimba Reserve and the SNP both fall within the upper Guinea biodiversity hotspots and are homes to rare birds and mammals such as elephants, monkeys, antelopes and pigmy hippos. The potential tourism market includes a relatively large resident expatriate community, and the growing number of Liberian diaspora returnees, most of whom are middle class.

Providence Island in Monrovia where the First Group of Freed African Slaves Landed in 1822

Providence Island was originally called the Dozoa Island. From its original name, it was first renamed Perseverance Island to indicate that the settlers who came to Liberia had the determination to find a new home despite all the setbacks they had encountered at Sherbro Island, now in the Republic of Sierra Leone.

On the 7th of January 1822, a transformational event happened in Liberia that is linked to African-American history: the first group of black American emigrants landed on Providence Island near what is now the capital city of Monrovia. Although African-Americans started emigrating in small numbers to Sierra Leone as early as the 1780s, the Providence Island landing marks the first "Back to Africa" critical mass emigration flow from the United States, numbering between 10,000-15,000 African-Americans to Liberia.

Blue Lake

Also known as Bomi Lake, Blue Lake is located in the Bomi Hills, about three miles north of the town of Tubmanburg in western Liberia. It is about 72 km west of Monrovia. It is about 300 feet deep and found below the peaks of the surrounding mountains which, with the reflection of the sun, give the lake its beautiful blue colour. The lake was formed

from a series of deep pits left behind by the Liberia Mining Company iron ore operations which closed down in the late 1970s.

Besides the tourist attractions listed above, the country's 350 miles of sandy shoreline along the Atlantic Ocean offers excellent deep-sea sport fishing for tuna, marlin, mahi, and wahoo.

Over the past 12 years, the country has experienced an increase in the number and quality of hotels and resorts that can contribute to the tourism sector. Notable amongst these are the following:

Libassa Ecolodge - located in Marshall, Margibi County. The area lies within a stretch of tropical forest, at the junction of a virgin lagoon and the Atlantic Ocean within 30 minutes' drive from the Robert's International Airport and Monrovia. It offers an eco-friendly resort with a wildlife sanctuary, accommodation, entertainment and sightseeing.

RLJ - located along the Roberts Field Highway outside Monrovia in what was once the Kendeja Cultural Village. RLJ Kendeja Resort and Villas was built by Bob Johnson, the multi-millionaire American developer and founder of the U.S. cable network, Black Entertainment Television. It is a 4-star beach hotel with villas that stands just few metres from the Atlantic Ocean.

Hotel Buchanan - located in Roberts Street, Buchanan City, Grand Bassa County. It is rated as one of the best hotels outside Monrovia with facilities to host events such as conferences and retreats, as well as entertainment.

Jackie Guest House - located in Ganta, Nimba County, the Jackie Guest House is one of several new hotel facilities serving the burgeoning economy of the region. It has facilities for accommodation, retreats and conferences.

Royal Grand Hotel - located on 15 Street, Sinkor, Tubman Boulevard in Monrovia, within just a few miles from the Liberian National Museum. It has facilities for meetings and conferences, gym, restaurants, spa and roof top bar.

Boulevard Palace Hotel - located on 13th Street, Sinkor, on Tubman Boulevard, the Boulevard Palace is one of the new hotels in Monrovia, Liberia, with facilities for meetings and conferences, gym, restaurants, and entertainment.

Farmington Hotel - located opposite the Roberts International Airport in Harbel, Margibi County, and the hotel sits on the banks of the Farmington River. It is the largest hotel-facility in Liberia with 164 rooms and suites, including three presidential suites along with conference and business facilities.

In addition to improvement in the number and quality of hotels, Liberia has also inaugurated a new airport terminal at the Roberts International Airport with improved facilities for travellers.

3.5.3.3 Recent Government Initiatives

Developing the country's ecotourism through the conservation of its biodiversity, as well as building modern infrastructure, can improve its international image and increase its appeal to tourists. This will, however, require significant public and private sector investment, as well as capacity building. To address this issues, the GoL recently developed the National Export Strategy on Tourism (2016-2020) as part of calculated efforts to diversify the Liberian economy and harness the significant tourism-based resources of the country. The strategy focuses on the following objectives:

1. Spurring policy, focusing and improving the business/investment climate of the tourism sector;
2. Improving necessary infrastructure for supporting the sector;
3. Improving skills development in the sector;
4. Ensuring environmental sustainability and the integration of local community involvement in the sector development process;
5. Improving institutional capacities and coordination in the sector; and
6. Improving the Liberian tourism brand and developing robust tourism offerings.

The above-mentioned strategy includes, amongst other things, plans for the establishment of a Liberian National Tourism Authority to serve as an autonomous and principal government agency to promote and regulate the tourism sector. In the interim, the Tourism Exploratory Committee was set up to guide development efforts and advise policymakers. In addition, the two tourism associations in the country, namely the Liberian National Tourism Association (LINTA) and Tourism Association of Liberia (TAL), have both taken steps to improve collaboration. At policy-level, efforts to incorporate tourism into key policy instruments, such as the Liberia Revenue Code, the Investment Law, and the National Trade Policy, have been proposed. Though these proposals are yet to be materialised, the government recognises tourism as a priority sector expected to spur economic diversification.

In 2019, the FDA, through its REDD+ Implementation Unit, contracted the services of Solimar International (based in Washington DC) to develop an action plan for sustainable tourism development. This followed an assessment by Solimar International of nine targeted landscapes to be protected and enhanced for tourism (*cf.* Solimar, 2019). These nine landscapes include:

i. Sapo National Park;
ii. Gola National Park;
iii. Grebo-Krahn National Park;
iv. Lake Piso Multi-Use Reserve;
v. Gbi (Krahn Bassa) Proposed Protected Area (PPA);
vi. Cestos-Sankwein PPA;
vii. Wonegisi PPA;
viii. Kpo Mountain PPA; and
ix. Foya PPA.

Based on a multicriteria analysis that considers biodiversity, iconic species, external access, conservation threats, protected status, and community interest, in the action plan

produced by Solimar International, the nine landscapes were ranked in terms of its potential/suitability for tourism development. These rankings are presented in Table 3.13 below.

Table 3.13: *Liberia Ranking of Targeted Landscapes for Tourism (Source: Solimar, 2019)*

Targeted Landscape (weighting)	Biodiversity	Iconic Species (x2)	External Access (x 2.5)	Internal Access (x 1.5)	Potential River Access (x 1.5)	Conservation Threats	Protected Status (x 2)	Community Interest	Short-term Tourism Potential	Total Score (rounded)	Rank
Sapo NP	9	9	5	4	8	-7	10	8	8	85	3
Gola NP	9	9	8	5	8	-6	10	8	9	97	1
Grebo-Krahn NP	9	9	2	4	4	-6	10	8	5	71	5
Lake Piso MUR	5	7	9	8	7	-6	5	9	9	87	2
Gbi PPA	9	9	5	4	6	-7	0	8	7	62	4
Cestos-Sankwein PPA	4	4	7	7	9	-8	0	·	6	51	6
Wonegisi PPA	8	7	4	4	5	-7	0	·	3	41	7
Kpo Mountain PPA	4	4	3	5	3	-5	0	·	3	30	9
Foya PPA	4	4	3	4	6	-5	0	·	3	31	8

The action plan by Solimar International presents tourism development opportunities (including eco-tourism) for Liberia's current and PPAs, as well as identifies priority actions that can catalyse sustainable tourism development and build upon the Liberian National Export Strategy on Tourism for 2016-2020. Also included in the plan is a list of proposed tourism pilot projects, strategies for development and marketing, potential tourism activities and attractions, as well as strategic objectives and further key action plans.

3.5.3.4 Challenges and Environmental Impacts of Tourism

The challenges of the tourism industry in Liberia include the inadequate institutional capacity of both the public and private sectors to undertake development of the sector. Though there has been some increase in tourism promotion and marketing activities lately, these have been quite limited owing to insufficient government funding couple with the poor access to finance in the private sector. Additional challenges, many of which are documented in the Action Plan for Sustainable Tourism Development, include lack of direct, frequent, or affordable air service, limited paved roads to many of the prime tourism destinations, current immigration visa policy, and a lack of visitor services and activities (trails for hiking, wildlife tracking, bird-watching, and other tourism-related activities) in the prime tourist landscapes. Moreover, local communities have not played a significant role in respect of the protection of natural and cultural resources in the country. As a result, in many areas, including protected parks, forests have been destroyed, wetlands drained and mangroves devastated, whilst there has been widespread poaching of wildlife.

Although there are no data of the current specific impacts of tourism on the environment in Liberia, based upon consultation with key informants and research on the subject, the following key impacts can be catalogued:

Table 3.14: *Tourism Environmental Impacts*

IMPACTS	SOURCES	RECEPTORS
➢ Land degradation, such as deforestation caused by fuel wood collection, use of building materials and land clearing for development of tourism facilities	➢ Increased construction of tourism and recreational facilities	➢ Scenic resources ➢ Forest and wildlife ➢ Water quality and quantity
➢ Pollution (air emissions, noise, waste and littering, releases of sewage, oil and chemicals, even architectural/visual pollution)	➢ Transport emissions and emissions from energy production ➢ Noise pollution from cars, and buses, as well as recreational music and dances ➢ Tourists generate a great deal of waste, which can degrade the environment in remote areas that have few garbage collection or disposal facilities ➢ Degradation of physical appearance of the water and shoreline from wastewater and sewage as a result of construction of hotels, recreation and other facilities ➢ Failure to integrate tourism structures with the natural features and indigenous architectural of the host environment	➢ Atmospheric environment ➢ Wildlife and host communities ➢ Terrestrial and marine animals ➢ Terrestrial and marine animals and water quality
➢ Physical impacts - land degradation and loss of wildlife habitats due to construction activities and infrastructure development ➢ Trampling of vegetation and soil, eventually causing damage that can lead to loss of biodiversity and other impacts	➢ Construction ➢ Development	➢ Ecosystem and scenery ➢ Forest and wildlife ➢ Host communities and their livelihoods
➢ Social impacts such as prostitution, cultural intrusion, spread of diseases (HIV/AIDS) ➢ Interaction of tourists with host communities resulting to social change that can affect local cultures and traditions, commercialisation of sex, increase in crime and gambling	➢ Increase in tourism with tourists from different cultures and background	➢ Host communities and livelihood

IMPACTS	SOURCES	RECEPTORS
➢ Preservation of local culture which attracts tourism, strengthening communities, provision of social services and infrastructures, commercialisation of culture and art, heritage preservation		

Despite the impacts catalogued above, the tourism sector can contribute to conservation if it receives adequate financial support. What is also needed is to reconsider Liberia's conservation values, improve environmental management and planning, as well as enhance environmental awareness and the protection of key biodiversity with regulatory measures and policies.

3.6 MARKET (WHOLESALE AND RETAIL)

Having market-places, especially in rural areas, is of significance to a small-scale farming household to sell produce and earn an income. However, a key finding is that access to market-places is severely limited in rural Liberia. There are several reasons for such poor access, including poor road conditions, the remote locations of some communities, or heavy rains. This makes it difficult for many farmers to get their products to market-places.

As many villages in Liberia are agrarian communities, their main source of livelihood is subsistence farming. However, income from selling farming produce is often way below the money required to sustain most households. The end result is households frequently losing the will to cultivate large farms, as many believe that their products will not make it to the market-place, despite their efforts at cultivating on a large scale. Although there are small market-places found at regular intervals across the country, larger markets are not close to agricultural fields. This forces farmers to walk with their products for far distances to market-places, which severely hinders this trade and potential income-earning opportunity.

The reality in the country is that the economy in larger, more economically established, areas does not reach the smaller villages where cash-flow is desperately needed to maintain agricultural production. Small-scale trading in agriculture and the exchange of money from one hand to the other remains stagnant and within the communities, as opposed to money coming in and going out of the villages from and to larger cities or towns. In these "enclosed" trading circles, rural villagers are rarely allowed the opportunity to expand their trading to larger cities or towns where there is a more significant cash economy. Market availability and the exchange of goods and services are also challenges in bigger cities, particularly those that are not connected to each other by paved roads.

3.7 ENERGY

3.7.1 Overview

One of the largest energy suppliers in Liberia is the Liberian Electricity Corporation, which electrifies around 15% of urban households in the country (LISGIS, 2017). According to USAID, Liberia has one of the lowest electricity access rates in the world (*ibid*, 2019). To put this into perspective, less than 20% of the population in the country's capital Monrovia has access to electricity (*ibid*.). However, Liberian households generate electricity from a wide range of sources, such as generators, wood, charcoal, batteries, and candles. The HIES undertaken in 2016 further established that around 70% of households in urban areas rely on coal/charcoal for cooking fuel, whilst most households in rural areas use wood (90.2%). For lighting, most households use lamps or batteries (*ibid*.) Improving the supply of energy is high on the government's agenda, as it aims to provide access to 35% of Liberians by 2030 (USAID, 2019).

The Liberia Common Country Assessment Report of 2018 notes that Liberia has one of the world's lowest rankings of electrification, but one of the highest electricity tariffs (at around USD0.35/KWH) (Primson Management Services, 2018). Electricity generation has increased, however, mainly due to the rehabilitation of the country's main hydro power plant [Mt Coffee; 88 Megawatt (MW)] and the construction of a 38 MW Heavy Fuel Oil (HFO) power plant (*ibid*.). The challenge of these plants seems to be a lack of transmission and distribution networks, which means that the electricity generated cannot reach sufficient households in the country. In May 2016, for example, the Common Country Assessment Report notes that Liberia had 23 MW grid installed electricity. However, only 2% of the population had access to own grid electricity, whilst an even smaller percentage (1%) of rural communities had access to small-grid electricity (*ibid*.). This effectively means that many hotels, restaurants or office buildings (especially in urban areas) have to generate their own electricity at a greater expense.

Ministry of Mines and Energy (MME) is the overall authority in charge of the energy sector. The energy regulator is the Energy Regulatory Board (ERB). The Liberia Electricity Company (LEC) is in charge of generation, transmission and distribution of electricity. On a regional level, it is a member of the West African Power Pool. The legal framework of the energy sectors is provided by the 2015 Electricity Law of Liberia. The main sector policy is the 2009 National Energy Policy.

3.7.2 Energy Resources

Biomass is reported to dominate energy consumption in Liberia with a share of more than 80% of the used primary energy sources. This includes woody biomass used for domestic cooking and heating. In 2000, it was estimated that over 95% of the population depend on firewood and charcoal for cooking and heating needs and palm oil for lighting. According to the most recent Census (2008 data, published in 2009) 70% of the urban population use charcoal for cooking and 5% of the rural population; 91% of the rural population use firewood for cooking and 21% of the urban population. In Monrovia, the percentage of households using charcoal is even higher, 85%. Around 2% of the population have access to clean fuels and technologies for cooking (World Bank, 2014).

Electricity and petroleum based modern type of energy services are used predominantly for economic production and transportation. For most households, the use of modern energy services consists mainly of kerosene, electricity, and liquefied petroleum gas for lighting, cooking, and entertainment. These are used predominantly by higher income households in urban areas.

3.7.3 Energy Demand

Forecast by LEC (2013), NORAD (2009), Norconsult (2012), and World Bank (2011), project electricity demand projections for three different scenarios: base, high and low; for the next 20 years (Figure 5.2). Projections include the current unsatisfied demand but excludes the mining sector. Based on this forecast, there is a potential for fast growth (at an annual rate of 10% in 2013-23), consistent with the country's economic growth expectations and the incorporation of large suppressed demand in the power system. It was projected that the peak load will reach 311 MW by 2033 and the corresponding energy demand will be 1,672 GWh. Monrovia was projected to remain the primary load centre, accounting for about two-thirds of the country's demand. The demand nationwide was expected to be much larger considering the electricity requirements of the mining companies.

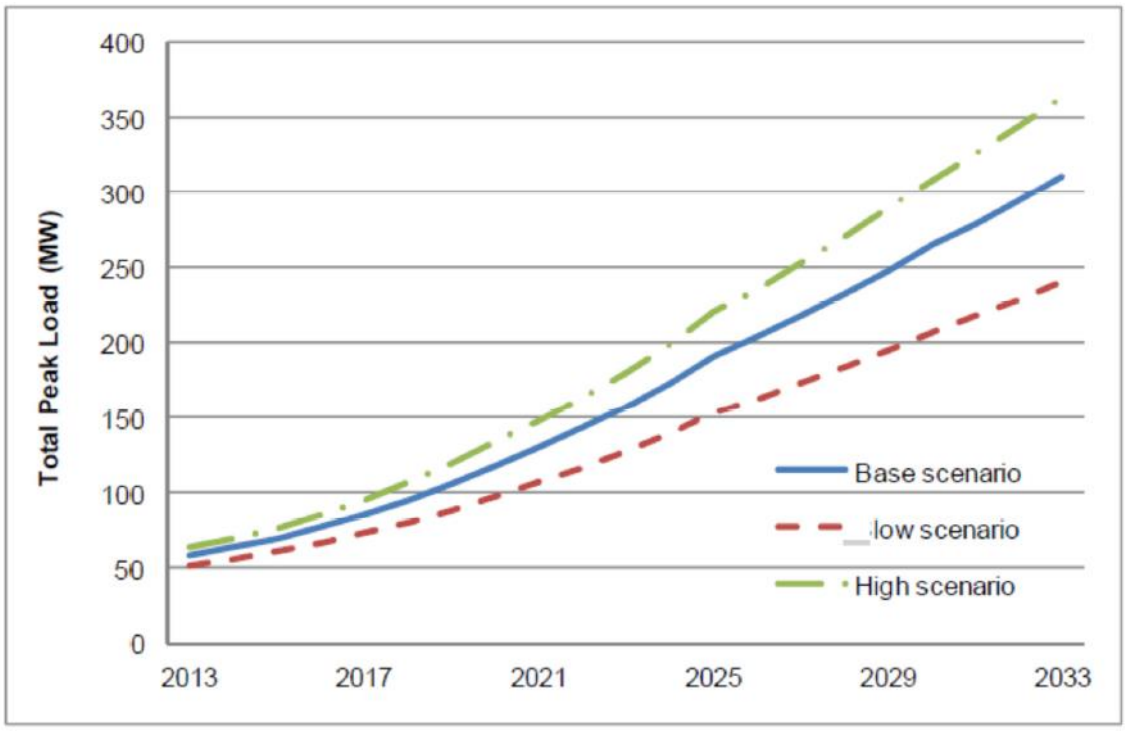


Figure 3.11: *Peak Demand of the Liberian Power System (Source: MME, 2013)*

3.7.4 Energy Supply and Expansion Projects

Prior to the civil conflict (1989-2003), Liberia had a total installed capacity of 191 MW (98% in and around Monrovia) serving around 35,000 customers, which represented approximately 7% of the country's population[11]. The system was operated by LEC. As a

[11] The generation mix was composed of a hydropower plant at Mount Coffee with a supply capacity of 63 MW

result of the inability of the LEC to meet the needs of the country and particularly the private sector due to its reduced hydropower generation during the dry season, some private citizens were compelled to secure their own generation, which reached 216 MW. Access to electricity in rural areas was limited to 10 isolated mini grids based on units fired by heavy fuel oil, with a total installed capacity of 13 MW. During the civil conflict, the Mount Coffee hydropower plant and other generation facilities, as well as transmission and distribution networks, which eventually led to the collapse of the LEC as the war intensified.

Having access to reliable energy is vital for the growth and development of Liberia's economy, but also rural communities. Many areas in Liberia still do not have such access. Although there is limited access to energy in some cities, the vast majority of rural households live without this resource. Firewood remains the most important source of energy, which is unsustainable in its current form. It is used primarily for cooking, heating and lighting. Very few rural households have generators.

Alternatively, sustainable sources of energy are needed in Liberia. Several options could be investigated, such as the country's potential to harness more energy from hydropower. Progress is being made in many counties which already benefit from initiatives such as the West African Power Pool. However, the outcomes of the latter project still need to be assessed.

The LEC Generation system is made up of the 88 MW Mount Coffee Hydro Power Plant and 38 MW of Light/Heavy Fuel Oil generators at Bushrod. LEC Peak load is between 27 to 38 MW (Load is gathered per day/week/month/year). The Mount Coffee Hydro Power Plant consists of four generating units rated at 22 MW each. There are 3 cross border 33 kV distribution lines from Cote d'Ivoire feeding into Nimba, Grand Gedeh and Maryland Counties. A network capacity analysis has shown that the 66 kV network capacity and network configuration is adequate for the short term. The 22 kV network, however, has serious constraints about accommodating new customer connections (both residential and commercial).

In 2009, the government of Liberia became a member of the West African Power pool after it ratified the Economic Community of West African States Energy Treaty. In the same year in May, Liberia developed its National Energy Policy (NEP) - An Agenda for Action and Economic and Social Development. The development of the NEP was recognised as an essential exercise towards the realisation of the goals and objectives of the Poverty Reduction Strategy (PRS), as well as contributing to the achievement of the Millennium Development Goals (MDGs). The NEP was developed in view of implementation of proposed energy sector reforms founded on three essential features:

(1) Demonstrating the Government's resolve for good governance and ensuring financial transparency in all sector transactions;
(2) Overcoming the significant obstacles to private sector investment in energy supply; and

during the wet season and 5 MW during the dry season (six months). The remainder was based on Heavy Fuel Oil (HFO) (31%) and diesel (21%).

(3) Creating the requisite institutional and legal framework and an independent regulatory regime.

The key policy objectives of the NEP include access: availability of modern energy services for all Liberians, in both the urban and rural areas; quality: ensure acceptability of energy products and services by adopting standards that are consistent with international best practice; cost: ensure affordability through least-cost production and utilisation of energy services.

The energy policy recognises that Liberia has significant opportunities to develop its energy resources, particularly hydroelectric power, solar and biomass. But, these sources of energy have not been adequately developed. The policy also notes that energy development and the environmental impacts are intricately related. The policy recognises the need to address both the physical and social environmental impacts created by energy development, consistent with the Environmental Protection and Management Law of 2003.

With the support of development partners, including the European Union (EU), USAID, Norwegian Agency for Development Cooperation, and the World Bank, post-war Liberian governments focused on investments intended to regenerate LEC's operations. These investments culminated into Emergency Power Programmes I and II that allowed for the construction of a small grid with an installed capacity of 9.6 MW (diesel generators) and a 66 kilovolt (kV) transmission line circuit. Modelled after the principle of public–private partnerships as set out in the NEP, the government engaged a management contractor to bring LEC to full functionality as a power utility with fully trained staff and build the customer base to a target level of some 33,000 customers. In July 2010, the government awarded a management contract to Manitoba Hydro International. The International Finance Corporation provided advisory services for structuring a performance-based contract and the government of Norway, USAID, and the World Bank provided a financing package of $50 million to LEC for the investments to be implemented by the management contractor.

As of July 2013, LEC had established a customer base of approximately 13,875 customers, compared with 2,469 in July 2010. Despite the progress attained thus far, by the end of 2012 Liberia still had one of the world's lowest rates of access to public electricity 1.6% nationwide and 6.7% in the capital city with the highest electricity tariff in Sub-Saharan Africa (and among the highest in the world) standing at more than $0.50/kWh, with LEC reporting high commercial and technical losses ranging from 25-40%.

3.7.5 Pollution from Energy Generation

Three general types of pollution are considered in this section, namely general indoor and outdoor air pollution, followed by the emission of GHGs.

Indoor air pollution: Air pollution from indoor sources is recognised as the single largest contributor to the negative health effects of air pollution in Liberia. It was estimated in 2004 that over 95% of the population relied on firewood, charcoal and palm oil for their

energy needs. In 2008, the proportion had remained much the same. Experts believe that the promotion of cleaner cooking fuels and clean stoves can help ameliorate this situation.

Outdoor air pollution: Outdoor air pollution comes in the form of uncontrolled waste burning, which is a common practice in most parts of the country. This is one of the practices that contributes to deteriorating air quality in urban centres. In rural areas, agricultural waste burning is noted to be the main source of poor air quality

Greenhouse Gases (GHGs): In 2015, Liberia released its Intended National Determined Contributions (INDC) submitted to the United Nations Framework Convention on Climate Change. The document identifies the energy sector as the leading source of GHGs primarily attributed to the use of petroleum products, firewood, charcoal, and palm oil. According to the report, petroleum products (primarily gasoline and diesel, and some jet fuel and kerosene) supply over 95% of the country's primary energy and are entirely imported. A decline in energy supply from 2000-2003 was followed by very rapid growth in consumption from 2003-2008. Consumption of petroleum products increased by 66% from 1999 to 2008, with transportation consuming 61%, and electricity generation (which uses gasoline and diesel oil) 29% in 2008.

During the civil war, which devastated the road network, there was a decline in the number of vehicles (sedans, Jeeps, trailers, trucks, and buses) to 5,660 in 2003. By 2005, the vehicle population had partially recovered, reaching 10,150. Most vehicles are poorly maintained and consume low grade diesel and mixed petroleum fuel that have high potential for GHG emissions.

With the advent of the civil conflict, Liberia has witnessed an increase in industrial activities. Albeit on a lower scale, many of the companies operate by using generators which burn fossil fuel to generate energy. Many of these industries have the potential to impact air quality significantly in the long-term. The most important industries in this regard are mining (iron ore and gold), rubber processing, palm oil processing, timber and diamond mining (amongst others). With this comes the need for promoting energy-efficient incentives, incentives for clean production and installation of pollution prevention technologies, actions to ensure compliance with regulations and promotion of renewable energy. At the national-level, power generation across the country substantially relies on fossil fuel. According to a report in 2010, 100% of the installed electricity generating capacity (197,000 KW) is generated from fossil fuel[12]. With credit to the Liberian Government and donors, the Mount Coffee Hydro-Power Plant, which was destroyed during civil conflict in the early 1990s, is now operational. Additionally, under the West African Power Pool, some communities in Nimba, Grand Gedeh and Maryland now have access to electricity; thus, reducing their use of fuel generators for energy and limiting air pollution in those areas.

As a result of the post-war era, electricity generation has also recovered significantly. Before the civil conflict, Liberia's total installed generation capacity was 412.7 MW, of which LEC owned 195 MW. In 2012, LECs installed generation capacity stood at 22.6 MW, with the rest produced by the private sector. Given the hydropower potential of the

[12] Countries of the World - 32 Years of CIA World Fact Books

country, the connection to the West African Power Pool supply and the potential for extended hydropower system, there is a potential for GHG reduction in the energy sector which could provide hope for Liberia to achieve its NDC target of reducing GHG emissions by 10% by 2030.

3.7.6 Potential Energy Resources

3.7.6.1 Biomass

Approximately 43% of Liberia is covered with forests (41,790 km², World Bank 2015), thus, there is no lack of trees in Liberia. The country has 11 designated National Forests (under limited protection) and two legally protected areas, Sapo National Park (approximately 149,000 ha) and East Nimba (about 15,000 ha). In 2009, the US national Renewable Energy Laboratory (NREL) conducted a study of biomass resources (other than forestry) in Liberia with a view on how these resources could be used for energy purposes. The report indicated that the potential annual waste stream from logging operations - once they restart - could be very substantial, with an estimated 20 million m³ available (162,645 TJ/year), of which 10.9 million m³ at sawmills and the remainder at the logging sites; most of that waste would be lost. The annual waste at the sawmills would be able to produce 100 million bags of charcoal, if all waste were convertible into charcoal; this is much more than is currently used in the country.

The report further estimated that of the total cropland in Liberia, 37% of the territory, only 6% is currently cultivated. The remaining cropland amounts to some 3 million hectares, which indicates that in addition to existing resources, there is a large potential for new crops, including tree crops that could yield resources suitable for charcoal production. The report also analysed the amount of biomass that could be generated from rubber plantations, oil palm trees as well as household farms.

3.7.6.2 Biofuels

All fossil fuels consumed in Liberia at the moment are imported. Since 2011, several multinational oil companies have received licenses for exploration activities. These include Anadarko Petroleum, African Petroleum, Chevron and ExxonMobil signed Productions Sharing Contracts (PSC) with the Liberian government. Some of these companies subsequently began exploratory drilling; 10 wells have been drilled so far. It is reported that Liberia has some offshore oil blocks from the continental shelf to water depths of 2500-4500 meters. The geology of the Liberian basin is complex, and experts indicate that finding oil will be extremely difficult and expensive. Some of the companies with licenses to explore for oil in Liberia have already relinquished oil blocks, including Anadarko, Repsol and Tullow, and recently African Petroleum, due to market challenges and lack of interest in the Liberian oil basin owing to the history of no discoveries of oil in commercial quantities in the basin.

3.7.6.3 Hydropower

Liberia's rainy season runs between April and November; the country has various rivers and a long sea-coast. The yearly rainfall is projected at approximately 510 cm (200 in) on

the coast, 200 cm (80 in) inland. Average relative humidity is about 82% in the coastal areas during the rainy season, and 78% to 50% in the dry season. Based on the Rural Energy Strategy and Master plan, the hydropower potential of Liberia has been identified at 2 300 MW. This potential is mainly measured based on large rivers with high mean annual flow and low heads. Several locations have heads and flows above 50 m^3/s, thus good for above 5 MW hydro schemes. However, the potential varies between rainy season and dry season.

3.7.6.4 Wind Energy

Because Liberia lies in a generally low wind region there is a limited potential for wind energy exploitation, though, it is likely that the highland and coastal areas might have some good prospects but not enough for commercial exploitation. Few sites in highland and coastal areas have the required minimum wind speed of 7m/s for wind power turbine plants. In the 2015 SE4All Action Agenda Report, Wind Generation in Liberia is projected to reach 0.47GWh in 2025. There is no assessment for wind energy or any recommendation to use wind energy in the Liberia Rural Energy Strategy and Masterplan.

3.7.6.5 Solar Energy

Liberia has a humid, tropical climate with relatively constant temperatures throughout the year, around the average of 27°C (81°F), hardly ever outside the range of 20°C (68°F) to 36°C (97°F). The monthly solar radiation on horizontal surface ranges from about 4 $kWh/m^2/day$ during the rainy season in June, July, August to 6 $kWh/m^2/day$ during the height of the dry season in February and March. As a result of this climate, the country has a high and consistent potential for solar energy across the country, adding to an average level of 1,712 $kWh/m^2/year$, which could generate 1,400 to 1,500 kWh/kWp.

3.7.7 Current Energy Initiatives and Projects

The existing LEC 66kV line route is depicted in Figure 3.12.

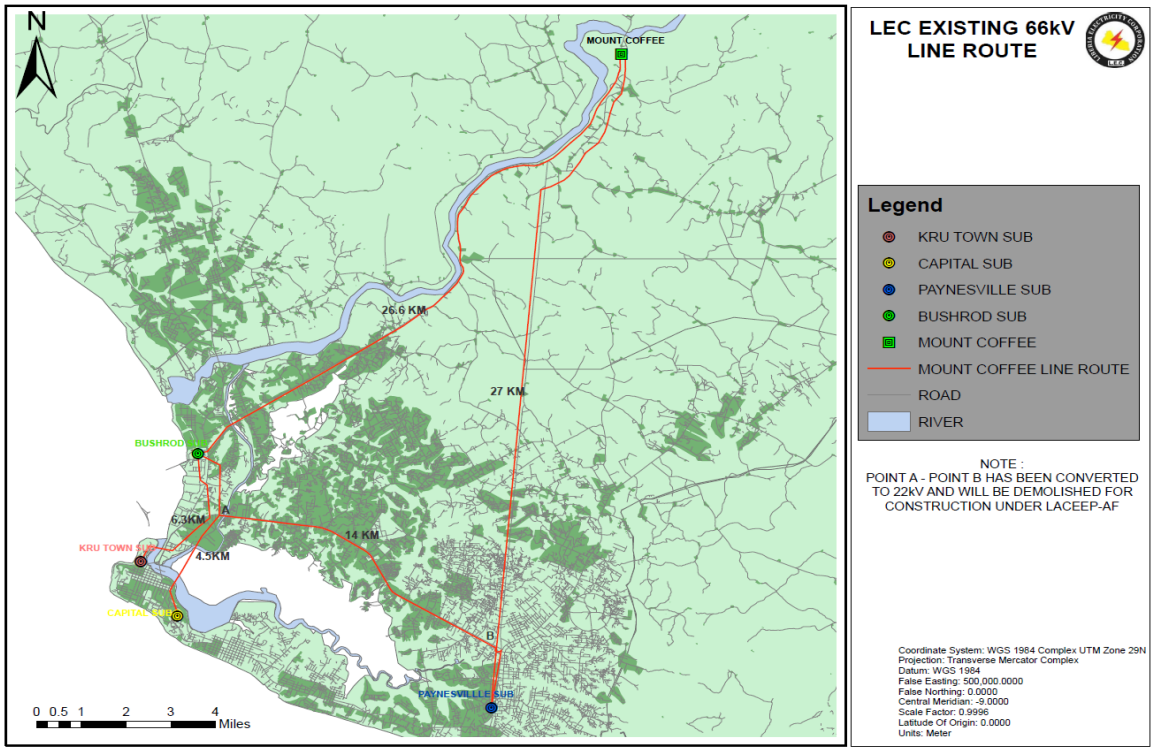


Figure 3.12: *LEC Existing 66kV Line Route. (source: LEC)*

In an effort to meet the growing energy demand in the country, the Liberian government is working with its international partners and donors to establish transformative energy priority projects. Some of these include, but are not limited to:

- Rehabilitation of the Mount Coffee Hydropower Plant, to provide 80 MW of additional hydropower production in the wet season and about 20 MW in the dry season. The project was commissioned by the end of 2015;
- Developing thermal power to compensate for the high seasonality of hydropower. The government secured financing for 38 MW of HFO units; with 20 MW commissioned;
- Developing the West African Power Pool Project – Côte d'Ivoire, Liberia, Sierra Leone and Guinea (WAPP–CLSG) Regional Transmission Line, an initial stage in enabling power trade in the region, as well as transforming domestic power systems by building backbone transmission lines in Liberia. It is expected to be commissioned by 2017;
- Developing the cross-border connection with Côte d'Ivoire to electrify towns in the border area of Liberia;
- Establishment of the Rural and Renewable Energy Agency (RREA) in 2010. RREA commissioned the first mini-grid system based on a 60 kW micro-hydro plant in rural Yandohun in May 2013, which is executing the Lighting Lives in Liberia programme to advance commercial availability of high-quality, efficient solar powered light-emitting diode lighting; and
- Mano River Initiative, supported by the African Development Bank, where Mano River Union Member States (Liberia, Cote D'Ivoire, Guinea and Sierra Leone) plan to further integrate their regional development, especially in the energy and transport sectors.

In recognition of the need to migrate from emergency response to long-term sustainable energy supply, the Government of Liberia prepared a Least Cost Power Development Plan aimed at expanding the electricity services needed to enhance economic growth. The plan identifies the type and scale of investments needed to increase electricity coverage to 70% of the greater Monrovian population and 35% of the national population by 2030. The plan focuses on investments in generation and transmission required to expand the power grid. There are several major transmission and distribution projects in Liberia being funded by international donor agencies to expand the network and to connect additional customers. Several projects are discussed below:

Liberian Accelerated Electricity Expansion Programme (LACEEP)

Electricity expansion is set to be achieved under the Liberian Accelerated Electricity Expansion Programme (LACEEP), which seeks to increase access to electricity and strengthen institutional capacity in the electricity sector. The project has two implementing partners: LEC and MME. LEC is responsible for implementing component One, which is expanding electricity from the City of Paynesville in Montserrado County to the City of Kakata in Margibi County and up to Wheala. The project is divided into three lots, which entail the construction of 66/33 kV substation in Kakata, the expansion of the existing 66/22 kV substation in Paynesville, and the construction of distribution lines in communities in Paynesville and Kakata. The project is connecting 25,000 new customers to the national power grid, while MME is responsible for the overall project coordination and implementation of component Two, the construction of facilities for off-loading, transport, and storage of heavy fuel oil; as well as Component Three which provides support to strengthen MME's institutional capacity.

The project was approved by the Board of Directors of the International Development Association (IDA) on the 30th of May 2013. The Financing Agreement between IDA and the Republic of Liberia was signed on the 3rd of July 2013, in the amount of SDR 23,400,000 (US$ 35M).

Liberia Accelerated Electricity Expansion Project - Additional Financing (LACEEP-AF)

The LACEEP-AF is intended to enhance the impact of the original LACEEP by scaling up the activities by connecting new residential, commercial, and industrial users and strengthening the capacity of LEC. This will be done through the addition of activities under component 1 (transmission and distribution) and component 3 (strengthening sector institutional capacity) which ensures increase in generation capacity that comes on line in the coming years; translating into increased and improved electricity services in Greater Monrovia and in Bomi and Grand Cape Mount Counties. The Project is divided into three lots. Lot 1: The construction of 66 kV transmission lines (Areas: 66 kV lines route: Bushrod SS-Virginia SS-Klee and Stockton Creek SS-Gardnersville SS-Paynesville).

The Monrovia Consolation of Electricity Project

This project is funded by the EU, and it is expected to expand and increase access to electricity to 38,000 new users in areas covering Central Monrovia up to The RLJ Hotel Junction in Eternal Love Winning Africa (ELWA), Paynesville. The project is divided into two lots:

- Lot 1: supply and installation of a 66kV transmission line and expansion works in six substations (Bushrod, Stockton Creek, Kru-Town, Capitol Sub, Congo Town and Paynesville); and
- Lot 2: supply and construction of 22/0.4kV distribution network from Central Monrovia to Kenejah.

Liberia Energy Efficiency Access Project (ELWA-RIA[13] CORRIDOR and Pleebo - Fish Town Corridor)

This project is jointly funded by the African Development Bank (AfDB), EU and the GEF. It is divided into two corridors and will expand and increase access to 45,000 new users. The project will extend access to electricity within the ELWA to RIA corridor and the Pleebo to Fish Town corridor. The project will provide for the construction of a 66kV double circuit transmission lines from Paynesville to RIA; the construction of two new substations (66/22kV and 66/33kV) in Schefflin and Harbel; the construction of MV/LV network in communities along the ELWA–RIA corridor; the construction of MV/LV network in communities along the Pleebo-Fish Town corridor; the connection of 45,000 new customers and the development of the institutional capacity at LEC, RREA and MME.

Electrification and Grid Upgrade Project

This project is funded by KFW Bank of Germany and is expected to deliver 16,000 new connections that will fill the gaps between the larger projects in areas such as Clay Ashland–Bentol, Fendell, Double Bridge-Pipeline-Police Academy, and Duport Road – Rehab communities. The main components of this project consist of the connection of households, as well as grid densification in the following three "gap" areas of Double Bridge-Pipeline and Police Academy, Du-Port Road to Rehab area and Clay Ashland-Bentol to Fendell.

Additional energy expansion projects are listed in Table 3.15.

[13] Roberts International Airport

Table 3.15: *Energy Expansion Projects in Liberia (source: LEC)*

Project	Impact	Region
Kakata Corridor (LACEEP) WB US$35m concessional loan	25,000 connections Connects Kakata to grid	Monrovia, Kakata, Kakata Highway
Bomi Corridor (LACEEP AF) World Bank US$60m concessional loan	Up to 36,000 connections including large users Connects value chain towards Sierra Leone border - SL EU funded	Monrovia – Bomi Corridor, Montserrado, Bomi & Grand Cape Mt. Counties
EU Monrovia Consolidation Project	38,000 domestic connections 57 large user connections	Central Monrovia up to The RLJ Hotel Junction in ELWA, Paynesville
RIA Corridor Liberia Energy Efficiency and Access Project (LEEAP) (AfDB/EU) US$21m concessional loan	Stretches the LEC network to Harbel/RIA Connects RIA – Critical National Infrastructure Minimum of 14,000 connections	Paynesville-RIA CORRIDOR & Pleebo–Fish Town Corridor
Additional Monrovia Connections (KfW) US$18m Grant	Connects up to 14,000 households and commercial users in "gaps" not covered by the large projects	Clay Ashland – Bentol- Fendell, Double Bridge-Pipeline-Police Academy, and Duport Road – Rehab communities
Electrification of Liberia's SE Counties (LEEAP) (AfDB/EU) (tbc) US$40-50m Grant	Connection of commercial and domestic customers in SE counties Commercial development of the SE	Extension of existing cross border lines in Grand Geddah, Maryland and Nimba
Rural Electrification Component of the Côte d'Ivoire, Sierra Leone, Liberia, Guinea (CLSG) 225kV Transmission Line WB/AfDB/KfW US$183m loan and grant	Access to wider West African Power Pool market Potential to export excess Mount Coffee energy in wet season 5 new substations from which LEC network can expand Connection of 130 rural communities along the line using "shield wire" technology (AfDB component)	

3.8 FISHERIES

3.8.1 Overview

The typical Liberian diet consists of fish as the primary source of animal protein, providing approximately 65% of the country's animal protein needs. It is estimated that over 20,000 people throughout the country are involved in fishing activities and earn their livelihoods from it (FAO, 2010).

Liberians have been engaged in fishing along coastline, lagoons and rivers, using nets, hooks and lines, and traps for many centuries. However, the earliest records only date

from 1960 when 44 canoes were recorded fishing along the coastline. By the 1980s fishery had expanded, especially amongst the Krus of Liberian ancestry, the Fanti and Ewe of Ghanaian ancestry and the Popoh of Togolese ancestry. Total catch was around 2,000 tonnes of small pelagic and demersal fish each year. At a similar time in the 1970s, a fleet of around 20 industrial vessels were also fishing in Liberian waters for shrimp and demersal fish. They used larger vessels, carrying crews of up to ten men and often going to sea for several weeks at a time. These vessels landed around 3 000 tonnes of finfish and 2,000 tonnes of shrimp per year. During this period, the Bureau of National Fisheries (BNF) considered that the fisheries had room for growth to an estimated total catch of some 50,000 tonnes per year, a level considerably above the reported catches at that time. (Fisheries and Aquaculture Policy & Strategy, 2014). While the aquaculture sector is not well developed and consists mainly of fishponds for subsistence, it does contribute to the livelihood and survival of the rural communities. Coastal fisheries in Liberia target crustacean species such as shrimp, as well as pelagic and demersal fish. The post-war economy of Liberia is dominated by agriculture (which includes fisheries) and accounts for 77% of its GDP while employing an estimated 70% of the labour force (CIA 2017).

3.8.2 Current Fishing Industry and Practices

3.8.2.1 Local Fish Production

The National Fisheries and Aquaculture Authority (NAFAA) was established by an Act of the Liberian National Legislature in 2017. Under the Act, the NAFAA is mandated to sustainably manage the fisheries resources of Liberia. The Research and Statistics Division of NaFAA has commenced with the gathering of high-quality fisheries research data which will assist with the management of the living marine and freshwater resources of the country. Prior to this, fisheries data consisted of a few fragmented estimates and were virtually non-existent.

The artisanal fishery sector which operates in the marine and inland waters of Liberia sustains around 33,000 full-time fisherman and processors in the nine coastal counties of Liberia. Approximately 60% of these people are female who operate from about 114 fish landing sites along the coast. The women are typically employed in the processing and trading of fish products, although there is only a small number of boats that are owned by Liberian women (The World Bank, 2009).

Historic trends in production with details on fishery type can be seen in Table 3.15 with an updated sector annual production summary. Current data obtained from NaFAA (see tables below). Up until recently, data collection has been rather ad hoc and incongruous which has led to a fair amount of uncertainty regarding the validity of the production figures reported.

Table 3.16: *Sector's Annual Summary (2010 – 2018) (Source: NaFAA)*

SECTOR'S ANNUAL SUMMARY	2010	2011	2012	2013	2014	2015	2016	2017	2018
Small Scale (Artisanal)	10,153.00	10,869.00	10,824.00	13,149.00	12,744.00	13,727.00	13,914.90	13,160.43	13,203.61
Large Scale (Industrial)	1959.94	1050.28	1021.81	1737.55	609.36	688.22	3850.19	11039.57	13492.76
Total	**12,112.94**	**11,919.28**	**11,845.81**	**14,886.55**	**13,353.36**	**14,415.22**	**17,765.09**	**24,200.00**	**26,696.37**
% of Production Small Scale (Artisanal)	**84%**	**91%**	**91%**	**88%**	**95%**	**95%**	**78%**	**54%**	**49%**
% of Production Large Scale (Industrial)	**16%**	**9%**	**9%**	**12%**	**5%**	**5%**	**22%**	**46%**	**51%**

Table 3.17: *Number of Operating Canoes on the Liberian waters, 2018 (Source: NaFAA)*

Number of Operating Canoes	
Total Number of semi Industrial Canoes	616
Total Number of Artisanal canoes	3015
Total # of Small Scale Canoes	3631
Total # of License Canoes 2018	134
% of License Canoes	1.34
Total of none License canoes	3497
% of total none License	98.66
Total number of standard fishing days in Liberia	24

Table 3.18: *Tuna production 2016/2017 (Source: NaFAA)*

Tuna production 2016/2017			
Species	**2016 Tuna production(kg)**	**2017 Tuna production(kg)**	**2018 Tuna production(kg)**
Yellow fin Tuna	789,306.67	4,366,170.00	4,826,911.00
Big Eye Tuna	388,000.00	353,410.00	1,664,516.50
Skip Jack Tuna	1,557,883.33	5,236,900.00	3,135,422.00
Frigate Tuna	4,000.00	18,270.00	630205.5
Marlin	7,000.00	8,040.00	
Other Species	132,000.00	657,360.00	2,760.00
Total:	2,878,190.00	10,640,150.00	10,259,815.00

Table 3.19: *Marine Fisheries Time Series Fishing Effort, 2004-2018 (Source: NaFAA)*

Marine Fisheries Time series Fishing effort	**ARTISANAL BOATS**			**INDUST. VESSELS**
Year	**Non-motorized boats (Kru)**	**Motorized Boats (Fanti)**	**Total Artisanal Boat**	**Trawlers**
2004	331	168	499	60
2005	348	217	565	32
2006	612	278	890	32
2007	879	360	1239	32
2008	1238	471	1709	32
2009	1714	602	2316	16
2010	2459	737	3196	16
2011	2517	752	3269	7
2012	2515	760	3275	3
2013	2615	814	3429	4
2014	2748	827	3575	1
2015	3163	685	3848	7
2016	3163	685	3848	4
2017	3552	702	4254	10
2018	3615	740	4355	6

Table 3.20: *Production Statistics for the Liberian Fish and Crustacean Sector 1995–2011 (ITC, 2014)*

Land Area	Ocean Area	Species	Scientific name	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Liberia	Inland waters	Freshwater fishes	Freshwater fishes	4000	4000	4000	4000	4000	4022	4014	4014F	3614F	3213F	2813F	2413F	17558	779	766F	770F	770F
	Marine areas	Crustaceans	Crustaceans	148	28	124	177	338	93	189	303	230	457	296	281	130	90	90F	90F	90F
		Diadromous fishes	Diadromous fishes	6	124	28	63	242	110	198	200	200	242	24	4	182	57	60F	60F	60F
		Marine fishes	Marine fishes	4675	3980	4339	6384	10071	7285	6039	6454	6354	9795	8002	6198	12357	6950	7070F	7070F	7070F
		Molluscs	Molluscs	0	175	2	73	31	30	70	75	70	31	1025	11	55	30	30F	30F	30F
	Sub-total Marine areas			4829	4308	4491	6697	10682	7518	6496	7042	6854	10525	9347	6494	12745	7127	7250F	7250F	7250F
Total Liberia				8829	8308	8491	10697	14682	11540	10510	11056	10478	13738	12180	8907	14501	7908	8018F	8020F	8020F
GRAND TOTAL				8829	8308	8491	10697	14682	11540	10510	11056	10478	13738	12160	8907	14501	7908	8016F	8020F	8020F

Source: FAO Fisheries and Aquaculture Information and Statistics Service (2013).
Available from www.fao.org/fishery/topic/16140/en. Accessed 3 December 201V 3.
Note: An 'F' next to production figure indicates FAO estimates

3.8.2.2 Fish Catches

The artisanal fishery sector of Liberia is on a small-scale and mostly in the marine environment. It typically accounts for 49% of the total fish landed in the country as of 2018. On the other hand, industrial fishing production is on a larger scale, and accounts for 51% as of 2018. These landings have, however, decreased in recent years. The fish landings by the artisanal sector are primarily consumed by the domestic market. Table 3.21 summarises the fish catches for 2018 for the artisanal sector which landed 13,201 tons at an estimated value of L$5,921,536.00 (NaFAA, 2018).

Table 3.21: *Total Catch and Estimated Value (L$) of Fish Caught in the Coastal Artisanal Fishery Sector per Liberian Coastal County (NaFAA, 2018)*

Year	Counties	Total catch (t)	Total value ('000)LD
2018	Bomi County	149.00	93,874.00
	Capemount County	881.00	151,739.00
	Grand Bassa County	4,557.00	1,261,376.00
	Margibi County	49.00	13,936.00
	Maryland County	621.00	1,328,807.00
	Montserrado County	5,979.00	1,486,798.00
	River Cess County	230.00	138,398.00
	Sinoe County	735.00	1,446,608.00
TOTAL		**13,201.00**	**5,921,536.00**

Populations of herring and small pelagic flying fish also occur seasonally in Liberian waters and are of economic value to the artisanal fishery of the country. The inland artisanal fishery of Liberia is traditional and primitive in terms of its fishing methods. This fishery is largely unmonitored with no information on its production being available. The Liberian fishing waters support a considerable resource, including numerous finfish species and crustaceans such as shrimps, lobsters and crabs. The main tuna species targeted by the pelagic fishery sector of Liberia is listed in Table 3.22 which reflects the substantial increase in total tuna production from 2,878,190 in 2016 to 10,640,150 in 2017.

Table 3.22: *Pelagic Fishery Landing for Liberia during 2016 and 2017 (NaFAA, 2018)*

Species	2016 Tuna production(KG)	2017 Tuna production(KG)
Yellow fin Tuna	789,306.67	4,366,170.00
Big Eye Tuna	388,000.00	353,410.00
Skip Jack Tuna	1,557,883.33	5,236,900.00
Frigate Tuna	4,000.00	18,270.00
Marlin	7,000.00	8,040.00
Other Species	132,000.00	657,360.00
Total:	**2,878,190.00**	**10,640,150.00**

Figure 3.13 depicts the landings of demersal fish species from Liberian waters from 10 demersal trawlers during the year 2018. It can be seen that the demersal trawlers land a number of fish species. Crustacean resources (not depicted), such as shrimp, are also utilised from the Liberian waters.

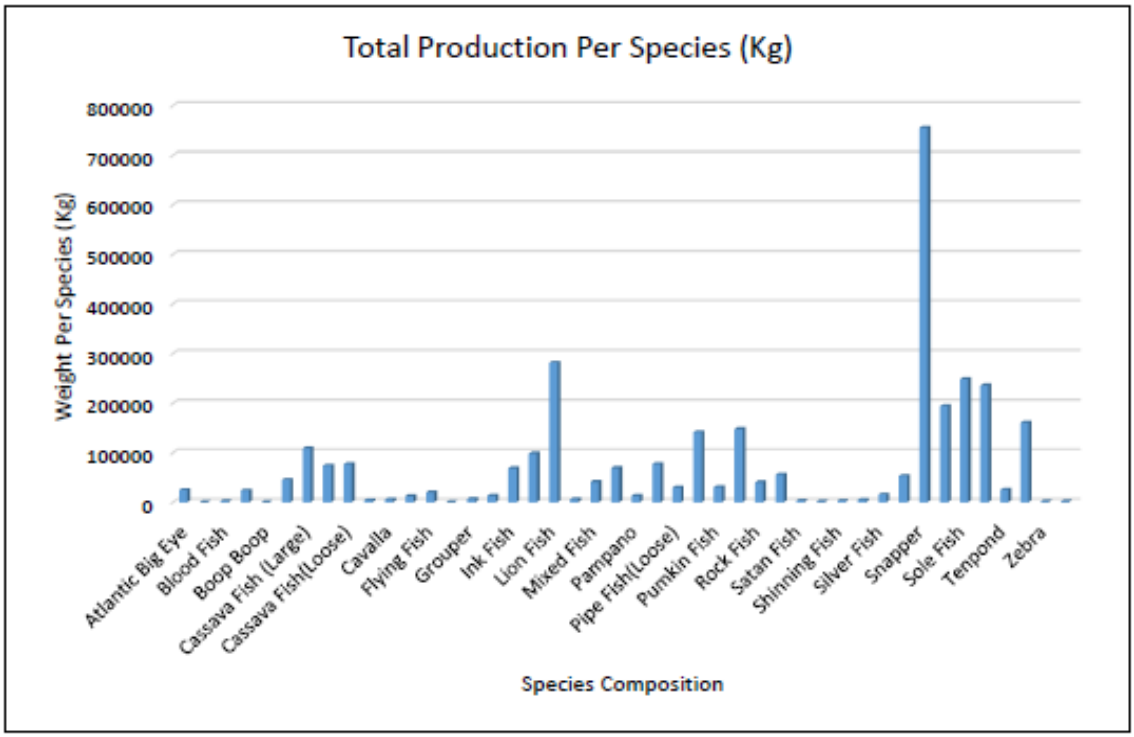
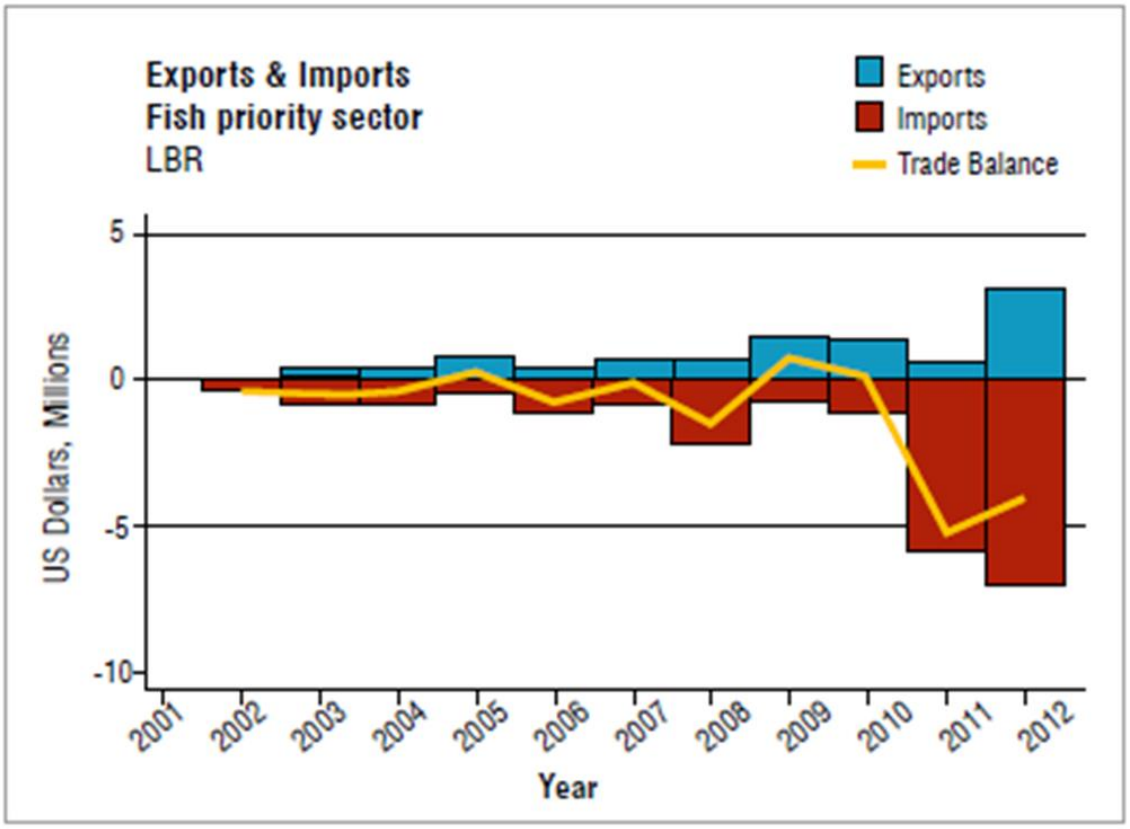


Figure 3.13: *Demersal Fish Catches for Liberia (NaFAA, 2018)*

Virtually all the crustaceans landed are processed and frozen before being exported to the USA, Greece, Belgium and the United Kingdom. However, all the finfish that is caught is frozen whole and made available to the local market for consumption since Liberia lacks the necessary infrastructure to be able to process and distribute export-quality finfish products. Although the landings of the crustaceans are significantly less than that of the fish, these fishery species have a higher economic value (BNF, 2007).

The trade balance between the import and export of fish (including crustaceans) and fisheries products can be seen in Figure 3.14 with the import of these products increasing during 2011 and 2012.



Source: ITC calculations based on 4-Digit COMTRADE HS 2002 data.

Figure 3.14: *Trade Balance in the Liberian Fish and Crustacean Sector (ITC, 2014)*

What is illustrated in Table 3.23 is the volume of imported fish and fishery products which decreased from the year 2016 to 2018. This may largely be attributed to the increase in the number of demersal trawlers from four to ten.

Table 3.23: *Import and Export Totals of Fisheries Resources for Liberia (NaFAA, 2018)*

Year	Import (MT)	Export (MT)
2014	22,694.33	-
2015	25,940.34	-
2016	51,267.74	55.20
2017	44,300.00	43.50
2018	28,814.67	187.50

Since 2010, the fisheries sector of Liberia has advanced and has become significantly more effective in terms of its management and, as a result, the production in the fisheries has increased. This may be attributed to the enforcement of the New Fisheries Regulations of 2010, the establishment of the Fisheries Monitoring Centre in 2011, and the formation of the Monitoring Control and Surveillance Coordination Committee which ensures stakeholders' participation in the development of fisheries. These changes may be

ascribed to initiation of the West Africa Regional Fisheries Project (WARFP) in 2009 which was instigated by the World Bank.

It should be noted that illegal fishing has also become a serious concern in Liberia. This topic is discussed under Chapter 9 on Emerging Issues and Outlooks.

3.8.2.3 Fishing Areas

The continental shelf of Liberia stretches from 16 to 56 km wide with a total area of around 18,400 km2. The Exclusive Economic Zone of Liberia extends 200 nm offshore and measures 229,700 km2 in area. The fishing zone of Liberia extends from the shrimp rich shebo grounds which border Sierra Leone in the west to Cavalla River Basin which borders Côte d'Ivoire in the east. An inshore inclusion zone covers the 6 mm nearest the land at a depth of area below the 6NM IEZ range from 40-70m and no trawling or commercial fishing is allowed in this zone as it is reserved only for subsistence, artisanal or semi-industrial fishing activities. This artisanal canoe fishery also operates in the shallow inshore waters, as well as the estuaries.

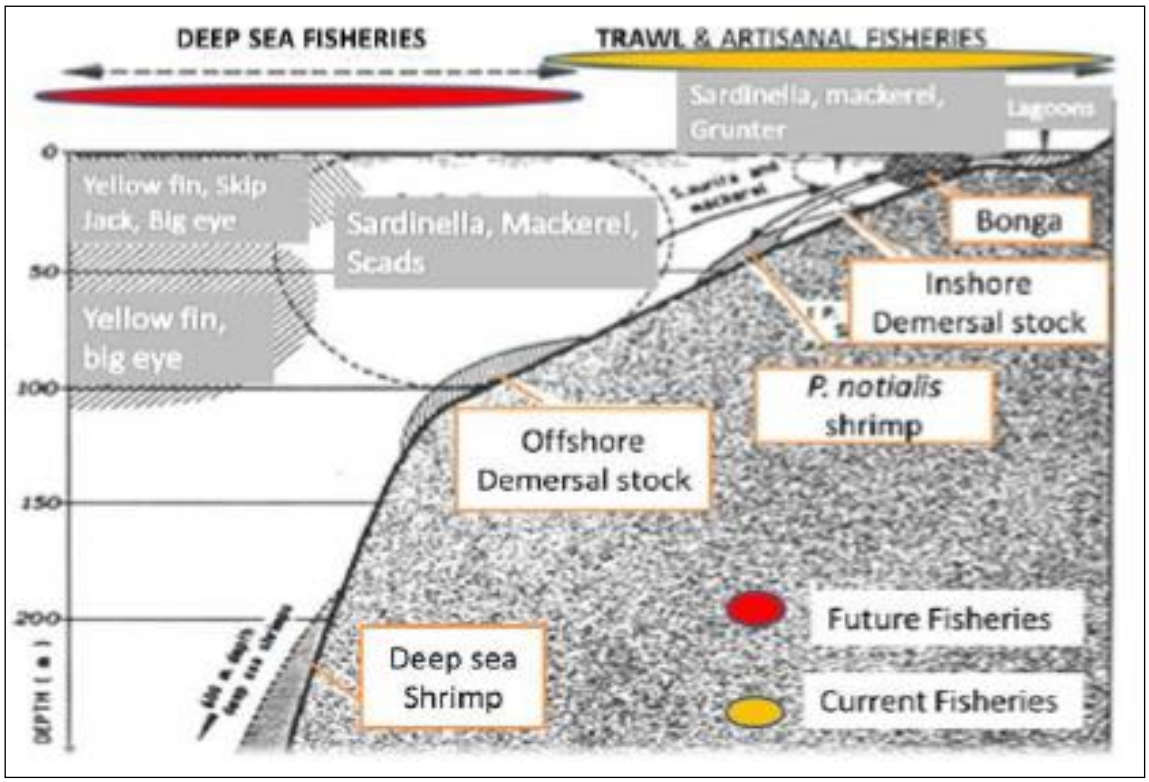


Figure 3.15: *Location and Description of Current and Future Fisheries in Liberian Waters (Subah, 2010)*

Over 1,800 km of rivers and watercourses, as well as water bodies such as lagoons and wetlands, support the inland fisheries of the country.

3.8.3 Aquaculture

There are approximately 1,050 landowners who are part-time subsistence fish farmers in the aquaculture sector, with an additional estimated 2,500 people involved in fish farming activities such as pond construction, pond management, fish harvesting, and other support services. No information is, however, available on the gender ratio of these fishery people (BNF, 2007), although it must be noted that unequal access to land ownership is a problem in Liberia with women particularly having limited land and resource rights (BNF, 2014).

There are five main fish species currently cultured in Liberia: the Nile tilapia (*Oreochromis noctilucus*), the mango tilapia (*Sarotherodon galilaeus*), red belly tilapia (*Tilapia zillii*), the African catfish (*Clarius gariepus*) and the sampa (*Heterobranchus longifiilis*). Around 95% of production is accounted for by two tilapia species, the Nile tilapia and the mango tilapia. Despite the lack of formal legislation prohibiting the use of exotic species for fish farming in Liberia, the Bureau of National Fisheries (BNF) restricts the introduction of exotic species for aquaculture as a means to protect the biodiversity for Liberia. The BNF will, however, permit the introduction of an exotic species for aquaculture purposes, but only once certain conditions have been met in terms of researching the species' biology and production. The total annual fish production per species is depicted in Figure 3.16 and shows that the majority of the production is from the Nile tilapia, followed by the Mango tilapia.

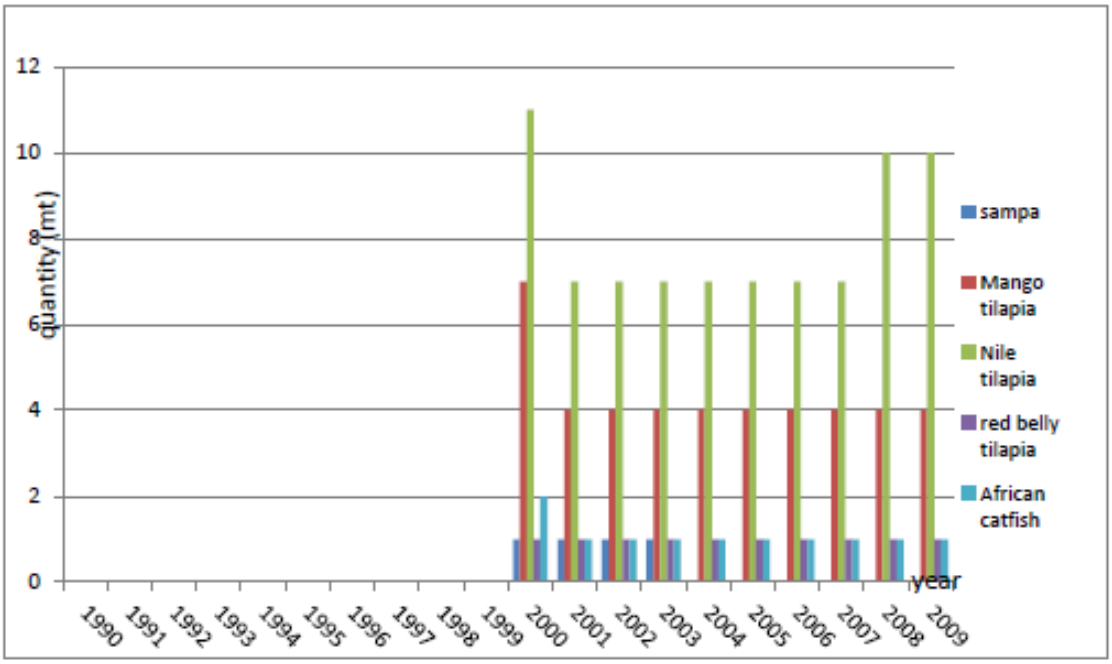


Figure 3.16: *Total Aquaculture Production per Fish Species in Liberia (FAO, 2009)*

Depending on the availability of land, subsistence aquaculture in Liberia typically consists of one or two small ponds which are about 200 m^2 to 400 m^2 in size. This production can be semi-intensive to extensive with very low inputs using limited resources. Fingerlings that remain post-harvest are typically used to restock the ponds for the next crop. A small number of hatcheries have recently been built in Liberia which help to provide the fingerlings required for stocking the ponds. Stocking density in these ponds is low with an average of 2 to 3 fish per m^2. The fish are fed an *ad hoc* diet

consisting of leftover livestock feed and agricultural by-products while the ponds are fertilised with manure from livestock such cattle, goats and chickens (BNF, 2007).

Aquaculture activities have been widely integrated with other agricultural activities throughout Liberia. More semi-intensive pond production of tilapia takes place in the northern and south-eastern regions of the country. Floating fish cages were introduced by a private farmer in the St. Paul River in 2009 (BNF 2007). Pre-war production of fish produced by aquaculture yielded 29 tons per annum in 1989 but then steadily decreased over the years during the conflict. It rose significantly to 22 tons in 2000 and was recorded at 38 tons in 2004 when the number of fish farmers increased from 350 to 1,050 (BNF 2007). As reported by the BNF in 2014, it is estimated that the aquaculture production could potentially reach 15,000 tons by the year 2030.

Culturing of fish in Liberia experiences a number of constraints, including the lack of proper irrigation methods and infrastructure for the production ponds. Appropriate resources need to be allocated to address these shortcomings and provide and/or improve the facilities needed to support this sector. The availability of feed and seed is also a constraint on the development and sustainability of the fish farms. Suitable hatcheries need to be provided that are able to consistently provide sufficient healthy fingerlings for farmers to restock their ponds. Appropriate high-quality feed at affordable prices also needs to be consistently and readily available to farmers to feed to their stock and a need to produce feed locally using available local ingredients.

3.8.4 Pressure on Fish Populations

The waters of the Liberian shelf are not the most productive of those in the sub-region, but with a rapidly expanding population of which more than 80% is dependent on fish as the source of protein, thereby increasing the demand for fish. It is, therefore, imperative that Liberia is able to provide sufficient food resources to its growing number of people. But the inability of the Country to hire a research vessel to routinely conduct an independent stock assessments of the country's fisheries resources remains a challenge.

During the civil war Liberia experienced significant illegal, unreported and unregulated fishing activities. It has been estimated that the country experienced an annual loss of over US$12 million at one given time due to illegal fishing from foreign trawlers. The demand for fish and crustacean has globally been steadily increasing over the years due to rapid increase in human population. The growth of the international market is growing at a healthy rate and Liberia may be tempted to increase its fisheries production in terms of its landings in order to capitalise on this opportunity.

3.8.5 Government Responses to Challenges

The sustainability and development of the fisheries sector is beleaguered by a number of constraints which includes the following:

- Inadequate institutional capacity and funding at the National Fisheries and Aquaculture Authority;

- A lack of suitable port or landing infrastructure in both the artisanal and commercial fisheries to facilitate the discharge of fish landings and processing;
- A lack of adequate transport infrastructure limiting access to fishing communities;
- Limited research in the aquaculture industry;
- A lack of good quality fingerlings for stocking the fishponds;
- A lack of suitable fish feed; and
- A lack of proper irrigation schemes for sustaining the aquaculture production.

The Liberian Government has attempted to address the constraints and challenges of the fisheries sector through the promulgation of the Fisheries Regulations Act of 2010 (GoL, 2010). This, in conjunction with the development of an updated fisheries policy, has resulted in more fish being legally caught and sold, and more income going to the treasury (BNF 2014).

The establishment of NaFAA by way of the Liberian National Legislature Act of 2017, has further benefitted the country and its people. NaFAA is mandated to monitor and sustainably manage the fisheries resources of Liberia. The NaFAA Research and Statistics Division has already commenced with the gathering of high-quality fisheries research data and producing invaluable fisheries data in reports. Liberia can now, hopefully, not only look forward to reliable and consistent data gathering and reporting on the fisheries catches but also accurate stock assessments of its fisheries resources.

3.9 CONCLUSION AND RECOMMENDATIONS

The pro-poor agenda recognises the importance environmental sustainability in the multisectoral approach towards national development. However, in this light, Liberia's long-term development blueprint which is the vision 2030 framework is underpinned by the principle of sustainable development and the recommendations set forth below should ensure the actualisation of the principle.

I. Adopt an integrated approach that addresses access to and management of natural resources, mainly land, water and forest, building infrastructures and access to markets, access to production inputs, the development of livestock and fisheries sub/sectors. More attention has to be paid to public investment in the sector as well as to reinforcement of technical capacities of MoA to be able to deliver services aimed at improving sustainable agriculture for food and nutrition security. There is also a limited private investment for food crops production (low agriculture).
II. It is recommended that policies need to incorporate intangible cultural heritage or symbolic cultural values into their conceptualisation of local cultural valuation, along with better tangible cultural heritage or utilitarian cultural values.
III. Given the potential of the tourism sector to spur socio-economic growth and development, the government is recommended to conduct a Strategic Environmental Assessment to determine the magnitude and scope of environmental and social impacts resulting from the development of the tourism industry in Liberia. Based upon the findings of such an assessment, an Environmental and Social Management Framework (ESMF) can be developed to safeguard environmental and social values from the negative impacts that could emerge from tourism development and management. Such a framework can strongly inform

land-use planning and building regulations to guide sprawling developments along coastlines, valleys and protected areas in support of development of tourism facilities.

IV. The national government should institute varieties of fiscal measures to compensate environment-friendly initiatives, including the green infrastructure or technology, green financing and discourage undertakings that are infamous for degrading the environment by accurately meting out penalties based on the “polluter pays” principle.

V. Encourage customers to make eco-responsible lifestyle choices and buying decisions. It will increase public attention on the environment friendliness of manufacturing practices and product ecological effects and inspire companies to follow environmentally sustainable standards.

CHAPTER FOUR: SOCIOECONOMIC STATUS, POVERTY, GENDER AND ENVIRONMENT

4.1 INTRODUCTION

This chapter looks at the nexus between socio-economic development and the environment. The first section deals with education and presents an overview of the literacy rate per age group and gender. The second part of the chapter presents empirical data on the economy of Liberia. The third section deals with nexus between health and environment. The chapter concludes with a look at link between gender and environment.

4.2 EDUCATION

The schooling system in Liberia consists of three levels: primary (elementary), middle (junior high) and secondary school (senior secondary education). Elementary (ages 6-12) and junior high school (12-15) are free and compulsory in Liberia, although the enforcement of this remains challenging, especially in rural areas. Many schools in the country are operated by Christian missionary churches (especially the Catholic and Methodist churches), although some (albeit very few) are also funded by the Monrovia Consolidated School System.

In terms of literacy, current estimates reveal that around 64.7% of Liberians are illiterate (LISGIS, 2017). This is based on household members' (between the ages of 15 and 49) own evaluation of their ability to read and write in any language. According to the HIES undertaken in 2016, the lowest literacy rate is in Grand Cape Mount (at 41.9%), whilst the highest is in Montserrado at 82.1% (LISGIS, 2017).

Table 4.1 provides literacy data from the government during a survey undertaken in 2010 where households were asked whether their household members can read and write a simple sentence in any language.

Table 4.1: *Literacy Rates by Sex, Age Group and Locality (percentages) (Source: LFS[14]/LISGIS, 2010)*

	Urban			Rural			Liberia		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Age group									
5-14	65.2	65.9	65.6	39.9	36.8	38.5	51.8	52.5	52.1
15-24	92.5	85.6	88.8	77.7	54.9	65.7	86.4	73.0	79.3
25-34	89.5	65.3	75.5	60.7	25.3	40.7	75.3	46.1	58.7
35-54	80.2	52.2	65.8	56.3	19.6	37.1	68.0	35.2	51.0
55-64	70.4	34.5	53.0	39.1	7.0	23.5	53.5	19.5	37.0
65+	56.5	15.0	36.4	21.5	7.0	14.8	34.1	10.1	22.9
All ages 5+	**78.9**	**65.6**	**71.9**	**52.3**	**31.2**	**41.6**	**65.6**	**49.2**	**57.1**
15+	85.1	65.4	74.7	58.9	29.0	43.1	72.4	47.9	59.4

What Table 4.1 shows is that the overall literacy rate is much higher for males than for females. It also shows that, in terms of locality, urban literacy levels are higher than rural

[14] Labour Force Survey

areas' literacy rates, with a substantial urban-rural difference in rates even among the youngest age group.

Figure 4.1 provides the country's literacy rates by county (defined in terms of people who can read and write in any language).

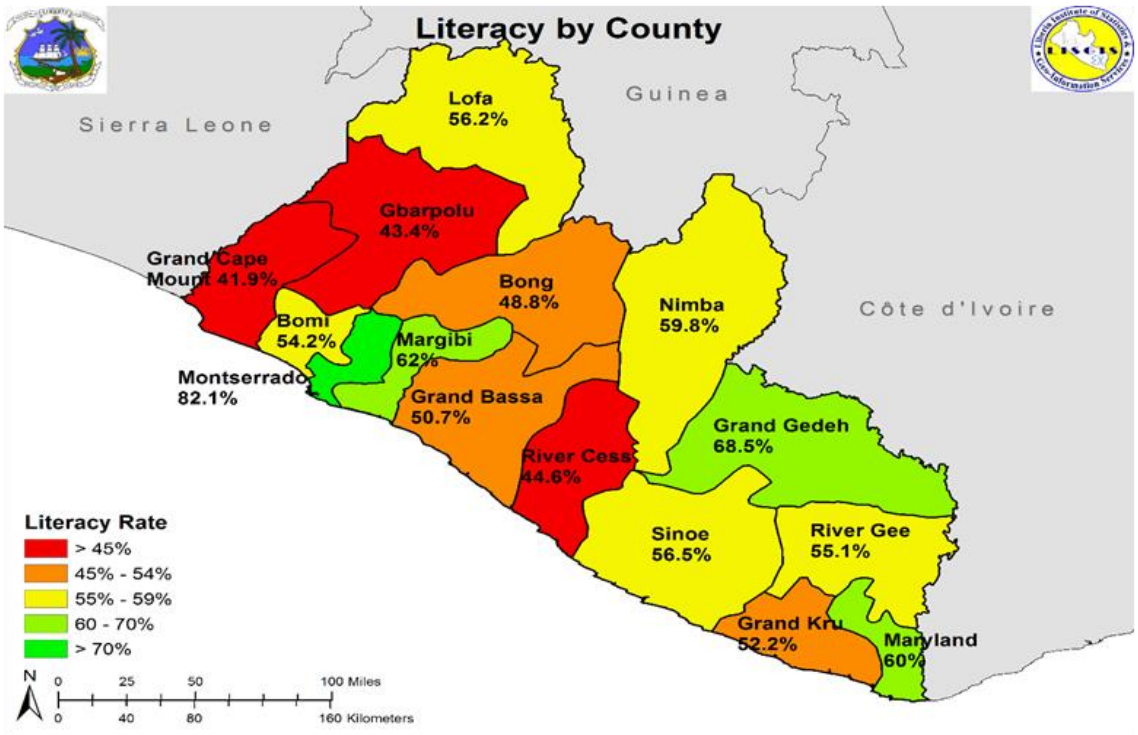


Figure 4.1: *Liberia's Literacy Rates per County (Source: LISGIS Household Income and Expenditure Survey, 2016)*

Figure 4.1 illustrates that Montserrado holds the highest literacy rate at 82.1%. This is followed by Grand Gedeh County (68.5%), Margibi (62.0%), Maryland (60.0%) and Nimba (59.8%).

The provision of tertiary education is hampered by the country's high senior high school drop-out rates. In 2015, the drop-out rate was estimate at 82% (Primson Management Services, 2018). Enrolment in tertiary education has increased, however, which adds pressure on government resources to provide teachers and infrastructure. To meet this demand, in 2017 the country adopted the Getting to Best Education Sector Plan 2017-2021, which revised the first sector plan in 2010. The latter plan aims to improve access to quality education, but also to invest in teacher professional development.

The data from the stakeholder engagement also seemed to indicate, in the engaged stakeholders' views, a sense amongst many that the general educational levels in the country are low and possibly even declining. Stakeholders in the education sector also referred to low school enrolment rates. As is often the case, children who should be enrolled in, and going to, school are kept at home to assist their parents with putting food on the table. This is coupled with a poor education system. In most of the communities visited, poor education can also be attributed to a lack of qualified teachers. Another reason for the country's poor education system may be the irregularity in teacher salaries

and benefits, which forces teachers to be engaged in other extra curricula activities as a means to augment their take-away salaries. Poor literacy levels might explain the high unemployment rate in the country, as the economy needs relevant skills and general know-how, which enhance employability.

4.3 ECONOMY

4.3.1 Current State of the Economy

There are various ways to determine economic status. These include focusing on the Human Development Index (HDI), or a country's Gross Domestic Product (GDP) growth. HDI is used by UNDP to measure a range of indicators, such as life expectancy, health, education, and standard of living. From this measurement, the UNDP assigns a score ranging from a low zero to a high of 1.0. On this scale, Liberia scores an HDI measurement of 0.435 (UN, 2018). Table 4.2 provides the Liberia's HDI trend between 1990 and 2017 (*ibid*.).

Table 4.2: *Liberia's HDI Trends (Source: UN, 2018: p.2)*

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 PPP$)	HDI value
1990	47.2		2.6	752	
1995	50.2		3.1	213	
2000	52.4	10.5	3.5	656	0.387
2005	55.1	10.0	3.8	516	0.378
2010	59.6	9.5	4.1	619	0.407
2015	62.0	10.0	4.4	694	0.432
2016	62.5	10.0	4.5	667	0.432
2017	63.0	10.0	4.7	667	0.435

In comparison, the HDI score for sub-Saharan Africa as a whole is around 0.475. This, therefore, means that Liberia scores low in terms of the HDI for sub-Saharan Africa. It should be noted, however, that the country's HDI has risen from 0.387 in 2000 (i.e. approximately 12%) (*ibid.*).

Liberia is among the poorest countries in the World, with an estimated GDP of US$839, and a per capita GDP of US$205 in 2009 (International Monetary Fund (IMF)). Looting and war profiteering destroyed nearly the entire infrastructure of the country. The Liberian economy was initially estimated to grow at 0.9% in early 2015, but due to contribution to real GDP it is estimated at 23.9%, marginally down from 24.2% recorded in 2014. In 2014, the economy was hit by Ebola Virus Disease (EVD) outbreak which paralysed economic activities in all sectors of the economy. The impact of EVD on the economy has been compounded by the steep decline in global commodity prices of its major exports: iron ore and rubber. Prior to the EVD outbreak in 2014, the economy grew at approximately 8% on average. The EVD epidemic, however, weakened activities in all sectors of the economy, resulting in a timid real GDP growth of 0.7% in 2014 to 0.3% in 2015. Table 4.3 below provides a trend in the country's macroeconomic indicators between 2015 and 2018.

Table 4.3: *Trend in Selected Macroeconomic Indicators for Liberia 2015-2018**

Macroeconomic Indicators	2015	2016	2017	2018
Real GDP Growth	0.0	-0.5	4.0	4.4
Real GDP Per Capital Growth	-2.4	-2.9	1.5	1.9
Consumer Price Index (CPI)	8.0	12.5	10.0	8.6
Budget Balance % GDP	-8.4	-2.2	-6.2	-7.0
Current Account % GDP	-29.2	-28.5	-22.5	-18.0
Source: **Adapted from Africa Economic Outlook (2017) pp3**				

** Source: Primson Management Services, 2018: p.1*

According to the Liberia Common Country Assessment Report for 2018 (Primson Management Services), the country also experienced inflationary pressures as these increased in 2017. The reason for this, as the latter report states, was due to the fast pace of the depreciation of the Liberian Dollar, compared to the US Dollar. Added to this was also an increase in indebtedness, or a growth in debt stock (ibid.), largely due to the scaling-up of infrastructure spending and heavy reliance on foreign aid or foreign direct investment. The report also notes that the country currently experiences high national expenditure patterns, which are not conducive to sustainable economic growth. For example, it is documented that the national expenditure pattern exceeds its GDP, which results in pressure on the Liberia Dollar exchange rate (Primson Management Services, 2018).

Still, endowed with a favourable climate for agriculture and rich in mineral resources, Liberia's economy has improved in the last few years. A statement published by the African Development Bank (AfDB) in 2019 reads that the country's GDP growth rebounded to around 3.2% in 2018, from 2.5% in 2017. This growth is largely based on natural resource extraction. The economy remains predominantly agrarian, producing rubber, coffee, cocoa, rice, cassava (tapioca), palm oil, sugarcane, bananas, plantains, sheep, goats, sweet potatoes, corn, citrus, pineapple, vegetables and timber.

4.3.2 Economic Sectors

Agriculture remains the largest economic sector in Liberia. Agriculture, including forestry, is critical to the economic development of the country. Agriculture is discussed at length under Section 3.4. As an overview, the traditional subsistence sector is predominantly agricultural and rural, and historically has been the source of livelihood for about 75% of the population. However, low levels of productivity characterise agriculture. This is reflected in the subsistence sector's relatively low contribution to GDP. In terms of commercial agriculture, rubber processing, palm oil processing, timber, cocoa and coffee are important and growing economic drivers. Liberia earns more than US$100 million and more than US$70 million annually from timber and rubber exports, respectively. The country largely exports to countries such as Poland, Switzerland, Netherlands and Germany (*ibid.*).

Foreign concessions generally, and agricultural concessions in particular, have a large and growing footprint in Liberia. As of 2013, the U.S. Agency for International

Development estimated that over 50% of Liberia's land has been conceded to foreign investors. The NGO, Rights and Resources Initiative, projected estimates closer to 75%. Liberian CSO and/or groups estimate that nearly 10% of the country's land have been awarded to just three agricultural companies: Sime Darby, Golden Veroleum Liberia (GVL), and Equatorial Palm Oil. Palm oil concessions have been particularly attractive to investors, as Liberia holds approximately 40% of West Africa's remaining rainforest and enjoys an ideal climate for palm oil production.

Mining, manufacturing, forestry and fishing also account for large components of Liberia's economy. Fishing is discussed in Section 4.4 under Chapter 4 on Aquatic Resources. Of these sectors, agriculture, forestry and fishing contributed US$70.3 million to the country's GDP in 2017 (AfDB, 2019). This growth rate is expected to continue to rise to around 4.7% in 2019 and US$4.8 million in 2020, mainly due to the growth in these three sectors. Alluvial diamond and gold mining activities also account for some economic activity.

Considering mining, the country is mostly reliant on the export of iron ore, gold and diamonds. Today, however, mining in Liberia has virtually ground to a standstill. Initially destroyed during the civil war, the sector also suffered badly as a result of the financial meltdown since 2008, resulting in the suspension of many formal mining activities in the country as the prices of ores and metals declined.

Even though Liberia has been a producer and exporter of basic products, local manufacturing, mainly foreign-owned, has been small in scope. The fact remains that Liberia is classified as a low-income country which is heavily reliant on international aid and imports. In illustration, the country's imports were calculated at US$1.247 billion in 2017, up from US$1.21 billion in 2016 (AfDB, 2019). Imports include fuels, chemicals, machinery, transport equipment, manufactured goods and foodstuff. Much of these are obtained from South Korea, Singapore, China and Japan (*ibid.*).

Currently, Liberia's revenues come primarily from rubber exports, but also revenues from its maritime registry programme. Being the second-largest maritime licenser in the world with more than 1,700 vessels registered under its flag due to its status as "flag of convenience", including 35% of the world's tanker fleet, Liberia earned more than US$18 million from its maritime programme in 2000 (US State Department, 2010).

4.3.3 Economic Diversification

Concurrent claims on the use of soil and overexploitation of the most naturally endowed forested areas seem to reflect the lag in the recovery of traditional sectors of the economy. The inability of the economy to recover seems to have contributed to high levels of uncontrolled exploitation of natural resources and the degradation of the natural environment upon which Liberia's residents depend for their survival.

According to the WB (2009), economic diversification remains the greatest challenge to achieve inclusive economic growth. Past experiences suggest that foreign investments in the traditional export sectors (rubber, palm oil, forestry and mining) are unlikely to create substantial employment opportunities, as these sectors are largely capital-intensive

enclaves with little direct or indirect links to the rest of the economy. Other areas of economic diversification can and should also be explored. For example, the GoL believes there may be sizable deposits of crude oil along its Atlantic Coast.

Over the years, the government, with support from the international community and its regional partners, has implemented various plans and strategies to bolster economic development. To name a few, these have included the Five-Year Medium-Term Plan for National Reconstruction and Development (2001-2006), the Poverty Reduction Strategy (PRS) (2006-2011) or the Agenda for Transformation (AfT) (2012-2017). On the 10th of February 2012, *then* President Sirleaf launched Vision 2030, which the new development strategy is following in the wake of the outdated PRS document (Liberian Perspectives, 2012). Reviewing Vision 2030, the document refers to the PRS which it claims had borne considerable fruits (GoL, 2012). However, the document acknowledges that a new strategy was needed to integrate development policies in a more holistic development framework (*ibid.* p:3). One rationale for the development strategy is to get Liberians to build a consensus on their own future for the country and to set milestones to address the social, political and economic challenges the country faces (WB, 2018).

4.4 POVERTY AND THE INFORMAL EMPLOYMENT SECTOR

4.4.1 Poverty and the Unemployment Rate

According to statistics from LISGIS in 2010 (the Liberian Labour Force Survey, or LFS), considering all ages, Liberia in 2010 had around 1.3 million people in the labour force; the comparable figure for the adult population is about 1.1 million. There are approximately equal numbers of males and females in the labour force, and slightly more of them in rural areas than in urban.

Various terms are used to try understanding the percentage of poor people in a country. WB reports refer to Liberia's HIES of 2016 where reference is made to approximately 50.9% of the population living in poverty (WB, 2018). The survey goes on to reveal that poverty is higher in rural areas (around 71.6%), compared to 31.5% in areas such as Monrovia. These numbers mean little without clarifying how the HIES defined poverty. Various definitions were employed by the latter survey, such as absolute poverty, food poverty or extreme poverty. The denominator where individuals cannot meet specific criteria is common in all three definitions. For food poverty, for example, the denominator is having a food consumption that falls below 2400 kilocalories per day (LISGIS, 2017: p. 13). Another concept often used is to define a section of the population living under the poverty line. In Liberia, approximately 54% of the population in 2014 were classified as living below the poverty line. This percentage was broadcasted in the media by the World Bank in 2016, defined as living below US$2/day (*cf.* WB, 2016).

Figure 4.2 below provides data from surveys conducted for the HIES in 2014 and 2016, which illustrates absolute poverty in Liberia per county.

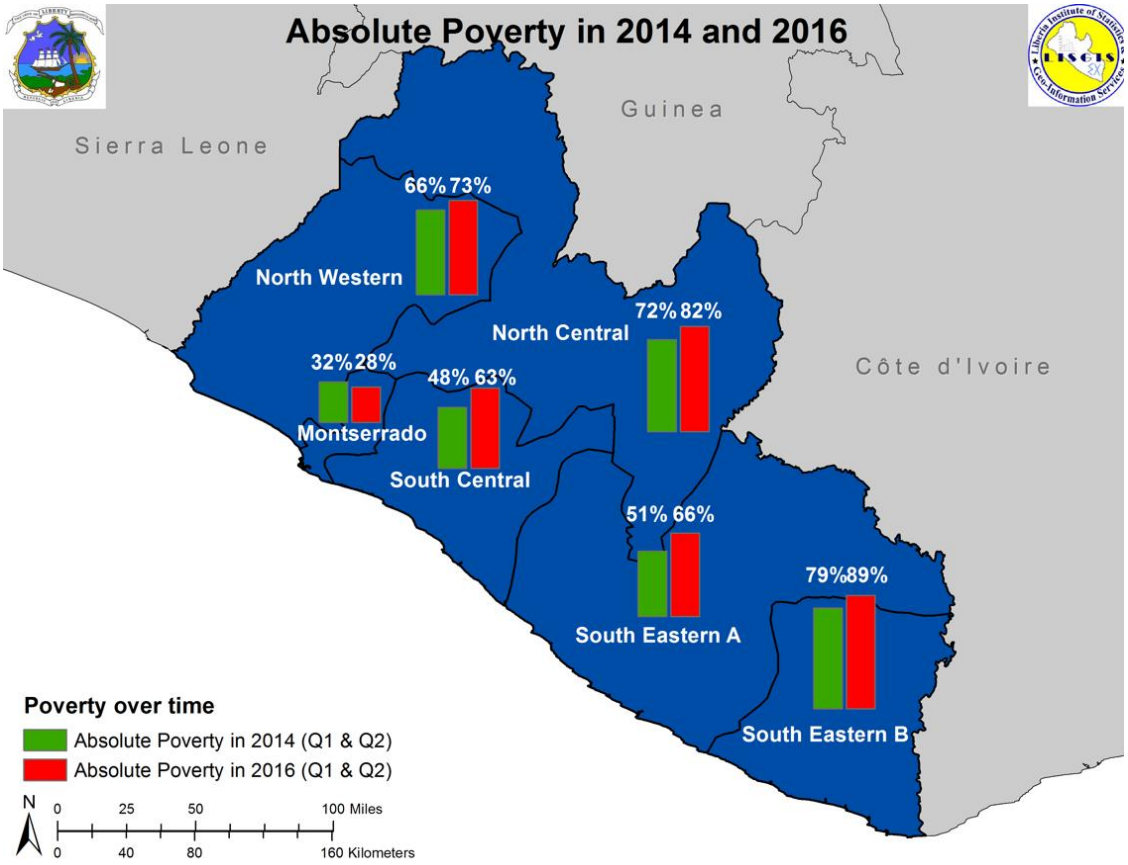


Figure 4.2: *Liberia Absolute Poverty per County (Source: HIES, 2016)*

Figure 4.2 illustrates clearly that poverty increased in all regions between 2014 and 2016, except in Montserrado, where poverty declined from 31.65% to 27.5%. Rural poverty is higher compared to urban poverty.

Another useful indicator of poverty is to consider the unemployment rate. However, this often gets misinterpreted as those working for themselves (such as farmers) are often not counted in statistics as belonging to the labour force. Employment figures usually report only on those households between the internationally accepted working-age population bracket of between 15 and 64 years (also refer to the LFS of 2010). The official unemployment figure for Liberia a measured by its LFS of 2010 is 3.7% (refer to Table 4.4). Unemployment is more prevalent in urban areas, as most households in rural areas engage in subsistence and small-scale commercial farming.

Table 4.4: *Liberia Unemployment Rate (Source: LFS, 2010: p. xiii)*

Labour market indicators: various ratios

	Labour force participation rate (%)	Inactivity rate (%)	Employment-to-population ratio (%)	Unemployment rate (%)	Vulnerable employment rate (%)	Informal employment rate (%)
Liberia	**62.8**	**37.2**	**60.5**	**3.7**	**77.9**	**68.0**
Urban areas	54.9	45.1	52.0	5.5	67.5	59.3
Rural areas	71.2	28.8	69.6	2.3	86.1	75.0
Male	66.1	33.9	63.8	3.4	68.3	61.3
Female	59.9	40.1	57.5	4.1	87.3	74.7
Greater Monrovia	52.8	47.2	49.3	6.5	63.2	56.6

Liberia LFS 2010

The predicament is that subsistence farmers who also sell some of their surplus farming produce have not been recorded by the Liberian census as being self-employed (LISGIS, 2017). However, farm labourers receiving a formal salary have been recorded. One could, therefore, argue that subsistence farmers are not seen as members of the society who are "actively" looking for work. In other words, 2.34% might not accurately reflect the country's real poverty rate. Moreover, this is a low figure for international standards.

As many people in Liberia work for themselves, a more accurate definition to use might be "vulnerable unemployment". This, according to the GoL, is defined as, "[…] those either employed on their own account or working as a contributing family worker for either the family farm or the household's non-agricultural business" (*ibid*. p. 55). Under this definition, approximately 80% of Liberians are unemployed (*ibid*.).

4.4.2 Informal Employment Sector

Employment can be defined as either being regular (often referred to as "formal") or non-regular (informal). Regular employment refers to work for which an employee has a formal and fixed contract with an employer (also referred to in some instances as being employed in the formal sector). Such work is usually long-term or without a fixed period, and could entail being employed by a company, the retail sector, or even domestic work.

Non-regular employment relates to a range of jobs which are usually more short-term and mostly without a formal contract, but for which some form of remuneration is obtained. Non-regular employment activities are usually defined as economic activities with no regular stream of income or return, for example salaries and wages. Non-regular employment in Liberia is mainly a subsistence enterprising sector. This often includes trading, small shops or even carpentry and some type of farm work which is paid. It comprises mainly micro-enterprises, such as cook shops, petty trading in dry goods, used clothing, and domestically consumed agricultural products, such as bitter balls, okra, beans, sugar cane, old palm and vegetables.

Non-regular and vulnerable employment were 67.9% and 74.1% in 2014, respectively. More women are employed in informal jobs (86.4% for women versus 3.8% for men respectively) (LISGIS, 2014). According to Cities Alliance in 2010, 49.5% of people employed outside of agriculture in Liberia were in the informal sector, with a further 10.8% in informal employment. In absolute terms, there were 343,000 informal workers (206,000 women and 136,000 men) in Liberia in 2010, compared to 62,000 in formal non-agricultural employment. Nearly three-quarters (72.1%) of all informal workers were in urban areas, and 61.2% of all informal workers were in the trade sector.

4.4.3 The Informal Sector Credit System

The financial sector of Liberia is highly dualistic. Existing along with the formal financial system, there is a significant informal financial sector with a large number of credit unions (about 225 at end of 2014) and traditional credit clubs ("Susu" clubs and Village Savings and Loan Associations, or VSLAs). The Susu Club, for example, consists of several citizens in the country who organise themselves into a particular Susu Club, and agree to pay a certain amount on a weekly and monthly basis. This money is given to a member

of the club. This process continues until all members of the club get paid. The paying or eating of the susu depends on the numbers of hands or amount paid to the club. For example, a Susu Club of 20 women may agree to pay LD$1000.00 per month each. The total of LD$1000.00 will be given to a member at the end of the month until everyone receives pay.

The current financial industry of Liberia is made up of nine commercial banks; 20 insurance companies with a number of insurance brokerage firms and agents; one development-finance company; one deposit-taking microfinance institution; 111 licensed foreign exchange bureaus; and seven Rural Community Finance Institutions (RCFIs), albeit in the pilot phase. Currently, most of the activities of commercial banks are concentrated in Monrovia. However, some commercial banks are providing financial services in urban areas outside of the capital city through branch banking. Notwithstanding the existence of these informal financial services providers, many rural parts of the country are still left without financial services.

The credit to the agricultural sector (the mainstay of economic growth) remains at the bottom of the credit ladder. At end-December 2006, agriculture accounted for only 7.1% of the total credit in the economy, whilst credit to the services sector constituted about 28.8%. Similarly, credit to the agricultural sector at end-December 2014 was merely 6.8% of total credits while services commanded 68.4% [Central Bank of Liberia (CBL), 2017].

4.4.4 Work Establishments

Figure 4.3 illustrates all the registered establishments in Liberia (2017).

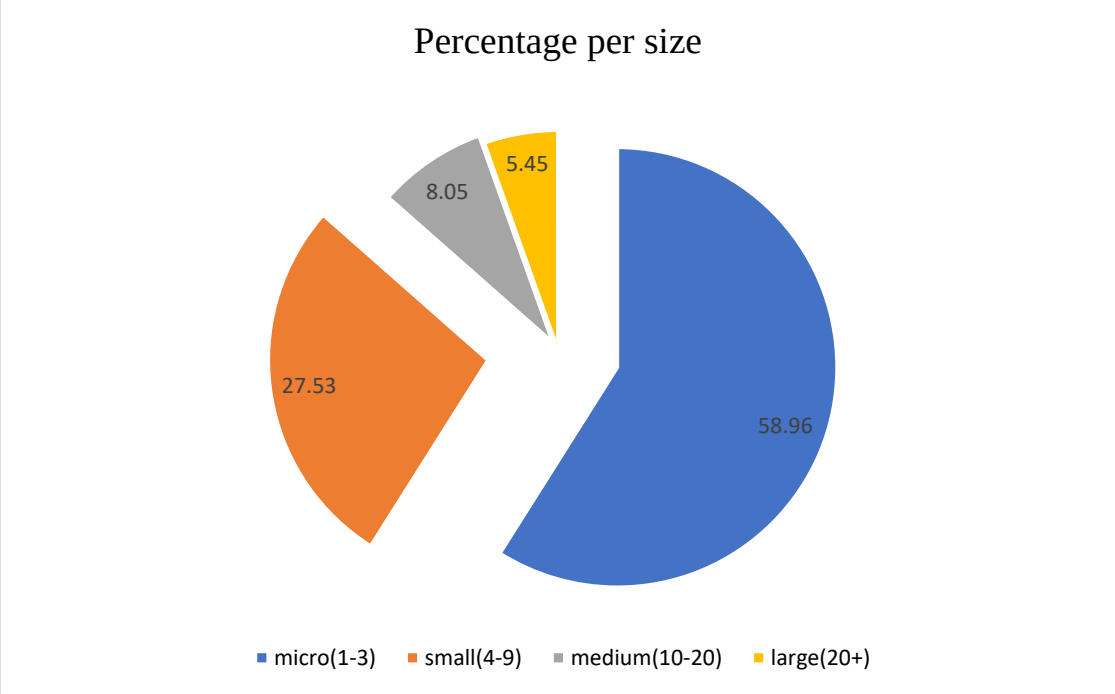


Figure 4.3: *Distribution of Establishments by Size in Liberia for 2017*

As indicated in Figure 4.3, 58.96% of the total establishments are micro establishments with employment size of 1-3 (i.e. employing between one and three people), whilst 5.45% are in the category of large with employment size above 20 employees. Table 4.5 provides data from the government's National Establishment Census of 2017 in terms of the number of establishments per county.

Table 4.5: *Distribution of Establishments by County (Source: LISGIS, 2017)*

County name	Frequency	Percentage
Bomi	203	1.15
Bong	473	2.68
Gbarpolu	126	0.71
Grand Bassa	489	2.77
Grand Cape Mount	198	1.12
Grand Gedeh	502	2.85
Grand Kru	113	0.64
Lofa	603	3.42
Margibi	672	3.81
Maryland	444	2.52
Montserrado	12,199	69.15
Nimba	822	4.66
Rivercess	79	0.45
River Gee	196	1.11
Sinoe	523	2.96
Total	17,642	100

As shown in Table 4.5, Montserrado had the highest number of recorded establishments (69.15%) in 2017, followed by Nimba County with (4.66%) and Margibi County (3.81%). The county with the least amount of businesses is Rivercess (0.45%).

In terms of gender, the same National Establishment Census of 2017 indicated that there are around 8,754 male Liberians with business establishments, compare to 5,061 females.

4.5 HEALTH

4.5.1 Sicknesses and Diseases in Liberia

Health is important to consider in this report as the quality of the environment significantly affects the health of Liberia's communities and residents. Poor water quality or contamination, poor waste management or air quality all affect various communicable and non-communicable diseases. As an overview of the health trend in Liberia, Figure 4.4 portrays the percentage of the Liberian population who were sick or injured by type of illness. The figure only gives a rough estimate of the type of illnesses that plagued those who were sick (figures are from 2010).

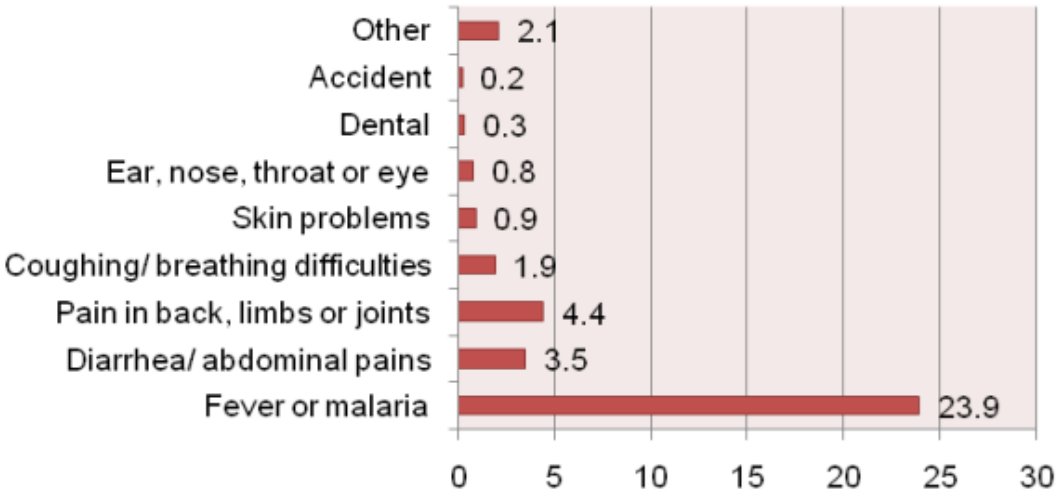


Figure 4.4: *Percentage Distribution of Population Sick or Injured by Type of Illness (Source: LISGIS / Core Welfare Indicator Questionnaire (CWIQ) Survey, 2010)*

Figure 4.4 illustrates that in Liberia, nearly one in every four persons (24%) has suffered from fever or malaria. This is likely to be the case since Liberia is located in the tropics where heavy rainfall and humidity promote the climatic condition that supports parasites that cause malaria and other forms of fever. Pain in the back, limbs or joints, as well as diarrhoea or abdominal pains, were also common, although these contribute to only 4% (respectively) of the population who were sick or injured in 2010.

According to the Centre for Disease Control and Prevention (CDCP) (2019), the following list represents the top 10 causes of deaths in Liberia:

I. Malaria;
II. Diarrhoeal diseases;
III. Neonatal disorders;
IV. Lower respiratory infections;
V. Ischemic heart disease;
VI. HIV/AIDS;
VII. Strokes;
VIII. Tuberculosis;
IX. Sexually transmitted infections; and
X. Cirrhosis.

Malaria is is the leading cause of deaths not only in Liberia, but also sub-Saharan Africa. According to the Demographic and Health Survey (DHS) of 2013, malaria is preventable, but still remains a major public health problem in the country. Hospital records in the country show that at least 33% of all inpatient deaths and 41% of all inpatient deaths amongst children under five years of age are caused by malaria (*ibid*.).

The LHDS of 2013 notes that Liberia has a general HIV/AIDS, prevalence of 2.1%. This is considered low, although the urban areas have a slightly higher rate than the rural areas: 2.6% to 0.8% respectively). The highest prevalence rates are found in Montserrado,

Margibi and Grand Bassa counties. The number of health facilities offering anti-retroviral therapy, from around 29 sites in 2009 to 54 in 2015 (Primson Management Services, 2018).

Measles are not indicated in the list above. However, recent data from the National Public Health Institute of Liberia (2017) indicates an increase in the number of suspected measles cases between 2016 and 2017. This data is presented in Figure 4.5 below.

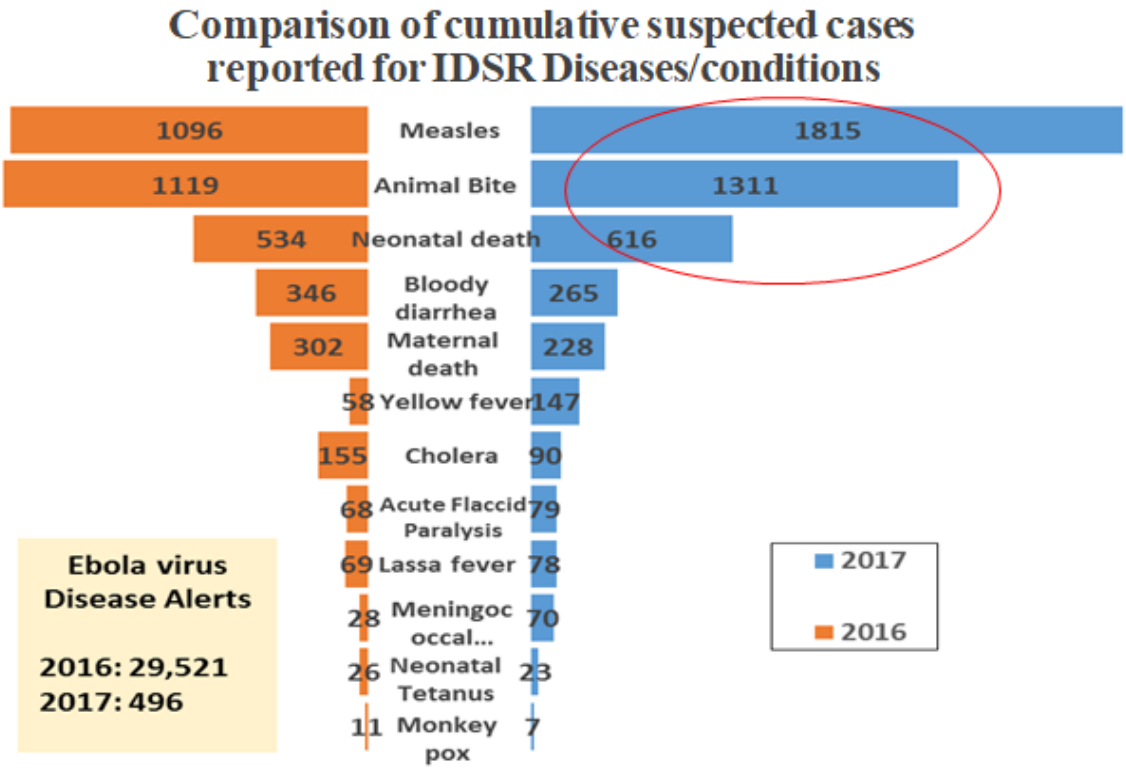


Figure 4.5: *Comparison of Cumulative Suspected Cases Reported for Integrated Disease Surveillance and Response (IDSR) Diseases/Conditions in Liberia between 2016 and 2017 (Source: National Public Health Institute of Liberia, 2017)*

For measles, the government has a vaccination programme for children who are one year of age (12 to 23 months). Table 4.6 provides data provided by the DHS (2013) of the share of children in Liberia vaccinated against measles by area of residency, gender and region (between 2007 and 2013).

Table 4.6: *Share of Children Vaccinated Against Measles by Socio-Geographic Characteristics (Source: DHS, 2013)*

Characteristic		2007	2013
	Liberia	63.0	74.2
Area of residence			
	Urban	76.7	77.6
	Rural	56.4	70.4
Gender of Household Head			
	Male	61.3	73.8
	Female	65.0	74.6
Region			
	North Western	67.8	81.5
	South Central	..	77.2
	South Eastern A	51.7	66.7
	South Eastern B	40.0	60.0
	North Central	59.8	72.6

Table 4.6 shows that, in Liberia, 63% of children received measles vaccination in 2007 while 74.2% of children received a measles vaccination in 2013. Disaggregated by areas of residence, the urban area rate of measles vaccination is higher than the rural area rate. That is 76.7% in 2007 and 77.7% in 2013. Whilst in rural areas, the rates were 56.4% in 2007 and 70.4% in 2013. The gap seems to narrow in 2013 by 7.2% for the year 2013. The vaccination against measles by gender of household head shows that female headed households' children vaccination rates are higher than the male headed households. On a regional level, North-Western vaccination rates are the highest amongst the regions. The lowest vaccination rates are observed in South Eastern B.

The most recent statistics on the government's measles vaccination programme and measles cases per county for 2017 are provided in Table 4.7 below.

Table 4.7: *Measles Cases and Treatment in Liberia 2017 (Source: National Public Health Institute of Liberia, 2017)*

Dates of reactive campaign	County	Health District	Communities	Number of confirmed cases	Age Group targeted	Number targeted	Number vaccinated	Coverage (%)
1 - 5 May 2017	Nimba	Tappita	New Tappita, Christian Community, Kola Tree, Central Tappita, New Tappita, Mano Camp,Grenpea, Power Plant, Vahn Town	79	6 - 59 month	1290	1,746	135%
8 - 12 May 2017	Margibi	Gibi	Kpelleh Jacob Town	5	9 - 11 month	420	355	85%
14 - 18 August 2017	Nimba	Zoe Geh	Mahnplay	10	6 - 59 month	193	111	57%
18 - 29 September 2017	Bong	Suakoko	Kayata Community	13	6 month-10 years	1002	839	84%
18 - 29 September 2017; 6 - 24 November 2017; 11 - 15 December 2017	Nimba	Sanniquelli	Neipa, Underground community, Air field Zone-1, etc.	46	6 - 59 month	1816	715	39%
16 - 30 October 2017	Bong	Suakoko	Gboimue and Suakoko town	14	6 month-10 years	1491	1969	132%
23 - 27 October 2017	Nimba	Zoe Geh	Zlantuo community	11	6 - 59 month	399	300	75%
4 - 7 December 2017	Bong	Zota	Gbansu-Suloma, Kororollie, Boryaquelleh, Dene-ta and Gaou	3	6 month-10 years	1,015	839	83%

Table 4.7 confirms 181 recorded measles cases in 2017, with the county having received the largest vaccination coverage being Nimba, Bong and Margibi.

Cholera, although not listed in the top 10 causes of deaths in Liberia, is another major health thread for which the government has prioritised action. In 2019, for example, a Contingency Plan for Cholera was drafted by the government. In this plan, the government notes that, "cholera is a global public health problem and remains an ever-present threat to the health of the population in many countries in Africa, including Liberia. According to WHO, an estimated 3-5 million cases of cholera occur annually with 100,000-120,000 deaths" (GoL, 2019b: p.1). The plan further provides the distribution patterns per county of recorded cases of cholera since 2016 and 2018. This data is provided in Table 4.8 below.

Table 4.8: *Distribution of Counties that Recorded Suspected Cases of Cholera, 2016-2018 (Source: GoL, 2019b: pp.1-2)*

Number of cases recorded					
S/N	**County**	**2016**	**2017**	**2018**	**Total**
1	Bomi	29	1	0	30
2	Bong	0	3	4	7
3	Gbarpolu	0	2	2	4
4	Grand Bassa	0	25	5	30
5	Grand Gedeh	0	4	1	5
6	Grand Kru	23	9	14	46
7	Lofa	4	0	1	5
8	Margibi	0	2	1	3
9	Maryland	0	4	4	8
10	Montserrado	17	6	12	35
11	Nimba	0	22	6	28
12	Rivercess	0	13	15	28
13	River Gee	0	2	1	3

Number of cases recorded					
S/N	County	2016	2017	2018	Total
14	Sinoe	0	13	8	21
Total		73	106	74	253

Lastly, monkey pox is also worth referring to, as Figure 4.5 illustrates a well-worth mentioning decline in recorded cases from 11 in 2016 to seven in 2017. Figure 4.6 illustrates the geographical distribution of suspected monkey pox cases in Liberia for 2016-2017.

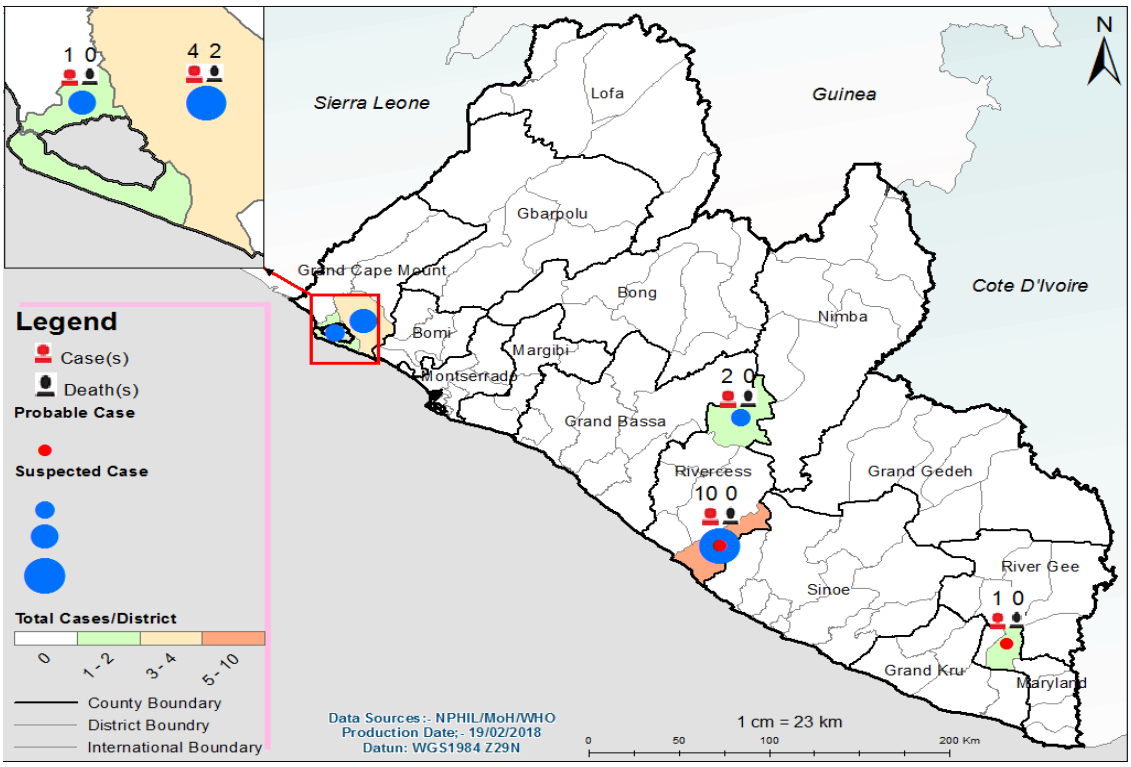


Figure 4.6: *Suspected Cases of Monkey Pox in Liberia for 2016-2017(Source: National Public Health Institute of Liberia, 2017)*

Plate 4.1: *Monkey Pox in Liberia (Source: National Public Health Institute of Liberia, 2017)*

More recently, Lassa fever has been reported in Liberia. Figure 4.7 provides the recorded cases for 2017.

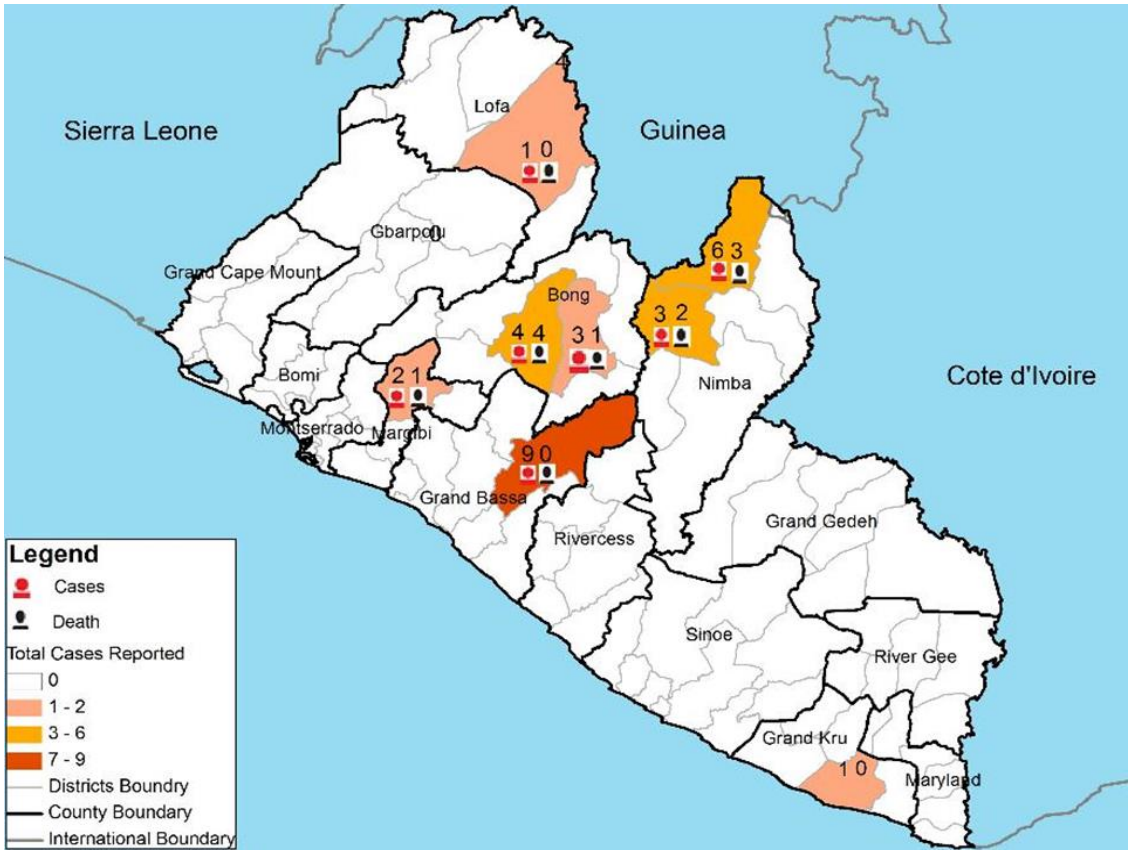


Figure 4.7: *Reported Cases of Lassa fever in Liberia for 2017 (Source: National Public Health Institute of Liberia, 2017)*

A report by the World Health Organisation (WHO) (2018) explains that this fever is endemic to Liberia, and that between the 1st of January 2017 and the 23rd of January 2018, 91 suspected cases have been reported across six counties. These counties are Bong, Grand Bassa, Grand Kru, Lofa, Margibi and Nimba. In response to this, the country has been dealing with the outbreak by sending county-level surveillance officers and rapid response teams to the counties, in addition to initiating cross-border epidemiological investigation and reinforcing infection control measures.

The government, largely (but not limited to) through the work of its National Public Health Institute of Liberia (NPHIL), has made great strides to manage the spread of diseases in the country since the last SoER. Apart from the annual vaccination programmes, the institute continue to train national- and county-level staff in Integrated Disease Surveillance and Response (IDSR) and has developed and validated the National Action Plan for Health Security (NAPHS) for 2018-2022.

4.5.2 The Ebola Virus Disease

4.5.2.1 Overview of the Spread of the Disease

Although not listed in the figures and tables, the Ebola Virus Disease (EVD) struck Guinea, Liberia and Sierra Leone in 2014. According to the WHO (2015), Liberia's first two cases of Ebola were reported in Lofa County on the 30th of March 2014. Previously, cases of the virus were recorded in Guinea in December 2013; later, the disease spread to

neighbouring Liberia and Sierra Leone, with minor outbreaks occurring elsewhere. On the 8th of August 2014, the EVD was declared a Public Health Emergency of International Concern by the WHO (WHO, 2014). Based on reports from the WHO Global Alert and Response Unit and the WHO's Regional Office for Africa, there were a total of 10,706 of confirmed EVD cases with a total of 4,809 deaths in Liberia, Guinea 28,542 cases and 3,806 deaths.

Figure 4.8 illustrates the spread of EVD to Liberia in 2014.

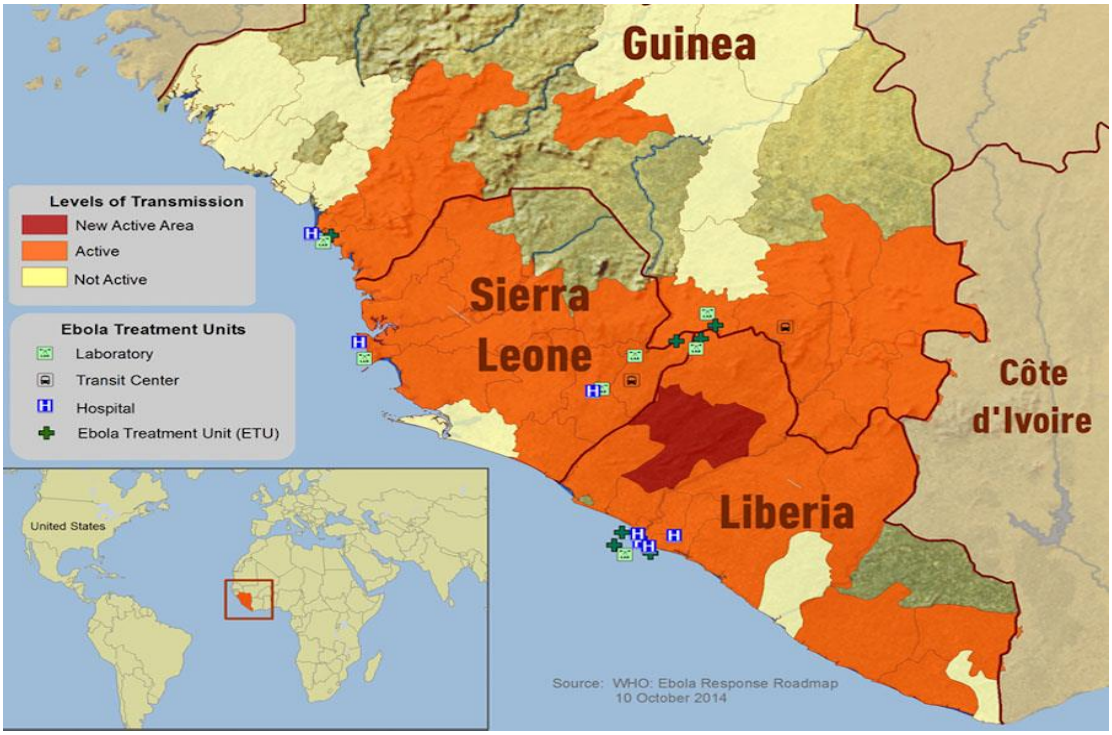


Figure 4.8: *Ebola Virus Disease Spread (Source: WHO, 2014)*

A study conducted by USAID PREDICT in 2018 isolated the EVD and found it present in a bat (*Mineopterus inflatus*) in the Sanniquellie Mah District, Nimba County. Today, there remains a significant presence of these fruit bats in the country with the likelihood of them being eaten by some individuals in some parts of Liberia, placing the country at a high risk of EVD outbreak transmission. In addition, the porosity of Liberia's points of entry also places the country at the highest risk of importation of EVD, including other infectious diseases. This is exacerbated by the fact that Liberia continues to have challenges with its ground crossing points, with neighbouring countries that continue to complicate the government work at ports of entry.

Before the outbreak of the Ebola epidemic, the country reportedly had 50 doctors catering to a population of approximately 4.3 million. The country's health system was seriously weakened by a civil war that ended in 2003. The EVD further exposed the weakness of the sector and had a dilapidating effect on the entire health care system.

4.5.2.2 Government Responses to Ebola Virus Disease

This disease is highly contagious and easily transmitted to others. As such, the government was quick in acting, however, as October 2014 started to see the situation stabilising. In August 2014, President Sirleaf declared a three-month state of emergency and introduced new regulations largely involving the restriction on movement of patients and their contacts. These regulations were enforced by the country's military (*ibid.*). At the time of drafting this SoER, authorities and international researchers were still in the process of having a vaccine on the market to prevent Ebola.

In response to the epidemic, the NPHIL also drafted in 2019 a Contingency Plan for the EVD (NPHIL, 2019). The latter plan includes various mitigation strategies which the government is currently employing. These include, for example, conducting training of front-line healthcare workers in the identification of EVD and its management, but also establishing IDSR community event-based surveillance systems and increasing awareness on the detection of community triggers. Updating and distributing an EVD Management Protocol and Guidelines have also been referred to in the contingency plan.

4.5.2.3 Effects of the Ebola Virus Disease on Rice Farming in Particular

The EVD has had a particularly bad effect on the country's rice farming activities. Figure 4.9 illustrates this based upon a survey conducted by the government of rice farmers in the country in 2016.

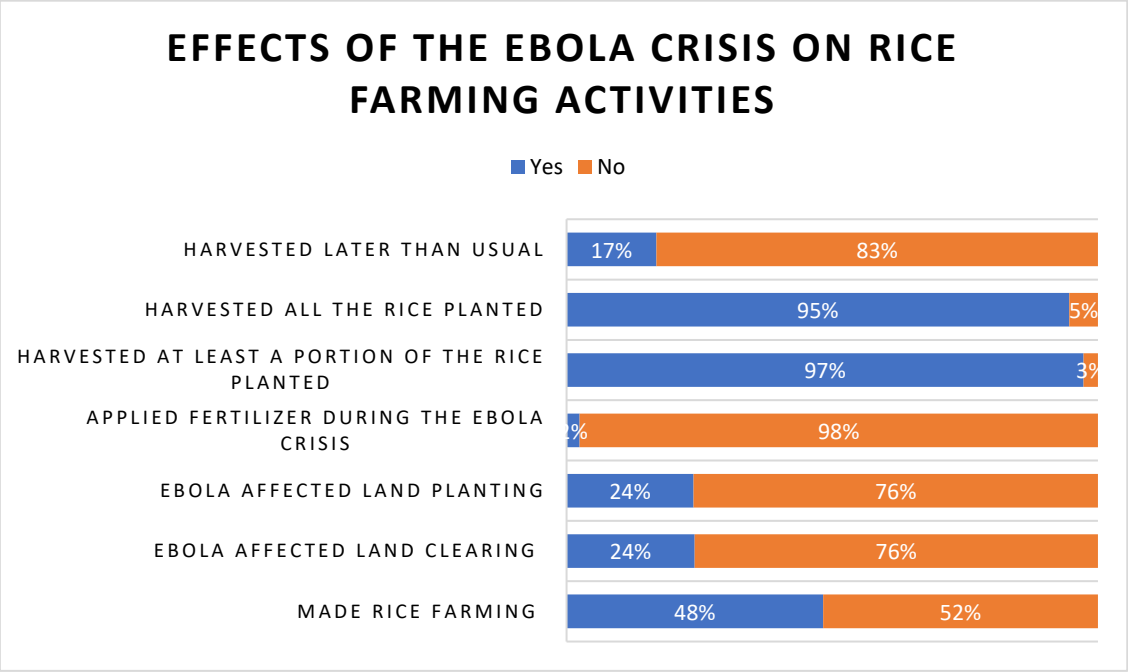


Figure 4.9: *Effects of EVD on Rice Farming (Source: LISGIS/Agriculture Recall Survey, 2016)*

What Figure 4.9 illustrates is that the main effect of the EVD on rice farming has been that 52% of farming households did not prepare rice farms during the Ebola crisis. Of the 48% of farming households who prepared rice farms, 24% reported that the Ebola crisis affected land clearing and planting. Only 2% of those who prepared rice farming applied

fertilisers during the Ebola crisis. Around 3% of farming household that farmed rice during the Ebola crisis did not harvest any portion of their rice. On average, 17% of farming households harvested their rice later than usual due to the Ebola crisis.

4.5.2.4 Effects of the Ebola Virus Disease on the Economy

Apart from the loss of life, the EVD outbreak had a number of significant economic impacts on Liberia, which are well-documented in various reports. In March 2015, the United Nations Development Group reported that, due to a decrease in trade, closing of borders, flight cancellations, and drop in foreign investment and tourism activity fuelled by stigma, the epidemic resulted in vast economic consequences both in the affected areas and throughout Africa.

The Financial Times in September 2014 in a report suggested that the economic impact of the Ebola outbreak could kill more people than the disease itself. One study found that 8% of automotive firms, 8% of construction firms, 15% of food businesses and 30% of restaurants had experienced closure due to the Ebola outbreak. In Montserrado County, it was reported that 20% of firms experienced closure. This led to a serious economic decline in the national economy during the outbreak, with Montserrado County being the hardest hit economically. Monrovia, the Capital City of Liberia, suffered construction and restaurant unemployment the most, whilst outside the capital, the food and beverage sectors suffered economically. Even in counties less affected by the outbreak, there was a decline in the number of employment and overall economic activities. As a result, various reports suggested a focus on economic recovery in addition to support for the healthcare system in the post EVD recovery efforts.

4.5.3 Health and the Environment

To illustrate how health is linked to the environment, one can only consider Liberia's water sources and diarrhoeal diseases. According to the DHS of 2013, waterborne diseases, such as diarrhoea, but also dysentery, are highly prevalent in Liberia due to poor water sources and quality. Unprotected wells, rivers and/or streams, but also ponds, lakes or dams are highly likely to carry such diseases. Data on access to improved water resources in Liberia show that there has been little change in access to improved water sources. The following table has been taken from the DHS of 2013.

Table 4.9: *Household Sources of Drinking Water (Source: DHS, 2013: p.11)*

	Households			Population		
Characteristic	Urban	Rural	Total	Urban	Rural	Total
Source of drinking water						
Improved source	85.8	55.5	72.6	85.8	56.6	73.0
Piped water into dwelling/yard/ plot	1.9	0.0	1.1	1.9	0.0	1.1
Public tap/standpipe	3.2	0.0	1.8	3.0	0.0	1.7
Tube well/borehole	1.5	0.8	1.2	1.8	0.8	1.4
Hand pump/protected dug well	71.5	53.7	63.8	72.9	54.8	65.0
Protected spring	1.2	0.7	1.0	1.1	0.8	1.0
Rain water	0.2	0.1	0.1	0.1	0.1	0.1
Bottled/sack water	6.3	0.1	3.6	4.8	0.1	2.8
Non-improved source	14.1	44.4	27.3	14.1	43.2	26.9
Unprotected dug well	6.2	9.2	7.5	6.5	9.4	7.8
Unprotected spring	0.5	2.8	1.5	0.5	2.7	1.5
Tanker truck/cart with small tank	4.8	0.3	2.8	4.4	0.3	2.6
Surface water	2.6	32.1	15.4	2.7	30.8	15.0
Total[1]	100.0	100.0	100.0	100.0	100.0	100.0
Time to obtain drinking water (round trip)						
Water on premises	9.7	4.8	7.6	10.6	5.6	8.4
Less than 30 minutes	66.6	76.7	71.0	64.4	75.5	69.3
30 minutes or longer	19.0	16.7	18.0	20.4	17.1	19.0
Don't know/missing	4.6	1.8	3.4	4.6	1.8	3.4
Total	100.0	100.0	100.0	100.0	100.0	100.0
Water treatment prior to drinking[z]						

What Table 4.9 illustrates is that around 85% of Liberia's urban households and 55.5% (or 72.6% of all households in Liberia) of its rural households have access to improved drinking sources (2013). These include piped water, public taps, hand pumps, etc. The DHS compares this with data from the 2007 DHS, which shows that around 82% of urban households and 56% of rural households used improved water resources in 2007. This shows little improvement in household access to water sources in the country.

The World Health Organisation (WHO) often refers to environmental burden of diseases which, in their definition, "[…] quantifies the amount of disease caused by environmental risks (WHO, 2019: p.1). Using this definition, diseases can then be attributable to the environment which is often then expressed in deaths and in Disability-Adjusted Life Years (DALYs) (*ibid*.). Using this indicator, the WHO produced the following figure, which illustrates which diseases in Liberia are caused by an environmental risk, and how this compares to other countries of the world.

Disease group	World's lowest country rate	Country rate	World's highest country rate
Diarrhoea	0.2	**67**	107
Respiratory infections	0.1	**40**	71
Malaria	0.0	**28**	34
Other vector-borne diseases	0.0	**2.4**	4.9
Lung cancer	0.0	**0.1**	2.6
Other cancers	0.3	**1.3**	4.1
Neuropsychiatric disorders	1.4	**1.8**	3.0
Cardiovascular disease	1.4	**2.9**	14
COPD	0.0	**1.0**	4.6
Asthma	0.3	**2.1**	2.8
Musculoskeletal diseases	0.5	**0.6**	1.5
Road traffic injuries	0.3	**3.8**	15
Other unintentional injuries	0.6	**6.9**	30
Intentional injuries	0.0	**2.2**	7.5

Figure 4.10: *Environmental Burden of Diseases (Source: WHO, 2019: p.1)*

Figure 4.10 illustrates how Liberia compares to the rest of the world in terms of the environmental burden of diseases. For example, as illustrated above, in Liberia, diarrhoea represents 67% of the country's diseases which are caused by an environmental risk. This is closely followed by respiratory infections and malaria.

4.5.4 Healthcare Provision

Considering healthcare, larger urban areas are serviced by public state hospitals, whilst smaller clinics are usually located in smaller villages. Private and religious hospitals and clinics are also distributed across the country, whilst many people rely on drug dispensaries and private doctors (LISGIS, 2017). Many clinics and hospitals are owned by the government but funded either by a combination of funders (i.e. "pool funding"), or individually by organisations such as USAID, the European Union (EU), Irish Aid or MERCI.

In 2013, LDHS surveyed households on how far they lived from the nearest health facility. To this question, 64% of respondents confirmed that they were walking distance from a health facility, followed by 29% who need to use public transport. More households are reliant on walking to such facilities in rural areas, as opposed to urban areas (75% and 56% respectively) (LHDS, 2013). Table 4.10 provides the average walking time of households to the nearest healthcare centre.

Table 4.10: *Distribution of Walking Time to the Nearest Healthcare Centre [Source: LISGIS/Households Income and Expenditure Survey (HIES), 2016]*

Time	Liberia	Urban	Rural
< 10 minutes	22.3	21.2	23.2
10-19 minutes	24.2	32.9	17.5
20-39 minutes	22.5	31.6	15.4
40-59 minutes	8.8	9.1	8.6
60-119 minutes	13.8	4.8	20.7
120+ minutes	8.5	0.4	14.7
Less than 60 minutes	77.8	94.8	64.7

Table 4.10 shows that, in rural areas of Liberia, about 64% of people take less than 60 minutes to reach the healthcare centre nearest to them, whilst 56.1% of the residences take less than 39 minutes.

Another way of determining access to healthcare is to consider how many Liberians visited a hospital or clinic inthe last 30 days. To this question, LISGIS (2017) determined that 63.2% of all visits made by Liberians in the last 30 days were to a government facility (either a hospital or clinic).

From discussions with the coordinator for the Public Health Surveillance Division of Infectious Diseases and Epidemiology at NPHIL (pers. Comm., Mianah, 2019[15]), the authors of this report note that there has been a gradual increase in the number of health facilities in Liberia since 2006. The number increased from 354 in 2006 to 551 in 2010. Although more health facilities have been established, the distribution of facilities across Liberia's counties and districts is claimed to be disproportionate (*ibid.*). This means that many, if not most, rural communities still have limited healthcare access. Quite literally, many ill villagers are transported to healthcare providers in hammocks. Some villages, on the other hand, have community clinics, but lack essential medical drugs and trained staff to sustain the functions of those clinics. This was reported as a major challenge facing many rural communities. As informed by the field visits, malaria and other preventable diseases are the major causes of illnesses and deaths in most rural areas. This was in part attributed to poor waste management. Compared to the past, the sector is said to have greatly deteriorated.

Apart from this bleak outlook on these environmental - and lifestyle exposure-related diseases, and a sense amongst many that the health sector has deteriorated, the government seemed to have made significant strides in lower its under-five mortality rate in the last few decades. According to the DHS of 2013, the under-five mortality rate seems to have declined over the last few years. As an illustration, during the period between 1998 and 2002, 185 deaths were recorded by the government per 1,000 live births. This reduced to 132 deaths per 1,000 live births during 2003 and 2007. For the period between 2008 and 2012, around 94 deaths/1,000 live births were recorded. The findings from the DHS report state that: "The overall pattern suggests that mortality levels have continued to decline over the past three decades" (ibid: p.111).

The following graph was taken from the WHO (2019) and illustrates the under-five mortality rate for Liberia between 1955 and 2019.

[15] Mr Advertus Nyan Mianah, Coordinator for the Public Health Surveillance Division of Infectious Disease and Epidemiology at the National Public Healthcare Institute of Liberia (NPHIL).

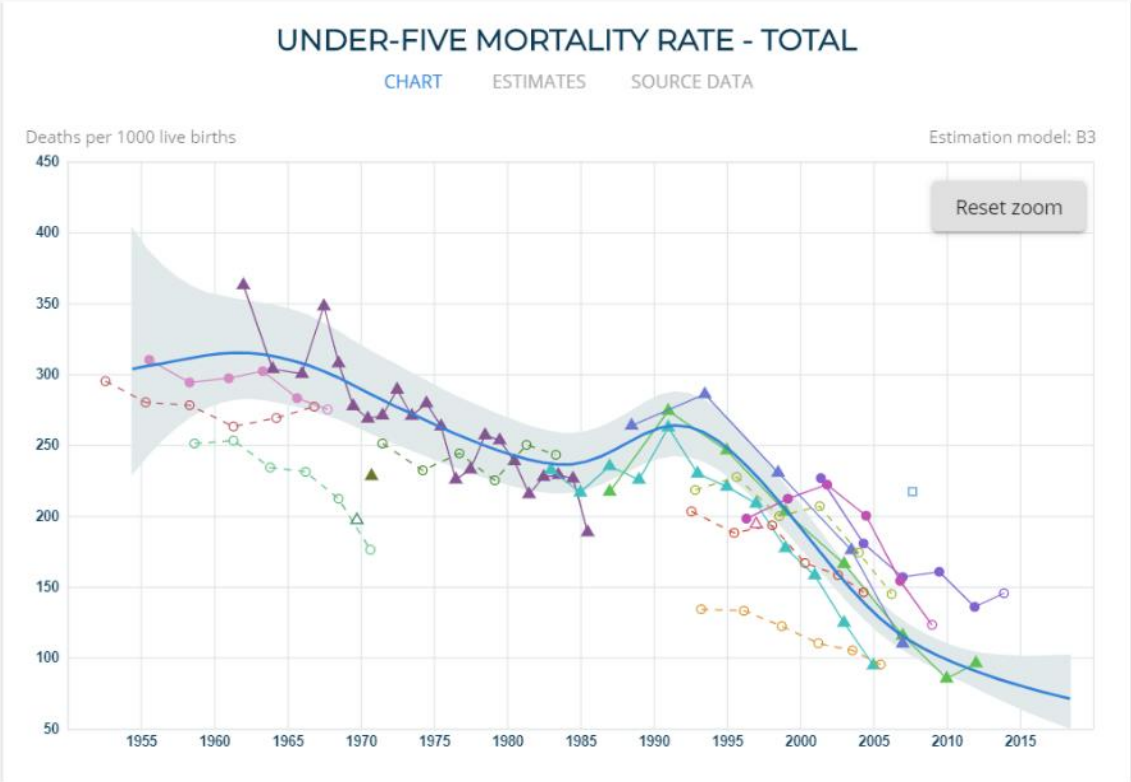


Figure 4.11: *Liberia Under-Five Mortality Rate (Source: WHO, 2019)*

What Figure 4.11 shows is that in 2006, for example, when the previous SoER was drafted, the under-five mortality rate stood at 119.51 deaths/1,000 live births. In 2019, the WHO estimates this figure at 70.94 deaths/1,000 live births.

4.6 GENDER

4.6.1 National Gender Policy

In an effort to ensure gender mainstreaming, the Government of Liberia adopted a National Gender Policy, which seeks to address the issue of gender inequalities and the marginalisation of women in Liberia. This policy seeks to break away cultural barriers and traditional mind-set of the Liberian society. It also endeavours to mainstreaming gender in all national development initiatives and enhance women and girls' empowerment for sustainable and equitable advancement. This policy, according to the 1st, 2nd and 3rd PERIODIC REPORT under The African Charter creates a situation where men and women are able to participate and benefit from development programmes on an equal basis (1st, 2nd and 3rd Periodic Report, 2014-2020).

4.6.2 Legal Assistance and Legal Aid Scheme

In addition, substantial improvements relative to access to justice and specific interests of women and girls have been achieved and developed by the Government of Liberia (GoL) in recent years. In institutional terms, in particular, the creation of Criminal court E, the SGBV Units under the Ministry of Justice (MoJ) which includes more than 60 WACPS (Women and Children Protection Section) officers with special training to handle Sexual

and Gender Based Violence (SGBV) cases were created under the Liberia National Police (LNP) and decentralised to all counties and 11 "One-Stop-Centres" in 7 counties are established to provide legal, medical, protection and psychosocial services to survivors. The concept of the One Stop Centre is designed to support survivors of SGBV by providing the services of the different service providers in one location to make it easier for the survivors to access the needed services in one facility. Since then, according to the 9th report of the GoL state of party report of the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW), over 860 survivors have received psycho-social, protection and legal services through the referral pathway (One -Stop-Centres, Referral Hospitals, Police and the Criminal Court ("E") in 2017 alone.

4.6.3 Gender Mainstreaming

Since the Civil Service Reform Strategy (2008-2011) which focused on mainstreaming gender and established the Gender Focal Point system, the Ministry of Gender, Children and Social Protection had focal persons in all Ministries, State Agencies, and National Commissions (MAC**s**). However, due to the change of government in 2018, a review of the Gender Focal Points (GFPs) listing is pending to determine whether or not those focal points staff from the MACs are still in their assigned positions. The assignment of the focal points was to ensure that the issues of gender are mainstreamed in GoL's policies in the different MACs, respectively. This initiative was meant to help bridge the gaps in addressing gender inequalities. Based on data from the 2017 baseline evaluation of the implementation of the revised National Gender Policy (NGP), 20 MACs were assigned as active GFPs in 2017, while the target for 2019 was to have GFPs in all MACs (Liberia 9th Periodic State of Party Report, 2019).

4.7 CONCLUSION AND RECOMMENDATION

There are complex relationships between socioeconomic status, on the one hand, deprivation and gender, and on the other hand is climate. Because of these variables the various exclusion many Liberians experience exacerbate their marginalisation and their tendency to degrade the setting. The following guidelines should be put in place to tackle these exclusions and avoid degradation of the country's environment:

I. Gender mainstreaming is the systematic process of institutionalising gender analysis and equity values in issues recognition preparation and implementation of development strategies and legislation for the development strategies and legislation for the benefit of children, boys, women, men and other marginalised groups with a view to achieving gender equality and equity (GoK *et al.,* 2005).
II. Mainstream poverty-environment interconnects with national and county growth planning, policy making, budgeting, programme execution and monitoring through financial and technical assistance (Drakenberg *et al.,* 2009) and strengthens public institutions' capacity to tackle negative nexus manifestations between the two variables. An important vehicle for this would be to finalise the formulation of a national environment policy on which all sectoral environmental laws would be anchored.
III. Educating young, socio-economic marginalised children. Providing equal

educational opportunities for the socio-economically disadvantaged, the disabled, and the girl child in Liberia is important. While other issues such as Free Primary Education (FPE) and Free Tuition Secondary Education (FTSE) should be the necessary first steps although other issues such as onerous household duties and cultural practices such as the FGM and early childhood marriage tend to scheme to keep girls out of school. Particular focus should be put on drafting in minority communities when promoting girl child education. However, if the socio-cultural impediments tend to militate against girls' education, affirmative measures should be taken to address these injustices.

IV. Sensitise men and women in matters of gender and the environment. Women's exploitation is so deeply rooted in cultures and psyches, that it remains invisible. Stereotypical gender roles are imposed by hierarchical family, social, economic and educational institutions. Consequently, both men and women need to be more mindful of the need to create a more equal society as true development suffers where half the population is shut out of the formal economy. Training in environmental and gender sensitivity for women and men, especially lawmakers, politicians and institutional, would enable them to discard their stereotypical views of the environment and women, as well as retrogressive cultural practices involving environmental degradation and the consignment of parts of society.

CHAPTER FIVE: CLIMATE CHANGE AND VARIABILITY

5.1 INTRODUCTION

This chapter details Liberia's perspective of climate change with emphasis on projections and impacts. An overview is provided of the impact of different sectors (transportation, waste, agriculture, industry, mining, infrastructure, and forestry) on the emission of greenhouse gases and the corresponding impacts on human health and the environment. There is also a reference to actions taken by the Liberian Government in combating climate change. Key interventions mentioned include Agricultural Adaptation, Coastal Defence and the development of a National Meteorological Monitoring System to enhance adaptive capacity. The chapter concludes by highlighting priority challenges and constraints for addressing climate change issues and capacity needs in Liberia.

5.2 CLIMATE CHANGE: SITUATION AND CONTEXT

Liberia covers an area of 111,369 square km (11,137,000 ha), with 13.5% covered by water and the remaining 86.5% consisting of land. The coastline of Liberia is estimated at 565-km in length. Despite substantial forest loss over the years, Liberia is a net carbon sink and still has significant forest, estimated around 30% of total land in 2009 by FAO. Additionally, Liberia holds around 40% of the remaining West African moist forest (Upper Guinean Forest). Liberia's population was put at 3.5 million in 2008 and it is projected to increase to 10.3 million by 2058, with more than 70% of the population living in coastal cities including Monrovia, the country's capital.

Amidst immense recovery efforts since 2005, Liberia remains one of the least developed countries. More than half of the country's population lacks access to basic social services and there is a high level of unemployment. Majority of Liberians use biomass as the primary source of energy. In 2004, it was estimated that over 95% of the population relied on firewood and charcoal for cooking and heating needs and palm oil for lighting. In 2009, it was estimated that 70% of the urban population use charcoal for cooking as compared to 5% of the rural population; 91% of the rural population use firewood for cooking as compared to 21% of the urban population.

In 2012, Liberia took a significant step towards transforming the country into a middle-income nation by adopting the Vision 2030. To achieve the Vision 2030, the AfT was also adopted as a framework for meeting the country's expectation for social development, sustained and accelerated growth, reflected in 5 pillars (Peace, Justice, Security and Rule of Law; Economic Transformation; Human Development; Governance and Public Institutions; Cross-Cutting Issues, including environment and gender). Attaining the middle-income country status by 2030, the economy was projected to maintain the GDP growth rate of 8.3% for two decades considering 2012 as the base year. However, an assessment of the economy in 2014 revealed that the real GDP growth for the country declined from 2.5% to 0.7% as a result of the slow pace of economic activities in the traditional sectors, exacerbated by the outbreak of EVD. With the gradual resumption of economic activities, the estimated GDP growth rate for 2015 is 4.5%. Liberia's economic growth to a large extend relies on its natural resources, particularly agriculture, minerals and timber.

As already discussed, Liberia's climate is tropical, hot, and humid all year round and has one of the highest rates of water resources per capita in Africa; however, water quality and sanitation remain a significant problem. Changes in seasonal rainfall patterns and rising temperatures negatively impact the water balance by decreasing total water levels and degrading water quality through contamination.

Climate change is one crucial factor that is known to affect ecosystems. The main impact of climate change on water quality is attributed to changing air temperature, hydrology and the hot and humid temperature in Liberia. Water quality and water supply reliability are jeopardised by climate change in a variety of ways that affect ecosystems and livelihoods. The main climate change consequence related to water resources is the increase in temperature. Liberia faces significant risks as results of climate change owing to heat. There is a critical need to 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.

Climate change in Liberia has increased flooding. It is predicted that global warming is accompanied by a rise in sea levels of as much as 60-100cm over this century affecting the subsidence of low-lying coastal areas or communities in West Point Township and Buchanan (SoER, 2006). However, in the previous SoER (2006), climate change is not described in detail and no recommendation was given in the fight against climate change.

Key climate trends since the 1960s include: increased average annual temperatures of 0.8°C throughout the country; an additional 57 "hot" nights per year on average (a 15.7% increase); decline in mean annual rainfall (difficult to determine whether this is part of a long-term trend because of the variable nature of rainfall in the region); increased frequency and unpredictability of intense rainfall events and rising sea levels.[16]

5.3 CLIMATE CHANGE PROJECTIONS AND POSSIBLE IMPACTS

There are various projections of Liberia's future climate. The most recent assessment in 2013 was prepared by John A. Stanturf and his colleagues on behalf of the United States Department of Agriculture Forest Service Office of International Programmes. The latter assessment points to a warmer and wetter climate in most parts of the country, especially in the coastal zone. One of the best estimates of the impact of future climate conditions on temperature is provided by the overall ensemble mean of 16 climate models across three emission scenarios. The latter, for example, includes that Monrovia will experience warming by 1.92°C by 2050 and 2.65°C by 2080 during the dry season (1.61°C by 2050 and 2.60°C by 2080 during the wet season) (Stanturf *et al.*, 2013). Irrespective of any emission scenarios, the Atmosphere-Ocean Global Climate Models (AOGCMs) are quite consistent in predicting warmer conditions across Liberia. The overall ensemble prediction across emission scenarios presents a slight increase in wet season rainfall of 1.54% by 2050 and 1.92% by 2080. The increased rainfall appears to occur mostly during the early months of the rainy season, beginning in the southeast in May and extending west along the coast in June and July, implying more intense rainfall events (Stanturf *et al.*, 2013).

[16] 2017 Climate Change Vulnerability Index

Table 5.1: *Potential Change in Temperature (°C) and Percent Change in Rainfall for the Dry (Dec-Feb) and Wet (Jun-Aug) Seasons of Monrovia (Source: Stanturf et al., 2013)*

Monrovia		Dry Season				Wet Season			
		B1	A1B	A2	Mean	B1	A1B	A2	Mean
2050 Temperature	Mean	1.54	2.15	2.07	1.92	1.30	1.79	1.75	1.61
	Std Dev	0.48	0.53	0.77	0.65	0.29	0.28	0.27	0.35
	Min	0.50	0.91	-0.07	-0.07	0.62	1.26	1.13	0.62
	Max	2.19	3.02	3.19	3.19	1.76	2.30	2.14	2.30
2080 Temperature	Mean	1.90	2.83	3.22	2.65	1.85	2.75	3.21	2.60
	Std Dev	0.47	0.57	0.81	0.84	0.45	0.56	0.63	0.79
	Min	1.10	1.91	1.26	1.10	0.80	1.57	1.85	0.80
	Max	2.68	3.81	4.77	4.77	2.75	4.01	4.35	4.35
2050 Precipitation	Mean	0.63	6.31	3.94	3.63	0.88	1.50	2.25	1.54
	Std Dev	-5.50	1.00	-2.00	-1.50	10.28	11.79	11.81	11.09
	Min	-22.00	-26.00	-24.00	-26.00	-26.00	-25.00	-25.00	-26.00
	Max	20.22	24.40	28.55	24.21	16.00	20.00	20.00	20.00
2080 Precipitation	Mean	6.13	6.50	11.13	7.92	3.13	1.94	0.69	1.92
	Std Dev	23.10	31.49	40.49	31.86	11.52	14.20	14.46	13.21
	Min	-25.00	-47.00	-35.00	-47.00	-29.00	-36.00	-32.00	-36.00
	Max	55.00	92.00	125.00	125.00	18.00	18.00	21.00	21.00

Vulnerability and adaptation assessments conducted have revealed that Liberia is faced with climate change and variability leading to extreme events, which have a negative impact on agriculture, forestry, health, energy and other sectors. Climate change impacts are marked by irregular patterns of rainfall, flooding, high temperature, and coastal erosion. These factors result to crops and livestock losses that intensify food insecurity and loss of income. For the most part, women and children are particularly vulnerable to the impacts of climate change. However, their unique knowledge and perspectives also provide opportunities for inclusive, equitable and efficient adaptation responses and coping strategies. Limiting climate change would require substantial and sustained reductions in GHG emissions (i.e. mitigation), which, together with adaptation, can limit climate change risks.

Liberia had limited resilience and adaptive capacity to combat the effects of climate change. Low adaptive capacity in the country was exacerbated by both climate change and non-climate change impacts. Liberia was ranked 4th of the five worst performing countries on the 2017 Climate Change Vulnerability Index (CCVI) with a score of 0.25.120.

Table 5.2: *Liberia Climate Change Vulnerability Index Score*

Rank	Country	Region	Score	Category
1	Central African Republic	Africa	0.01	Extreme
2	DR Congo	Africa	0.20	Extreme
3	Haiti	Africa	0.24	Extreme
4	Liberia	Africa	0.25	Extreme
5	South Sudan	Africa	0.41	Extreme

Source: 2017 Climate Change Vulnerability Index, Verisk Maplecroft 2016

The high risk was due to high levels of poverty and extreme dependence on climate sensitive sectors. Recurring crop failure and irregular rainfall patterns were increasingly

leading to high food insecurity and subsequently malnourishment. The majority of the population lived in extreme poverty and their livelihood strategies were entirely based on the natural environment making it difficult to manage the environment sustainably, hence the risk of climate change vulnerability continued to increase.

5.4 IMPACT ON ECONOMIC SECTORS

The profile provides an overview of climate risk issues in Liberia, including how climate change will potentially impact agricultural production, water resources, coastal zones, fisheries and human health. The brief includes an overview and climate summary of Liberia, as well as projected climate changes. Also included is information on sector impacts and vulnerabilities to climate change, the policy context and information regarding ongoing NAP projects in Liberia. High reliance on climate-sensitive activities renders Liberia vulnerable to climate variability and change, expected to manifest in higher temperatures, more extreme weather events such as heavy rains, and rising sea levels. Agricultural productivity is even more vulnerable to a changing climate, and saltwater and freshwater fisheries are likely to suffer as sea temperatures increase and coastal ecosystems (mangroves and wetlands) are damaged. Coastal zones, home to the majority of the population, infrastructure and economic activity, are at risk from flooding and erosion associated with sea level rise, which will lead to salinisation of coastal agricultural fields.

5.5 AGRICULTURE AND CLIMATE CHANGE

Agriculture has been an important source of economic growth since the collapse of the formal economy during the civil war. The sector contributes 35.2% of GDP and provides livelihoods to 67% of the population. Rice is the country's primary staple crop, cultivated by 74% of farmers. Rice is highly sensitive to increased humidity, temperatures and intense rainfall, and to the pests that thrive in these conditions.

5.6 WATER RESOURCES

Liberia has one of the highest rates of water resources per capita in Africa. Changes in seasonal rainfall patterns and rising temperatures, however, will negatively impact the water balance by either decreasing total water levels or degrading water quality through contamination. Runoff in the St. Paul River Basin is projected to decrease 0.7–25% by the 2020s due to precipitation and temperature changes, impacting potential hydropower production at the Mount Coffee plant and the water supply for Monrovia, the capital. In rural areas, water is largely supplied from shallow wells whose levels fluctuate with rainfall variability, particularly during the dry season (December – April). Reduced water levels further stress water quality as pollutants are concentrated. This is a particularly serious potential adverse impact as people rely heavily on surface water when wells dry up. Increased temperatures and intense rainfall are putting greater pressure on the water and sanitation sector, which was severely damaged due to fighting and vandalism sustained over 14 years of civil war.

As already discussed, Liberia's climate is tropical, hot, and humid all year round and has one of the highest rates of water resources per capita in Africa; however, water quality and sanitation remain a significant problem. Changes in seasonal rainfall patterns and rising temperatures negatively impact the water balance by decreasing total water levels and degrading water quality through contamination. Climate change in Liberia is impacted by its water ecosystems, which change the water quality via different biochemical processes. Climate change is one crucial factor that is known to affect ecosystems. The main impact of climate change on water quality is attributed to changing air temperature, hydrology and the hot and humid temperature in Liberia.

Water quality and water supply reliability are jeopardised by climate change in a variety of ways that affect ecosystems and livelihoods. The main climate change consequence related to water resources is the increase in temperature. Liberia faces significant risks as results of climate change owing to heat. There is a critical need to 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.

Climate change in Liberia has increased flooding. It is predicted that global warming is accompanied by a rise in sea levels of as much as 60-100cm over this century affecting the subsidence of low-lying coastal areas or communities in West Point Township and Buchanan (SoER, 2006). However, in the previous SoER (2006), climate change was not discussed in detailed and no recommendation was given in the fight against climate change. Nevertheless, the current SoER has not left the issue of climate out.

5.7 FISHERIES

Fish are an important component of the Liberian diet and the primary source of protein in coastal areas. Liberia's fisheries include coastal marine fisheries, involving industrial and artisanal activities; inland river and lake fisheries, which are underdeveloped and artisanal; and aquaculture, which consists of small, freshwater ponds producing tilapia in rural areas of non-coastal communities. The fisheries sector suffered during the civil war, and now faces risks from climate change and climate variability. Rising sea surface temperatures are reducing biodiversity and overall stocks as a result of death, diminished reproductive cycles and migration to cooler waters. Changing rainfall patterns, particularly during the dry season when inland river and pond levels are low, are causing significant numbers of low productivity.

5.8 HUMAN HEALTH

Liberia's population already suffers from several environmental problems that will likely be intensified by climate change. Malaria is one of the leading causes of morbidity and mortality, accounting for 38% of all hospital visits. Increased rainfall and flooding are likely to cause outbreaks of malaria, cholera (expected to increase 10% by 2100) and diarrhoeal diseases of epidemic proportions. The incidence of Lassa Virus (LASV), the third highest cause of morbidity, is also expected to rise as heavy rainfall increases. Cases of LASV, carried by the multimammate rat, double or triple during the rainy season when rat populations grow rapidly. Dengue fever, already present in neighbouring Côte

d'Ivoire, could expand into Liberia as temperatures rise. Respiratory diseases may be exacerbated by heat stress and increased rainfall levels.

5.9 FOREST ECOSYSTEM

Liberia is home to 40% of West Africa's forest cover, which is used for food (Non-Timber Forest Products (NTFPs) and wildlife), fuel wood, medicinal products and energy. Rainfall projections are too inconclusive to predict with certainty if climate change will significantly impact tropical forests. However, substantial evidence shows that increased duration and intensity of rainfall leads to slower tree growth and, in more severe cases, rotting because of waterlogged tree roots. Increased runoff due to heavy rain, combined with root loss may cause greater siltation of surrounding reservoirs and rivers. Rising temperatures have also created environments where pests, including the pine caterpillar *(Dendrolmus punctatu)*, can thrive.

5.10 SEA LEVEL RISE

Tidal records have shown an increase of the sea level over large parts of the world in the last decade. The Intergovernmental Panel on Climate Change (IPCC) Response Strategies Working Group stated already in 1990[17] that Liberia is one of the most vulnerable countries to coastal erosion. Especially, the highly valued coastal wetlands are at stake.

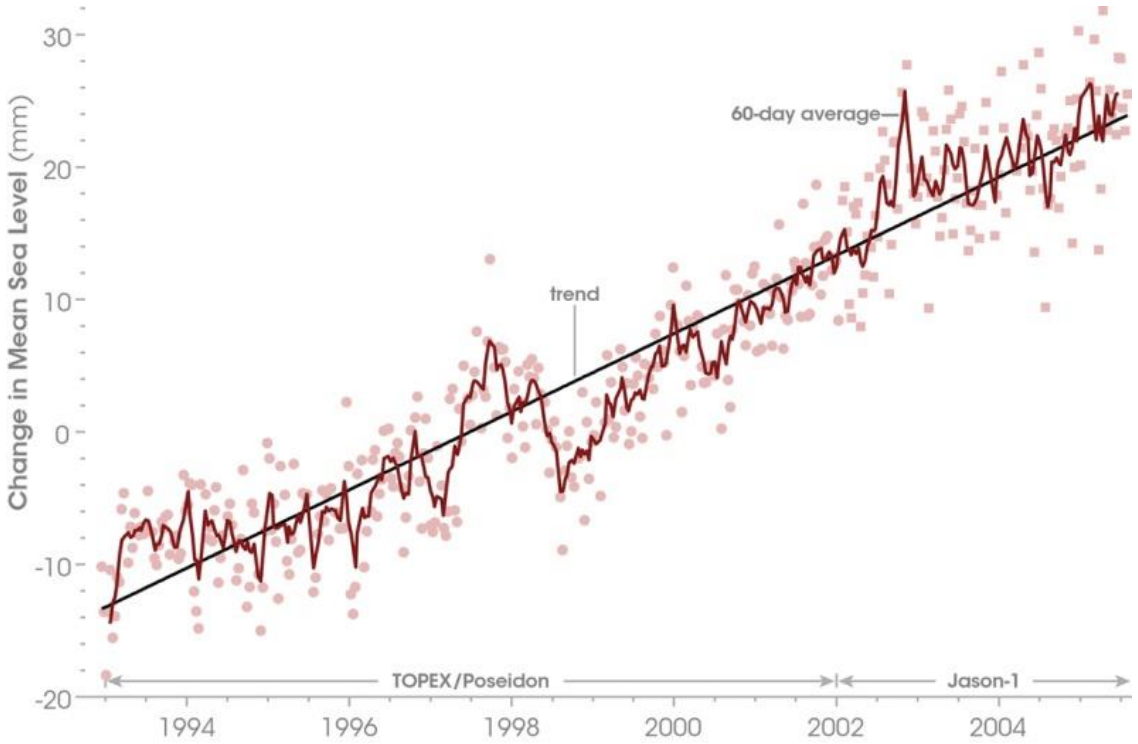


Figure 5.1: *Sea Level Rise as Measured by the TOPEX/Poseidon and Jason-1 Satellites (Source; Wikipedia)*

[17] http://www.epa.gov/climatechange/effects/downloads/adaption.pdf

Several consequences could be expected for a rise in sea levels in Liberia due to Climate Change. In particular, low-lying areas such as Bushrod Island, West Point, part of Rivercess, Grand Bassa and many other parts of the coastal zone will be profoundly affected. The expected impacts of sea level rise are direct inundation of low-lying wetland and dry land areas; erosion of soft sandy coastlines by increasing offshore, loss sediment; increases in salinity of estuaries and coastal aquifers; raised coastal water table; exacerbate coastal flooding; and storm surge damages. These impacts will in turn influence coastal habitat, biodiversity and socio-economic activities.

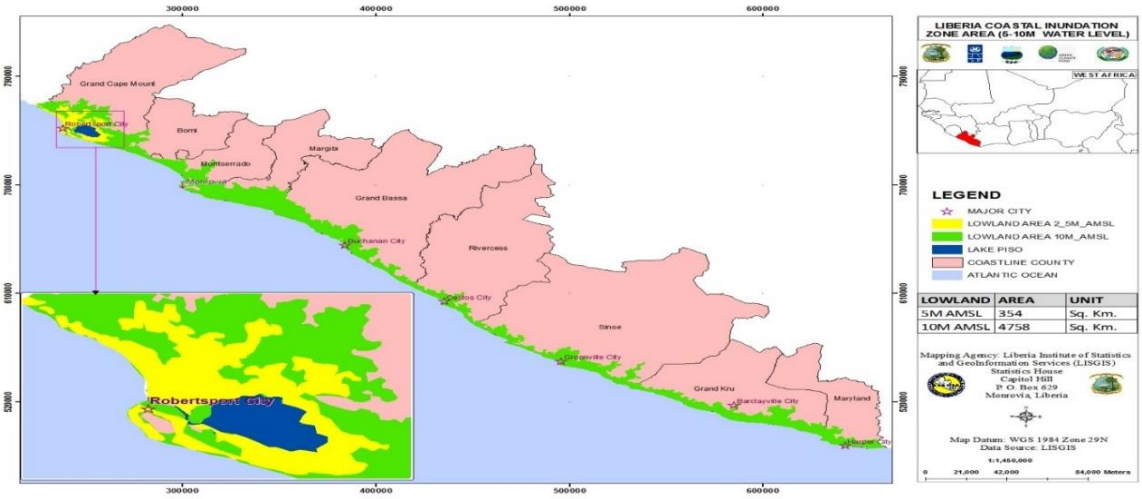


Figure 5.2: *The Map Above Shows 5-10m AMSL of an Area (354-4758km-sq. Report LIGIS- 2019)*

5.11 STAKEHOLDER CONSULTATION ON CLIMATE CHANGE

Most communities consulted across the country seem to be aware of climate change and the impacts thereof. Nearly all communities visited showed awareness which, according to many, can be seen in the changing weather patterns. Many would refer to Liberia's two main seasons, namely the wet and dry seasons; arguing that these two seasons are not as stable or reliable as they used to be. This has affected many farmers' crop yields, as they are used to plan their cultivations according to the seasons. Increased flooding has also been reported, which is worsened by deforestation and other climate change-related effects. In Buchanan and Monrovia, many of those interviewed from communities such as New Kru Town, West Point, Atlantic Street and Fanti Town point to the increasing wave of coastal erosion and flooding, which they attribute to climate change. Whilst in Nimba, residents noted the increase in torrential storms. These impacts are said to be exacerbating the existing poverty conditions and impacting on livelihood and health, whilst at the same time, these are responsible for mass migration and the loss of lives and properties.

5.12 CLIMATE MONITORING

Liberia faces numerous challenges in regard to observing system in providing climate prediction. In 2004, Liberia participated in the Meteorological Transition system (PUMA) along with other countries in Africa; about 53 countries benefited from the project. The equipment was provided by EUMETSAT. The system provided transformation of meteorological services over the continent. The network provided information for early

warning of natural disaster, improve food security, better health management, more efficient water and energy use, and safer transport. The observing system also provided environmental monitoring, both desertification and climate change effects with greater precision. The observing system is presently installed at the Roberts International Airport in Margibi County since the 24th of March 2005. The System presently installed at RIA has basic output for climate change data collection.

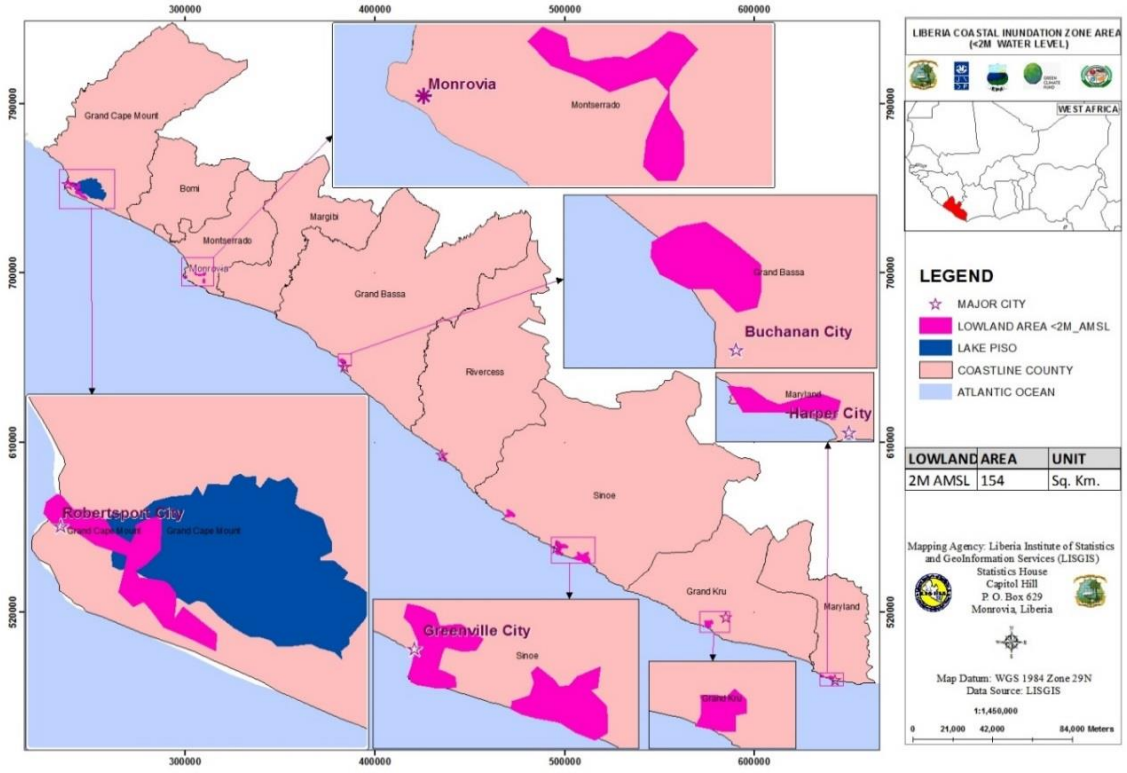


Figure 5.3: *Map from LISGIS Lab. Oct. 2019*

The increased need to collect and assess water quality data relative to climate change drivers, and to guarantee sound water management, the environment and human health protection is challenging for many developing nations, including Liberia. Therefore, without water quality data as a baseline, challenging expressions such as "sustainable development" and "environmentally sound management of water resources", will be meaningless. The need for the EPA to enhance the water quality data collection for the improvement of health is significant.

Water Quality Monitoring (WQM) is an essential tool in water resource planning and policy development. For effective global WQM programmes and activities, the technical capabilities, information needs, and the scale of programme development and delivery need to be assessed. There are various gaps in WQM, however, these include a lack of data from monitoring stations, as well as a lack in policy covering integrated management of monitoring watersheds using monitoring stations.

5.13 GREENHOUSE GAS EMISSIONS AND ASSOCIATED IMPACTS

5.13.1 Overview

In its Initial National Communication (INC) on climate change, submitted to United Nations Framework Convention on Climate Change (UNFCCC) in 2013, Liberia presented a national inventory of anthropogenic emissions by sources and removals by sinks of GHGs, as well as a description of steps the country intended to undertake as its contribution in achieving the global objective of UNFCC. In the absence of Land Use, Land-Use Change and Forestry (LULUCF) (2), Liberia's total national GHG emissions for the year 2000 was estimated to be 8,022 Gg of equivalent Carbon dioxide (CO^2) (Liberia Initial Communication, 2013). Of the four non-LULUCF sectors responsible for the country's sources of GHGs, the energy sector was the most significant, accounting for about 67.5% of the national total, which is trailed closely by the agriculture sector's contribution of about 31.9%, whilst the waste sector accounted for 0.6% (*ibid.*). The GHGs of concern reported by Liberia in 2013 from the three-mentioned sectors are mainly Methane (CH_4), with a contribution of 51.6%; CO_2, with a contribution of 44.5%; Nitrous Oxide (N_2O) with a contribution of 3.9% (*ibid.*). Other important gases include Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (*ibid.*).

Table 5.3: *GHG Emissions by Sector (Source: Liberia Initial Communication, 2013)*

GHG Emissions by Sector (without LULUCF), 2000		
GHG Source and Sink Categories	**Total Gg CO_2 Equiv.**	**Sector Share (%) (without LULUCF)**
Energy	5,414	67.5
Industrial processes	NO	NO
Solvent and other product use	NE	NE
Agriculture	2,562	31.9
LULUCF	-96,811	
Waste	46	0.6
Other (please specify)	NO	NO
Total without (LULUCF)	8,022	100
Total (with LULUCF)	-88,789	
Note: LULUCF – Land Use Change and Forestry		

Based on a report prepared by the World Resources Institute (WRI) in 2012, Liberia is said to have emitted 17 million metric tons, with the land-use change and forestry sector contributing 90% to overall emissions, followed by the waste sector emitting 4% and the agriculture sector emitting 3% (WRI, 2012).

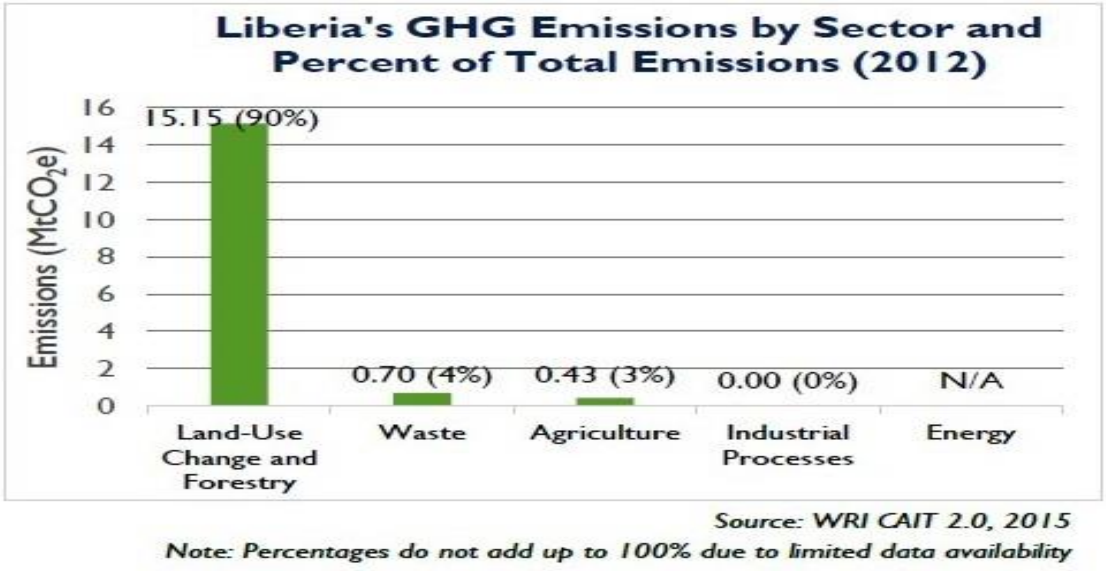


Figure 5.4: *Liberia's GHG Emissions by Sector and Percentage of Total Emissions (2012) (source: WRI CAIT 2.0 2015)*

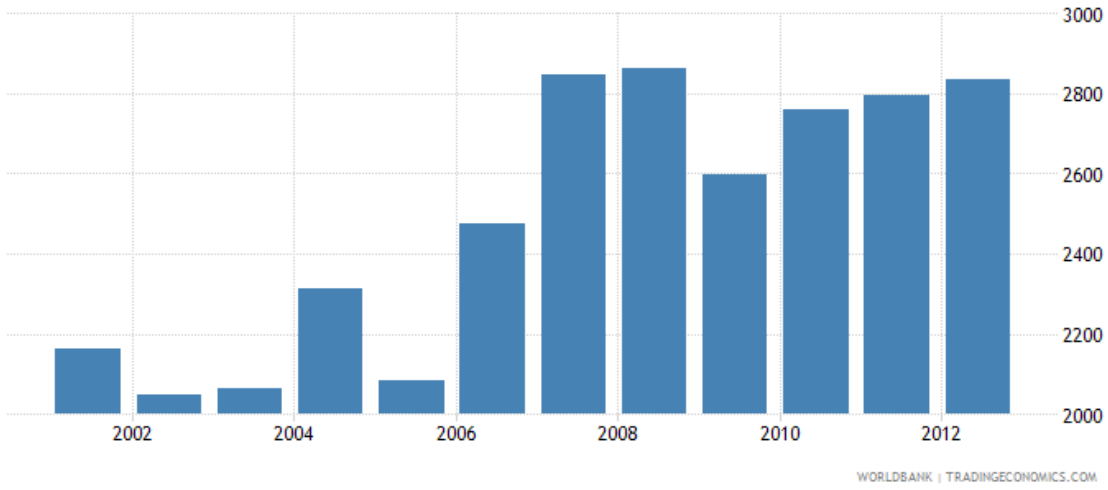


Figure 5.5: *Liberia Total Greenhouse Gas Emissions Per Year (Source: Liberia-total –greenhouse-gas-emissions-kt-of-CO_2-equivalent-wb-data)*

5.13.2 Emissions from the Transport Sector

Given the limited road infrastructure and poor quality of roads across the country, the increase in vehicular emissions is also a matter of concern, as this is a source of emission for carbon dioxide and other GHGs into the atmosphere. The increase in use of two-stroke motorcycles, "pen-pen", as a common substitute to passenger transport has brought relief amongst many ordinary Liberians, especially those in remote areas where roads are impassable. Some experts point to the need to explore other forms of transport, such as water transport, mainly along the oceans, as well as investment into expansion and improvement of public transport and mass transit. What is also needed are regulations on the quality and age of vehicles, including motorcycles that can be imported into the country, and actions to promote non-motorised transport. Many stakeholders

acknowledged the risk of air pollution in regard to environmental and public health, i.e. respiratory disorders, cancer, etc.

5.14 GOVERNMENT RESPONSES TO CLIMATE CHANGE

Utilising technical support and funding from the GEF and UNDP, Liberia completed its NAPA in 2008. This initiative was guided by existing national development plans such as the National Reconstruction and Development Plan (NRDP), NBSAP and the MDGs of 2004. The preparation of NAPA was based on broad level stakeholders' participation. The studies revealed that Liberia was faced with climate variability and extreme events with negative impact on agriculture and socio-economic development. NAPA identified several projects and urgent adaptation needs using multi-criteria analysis. These were validated at a stakeholder's forum, as a result of which three projects emerged as priority needs of Liberia.

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

Additionally, Liberia has undertaken several initiatives to address environmental and climate change issues. Most recently, the country received support from the Green Climate Fund (GCF) in 2017 for the purpose of advancing its medium to long-term adaptation plans to increase resilience in critical sectors. The project is implemented by UNDP, in collaboration with the EPA. Under this project, the country was able to finalise and launch its National Climate Change Policy and Response Strategy, which, together with Liberia's Nationally Determined Contributions (NDC) to the Paris Agreement - has provided clear direction on where Liberia wants to go as a country, and the efforts required to achieve long-term adaptation. The strategy is particularly important because it gives a clear signal to domestic and international investors and donors about the climate-resilient strategic priorities of the country. The ratification of the Paris Agreement in 2018, further demonstrated Liberia's commitment to global efforts in combating climate change. Liberia has made significant efforts in generating an evidence base to inform decision making and planning. This has largely been created through vulnerability and risks assessment on key sectors – agriculture, forestry, fisheries, coastal – as well through various gender analyses.

These studies are revealing new findings which can support the development of focused investment ideas, including GCF funding proposals; cardinal to advancing medium to long-term adaptation goals. Other major milestones of the project include developing a national disaster strategy and action plan, mainstreaming climate change adaptation into national planning and budgeting processes, engaging private sector into climate change adaptation and mainstreaming climate change adaptation into sectorial planning. To ensure sustainability in capacity building effort, the country in 2018 launched a graduate

programme in environmental studies and climate change. Adding this degree programme will enable the University of Liberia not only to enhance its own strategic goals, but also to carve out a place at the forefront of higher education's efforts to educate leaders capable of addressing the complexities of environmental challenges in Liberia (Tumbey, 2019). Liberia is also implementing the Cross-Cutting Capacity Development (CCCD) Project, which is part of a portfolio of capacity building intervention in Liberia that encourages regional cooperation and knowledge and information exchanges. The goal of the CCCD Project is for Liberia to make better decisions to meet and sustain global environmental obligations. This requires the country to have the capacity to coordinate efforts, as well as best practices for integrating global environmental priorities into planning, decision-making, and reporting processes. The project seeks to strengthen a targeted set of national capacities to deliver and sustain global environmental outcomes within the framework of sustainable development priorities.

5.15 PRIORITY CHALLENGES AND CONSTRAINTS FOR ADDRESSING CLIMATE CHANGE ISSUES AND CAPACITY NEED

The major impediments with regard to addressing climate change relates to**:** limited means of implementation (human, technological, and financial constraints); limited access to data and information, including data management and retention to support disaster preparedness and climate change adaptation; low capacity to implement regulatory frameworks and laws, including the Environmental Protection and Management Law; and inadequate coordination and collaboration amongst agencies.

Addressing these impediments would require development of institutional and human resource capacity, such as:

- Developing climate models and weather forecasts on inter-annual and inter-decadal rainfall and temperature patterns in Liberia;
- Increasing public awareness particularly to vulnerable communities, such as farmers and coastal settlements, on the impacts and risks of climate change and on adaptation strategies;
- Infrastructure improvement to facilitate the implementation of adaptation strategies;
- Mainstreaming climate change adaptation into development planning and policies through programmes in agriculture, forestry, fisheries, coastal zone management, energy, health, etc.;
- Increasing access to early warning information for disaster preparedness and use by farmers, fishermen, forest users, etc.; and
- Strengthening the capacity of the National Climate Change Secretariat (NCCS) to enhance its coordination role as well as mobilisation of policy makers around climate change issues.

It is also a primary importance to strengthen implementation of the National Climate Change Policy and Response Strategy in addition to other regulatory and policy frameworks related to climate change, which will require adequate funding for the EPA and associated agencies of government.

5.16 CONCLUSION AND RECOMMENDATIONS

In Liberia like the rest of the world, climate change and weather are having adverse impacts. They have intensified environmental degradation, decreased agriculture production and food security, increased flooding incidences, landslides, droughts, disease epidemics, damaged physical infrastructure and reduces the risk of competing natural resources. Even though the susceptibility to such impacts is discrete and context-specific, it has the potential to contribute to substantial economic costs that could impede the achievement of the pro-poor agenda for development and prosperity.

The national adaptation plan offers a broad coordinated, structured mechanism for government, private sector, civil society and other stakeholders to incorporate climate change and variability considerations into national development planning and implementation at different levels. While the trajectories of future climate change and the impacts of variability in Liberia are uncertain, institutes are required to prepare for uncertainty as a justification for inaction, proactive approaches to plan for the uncertain future. The following guidelines need to be adopted in addition to formulating a national climate change strategy and enacting climate change law:

I. Identify and capitalise on future opportunities posed by climate change and uncertainty (such as carbon trading);
II. Establish specialised institutions and centres of excellence that will allow Liberia to enunciate feasible strategies for mitigation and adaptation; and
III. Develop early warning systems and connect climate change with reduced risk of disasters at all rates.

Increase coordination of climate change adaptation strategies and mitigation initiative at the state, city and community level to increase monitoring and reporting.

PART THREE: STATE OF LIBERIA'S GEOPHYSICAL AND BIOLOGICAL ENVIRONMENT

CHAPTER 6: BIODIVERSITY

6.1 INTRODUCTION

This section of the report considers the environmental state and trends which intersect with each other, and which cannot be viewed in isolation. One example of this is biodiversity. The word "biodiversity" is used to mean the variety of life on our planet, measurable as the variety within species, between species, and the variety of ecosystems. A discussion on biodiversity, therefore, intersects other environmental states and trends, such as Liberia's terrestrial or aquatic resources. Subsequent to biodiversity, the concept of PES is also discussed, which provides a link with various resources already considered.

Another resource which is discussed under this section is culture and tourism, which transverses to cover issues related to biodiversity, terrestrial and aquatic resources, as well. Lastly, energy is also considered under this section. By discussion energy, several environmental states and trends already discussed intersect, most of which relate to the ecology (such as biomass), climate and pollution. The chapter concludes by discussing challenges faced in the sector and highlights key responses by the Government of Liberia to develop improved forest management policies and regulations, and to accost a host of related challenges in the forestry sector.

6.2. BIODIVERSITY AND ECOSYSTEMS

6.2.1 Overview

Liberia has a very substantial share of global biodiversity within its borders. Liberia has been regarded as one of the biodiversity hotspots in the world, and one which contains the highest remaining portion (42%) of the Upper Guinea Massif including plants with high endemism. The country boasts over 2000 vascular plant species, 600 bird species, 75 reptile species, and 150 mammal species (NBSAP 2017). To enhance the conservation and sustainable utilisation of biological resources, Liberia needs a sound, comprehensive and holistic blueprint (strategy) which will chart the way to sustainable management/governance of these resources.

Biological heritage is important to mankind in many ways, providing us with ecosystem services like clean water, contributing directly to the economy through industries like fishing and tourism, supporting livelihoods by providing food, medicine and building materials, and generally, improving our health and well-being. The value of biological diversity has three components:

1) Many species have a direct value through the products that can be harvested, for instance, many medicines used throughout the world have active ingredients extracted from plants and animals.
2) The pollination of agricultural crops by insects is an example of the indirect value where aspects of biodiversity bring economic benefit without the need to consume the resource.

3) There is also an ethical value to the diversity of life. Although it does not always lend itself to economic valuation in monetary terms, we still appreciate the beauty of the rose flower.

Through the most powerful human influence; habitat destruction and ill-conceived developments; biodiversity is under threat world-wide. The focus is frequently on the accelerated rate of disappearance of a species in the face of human influence. Biodiversity encompasses more than just species richness. We should ensure that we protect representatives of as many types of communities and ecosystems as possible. By conserving suitable habitats, we are also improving the survival chances of the species and populations contained therein. Living landscapes preserve the option value of biodiversity – the potential to provide benefits in the future. To protect biodiversity effectively, we need to conserve (Driver *et al*., 2003):

- A representative sample of all biodiversity; and
- The ecological and evolutionary processes that allow this biodiversity to persist over time.

Important driving forces putting pressure on the biodiversity resources of Liberia are:

- Population growth;
- The demand for economic growth to provide wealth and job creation;
- Demand for housing and associated services for historically disadvantaged people;
- Unsustainable extraction of natural resources as a result of poverty or greed;
- Poor land use practices promoting soil erosion and infestation by invasive alien plants;
- Poor waste and pollution management;
- Climate change; and
- Lack of understanding (ignorance of the importance of conserving biodiversity).

It is approximated that over 60% of the country's forested landscapes is degraded and this must have resulted in the extinction of hundreds of thousands of animals, plants and other organisms. Ninety-two conservation priority areas are identified in Liberia (Junker *et al*., 2015).

6.2.2 Declared Protected Areas and their Status

Liberia has 19 proposed and protected areas making up 4.05% of terrestrial land cover and 0.1% of total marine cover. Of the 19 reserves, 10 are national parks, 2 nature reserves and 1 national forest park, and multiple sustainable use is reserved respectively. In addition, 5 of these are Ramsar sites; wetlands of international importance. The following section considers some of the country's national parks and important wetland areas.

Gola Forest National Park

Designation	National Park
Status year	–2016 - Gazetted
Management authority	Department of Forest Conservation; Forest Development Authority
Area	88 130 ha
Transboundary site and area	Sierra Leone 710.7 km^2

East Nimba Nature Reserve

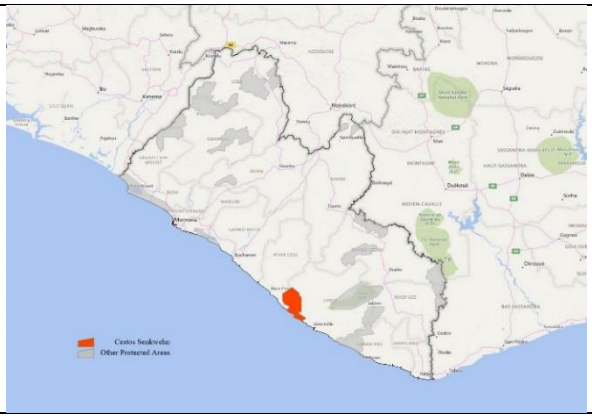
Designation	Nature Reserve
Status year	2003 - Gazetted
Management authority	Department of Forest Conservation; Forest Development Authority
Area	13 569 ha
Transboundary site and area	Mount Nimba Strict Nature Reserve in Guinea and Ivory Coast – 221.3 km^2

Sapo National Park

Designation	National Park
Status year	1983 - Gazetted
Management authority	Department of Forest Conservation; Forest Development Authority
Area	184 406 ha
Transboundary site and area	None

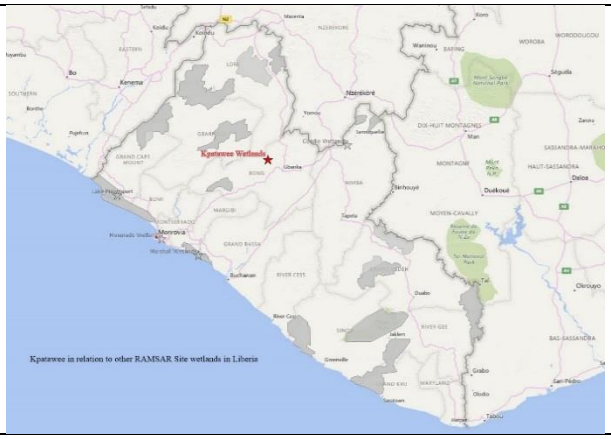
Cestos Senkwehn National Park

Designation	National Park
Status year	2003 – Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	80 348 ha
Transboundary site and area	None



Kpatawee Wetlands

Designation	Ramsar Site
Status year	2006 - Designated
Management authority	Not reported
Area	8.35 km^2
Transboundary site and area	None

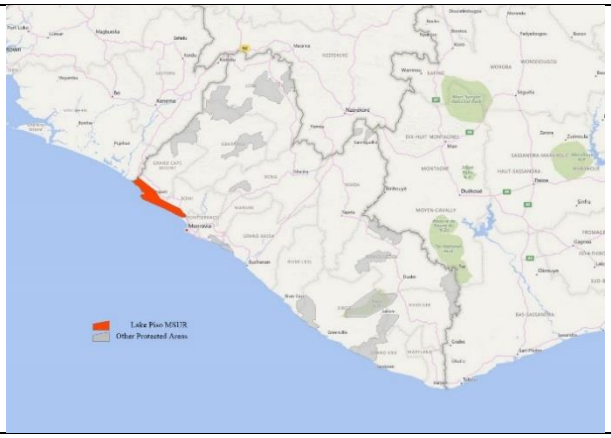


Kpo Mountains

Designation	National Park
Status year	2003 - Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	83 709 ha
Transboundary site and area	None

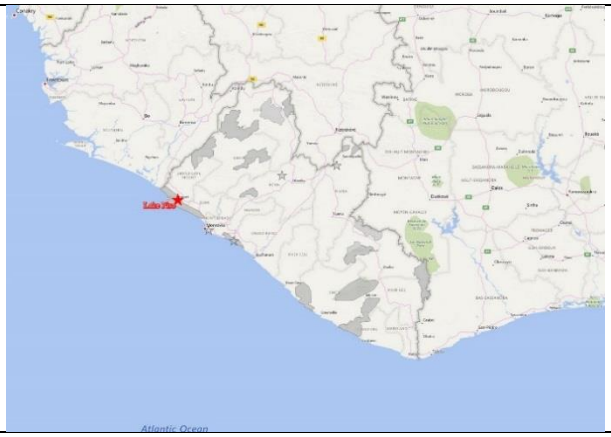
Lake Piso Multiple Sustainable Use Reserve

Designation	Multiple Sustainable Use Reserve
Status year	–2011 - Gazetted
Management authority	Department of Forest Conservation; Forest Development Authority
Area	97 975 ha
Transboundary site and area	None



Lake Piso

Designation	Ramsar Site, Wetland of International Importance
Status year	2003 - Designated
Management authority	Not Reported
Area	76 091 ha
Transboundary site and area	None

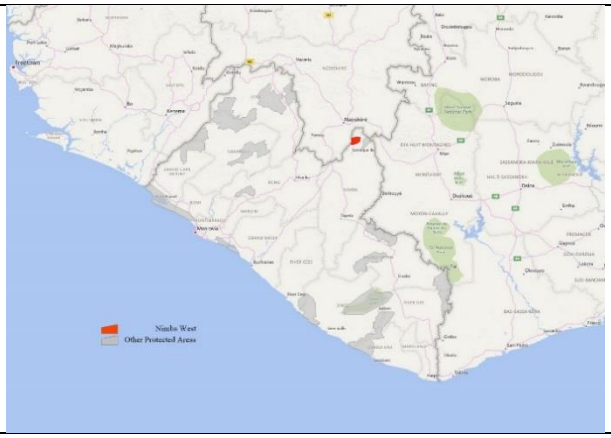


Marshall Wetlands

Designation	Ramsar Site, Wetland of International Importance
Status year	2006 - Proposed
Management authority	Not Reported
Area	23 813 ha
Transboundary site and area	None

Nimba West

Designation	National Park
Status year	2003 - Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	10 482 ha
Transboundary site and area	None



Grand Kru-River Gee

Designation	National Park
Status year	2003 - Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	135 100 ha
Transboundary site and area	None

Margibi Mangrove National Park

Designation	National Park
Status year	2003 - Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	23 813 ha
Transboundary site and area	None

Foya National Park

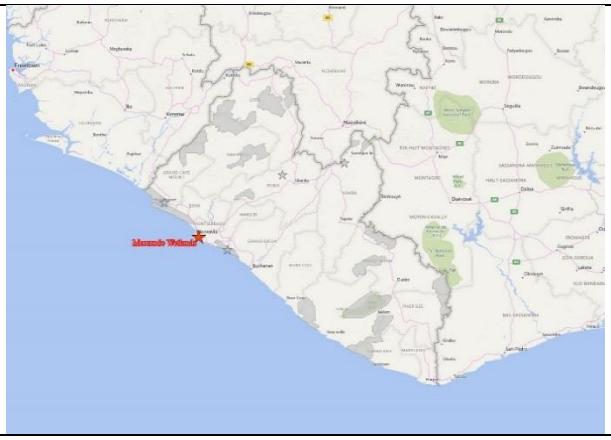
Designation	National Park
Status year	2003 – Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	164 628 ha
Transboundary site and area	None

Bong Mountain National Park

Designation	National Park
Status year	2003 - Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	24 813 ha
Transboundary site and area	None

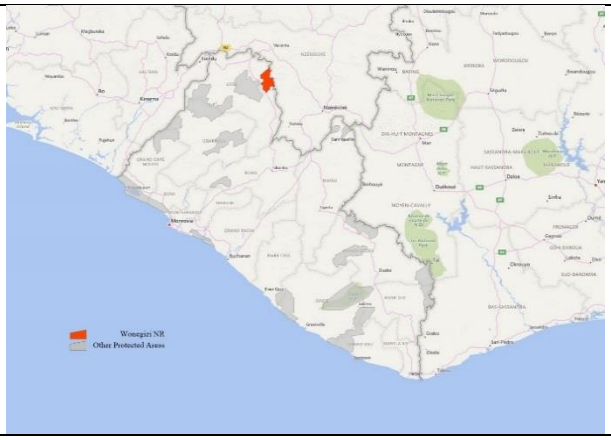
Mesurado Wetland

Designation	Ramsar Site; Wetland of International Importance
Status year	2006 – Designated
Management authority	Not Reported
Area	6 760 ha
Transboundary site and area	None



Wonegizi Nature Reserve

Designation	Nature Reserve
Status year	–2016 - Gazetted
Management authority	Department of Forest Conservation; Forest Development Authority
Area	37 979 ha
Transboundary site and area	Guinea; 1161.7 km^2



Grebo National Forest Park

Designation	National Forest Park
Status year	2003 - Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	97 136 ha
Transboundary site and area	None

Gbi National Park

Designation	National Park
Status year	2003 - Proposed
Management authority	Department of Forest Conservation; Forest Development Authority
Area	88 409 ha
Transboundary site and area	None

Gbedin Wetlands

Designation	Ramsar Site; Wetland of International Importance
Status year	2006 – Designated
Management authority	Not Reported
Area	25 ha
Transboundary site and area	None

6.2.3 Threats to Biodiversity and Cause of Biodiversity Loss

The field visits revealed that Liberians are aware of the negative impacts on the country's rich biodiversity. The general public attribute issues such as increased waste generation, the over-exploitation of the forest cover, land degradation and water pollution as having negative impacts on the natural environment. It is also true that different communities experience different environmental impacts. For example, in places where there are mining activities, environmental conditions differ from those of predominantly farming communities. Almost all communities have, however, noticed a negative change in the natural environment and present strong cases for improved planning and management considerations.

Most of the monoculture plantations associated with Liberia's agricultural economy are established on landscapes which were once forested. In this decade, more than any other in Liberian history, an unprecedented upsurge of oil palm plantations occurs. These are huge monoculture plantations of exotic oil palm whose seeds are used to produce palm oil.

In total, three (3) companies have 629,000 ha of land under palm plantations, which is just under 6% of Liberia's total expanse of just over 11 million hectares. This is an extremely large area for such a small country. There is a degree of geographic overlap between mineral deposits, exploration permits and the protected area/forest reserve network. As exploration occurs within these areas, forest cover and biodiversity are significantly affected negatively. Forest destruction is locally expanding and permanent as a result of mining. Other environmental impacts of mining include siltation of rivers, ground and surface water pollution, and forests, and therefore habitat fragmentation, among others. Iron ore mining concessions, past and present, cleared tropical rainforests for mines from open-cast pits and this creates unmanaged disposal sites. There is no post-environmental impact assessment on mined landscapes and so human health, social and environmental impacts/risks of industrial and artisanal mining remain largely unknown (UNDP 2006).

There are more than 100,000 artisanal miners in Liberia, (UNEP 2004) and the number is growing. This particular class of miners faces numerous organisational and related problems (Brownell 2009). In 1999, MME estimated that there were 5000 unlicensed and

1000 licensed mining and dealing operations in the country [Economist Intelligence Unit (EIU), 2003]. This type of mining is causing perpetual displacement of people, and as such, increased pressure on the remaining forests. For example, hunters have increased their assault on the dwindling wildlife to supply bush meat to mining settlements. Another significant impact is siltation which is threatening freshwater fish population in mining areas. Competitively, the dreadful impacts of mining on ecosystems and human lives are the same for both industrial and artisanal activities but are quite heightened and broaden in scope and impact for industrial mining concessions as compared to artisanal mining. Mining is a direct internal threat, as well as an external direct threat.

Shifting cultivation is a traditional farming system which the majority of Liberia's population is engaged in. Farm size falls within the range of 1-5 ha and food crops such as cassava and rice are the major crops grown. The staple food crops of Liberia are rice and cassava. Other crops grown for local consumption and trade include sugarcane, bananas, citrus, plantain, pineapple, sweet potatoes, corn and vegetables. Traditionally, domestic production of the country's main staple foods still relies on a traditionally low input/low output, shifting cultivation-mixed crop system.

Liberia is unusual in the high importance of bush meat, and in the lack of adequate alternatives to native animal protein. The economic value of this native animal protein is enormous, rivalling pre-war timber revenues in the country, and the industry is effectively unregulated. Because of the impacts of hunting on protected animals in the wild and because the harvest is generally assumed to be unsustainable at current levels, Liberia has a bush meat crisis, and could lose an important source of animal protein, rural and urban livelihoods, and some of its protected species if the industry continues to be poorly regulated [Development Alternatives Inc. (DAI), 2009].

In tropical rainforest ecosystems, there is a coevolving relationship between trees and a variety of animals, ranging from tiny thrips and midges, to bats and bees. These relationships can be quite specific, with one type of insect or bird being solely responsible for pollinating the flowers of particular species, or even genus of forest trees.

6.2.4 Government Responses to Challenges

Increasing numbers of people placing greater demands on the natural environment are compromising ecological integrity at an unprecedented rate. Mainstreaming biodiversity considerations into socio-economic agendas holds most promise to turn the situation around. It is necessary to:

- Integrate the protection and management of biodiversity resources with all human development by means of local, regional and national conservation initiatives;
- Build capacity in the areas of conservation assessment, taxonomy, green technology and knowledge transfer;
- Increase capacity in environmental law enforcement, management and education;
- Strengthen existing biodiversity conservation programmes to identify ecosystems, species and genetic resources that are at imminent risk of extinction; and
- Implement strong countermeasures to slow down the speed with which the loss of biodiversity occurs.

6.3 WILDLIFE RESOURCES

6.3.1 OVERVIEW

The major environment related laws protecting wildlife in Liberia is the Wildlife and National Parks Act of 1988 under the custodianship of the FDA. In November 2005, CI led a survey to assess Liberia`s remaining biodiversity. At last count, the country was home to 2,200 species of plants, 193 mammals, and 576 bird species. A new wildlife law, National Wildlife Conservation and Protected Area Management law
making it illegal to catch, kill, eat, sell wildlife was passed in November 2016. For Liberia, biological diversity has declined significantly over the years, and the country has lost many species, while most of its ecosystems have been degraded significantly (NBSAP, 2017).

6.3.2 PRESSURE ON WILDLIFE RESOURCES

The pressures on Liberia's wildlife resources include, hunting and poaching for both the illegal wildlife trade market, as well as the bush meat market. The loss of natural habitats through increased forest degradation due to mining, clearing, afforestation and other agricultural activities add to the pressure of International Union for Conservation of Nature (IUCN) species on Liberia's wildlife resources.

The following list includes all mammals which occur in Liberia and are rated as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU):

Table 6.1: *Examples of the Classes of Threatened Species of Animals, Plants and other Organisms in Liberia [Sources: Wold Conservation Monitoring Centre (WCMC), IUCN, FAO (NBSAP)]*

Class	Total Species	Total Endemic	Total Threatened
Amphibians	38	4	1
Plants	2,200	103	46
Mammals	193	n/a	17
Birds	590	1	22
Reptiles	67	2	2
Molluscs	n/a	n/a	1
Other Vertebrates	n/a	n/a	1
Ants	1,000	N/A	89
TOTAL		110	89

Table 6.2: *Threatened, Endangered and Vulnerable Mammals*

Species Threatened and endangered	Vulnerable
African elephant (Loxodonta africana)	Aellen's roundleaf bat (*Hipposideros marisae*)
Chimpanzee (Pan troglodytes)	African elephant (*Loxodonta africana*)
Diana monkey (Cercopithecus diana)	African golden cat (*Profelis aurata*)
Liberian mongoose (Liberritia kuhn	Buettikofer's epauletted fruit bat (*Epomops buettikoferi*)
African elephant (Loxodonta africana)	Jentink's duiker (*Cephalophus jentinki*)
Nimba otter shrew (Micropotamogale la mollier)	Pygmy hippopotamus (*Hexaprotodon liberiensis*)
Red colubus (Procolobus badius)	Sperm whale (*Physeter catodon*)
Allens's round leaf bat (Hipposideros marisae)	Spotted-necked otter (*Lutra maculicollis*)
Buettilkofer's epauletted fruit bat (Epopops buettikoferi)	West African manatee (*Trichechus senegalensis*)

Species Threatened and endangered	Vulnerable
Jentinks duiker (Cephalophus jentinki)	Zebra duiker (*Cephalophus zebra*)
Pygmy hippopotamus (Choeropsis liberiensis)	
Sperm whales (Physeter catodon)	
Spotted-necked otter (Lutra maculicellis)	
West African manate (Trichecnus senegabnsis)	
Zebra duiker (Cephalophus zebra)	

Source: LNBSAP, EPA 2011-2022

One of the most critical driving forces for deforestation is shifting agriculture, followed by forest harvest; the latter is a major driving force in Liberia. These have contributed significantly to the rapid acceleration of forest depletion. Other animals threatened by shifting cultivation include the African elephant (*Loxodonta africana*), Chimpanzee (*Pan troglodytes*), the Red colobus (*Procolobus badius*), Diana monkey (*Cercopithecus diana*), the Jentink‘s duiker (*Cephalophus jentinki*) and the Zebra duiker (*Cephalophus zebra*) WCMC 2000, FAO, 1999].

The edible animal and plant products, such as bushmeat, mushrooms, fruits, beverages and snails, are supposed to be the most important non-wood forest products in Liberia. Other non-wood forest products are medicines, colourants, bamboo and rattan cane used for furniture construction.

Surveys in the forests of the Cestos and Senkwehn Rivers showed a significant decline in the density of wildlife. No reliable estimates exist on the quantities of animals killed, nor of such meat. As commercial hunting increases previously held taboos that serve to protect selected species are ignored, resulting in all species being hunted. Commercial hunters are particularly indiscriminate, tending to target large animals. Hunting is governed by a permit system managed by the Wildlife and National Parks Division of the FDA which restrict hunters to certain animals to be killed, but limited logistics and a lack of implementation capacity make the enforcement of the legislation very challenging.

Bushmeat is the major source of protein and an important income generating activity for the bulk of the Liberian people, especially for rural dwellers. Wildlife resources contribute to 60-90% of the consumption of animal proteins throughout the country. Most popular species are small antelopes and monkeys. Liberian population of chimpanzees is estimated at only 1,000-5,000. Currently, commercial hunting is leading to extinction of many of the endemic species, which has resulted in importing of bushmeat from Sierra Leone and Guinea.
The pressures on Liberia’s wildlife resources is exacerbated by:

- Enforcement;
- Inadequate wildlife policy and protected areas management plans;
- Inadequate capacity for wildlife management;
- Inadequate protection for critical species, habitats and heritages;
- Inadequate community and private sector initiatives in protected areas management;
- Lack of or poor management of buffer zones around protected areas;
- No comprehensive data on the status and trends of wildlife and habitats; and
- Inadequate legislative measures and standards in wildlife management.

6.3.3 WILDLIFE POPULATION TREND

Liberia has yet to realise sufficient effort to build local capacity in data gathering in terms of wildlife and biodiversity information. Hence, an absence exists of the country's biodiversity data on important biodiversity platforms. What is well-documented, however, is that the wildlife populations of various Liberian animals have been put under tremendous strain due to poaching, hunting, and other means of exploitation for either economic gain or plain survival.

Populations of forest-dependent animals have been reduced to such low levels that a number of them can no longer be considered viable. Large mammals have become the first to be eliminated from forest areas. As in most other countries in West and Central Africa, people in Liberia have always hunted and relied on bushmeat to provide them with protein (Anstey, 1991; Bene and Dufour, 2011). The bushmeat trade is a lucrative business in Liberia, as in other parts of Africa (Oates, 1986; Barrie and Kante, 2004; Sanderson and Trolle, 2005; Barrie and Aalandong, 2005; Bene and Dufour, 2011). The apparent extinction of Miss Waldron's Red colobus (*Piliocolobus badius waldroni)* has been attributed to hunting and the demand for bushmeat (Oates *et al*., 2000). West African chimpanzees are the most threatened of the three subspecies mainly due to habitat loss, high hunting pressure and the pet trade (Kormos and Boesch, 2003).

Table 6.3: *Scientific, Common and Local Names of Animals in Liberia's Forested Landscapes Source: LNBSAP, EPA 2011-2022*

Scientific name	Common/Local name	IUCN Red List Category*
Cercopithecus diana	Diana monkey	VU
Loxodonta cycloids	Forest elephant	EN
Syncerus coffer	Buffalo	LC
Pan troglodytes	Chimpanzee	CR
Panthera pardus	Leopard	VU
Tragelaphus euryceros	Bongo	NT
Potamochoerus porcus	Bush Pig	LC
Cephalophus niger	Black duiker	LC
Cephalophus dorsalis	Bay duiker	NT
Cephalophus ogilbyi	Ogilbyi duiker	VU
Cephalophus zebra	Zebra duiker	VU
Cephalophus maxwellii	Maxwell duiker	LC
Tragelaphus scriptus	Bushbuck	LC
Hylochoerus meinerizhageni	Giant forest hog	LC
Procolobus badius	Red monkey	EN
Cercopithecus torquatus	Sooty mangabey	NT
Colobus polykomos	Black & White colobus	VU
Cephalophus silvicultor	Antelope	NT
Cercopithecus mona	Field monkey	LC
Cephalophus jentinki	Jentink's duiker	EN
*Explanation of IUCN's Categories for Threatened Species (see This and Table 2): CR=Critically Endangered, DD=Data Deficient, EN=Endangered, LC=Least Concern, NT=Near Threatened, VU=Vulnerable, NA=Have yet to be assessed.		

6.3.4 GOVERNMENT RESPONSES TO CHALLENGES

The Global Biodiversity Information Facility (GBIF) is an international network and research infrastructure funded by the world's governments and aimed at providing anyone, anywhere, open access to data about all types of life on earth. The project seeks to build capacity of local data collectors, academic institutions, government agencies and other stakeholders to mobilise, process and conserve Liberia's biodiversity data in standard data sharing formats to be published and accessed by national and international data users. Development of such information resources will have important implications for the management and conservation of biodiversity in Liberia and across the West African region.

Coordinated by University of Liberia, in collaboration with the Liberian Forestry Development Authority (Liberia), Fauna and Flora International (Liberia) and the University of Kansas (USA), the project will enhance national capacity for biodiversity data mobilisation, processing, management and publishing through multi-stakeholder training workshops for data managers and users in Liberia. Combined efforts will result in mobilisation of high-quality occurrence and distribution data for species in Liberia, as well as comprehensive checklists of key fauna and flora species of global conservation concern occurring in the country.

Additionally, a separate unit within the Conservation Department of the Forestry Development Authority of Liberia has been established. The work of the Confiscation Unit is to ensure the enforcement on wildlife are implemented. Over the years, this effort on the part of the government has led to thousands of bush meats been confiscated and burned or auction. Check points have been established alongside existing checkpoints and with joint security to ensure that bush meat confiscations is enforced. As a means of further strengthening the abolishing of trade in bushmeat, in 2006, the Government of Liberia published a proclamation prohibiting hunting and trade in wildlife. As an answer to the trade in wildlife, all live wildlife confiscated are sent to the Libassa Wildlife Sanctuary where such wildlife are care for and later release into the wild. The Libassa Wildlife Sanctuary was established in collaboration with the Forestry Development Authority.

6.5 ECOSYSTEM SERVICES AND VALUES

6.5.1 Overview

The diverse benefits that we derive from the natural environment are sometimes referred to as ecosystem services. Ecosystems support plant and animal life by maintaining the overall balance in nature. When functioning well, ecosystems also bring multiple benefits to people. These benefits range from provision of basic commodities, such as food and fuel, to spiritual benefits. Examples of these services include the supply of food, water and timber (provisioning services); the regulation of air quality, climate and flood risk (regulating services); opportunities for recreation, tourism and education (cultural services); and essential underlying functions such as soil formation and nutrient cycling (supporting services).

Ecosystem services can be roughly divided into:

- Supporting services - those services creating conditions necessary for the provision of all other ecosystem services, for example photosynthesis or soil formation;
- Provisioning services - all products coming from ecosystems, for example food, fibre, fuel, herbs and medicinal plants, genetic resources, drinking water;
- Regulating services - the capacity of ecosystems to regulate important natural processes, for example regulation of climate, quality and quantity of water, etc.; and
- Cultural services - non-material benefits from ecosystems, for example the aesthetic and recreational value of landscapes.

Today, through our activities, we often exploit natural resources, influencing the capacity of ecosystems to provide us with their beneficial services. Agriculture, forestry, fishing, even tourism can be hard for ecosystems to swallow. With our excessive activities we impact air quality, water purification processes, flood control, and the earth's climate. (WWF, 2019).

PES is an innovative approach to nature conservation, although not accepted by all experts as they perceive it as a weakness in the system with risks by allowing open markets to assign value to ecological systems. PES is the name given to a variety of arrangements through which the beneficiaries of environmental services, from watershed protection and forest conservation to carbon sequestration and landscape beauty, reward those whose lands provide these services with subsidies or market payments.

Arranging payments for the benefits provided by forests, fertile soils and other natural ecosystems is thought to be a way to recognise their value and ensure that these benefits continue well into the future. Payments for Ecosystem Services encourage the maintenance of natural ecosystems through environmentally friendly practices that avoid damage for other users of the natural resources.

Across the world, environmental conservation is critical to secure the flow of ecosystem services that are essential for people and nature. With funding for natural resource management dwindling, a variety of PES schemes have emerged as potential sources of sustainable financing for conservation. This is one of the main arguments in favour of PES. In addition to preserving natural resources, this method is thought to improve rural areas and rural lifestyles (WWF, 2019).

In practice, PES often involves a series of payments to land or other natural resource managers in return for a guaranteed flow of ecosystem services (or, more commonly, for management actions likely to enhance their provision) over-and-above what would otherwise be provided in the absence of payment. Payments are made by the beneficiaries of the services in question; for example, individuals, communities, businesses, or government acting on behalf of various parties.

The basic idea behind PES is that those who provide ecosystem services should be paid for doing so. PES, therefore, provides an opportunity to put a price on previously non-valued ecosystem services like climate regulation, water quality regulation and the provision of habitats for wildlife and, in so doing, brings ecosystem services into mainstream economics.

One unique PES approach was the Hoima and Kibaale PES intervention. This intervention took place from 2010 to 2013 and was especially unique because it was the first PES programme set up specifically for a randomised control trial to empirically determine its impact on deforestation (Jayachandran, 2016). In the treatment villages, owners of forested land were paid $28 per year over the course of two years for every hectare of forest land that was left intact, with the possibility of additional payment for planting new trees. The payment scheme amounted to 5% of the average annual income for the typical participating landowner (Jayachandran, 2016). The programme evaluation found there to be significantly less deforestation in participating villages (2%-5%) than in control villages (7%-10%) (Jayachandran, 2016). It is important to note that the programme did not carry on beyond the evaluation period, and it is assumed that previous forest practices will resume once landowners stop receiving programme payments (Jayachandran, 2016).

6.5.2 Types of Payments for Ecosystem Services

There are three broad types of PES schemes (Smith *et al*, 2013):

- Public payment schemes through which government pays land or resource managers to enhance ecosystem services on behalf of the wider public;
- Private payment schemes, self-organised private deals in which beneficiaries of ecosystem services contract directly with service providers; and
- Public-private payment schemes that draw on both government and private funds to pay land or other resource managers for the delivery of ecosystem services.

Table 6.4: *Examples of Payment for Ecosystem Service Schemes (Smith et al., 2013)*

International	National	Catchment	Local/Community
Examples include Reducing Emissions from Deforestation and Degradation (REDD+) whereby developing countries that are willing and able to reduce emissions from deforestation and degradation are paid by developed countries for doing so.	For example, the Environmental Stewardship programme, a government-financed scheme in which about £400 million a year is paid to farmers and land managers on behalf of the public in return for more environmentally sensitive farming.	For example, downstream water users paying for appropriate watershed management on upstream land. These schemes tend to be privately financed, for example where a water utility pays upland land managers on behalf of its customers to implement certain measures designed to stabilise or improve water quality.	For example, a scheme whereby residents collectively fund a warden or environmental organisation to manage local green space for biodiversity, landscape and recreational value.

For a PES scheme to work it must represent a win for both buyers and sellers. PES may be positive from a buyer's perspective if the payments are less than those associated with any alternative means of securing the desired service. For example, it may be less

expensive for a water utility to pay landowners for improved catchment management than to pay for additional water treatment (Smith *et al*, 2013).

PES schemes may be positive from a seller's perspective, if the level of payment received at least covers the value of any returns foregone as a result of implementing the agreed interventions. For example, a farmer may be willing to create ponds for enhanced water storage if the payments received at least cover the costs of doing so, including the costs associated with any lost agricultural production (Smith et al, 2013).

6.5.3 Barriers to implementing Payment for Ecosystem Services in Liberia

6.5.3.1 Information Barriers

For a country like Liberia that currently is dealing with land tenure challengers and the relocation of peoples displaced by the civil war, it is unlikely that a market for services will arise in the absence of government intervention. In the current state of affairs, if a land use provides valuable ecosystem services it is unlikely that they are widely recognised or appreciated by beneficiaries. Thus, education and outreach may prove an important part of designing a PES programme for Liberia.

Other information barriers that provide a challenge to implementing PES schemes in Liberia may include:

- Potential buyers of ecosystem services (consumers, businesses, utilities, government agencies, and even conservation NGOs) are often unaware of their dependence on ecosystem services. User-financed schemes are, therefore, biased toward ecosystem services that already have some sort of market value, e.g. water companies paying upstream land managers to deliver water treatment savings;
- Potential sellers are often not aware of ecosystem service payments and markets, or they do not know how to find potential buyers;
- To compound the situation, few policy-makers and regulators are knowledgeable about the policy requirements and implication of PES;
- Lack of awareness has an impact on the ability to find willing and able buyers of ecosystem services;
- The concept of PES may be perceived as too new and complex and therefore risky; and
- A lack of clarity for buyers over what it is they are buying, as the linkages between specific management practices and ecosystem services outcomes are often unclear.

Addressing these issues often requires specific technical skills to bring the right kind of information to the buyers, including information on the value of the ecosystem service and what benefits it delivers. Ideally, Liberia should engage multi-disciplinary professionals with the skills to firstly identify all potential ecosystem services that exists within its wealth of biodiversity and then to assess links between management and ecosystem service outcomes (refer to Technical Barriers below).

A necessary condition for the design of a "genuine" PES is a clear relationship between the type of land use being promoted and the provision of ecosystem services. It is, therefore, imperative to develop a sufficient understanding of the links between biophysical systems, functions, services and, ultimately, benefits or values in order to design a workable PES programme [Department for Environment, Food and Rural Affairs (DEFRA), 2010].

As the FAO has emphasised, many ecosystem services arise from complex processes, making it difficult to determine which actions affect their provision and precisely who the providers and beneficiaries are (FAO, 2007). For Liberia, getting the science right is crucial and requires a clear understanding of the biophysical relationships between current land-uses and their environmental consequences. If the link between landscape management and service provision is poorly understood, then the buyers will have little confidence that they are receiving value for their money (Salzman, 2009). Muradian *et al*. (2010) argue that to achieve a "genuine" PES requires developing sound, context specific, socio-ecological research prior to implementation, which could guarantee a realistic connection between payments, services and economic benefits. Because direct monitoring of ecosystem service outputs is difficult or costly, most PES schemes rely on observable proxies, such as actions or outcomes (e.g. the presence of buffer strips or the amount of forest cover) (Jack, 2008).

Baselines are an essential element of any mechanism aiming to address ecosystem service loss and degradation. Baselines provide [Organisation for Economic Cooperation and Development (OECD), 2010]:

- Information on the expected trends in the provision of ecosystem services and, hence, the magnitude of the incentives that will be needed to attain a certain goal;
- A reference against which programme performance can be assessed over time;
- A means to demonstrate that payment leads to additional benefits relative to the status quo; and
- A basis for developing eligibility criteria for participation in a PES programme.

The complex nature of ecosystem service provision means that it can be difficult to, firstly, identify which land uses and/or managers are providing a service(s) and, secondly, who is benefiting from that service(s) (Kruger and Casey, 2007). Therefore, identifying who should pay whom (and where property rights lie to underpin this) can be problematic, especially in Liberia.

Whereas the providers of some provisioning services may be relatively easy to identify, the diffuse nature of many other ecosystem services makes it difficult to locate precisely who is responsible for their provision. In the case of biodiversity, the impacts of individual actions can be hard to separate from those undertaken on neighbouring landholdings (Salzman 2009). Securing an ecosystem service in one location could lead to increased pressure to convert or degrade ecosystem services in another. The environmental benefits obtained from PES can, therefore, be overestimated.

A key issue in developing PES programmes in Liberia is likely to be a shortage of skills and experience. Establishing a PES programme will involve a range of activities, many

of which will require specialist knowledge and expertise. These include establishing an ecosystem services baseline; identifying appropriate land management interventions; negotiating complex agreements which potentially extend over many years; handling financial transactions; and undertaking monitoring, evaluation and review.

A wide range of role players and institutions are to be involved in PES including buyers, sellers, brokers, government departments, regulatory agencies, business support services, financial institutions, and third-party certifiers and verifiers. As such, establishing a PES programme is likely to require a wide range of competencies including technical, financial, negotiating and engagement skills.

6.5.3.2 Policy and Regulatory Barriers

Overlaps, interactions and unclear boundaries may exist between various national and international policies and regulations. This may lead to problems of "double counting" and additionality for PES schemes and arguably dampened incentives to take up private sector PES and/or voluntary measures.

The Liberian government's commitment to international agreements on, for example, biodiversity and climate change ensures that it is compelled to ensure the provision of ecosystem services, and thus a certain level of funding for PES schemes is used. Effective PES institutional mechanisms are needed for achieving the efficiency in certification, monitoring and the creation of a national registry of ecosystem services, and their market-based management.

There is also a need for community-level institutions and the involvement of various stakeholders in the process of marketing ecosystem services and setting up the payment schemes.

PES programmes require a great deal of cooperation that depends on state and/or community engagement. Local confidence must be won, and small stakeholders need increased bargaining power to deal with more powerful stakeholders.

For PES schemes to be sustainable, the Liberian government can play several roles in capitalising on PES opportunities:

- As a potential buyer, and have a role in PES initiatives;
- As potential facilitators in bringing together buyers and sellers; and
- Provide PES institutional framework where the following functions can be carried out:

    - *Development and implementation of a mechanism to collect and manage payments from service beneficiaries (i.e. the buyers of the ecosystem service);*
    - *Development and implementation of a mechanism to negotiate with and contract service providers, quantify the ecosystem service they are providing and monitor their participation (including record keeping); and*
    - *Development and implementation of a governing structure for making decisions and resolving disputes.*

6.5.3.3 Institutional Barriers

A precondition for functioning markets is the presence of discrete providers and beneficiaries (Salzman, 2009). Unless a relatively small number of providers and beneficiaries can get together, transaction costs become too high for contract formation. The public goods nature of many services makes this a real concern. In order to overcome this problem, a supporting institutional environment is needed.

Appropriate forms of property rights or tenure security play a key role in both economic incentives and payment arrangements because they control access to benefits and define responsibilities for actions needed to ensure their provision. Thus, they determine who has access to resources, and whether those who pay the costs of management practices have access to any of the benefits, and therefore, have an incentive for conservation. The key pre-requisite for a well-functioning PES programme is that property rights are clearly defined and enforced, which is likely to be an issue in Liberia.

Other key legal issues may include:

- Lack of accountability – where a contractual approach is taken the delivery of PES will be binding only on the parties to the contract, unless statute provides otherwise;
- Lack of effective enforcement mechanisms – consider the effectiveness of enforcement mechanisms if the "seller" fails to deliver the required service; and
- The need to consider the burden of proving that failure is the "seller's" responsibility rather than, for example, another upstream water proprietor.

6.6 FORESTRY AND WOODLAND

6.6.1 Introduction

Since its foundation in 1952 as the Bureau of Wildlife attached to the MoA (FAO 1975) and as Forestry Development Authority (FDA) established by an Act of Legislature in 1976, the Authority, a state corporation, has been mandated to ensure the sustainable management and conservation of Liberia's forests and related natural resources for the benefit of present and future generations. The mandate was further strengthened through the National Reform Law of 1979. Specific tasks of the FDA are to: (i) Provide long-term and medium-term planning in the forestry sector; (ii) Prepare forestry policy, law and bear responsibility for administration; (iii) Supervise adherence to forest legislation and concession agreements; (iv) Calculate and determine forestry fees; (v) Evaluate investment proposals and execute reforestation and forestry research and training; and (vi) Monitor activities of timber companies, execute protected area programmes and administer wildlife and national parks. In a variety of ways and with varying levels of recognised success, the FDA has lived up to its mandate; although much more needs to be done.

Liberia's lowland tropical rainforests comprised of wet evergreen forests in the southeast of the country with rainfall above 2000 mm, and moist semi-deciduous forests in the northwest with rainfall between 1,600 mm and 2000 mm. These two distinct zones of high forests are critical for carbon capture and storage within Liberia and are among the largest continuous forest blocks in West Africa. According to global estimates, the forests

in northern Liberia have some of the highest density of above-ground biomass carbon in the world – higher even than in the Amazon rainforest (CI 2017, Avitabile *et al.* 2016).

About 60 years ago, continuous high-density lowland tropical rainforest ecosystem or high forest almost entirely populated more than 90% of Liberia's terrestrial landscape (Kryn and Fobes, 1959). Scattered patches of mangrove forests mostly located along Liberia's 350-mile coastline were also reported (Gatter, 1998 and Mayer, 1951). In 2009, the FAO (2009) approximated the country's forest cover at 31.6%. Recently, it is estimated that forest cover totalled 4.32 million hectares and is characterised as tropical rainforest (with 80% canopy cover) or 45% of Liberia's terrestrial landscape (CI, 2017). In 2015, forest with canopy cover of 30% covered 6.5 million hectares, which is 68% of Liberia's land surface. This includes some areas under tree crops such as cocoa, oil palm and rubber (World Bank, 2018). Because the current definition of "forest" in Liberia does not include tree crops, it is fair to say that 45% of forest cover is more accurate for the current expanse of the country's forests.

6.6.2 Forest Resources

The UGF of West Africa is one of the world's priority biodiversity hotspots. It extends from Guinea and Sierra Leone in the west, through Liberia, Ivory Coast and Ghana, to Togo in the east. In addition to the unique habitat it provides for wildlife, the forests are of vital importance for the livelihoods of millions of West Africans and provide key ecosystem services of local and global importance that include cultural identity and stability, as well as strengthened local knowledge systems.

Liberia's forests boast flora and fauna species that are both rare and at risk of extinction. Examples of some of the endangered (EN) and vulnerable (VU) floral species are the *Entandrophragma* spp. (*E. angolense*, *E. candollei*, *E. cylindrica*, and *E. utile*), *Guarea cedrata* (VU), *Khaya anthotheca* (VU) and *Tetrabelinia tubmaniana* (VU). Chimpanzee (*Pan troglodytes*), pygmy hippopotamus (*Choeropsis liberiensis*), forest elephant (*Loxodonta cyclotis*) (VU), Diana monkey (*Cercopithecus diana*) (VU), leopard (*Panthera pardus*) (VU), and giant ground pangolin (*Smutsia gigantean*) (VU) are examples of the country's animal species. There is still much to learn about the forest's biodiversity and socio-economic environmental importance.

According to figures from the World Conservation Monitoring Centre (WCMC), Liberia's forests contain 585 million metric tons of carbon in living forest biomass. Liberia has some 881 known species of amphibians, birds, mammals and reptiles. Of these, 0.8% are endemic and 4.2% are threatened. Liberia is home to at least 2200 species of vascular plants, of which 4.7% are endemic. Around 1.3% of Liberia is protected under the International Union for Conservation of Nature (IUCN) categories I-V. Few examples of endemic floral species are *Bertiera sinoesis*, *Cola liberica*, *Gilbertiodendron obliquum*, *Tetraberlinia tubmaniana* and *Tragia liberica*. For faunal species, the examples are Langer's screeching frog (*Arthroleptis langer*), Monrovia killifish (*Callopanchax monroviae),* Gbanga Forest tree frog (*Leptopelis bequaerti*), and pygmy hippopotamus (*Choeropsis liberiensis)*.

Liberia has adopted Sustainable Forest Management (SFM) practices through which conservation of the nation's forests and sustainable harvesting (production) of forest resources are ensured. The NFRL (GoL 2006), other Acts of Legislation (e.g. FDA 2007) and the Code of Timber Harvesting practices are the guiding instruments for SFM in the country. Forest harvesting can generate many economic, social and environmental benefits for Liberia and Liberians. However, poor forest governance and management practices can lead to serious environmental degradation and adverse impacts on direct forest-dependent communities and Liberia as a country (Sixth CBD Report, 2019).

The FDA published its first Liberian Code of Practice for Timber Harvesting (hereafter referenced as the "Code") in September 2007.The Code was developed to provide a clear set of guidelines to help foresters and logging companies select or/and develop sound harvesting practices .The Second edition of the Code as amended on 31 May 2017, was produced in consultation with stakeholders within the forest sector in Liberia and with technical and financial assistance from the Liberian Voluntary Partnership Agreement (VPA) support Unit funded by the EU and the United Kingdom Department for International Development (DFID).

The Code applies to all natural forest areas in Liberia and its objectives are to: (i) Provide forest operators [Forest Management Contracts (FMCs)], Timber Sales Contracts (TSCs), PUPs and Community Forest Management Agreements (CFMAs) with a set of guidelines and standards of logging/utilisation and reduce environmental impacts. This is primarily achieved by giving guidance in mitigating intolerable risks in logging operations; and (ii) Provide a sound foundation to comply with Liberian legality requirements related to forestry.

Responsible and equitable forest governance and SFM practices are among the best approaches to protecting wildlife. The crisis Liberia faces today in its fast depleting wild animal population is not confined to terrestrial environment. Marine ecosystems also are equally impacted by unsustainable harvesting. Issues relating to the felt impoverishment of the marine environment are as far reaching as those of the terrestrial environment.

A separate linked, strategic approach is, therefore, required for marine ecosystems. Similarly, a separate but linked strategic process may be required for conservation of freshwater ecosystems in Liberia which should recognise the unique elements of the aquatic fauna as briefly examined elsewhere (EU, 2015). Liberia is slowly but certainly taking a healthy and determined path towards protecting and conserving its terrestrial and marine wildlife through legislation and the establishment of protected areas, although more are established on terrestrial ecosystems. In addition to actions taken to protect and conserve wildlife by protecting their habitats through national parks, nature reserves and the creation of corridors, the Act Adopting the National Reform Law (GoL 2006), Section 9.12, forbids the hunting, capturing or possessing certain animal species unless specific authority has been received from the FDA. These animals are declared "fully protected animals of Liberia". Liberia is a signatory to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora, CBD (Convention on Biological Diversity) and related conventions as the country works with a host of international partners and projects to fight animal trafficking, such as WABiCC (West Africa Biodiversity and Climate Change). WABiCC is a 5-year programme funded by USAID

that aims to improve conservation and climate-resilient, low-emissions growth across West Africa. One of WABiCC's approaches to improve conservation is to combat wildlife trafficking and coastal resiliency (USAID 2016).

6.6.3 Trends of Forest Production and Consumption

Liberia's Permanent Forest Estate (PFE) covers an estimated 1.41 million ha, comprising 1.31 million ha of natural-forest production PFE and 101,000 ha of protection PFE. None of the PFE is currently thought to be under SFM. The existing protection of PFE comprises less than 3% of the country's uncommitted forests of about 2 million ha. In written history the need for sustainability in natural resource management was first expressed in 1713 by Hans Karl von Carlowitz, a Saxonian mining director, who was concerned about sustainably supplying the large quantities of wood required in the many silver mines he was managing to generate wealth for the King of Saxony (Morgenstern, 2007). That event heralded the birth of the principle of sustained yield, which forest management agencies in many countries around the world have adopted. Evidence of SFM in Liberia, however, has existed in principle since 1963 when logs were shipped out of Liberia for the first time (FAO, 1975).

Over the 25 year between 1980 and 2005, the country's forest estate has been reportedly reduced by 22% (FAO, 2005), suggesting an average annual rate of deforestation of 0.9%. In addition, it was estimated that about 30% of Liberia's potentially commercial forests have been logged within that period (Bayol and Chevalier, 2004). A 2008 forest change analysis carried out by a partnership between the FDA, and CI and South Dakota State University suggests an average increase of the deforestation rate at 0.2% in 1986-2006 (R-Pin 2008).These numbers , and we could go on and on along this path of discussion, strongly testify of a deteriorating forest estate, even though they are average rates obtained by dividing the area of forest loss by the number of years encompassing the study, Shearman (2009) argued that average rates are somewhat confusing as they indicate that the same area of forest is lost each year.

6.6.4 Liberia Forest Cover Change and Tree Cover Loss 2014 - 2018

The below analysis was done using mapped areas of tree cover loss using global data. The global dataset is not able to distinguish the loss of natural forests from loss in plantations or secondary or degraded forests. This is because it might confuse large grassland for deforestation. Therefore, the analysis refers to "tree cover loss", not "deforestation." A national forest inventory report for Liberia is being finalised. The report is expected to give the detail forest inventory of the county.

A current annual deforestation (tree cover loss) rate of forest cover in Liberia is approximately 0.31%. However, this number may vary significantly depending on the forest definition used, and whether plantation forests are included. Large areas of tree cover loss along Liberia's coast are a result of recent clearing for oil palm. The band of tree cover loss in the centre of the country, extending from the coast outside Monrovia to the middle of the country, is driven by rubber plantations. Finally, there are small (<1 ha) patches of tree cover loss scattered through the central corridor of the country. This loss

is likely a result of subsistence pressures, such as small-scale agriculture, charcoal production and local timber harvesting (CI, 2017).

6.6.5 Forest Inventory

The first National Forest Inventory for Liberia was launched on the 4th of June 2018 in Lofa County. The project is funded by the Forest Carbon Partnership Facility and implemented by the Forestry Development Authority (FDA) in Liberia. Unlike previous forest inventory, this one was fully digitised with the usage of the Open Forest toolkit. There are two (2) previous inventories: a 1968 one was conducted by the German Forestry Mission, while the 2007 one was conducted by the Forestry Development Authority and partners. In these two studies the focus of the studies was on particular areas and not the entire forest, producing only regional or local estimates of forest resources. The present inventory covered national estimates of the forest resources. The makeup of the team includes six biophysical teams, two socio-economic teams, a data management and support team, as well as a supervisory team. The team was expected to complete the first priority area by September 2019. This current inventory is expected to build upon past support from the UN-REDD Programme, under which personnel capacity building was done on National Forest Inventory and forest change mapping. It is expected that the next SoER will build on this current National Forest Inventory of Liberia as the document was not completed, validated and published upon the completion of this SoER.

Table 6.5: *Scientific and Local Names of Timber Tree Species* in Most of Liberia's Forested Landscapes*

Scientific name	Local/trade name	Use	IUCN Red List Category
Amphimas pterocarpoides	Lati	Wood is used for lumber and sap (from the bark) is used to treat dysentery.	NA
Anopyxis klaineana	Kokoti, White Oak	Wood is used for plank and general construction purposes, and the bark is used to treat infectious diseases and ulcers.	VU
Anthonotha fragrans	Kibokoko	Wood is used for lumber.	NA
Beilschemiedia mannii	Bide-tue	Wood is suitable for carpentry and cabinet work.	NA
Canarium schweinfurthii	Aiele	Wood is used for furniture and core veneer, and bark and resin are used to cure gonorrhoea and leprosy.	NA
Capocalyx aubrevillei	Capocalyx,Mah	Wood is used as a source of native salt and as lumber, and the bark is used to treat coughs.	NA
Chlorophora excels	Iroko, Odum	Wood is used for constructions of all kinds, including railway	VU

Scientific name	Local/trade name	Use	IUCN Red List Category
		sleepers, doors, window frames, household posts, wagons, wheels and barrels.	
Coula edulis	African walnut, Attia,Slah	Wood is used for house posts, railway sleepers, bridge piles, doors, and turnery.	VU
Cynometra Ananta	Apome	Wood is used for decking and railroad tires.	EN
Dacryodes klaineana	Adjouabra, Monkey plum	Wood is used for lumber and fruits are eaten by animals and people.	NA
Entandrophragma angolense	Edima, Tiama	Wood is used for furniture, cabinet making, interior decorating, panelling, boat and ship fittings, joinery and liked veneer.	VU
Entandrophragma candollei	Kosipo	Wood is used for carpentry and cabinet-making	VU
Entandrophragma cylindricum	Sapele, Lifaki	Wood is used for interior decoration, cabinet-making, furniture, panelling and boat building.	VU
Entandrophragma utile	Sipo, Utile	Wood is used for plywood making, as well as in panelling, boat building and cabinet-making.	VU
Funtumia elastic	Mutundu	Wood is used locally for doors, planks and furniture.	NA
Gilbertiodendron preussii	African oak, Red wood	Wood is used for boat and ship building.	VU
Guarea cedrata	Obobo, Guarea	Wood is used for veneer and panelling, furniture, high-class joinery, and boat-building.	VU
Hallea ciliapa	Abura, Bahia	Wood is used for interior joinery, furniture, light construction and for accumulator boxes, containers for chemicals, drawers, plywood, brushes and wagon building, electric	NA

Scientific name	Local/trade name	Use	IUCN Red List Category
		switch boards, carving and laboratory tables.	
Heitiera utilis	Niangon, Whismore, Bai	Wood is used for carpentry, cabinet, furniture making, ship-building, greenhouses, turnery, veneer, plywood, construction work and joinery.	VU
Khaya anthotheca	Acajou-blanc white mahogany	Wood is used in cabinet making, plywood manufacture, high-class joinery and furniture.	VU
Klainedoxa gabonensis	Eveuss, Klainedoxa	Wood is used for railway sleepers and for canoes, planking of ship decks, piles, wooden paving, heavy carpentry, poles and firewood.	VU
Lophira alata	Ekki,Ironwood	Wood is used for railway tiles, heavy duty flooring, heavy construction as bridges and wharves.	VU
Lovoa trichilioides	Lovoa, Tigerwood	Wood is used for furniture, cabinet work, panelling and high-class joinery.	VU
Nauclea diderrichii	Bilinga, Breimstone, Kusia	Wood is used for mortars, as well as railway tiles, furniture, flooring, bridges and general construction work.	NA
Newtonia aubrevillei	Atembre	Wood is used for lumber and as an aphrodisiac.	NA
Oldfieldia Africana	African oak	Wood is used to construct bridges and for heavy construction.	VU
Parinari excels	Parinari	Wood is used for railway sleepers, general construction, flooring, bridges and general construction work.	NA
Parkia bicolour	Parkia, Locust beans	Wood is used as sawn timber.	DD
Pentaclethra macrophylla	Oil bean tree, Jehborh	Wood makes an excellent timber for railways as it has strong resistance to termites. The pods of this leguminous tree species	NA

Scientific name	Local/trade name	Use	IUCN Red List Category
		makes quality firewood and the ashes produced therefrom are used as soda added to soup. Seeds are eaten when roasted, and bark is used to treat hunchback and leprosy.	
Pentadesma butyracea	Black mango, Sulutue	Wood is used for pit props and for food and soap in some communities.	DD
Piptadeniastrum africanum	Dahoma, Kuweh	Wood is used for heavy construction and flooring, car building, railway carriages, floor fittings and features in providing shade for coffee and cocoa in an opportunistic agroforestry system in some communities, and the bark is used to treat toothache.	NA
Terminalia ivorensis	Blie Framire	Wood is used for fine carpentry, building, flooring and plywood fabrication.	NA
Terminalia superba	Limba, Afara	Wood is used as core and face of veneer, furniture of all kinds, features in opportunistic agroforestry systems as shade tree in some communities, parquet floors with light traffic, and construction of houses.	NA
Tetraberliniana tubmaniana	Liberian pine Tetra	Wood is recommended for plywood, indoor construction, floors, steps and furniture.	EN
Tieghemella heckelii	Makore, Baku	Wood is used for high-class furniture, joinery, cabinet work and as a veneer.	VU
Triplochiton scleroxylon	Obeche, Samba, Wawa	Wood is used for plywood making, and for the construction of pianos, boxes, organs, shelves and furniture.	VU
Uapaca guinensis	Karro, Rikio	Wood is used as a high-quality charcoal and seeds are edible by	NA

Scientific name	Local/trade name	Use	IUCN Red List Category
		people and wild animals.	
*These tree species feature in the timber trade and much has been learned and written about them. There is a variety of other tree species of local importance that science must learn about in the country.			

The following figures illustrate the forest cover loss in Liberia between 2001-2013, 2001-2014, 2001-2015, 2001-2010 and 2001-2017.

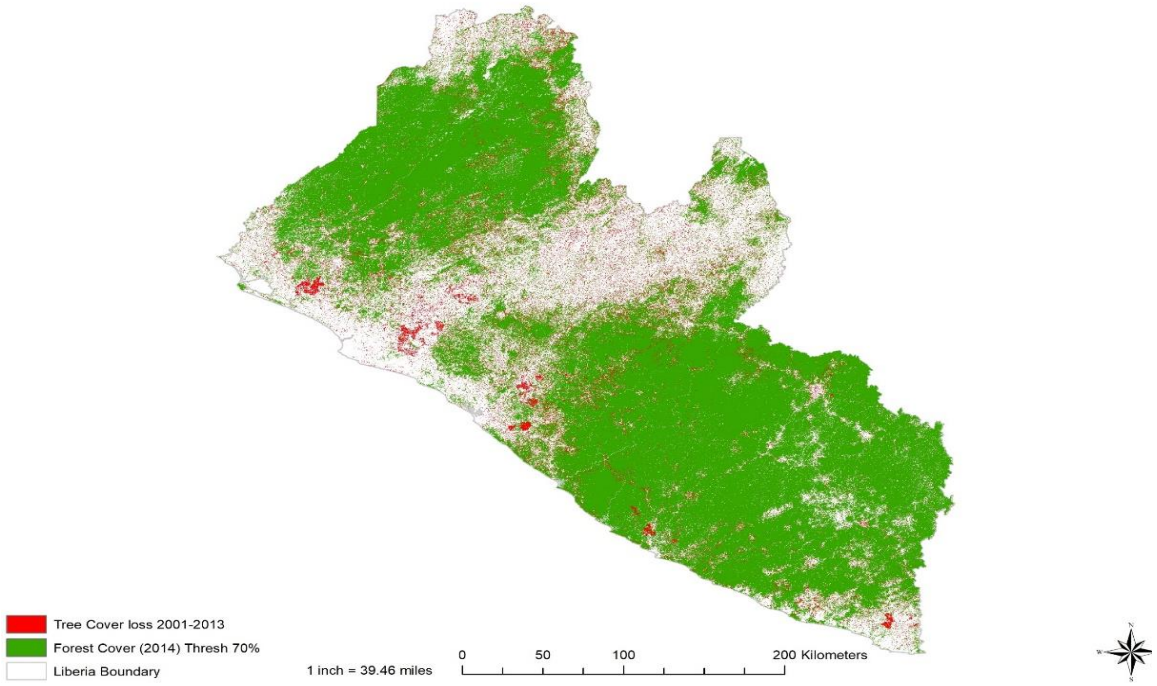


Figure 6.1: *Forest Cover (2014) and Tree Cover Loss Extents 2001-2013 (Source:* https://earthenginepartners.appspot.com/science-2013-global-forest/download *v.1.6.html)*

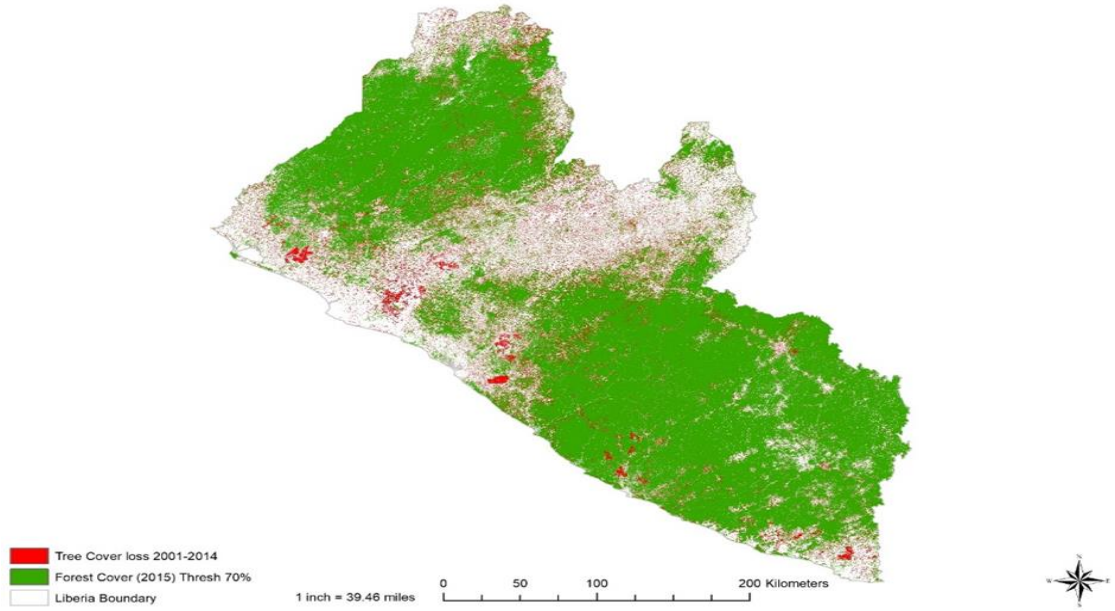


Figure 6.2: *Forest Cover and Tree Cover Loss Extents 2001-2014 (Source:* https://earthenginepartners.appspot.com/science-2013-global-forest/download v.1.6.html*)*

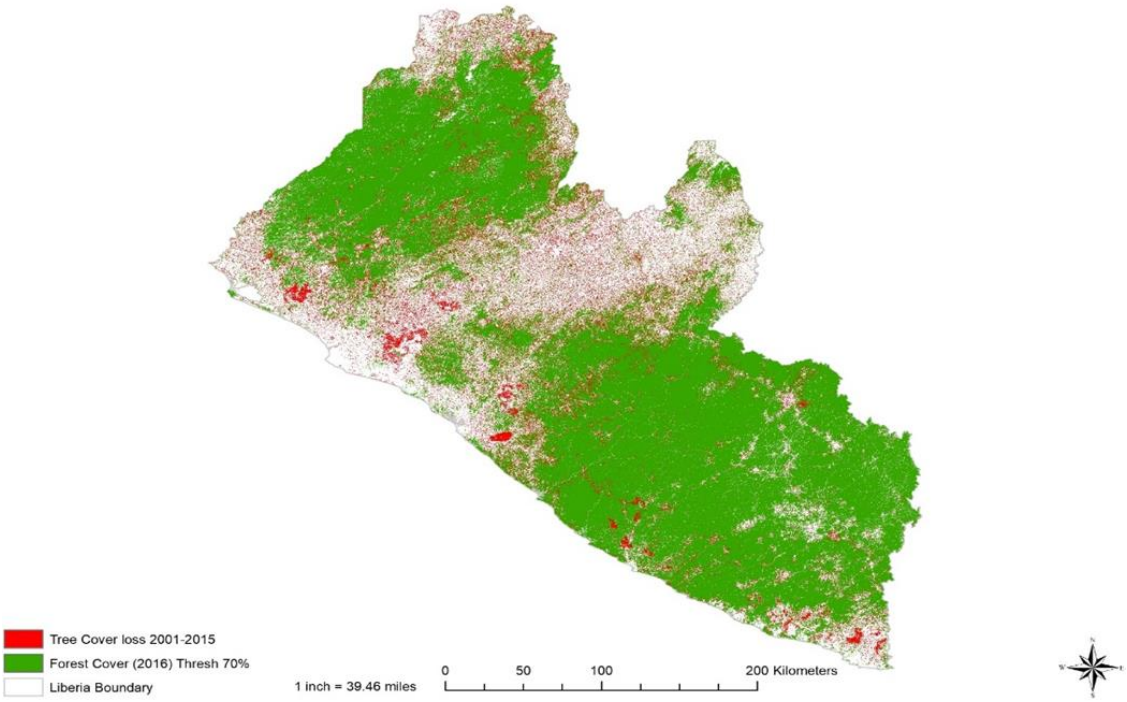


Figure 6.3: *Forest Cover and Tree Cover Loss Extents 2001-2015 (Source:* https://earthenginepartners.appspot.com/science-2013-global-forest/download v.1.6.html*)*

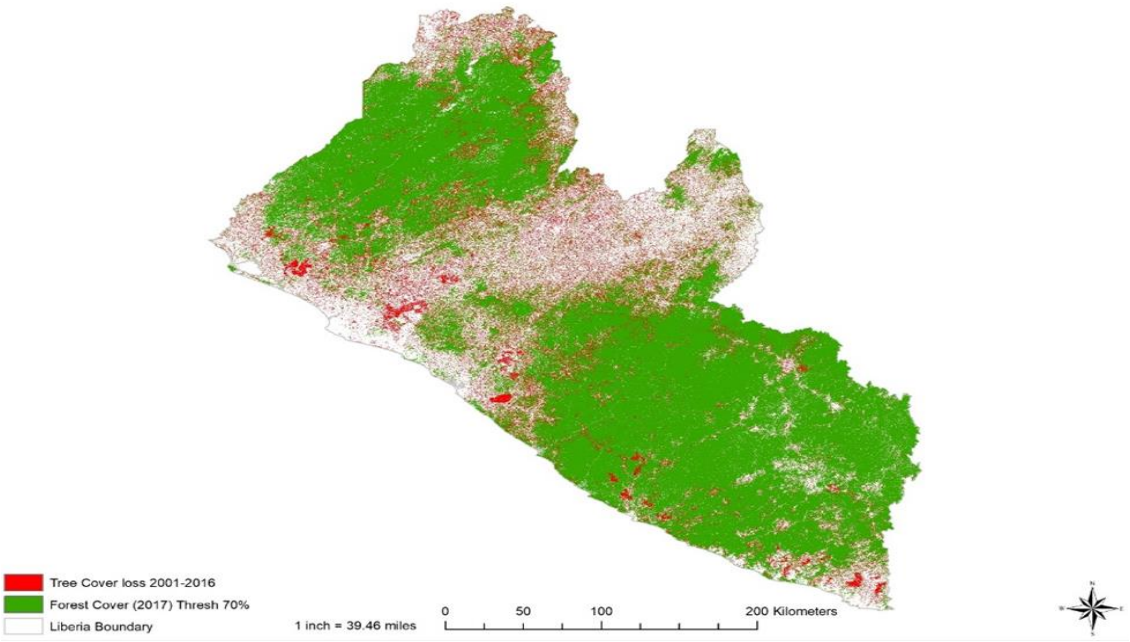


Figure 6.4: *Forest cover and Tree cover loss Extents 2001-2016 (Source: https://earthenginepartners.appspot.com/science-2013-global-forest/download v.1.6.html)*

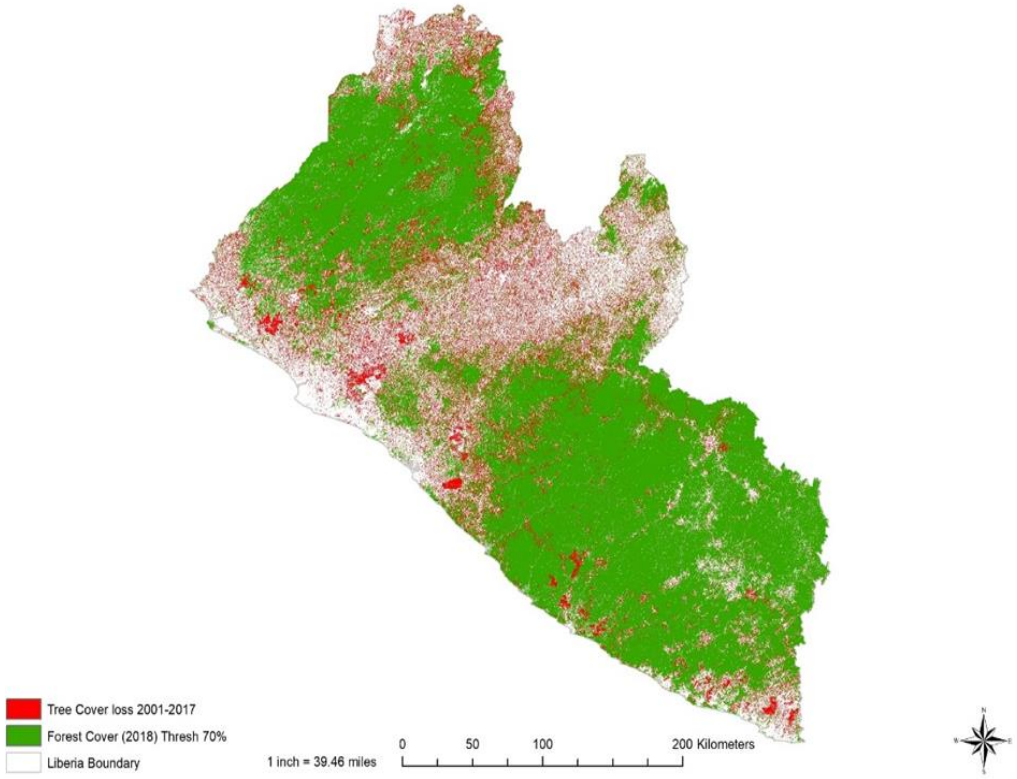


Figure 6.5: *Forest Cover and Tree Cover Loss Extents 2001-2017 (Source:* https://earthenginepartners.appspot.com/science-2013-global-forest/download *v.1.6.html*

Historically, the main drivers of DFD (Shearman (2009) include: (i) Slash and burn agriculture; (ii) Small-scale chain-saw logging; (iii) Mining; (iv) Post-conflict migration; and (v) Extensive and excessive commercial logging. Except of post-conflict migration, current evidence points to: (i) Slash and burn agriculture; (ii) Charcoal production; (iii) Agro-industrial tree plantations that replaced forests; (iv) Mining; and (v) Chain-saw logging are the principal drivers of Deforestation and Forest Degradation (DFD) (CI 2017, FDA 2015). Evidence is as overwhelming and irrefutable that Liberia is fast losing its forest estate.

In 2001, the United Nations Security Council (UNSC) imposed sanctions on Liberia in response to its Government's role, as was alleged, in the conflict in Sierra Leone. The sanctions included a ban on the procurement of arms and on trade in Liberian diamonds. The UNSC in 2003, imposed additional sanctions to prohibit trade in round wood and timber products originating in Liberia, to prevent revenues from timber exports being used to finance the on-going war. Following the Peace Agreement signed in Accra, Ghana, that ended the war in 2003, the National Transitional Government of Liberia (NTGL), working with civil society groups and international partners, developed a roadmap for reforms in the forest sector so that sanctions can be lifted.

Key to the reform process was the establishment in early 2004 of the Liberia Forest Initiative (LFI) (an amalgam of international and national NGOs, international research institutions, UN organisations, bilateral partners and associated government agencies, the World Bank and the International Monetary Fund). These partners and stakeholders in peace and the rule of law in Liberia, under LFI, served to develop consensus on the way forward for the sector and as a catalyst for the development among working partnerships and stakeholders to deliver on agreed priorities and actions (World Bank, 2012).

Right after LFI was structured, the NTGL constituted a Forest Concessions Review Committee (FCRC) to review the forestry sector and its role in the conflict, and to evaluate the legal status of all timber concessions. The FCRC, based on its findings, recommended that (i) All forest concessions be declared void or invalid from the outset; (ii) The debarment of 17 forestry companies; and (iii) A series of key reforms be made to the 2000 National Forestry Law to improve transparency, accountability, and public participation in the forest sector. The government of Liberia, that of former president Johnson-Sirleaf, accepted the Committee's recommendations and signed Executive Order number 1, on the 2nd of February 2006, to strengthen implementation of FCRC's recommendations. In recognition of the full compliance of government with the recommendations of note, the UNSC voted not to renew the timber sanctions in June 2006 (World Bank, 2012).

The FDA is seriously under-resourced. The Authority has recently attempted to review concession agreements to decide which are legitimate, a difficult task since many files were lost or destroyed during the civil war. There is strong support across a range of stakeholders for community-based forest management and greater benefit-sharing with rural people. No silvicultural system has been devised for Liberian forests other than a selective logging regime. When properly planned and executed, however, logging (timber harvesting) is an integral component of forest management systems designed to promote sustained timber yields, or the more all-encompassing goal of sustainable management

(Putz *et al.*, 2000). Unfortunately, logging in Liberia all-too-often represents a timber mining activity carried out without regard for renewability of this natural resource. Other silvicultural treatments designed to promote sustainability are often prescribed in publications as guidelines but rarely applied, such as the concept of sustained yield and low impact logging. The prescribed felling cycle of 25 years is so short a time for tropical forests like Liberia's and there is no basis in research that supports its application in forest management in Liberia.

After enactment of the National Forestry Reform Law of 2006 (NFRL, 2006) that provided the framework for legal and transparent operation of the sector, the Government re-initiated commercial forest concessions, as a result of which seven (7) Forest Management Contracts (FMCs) were awarded in 2009. The following tables show the level at which the country's forested landscapes are contracted to timber miners, or loggers who have total disregard for the ability of Liberia's forests to regenerate.

Table 6.6: *Concessions, Likely Maximum of Total Volume of Wood, Annual Cut and Size of Contract*

Concession	Likely maximum of total volume of wood (m^3)	Estimated annual cut on a 25-year rotation period	Size of contract (in Hectares)
FMC-A	672,552	26,902	119,164
FMC-B	187,294	7,492	56,839
FMC-C	193,540	7,742	59,322
FMC-F	1,431,916	57,277	256,445
FMC-l	732,944	29,318	131,307
FMC-K	1,479,092	59,164	269,391
FMC-P	803,608	32,144	119,524
Total	4,447,560	220,038	1,011,997

Source (Shearman, 2009)

About 10 years later, CI (2017) appeared to have reproduced Table 6.7, but with differences in some figures and with additional information reflected in the following table.

Table 6.7: *Timber Concession Contracts, Operating Hectares and Volume Harvested*

Concession	Location of contract	Volume harvested (m^3)	Size of contract (in hectares)
FMC-A	Lofa County	0	119,240
FMC-B	Rivercess County	748,734	57,262
FMC-C	Nimba, Gibi,& Doru	15,416	59,374
FMC-F	River Gee, Grand Gedeh Counties	17,778	254,583
FMC-l	Grand Gedeh, Sinoe Counties	25,573	131,466
FMC-K	Nimba, Rivercess, Grand Gedeh Counties	164,728	266,910
FMC-P	Grand Kru, Maryland and River Gee Counties	14,345	119,344
TSC-A15& A16	Grand Cape Mount County	623	5000
CFMA-2	Grand Gedeh County	32,219	135,667
CFMA-4	Nimba, Gibi, Doru	7,343	66,150
Total		1,026,763	1,214,996

Source (CI, 2017b, citing FDA)

CI (2017a, b) also provided estimates of the quantity of harvested and transported timber by chain-saw logging, the other primary form of timber harvesting in Liberia. The estimates are relatively small in extent compared to commercial concessions. The quantity of wood quarterly harvested in 2015, as the next table shows, was 43,000 m^3, slightly higher than that of 2014, which is 39,000 $m^{3.}$

Table 6.8: *Timber Harvested and Transported Quarterly Through the Chain-Saw Logging Industry*

Quarter	Wood type	2014		2015		Change
		Quantity	M	Quantity	M	
Q1	Sawn (pieces)	99,587	5,278	184,875	9,798	4,520
	Round pole	93.5		115		
Q2	Sawn	337,517	17,888	165,356	14,919	-2,960
	Round pole	2101/2		273		
Q3	Sawn	69,442	3,680	165,356	8,764	5,083
	Round pole	603/4		167		
Q4	Sawn	228,998	12,137	177,885	9,428	
	Round pole	1903		228		
Total			38,984		42,909	3,925

Source (CI 2017a)

The Commercial Forestry Department had just completed a nationwide assessment of various concession types in 2019, encompassing FMCs, Timber Sale Contracts (TSCs) and areas awarded to holders of CFMAs.

The following table provides information about each contract, including contract type, location and so on.

Table 6.9: *Name of Company, Contract Type, Contract Location, and Duration and Size of Contract*

Name of Company	Type	Contract Location	Permit Date	Expiration Date	Contract Duration (in years)	Size (ha)
Forest Management Contracts (FMCs)						
Alpha Logging & Wood Processing, Inc.	FMC-A	Lofa & Gbarpolu Counties	27 May 2009	26 May 2024	25	119,240
Mandra Liberia/E.J.&J Investment	FMC-B	Rivercess County	27 May 2009	26 May 2024	25	57,262
Mandra Liberia/Liberia Tree & Trading Company	FMC-C	Rivercess County	27 May 2009	26 May 2024	25	59,374
Euro Liberia Logging Inc.	FMC-F	River Gee & Grand Gedeh Counties	30 Sept 2009	29 Sept 2024	25	254,563
Geblo Logging Company	FMC-l	Grand Gedeh & Sinoe Counties	30 Sept 2009	29 Sept 2024	25	121,466
International Consultant Capitol	FMC-K	Nimba, Rivercess & Grand Gedeh Counties	30 Sept 2009	29 Sept 2024	25	266,910
Atlantic Resources Limited	FMC-P	Grand Kru, Maryland &	30 Sept 2009	29 Sept 2024	25	119,344

Name of Company	Type	Contract Location	Permit Date	Expiration Date	Contract Duration (in years)	Size (ha)
		River Gee Counties				
Timber Sale Contracts (TSCs)						
Tarpeh Timber Corporation	TSC-A2	Grand Bassa County	27 June 2008	25 June 2024	3	5000
Akewa Group of Companies	TSC-A3	Grand Bassa County	27 June 2008	25 June 2011	3	5000
Bulgar & Vincent Investment Corp	TSC-AG, A9 &A10	Gbarpolu & Grand Cape Mount Counties	27 June 2008	25 June 2011	3	5000
Bargo & Bargo Enterprise	TSC-7	Gbarpolu County	27 June 2008	21 July 2010	3	5000
Bassa Logging Corporation	TSC—A11	Grand Cape Mount County	21 July 2010	20 July 2013	3	5000
Sun Yeun Logging Corporation	TSC-A15	Grand Cape Mount County	21 July 2010	20 July 2013	3	5000
Thunder Bird	TSC-AB	Grand Cape Mount County	1 Oct 2010	30 Sept 2013	3	5000
Community Forest Management Agreements (CFMAs)						
StarWood Metro, Community	CFMA	Grand Bassa County	16 May 2018	15 May 2023	15	8,833
Sewacajua	CFMA	Sinoe County	25 June 2017	24 June 2032	15	31,936
Delta Timber Corporation, Nimopo Community	CFMA	Sinoe County	_____	_____	15	7,320
Tetra Enterprise Inc.	CFMA	Rivercess County	27 March 2017	24 March 2032	15	36,637
Akewa Group of Company, Beyanpoye Community	CFMA	Margibi County	25 March 2017	24 March 2032	15	33,338
Sing Africa Plantations, Blyeama Community	CFMA	Lofa County	_____	_____	15	49,444
Liberia Tree Corporation, Gbi Community	CFMA	Nimba County	_____	_____	15	31,155
LTTC Doru	CFMA	Nimba County	17 May 2016	15 May 2031	15	36,192
Kparblee Timber Corporation	CFMA	Nimba County	4 Oct 2018	3 Oct 2033	15	9,926
Booming Green	CFMA	Grand Bassa County	17 Jan 2018	16 Jan 2033	15	12,611
LTS Green Inc. Gheegban #2	CFMA	Grand Bassa County	17 Jan 2019	16 Jan 2034	15	12,576
Total (Area)						1,315,703
Note: Most of the 25 logging concessions listed here are non-functional(Pers. Information, a staff of the Commercial Forestry Department, FDA, 9 October 2019)						

Source (FDA 2019, Commercial Forestry Department, Whein Town, Mount Barclay, Monrovia, Liberia)

The forestry industry produced about 500 thousand m^3 of logs in 2015.The civil war (1989-2003) destroyed the forestry industry and rural infrastructure, and consequently round logs currently account for the bulk of the export volume. The export value of primary timber products accounted for around USD44.1 million in 2015. Table 6.10 shows the type of forest products exported, production quantity and other important variables.

Table 6.10: *Exported Product Type, Production Quantity, Import Quantity, Domestic Quantity and Export Quantity of Wood Products*

Type of product Exported	Production quantity	Import quantity (x1000m^3)	Domestic consumption (x1000m^3)	Export quantity (x1000m^3)
Log (Ind. Round)	500	0	346	154
Sawn wood	132	0	132	1
Veneer	0	0	0	0
Plywood	0	4	4	0
Total	632	4	4	155

Source (ITTO, 2017)

It also must be mentioned here that in 2015, the total economic contribution of forests to the timber industry was USD221 million, of which the bulk, USD212 million, was contributed by commercial concessions. In the same year, Liberia's GDP was approximated at USD2.05 billion. Thus, roughly, 11% of the country's GDP can well be attributed to the timber industry that year. However, this is an underestimation of the total contribution of the forest sector to the country's economy, as data was hardly available for timber harvested for local use. Moreover, valuable NTFPs, bush meat and charcoal for example, are often not accounted for (CI, 2017a) and logs (unprocessed wood) accounted for nearly 80%) of the type of wood products exported.

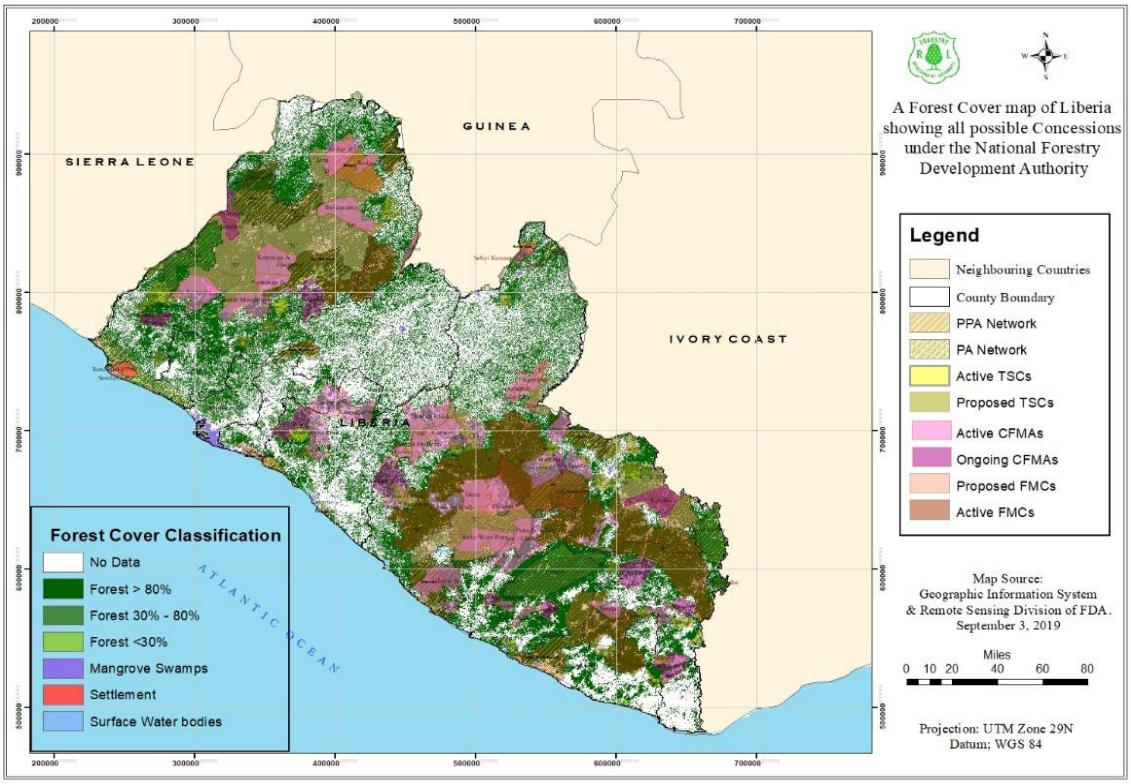


Figure 6.6: *A Forest Cover Map of Liberia showing all Possible Concessions under the Administration of the Forestry Development Authority (Source: World Resources Institute, FDA Headquarters, Whein)*

Currently, 44.9% (45%) or about 4,329,000 ha of Liberia is forested as mentioned earlier. Of this, 4.0% (175,000 ha) is classified as primary forest, the most bio-diverse and carbon-dense form of forest. In addition to this, the country has tree plantations of 8,000 ha. Given the change is forest cover between 1990 and 2010, which in part is reflected by the map on forest cover, Liberia lost, on average, is 30,000 ha or 0.61% of forest per year. In total, between 1990 and 2010, Liberia lost 12.2% of its forest cover, or around 600,000 ha (FAO 2011).

Figure 6.8 depicts the net change rate of Liberia's forest from 2010 to 2015. As our forests depletes in the face of competing land uses that erode this priceless ecosystem, it is reasonable to expect the rate of forest loss to gain momentum. There is, however, a silver lining in this threatening reality that forest erosion imposes replenishing the forest estate to the level at which it can significantly counter the downward spiral of DFD. Even with the reported and felt rate of forest loss in our time, Liberia's forests contain 585 million metric tons of carbon in living forest biomass.

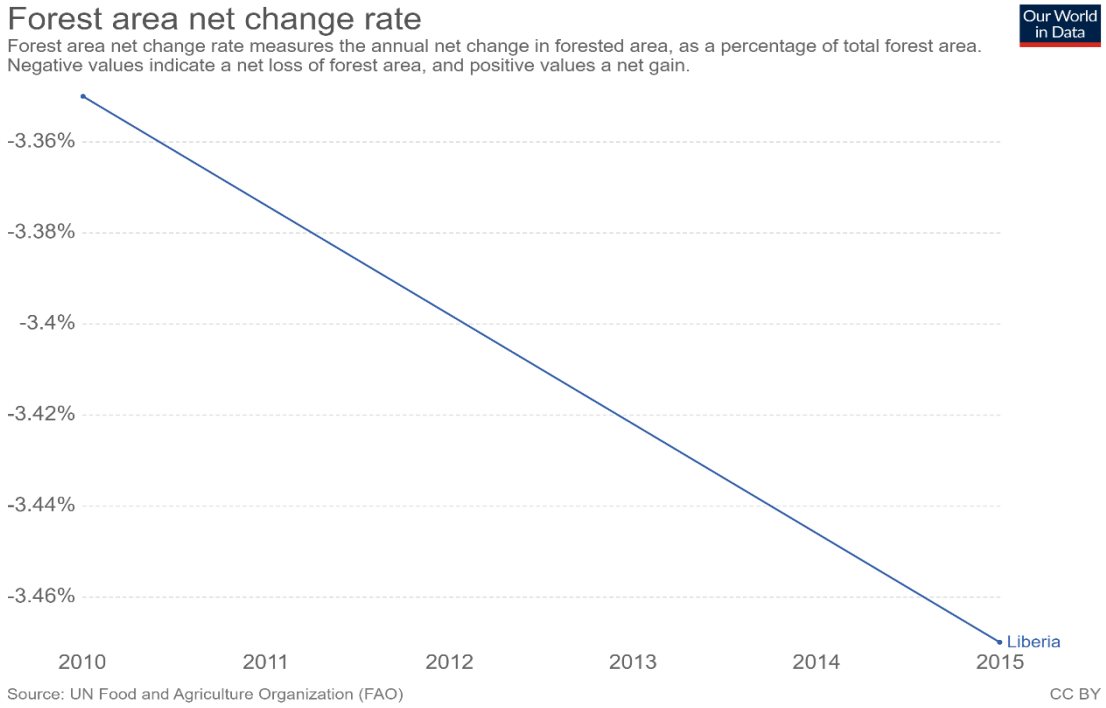


Figure 6.7: *Forest Area Coverage in Liberia between 1990 and 2015 (1 km2 = 100 ha) Source:* https://www.indexmundi.com/facts/liberia/indicator/AG.LND.FRST.ZS

6.6.6 Pressure on Forest Resources

Natural systems, such as forests, including Liberia's biodiversity rich tropical rainforest ecosystems, provide the physiological necessities and a range of other functions that support a quality environment that ultimately nurtures life (animals, plants, other organisms) on Earth by purifying and recycling air, essential mineral nutrients and water, absorbing and transforming wastes, and preventing diseases and stabilising climates. Other ecosystems of pertinent significance in these respects include grasslands, oceans and water bodies (Odum, 1989).

The broad variety of forests in the world – in tropical , subtropical, Mediterranean, temperate and boreal regions – together account for two-thirds of all terrestrial ecoregions and provide a wide range of additional environmental services that include biodiversity conservation, water supply (in quantity and quality), carbon capture and storage, flood control, protection against soil erosion and desertification, air purification, temperature amelioration and as a habitat for at least 80% of the Earth's biodiversity (GEF, 2008). Our forests also possess exceptional values in cultural, economic, health, spiritual and social dimensions of life while sustaining languages and local knowledge systems (see Amo-Rodriguez *et al.,* 2010, Cristancho & Vining, 2004).

Quite apart from their ecosystem/environmental functions, Liberia's forests provide a rich assortment of products such as timber, a variety of NTFPs. Liberia's forests, therefore, exert decisively critical impact(s) and multi-dimensional roles in changing the biological, chemical and physical state of the natural environment for better or worse. Two of the most important categories of our forests, NTFPs, are charcoal and firewood. As of 2008, 57% of all households in Liberia use wood (firewood/fuelwood) as their main source of

cooking fuel, and 37% use charcoal (LISGIS 2011). The charcoal and firewood industry makes significant contributions to Liberia's economy (World Bank 2018, USAID 2015, and USAID 2017):

i. Wood and charcoal serve as primary cooking fuel sources for nearly 98% of Liberia's population; this includes 43.8% of households using charcoal (70.3% in urban areas and 9% in rural areas) and 54% using wood (26% in urban areas and 90% in rural areas).

ii. Charcoal is the second largest informal wood-based industry, following the informal timber industry in Liberia, with an estimated annual market value of US$15–25 in 2009. Additionally, there is an increasing trend in charcoal production, which grew by 4.6% every year between 2002 and 2012, and which indicates the growing dependence of the population on charcoal for daily needs. The average annual charcoal expenditure per household was estimated at US$171, or 22% of total household income (USAID 2015). Thus, there is clearly a huge opportunity in this sector for income and government revenue generation, with adequate regulation and management.

iii. Due to lack of regulation, the charcoal industry is highly decentralised with a well-developed but informal value chain. Annual charcoal use in Monrovia was estimated at around 1.03 million metric tons in 2010 and valued at about US$15.8 million; it is assumed that this is about 75% of the total volume used in the country and is equivalent to 1.1 million m^3 of wood (USAID 2015). Thousands of Liberians, including women, are involved in the charcoal value chain, both in production and retail.

Throughout Liberia's history, the country has depended almost exclusively on its natural forests to meet the needs of the burgeoning human population. Tree plantations have never truly been established to augment the country's need for timber and wood products. The threats to our forests, direct or indirect as these may be, are existential. Such threats include, but are not limited to, logging, uncontrolled hunting and mining, the expansion of unregulated and unsustainable farming and agro-industrial crop plantations; all which have replaced forested landscapes with open land.

Even though Liberia still has some forests, the site assessments and community consultations revealed that there is an increase in air and ground population which has a sturdy impact on the natural environment. Due largely to human population growth, issues such as increased waste generation, overexploitation of forests, coupled with land degradation and water pollution have all contributed negatively to the forest environment. Much of the type of pollution generated depends on the kind of livelihood activity being pursued in different areas. For example, one would expect farming areas to produce a different type of pollution than mining operations.

Significant portions of Liberia's forest resources are lost annually to poor land-use practices. Continuous artisanal mining activities, for example, carried out by illegal small-scale miners in many rural communities have, over the years, affected forest cover. This has exacerbated the socioeconomic condition of the most vulnerable citizens, who are

often the rural poor. Aside from mining, the consultations revealed that primitive farming methods (slash and burn) practised by most farming households (especially in rural areas), have also contributed to rapid deforestation. One issue is the fact that local farmers are unaware of their footprint on the forests and continue to clear large swathes of land without improving their farming techniques.

Several interactions with the communities have shed more light on a belief amongst many that there is no control over the use of the forests. Accordingly, there is said to be no mechanisms in place to regulate hunting, farming or other practices in many, if not most, of the communities visited. Several stakeholders would mention, for example, the disappearance of some common animal species, such as deer and monkeys, as well as the disappearance of several tree species at an unprecedented rate. This has been accelerated by pit-sawing and logging in forested areas. Clearly, the pollution footprint on the forestry environment is rather noticeable and presents a strong case for planning and better management considerations.

In summary, the data reveals five (5) key culprits of forest loss and/or pollution for improved management decision-making. Each one is briefly described below:

i. Inefficient and Ineffective Law Enforcement: There have been repeated reports of encroachment in national parks by hunters, miners and agro-industrial crop plantations. The FDA relies almost entirely on park rangers to control or interdict this wave of unauthorised entries. The result of such unauthorised land access is the loss of forest cover in many parts of Liberia, violating the integrity of protected areas/forests which are supposed to be managed sustainably. Such forests are being cut down and are never replaced, replanted or rehabilitated. Law enforcement in park fringe communities is being strengthened through training of rangers not only to conduct patrols effectively and efficiently, but to also engage the communities and learn from them as to their sense of how best to conserve and protect protected areas.

ii. The Dependence on Charcoal and Firewood: The level at which Liberians depend on charcoal and firewood as sources of fuel is quite significant (about 98%). Both are extensively used as fuel for cooking, heating, ironing clothes and many other uses. This is not only a major source for air pollution and deforestation resulting in increased levels of carbon that is released in the atmosphere when wood is afire, these also are a health hazard. Eco-stoves have been recommended and introduced in some communities in attempts to reduce the level of dependence on wood, but a host of challenges were voiced that the stoves have of their own. The most common ones from users are that they are so expensive, and not fitting or suitable to prepare some native dishes. Solar panels are being tested around the country and are found to be very helpful and useful but only for lighting purposes, not for heating or cooking.

iii. The Dependence on Natural Forests as the Main Source of Timber: Forest management should pursue two important goals simultaneously. These are to preserve the environment, and also to manage the sustainable usage of wood to meet the current and future needs of an increasing human population. Although

plantations can and should be developed to augment and regulate the supply of timber, natural forests are more diverse than plantations and often yield timber of high quality as much as feature significantly in climate change adaptation and mitigation. Natural forests, for example, capture and store more carbon than plantations and serve as a habitat for native plant species in all its diverse forms. In Liberia, saving a reasonably significant portion of the natural forests makes sense from a biodiversity and ecological perspective, but also from a point of preserving and sustaining traditional livelihoods which depend on such forests. The dependence on wood for charcoal and firewood is significant. Both are extensively used as fuel for cooking, heating, and ironing (clothes). This is a major source of air pollution and contributes notably to deforestation.

iv. The Lack of a National Land-Use Plan and a Strategy for its Implementation: LLA classifies land ownership into four categories, namely customary, government, private, and public. However, Liberia does not have a national land-use plan that describes the best use(s) for areas of land. Forest lands continue to be replaced with, and used for, farms, mines, human settlements and other uses. In fact, the limited forested areas that are set aside for conservation purposes, such as national parks are being encroached on by illegal miners, hunters and farmers.

v. Poor Management of Community Forestry: Basically, there are two models of forest management in Liberia. The first is concessional forest management in which logging companies from areas other than the communities are awarded contracts to extract wood from forests upon which locals have depended for their socioeconomic well-being for nearly a century or more. Logs are transported by huge trucks through the rural towns and villages and the benefits have largely been the dust that often blow from the backs of the trucks as they make their way from the concession to the port for export. Community forest management is the second model. This model, supported fully by the Liberian government, recognises the need to make community forest management real. The Community Rights Law (CRL) with respect to forestland (CRL 2009) is an embodiment of government's sincere and determined commitment to community forestry, hence community forest management.

Community forestry is primarily meant to provide forest-dependent communities the right to manage forests closest to them and reap corresponding benefits from such forests by fulfilling the responsibilities they have in managing these forests. Some of the numerous benefits of community forestry include (Gunter 2004):

- Long-term community economic development resulting in the increased self-reliance of rural communities;
- Local employment in rural communities;
- Local-level decision making that leads to locally appropriate decisions and improves the incentives to consider the long-term benefits of sustainable management;
- Increased potential to resolve conflicts over timber harvesting in watersheds and other sensitive areas;

- Protection of drinking watersheds, views capes, and other values that are important to communities and to local and regional economic activity;
- Enhanced opportunities for education and research. Community forests can be laboratories for testing innovative forest practices; and
- Community participation in resource management leads to an improved awareness of forest legal management among members of the public.

The most pressing challenges community forest management faces are (Global Witness 2017):

- Insufficient safeguards to ensure it is the people in the "community" who actually make decisions about how to manage their forests and forest resources. Failing to ensure this is highly likely to create CFMAs that would violate the 2009 Community Rights Law;
- The legal framework contains loopholes that will allow companies to log, and possibly clear-cut large swaths of community forests, and is drafted in a way that encourages industrial-scale logging; and
- References in the 2017 CRL Regulations to rules that govern Liberia's large logging contracts encouraging communities to partner with logging companies and discourage them from exploiting the diverse goods and services they have enjoyed from their forests in the past.

One may argue that logging companies are only interested in logging if it is on a commercial scale. Such companies have the advantage over communities of being able to easily clear thousands of hectares of trees in a matter of a few days. This is transforming forested land at a very rapid pace; meaning that logging companies deplete forests faster and often log important trees which residents use for other purposes than timber. Communities do not exclusively depend on logging alone, as logging companies do. Communities also use forests for bush meat, bush yam, fruits, nuts, mushrooms, medicines, palm wine, rattan, etc., and often do preserve patches of old forest growth as sacred areas for traditional rituals. Because communities get more out of these forests than just timber, they do not have the same incentives to clear forests as logging companies do. The management practice of allowing community forests to be taken over by logging companies could possibly excel forest depletion and does not serve the interests of forest conservation.

Plate 6.1: *Site assessments by Greencons across Liberia, highlighted the unsustainable slash-and-burn agricultural practices*

6.6.7 Forest Encroachment

Historically, continuous high-density forests dominated the whole territory of the country, but in recent times land development, timber extraction and introduction of rubber plantations have opened areas of high-density forests and resulted in the expansion of agriculture and mining. As a result, man-made savannah is spreading along the coast and extending inland, while the same can be observed along the northern Liberian border. This area is now supporting a diverse mix of vegetation ranging from low bush, patches of high forest, and gallery forests near rivers, grass dominated, thorny shrubs, and cultivated land (CI 2017b).

The national REDD+ strategy identifies the drivers of DFD of greatest short term (0-10 year) and longer-term (10+ years) impacts, hence the principal culprits of forest encroachment. The drivers of short-term impact are oil palm plantations of major palm oil concession-holding companies that have already been established and those planned for next 10-15 years, TSCs, pit sawing and charcoal production. Longer-term drivers are shifting cultivation, commercial logging and mining (FDA 2015).

6.6.8 Government Responses to Challenges

Several initiatives have been spearheaded by the GoL to develop improved forest management policies and regulations, and to accost a host of related challenges in the forest sector. Among the principal achievements of government's honest commitment to reform have been (World Bank, 2018, CI, 2017, World Bank, 2016, 2012, Blundell, 2008):

i. The National Forest Reform Law (NFRL) of 2006 (GoL 2006) (that identifies "SFM" as a national forest management goal and calls for an appropriate

integration of community, conservation and commercial forestry, commonly known as the Three C's Approach. Recently, another Carbon, has been added. What this approach signifies is a shift from a "revenue generating" centric approach to one aligned with a more integrated approach. This, in essence, means the forest sector vision is comprehensive, integrating all aspects of forestry through the 4C's approach, with a focus on community, commercial, conservation, and carbon.

ii. The CRL with respect to forestlands (CRL 2009): The CRL provides the legal clarity regarding forest ownership and use rights. It represents a significant step toward involving one of the most pressing issues in Liberia's forest sector, the lack of legal clarity regarding forest ownership and use rights (World Bank 2012).The Government realised that the strong focus on largely export-oriented commercial forestry in forest management endeavours in Liberia absorbed much of the capacity available, with the effect of marginalising conservation forestry aspects and diverting attention away from development of domestic processing capacity and markets. The advent of community forestry addresses this problem.

iii. Establishment of a chain of custody for forest resources: The first country-wide chain-of-custody system was established by means of a contract between the Government of Liberia and the Swiss-based Society of General Surveillance (SGS). SGS developed the system, scaled it up proportionate to the roll-out of timber contracts and readiness of the companies, and built the capacity of the FDA, the Ministry of Finance and other government agencies to operate and administer the system.

iv. Institutional reforms in the FDA (the FDA was structured with staffing cut from more than 500 to about 300 employees). Terms of reference were developed for each staff position, and a new organisational structure was put in place to the implementation of the 3C's approach at that time.

v. Awarding of FMCs (in which legal framework and ground rules are defined for SFM and economic revival of the sector).

vi. Liberia Extractive Industries Transparency Initiative (EITI) (that provides an oversight mechanism of commercial activities and revenues generated in the oil, gas, and mining sectors): The mechanism includes the regular publication of the reconciliation and audit statements of individual companies (profits) and government (revenues received) (Blundell 2008). With passage of the Liberian EITI Act in 2009, Liberia became the first EITI signatory to include contracts and receipts from forestry in its initiative. The Liberian EITI publishes all forest concession and sales contracts, as well as all payments made by the companies to the government and government's receipts from those contracts.

vii. LFSP: The development objective of the project is improved management of, and increased benefit sharing in, targeted landscapes. It represents a paradigm shift in forest resource management insofar as it includes using climate finance as a catalyst for forest conservation and continued carbon sequestration. The project

has already incorporated the landscape approach into implementation by moving beyond forest sector interventions to take into account multiple interrelated interventions (such as agriculture and land use planning) at the landscape scale and considering improvements in both ecosystems and livelihoods. The priority target areas of the project are preselected landscapes in the northwest (Bomi, Gbarpolu, Grand Cape Mount, Lofa Counties), Northern Nimba, and the southeast (Grand Kru, Grand Gedeh, Rivercess, River Gee and Sinoe Counties). Besides the communities in the targeted regions of the country, LFSP is carefully designed to benefit the government at the national and county levels by supporting clearer regulations for decentralised forest management and linkages between spatial planning and forest land use planning which the project proposes and delivers through technical assistance; consultancy services; non-consultancy services, works, goods and operational costs directed at state institutions and policies; protected areas; forest management and sustainable production; forest monitoring systems; and management, monitoring and communications (World Bank 2016). The project is being implemented, quite successfully, by the REDD+ Implementation Unit of the FDA.

viii. National Adaptation Programme of Action (NAPA) (2008): Identifies relevant stakeholders and suggests measures to help increase the country's capacity to address climate variability and change impacts. NAPA also highlights the importance of mainstreaming adaptation into sectoral policies and national development strategies, plans, and frameworks; and Initial National Communication (INC). NAPA identifies agriculture, forestry, wetlands, fisheries, energy, water resources, coastal zone management, and health priority areas for adaptation, given their vulnerability to climate change impacts.

ix. The National REDD+ Strategy and Climate Change: Reducing emissions from deforestation has received much attention since the issue was first placed on the agenda of the UNFCCC (United Nations Framework Convention on Climate Change) in 2005 (Pistorius, 2012). The original idea was to simply contribute to climate change mitigation by creating incentives for developing countries, including Liberia, to keep their forests standing as deforestation is an important cause of carbon emissions. Since then the scope of the policy has expanded and currently encompasses deforestation, forest degradation, conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries, collectively known as REDD+ (Visseren-Hamakers *et al.*, 2012). In practice, Liberia's REDD+ Strategy has 3 key phases (World Bank 2016): (i)Readiness – Development of a national REDD+ Strategy and setting up institutional arrangements , including a feedback and grievance mechanism; (ii) Investments and reforms – Implementation of the REDD+ Strategy through the facilitation and improvement of enabling conditions (legal framework, capacity building, governance structures, and monitoring and verification systems), and investments in conservation, commercial and community forestry activities; and (iii) Performance-based carbon payments for verified emission reductions achieved, among others, through activities of the second phase.

x. Community forestry: The Government of Liberia, with USAID and United States Forestry Service funding, has significantly benefited from four community forest management projects and programmes in Liberia. These projects have also supported biodiversity conservation and the agriculture sector. The common and overall goal of these projects is to introduce, operationalise and refine appropriate models for community management of forest resources for local self-governance and enterprise development. The projects are: The Land Rights and Community Forestry Programme (LRCFP) (2007-2011), the Liberia Forestry Support Programme (2011-2012), the People, Rules and Organisations Supporting the Protection of Ecosystem Resources (PROSPER 2012-2017) and Forest Incomes for Environmental Sustainability (FIFES) (a 5-year project that ends in 2020). As of December 2016, the FDA was considering approval of about 120 CFMAs (FDA, 2016) across Liberia.

xi. VPA: The EU and the Government of Liberia signed a VPA on Forest Law and Enforcement, Governance and Trade (FLEGT) in timber products shipped to the EU (European Commission, 2011). The agreement provides a legal framework aimed at ensuring that all imports of timber products from Liberia into the EU have been legally produced. As VPA defines them, timber products are wood in any form, including sawdust, other wood wastes and scrap) as well as any finished wood products. Wood from Liberia's rubber plantations also comes under the agreement. VPA gives specifics on FLEGT licensing scheme and a set of procedures and requirements for verifying and attesting that timber products shipped to EU are legally produced or acquired.

6.4 WETLAND RESOURCES

6.4.1 The Value of Wetlands

Wetlands are unique and distinct ecosystems characterised by soil which is inundated or saturated by water either seasonally or all year round. Four (4) major types of wetlands occur in Liberia: inland swamp, inland riverine, lacustrine and coastal wetlands. Wetlands are typically characterised by a high diversity of plant and animal species, supporting both terrestrial and aquatic vegetation and providing important habitats for many animals, including fisheries species. They play an important role in the hydrological cycle by providing important ecosystem services and acting as buffers of intense meteorological events. Wetlands are known to lessen the effects of heavy rainfall and flooding and also moderate the impacts of high tides and a rise in sea levels on human settlements and natural resources. These ecosystems are also invaluable in trapping sediments and stabilising shorelines.

Liberia only has eight (8) major wetlands, of which five (5) are of international importance in terms of conservation and are listed as Ramsar sites. The wetlands of Liberia and its characteristics are detailed below in Table 6.11.

Table 6.11: *Summary of the Major Wetlands in Liberia*

No.	Name	Region	Type	Size (ha)	RAMSAR
1.	Gbedin Wetlands	Nimba county	Inland swamp	25	Yes
2.	Kpatawee Wetlands	Bong county	Inland riverine	835	Yes
3.	Lake Shepherd	Gawulu-Tombe	Coastal	76,091	Yes
4.	Marshall Wetlands	Margibi county	Inland riverine	12,168	Yes
5.	Mesurado Wetlands	Montserrado	Coastal	6,760	Yes
6.	Lake Piso	Grand Cape Mount	Coastal	48,953	Yes
7.	Bafu Bay	Sinoe county	Coastal	n/a	No
8.	Cestos-Senkwehn	Rivercess county	Inland riverine	n/a	No

Resources gained from wetlands are also vital to the livelihood and survival of people living in the surrounding areas in Liberia. The Marshall wetlands consist of large stands of mangroves, which support substantial fish populations. Wetlands are very important nursery and spawning areas for many fish species. Other wildlife, such as mammals and birds, are also plentiful in this area, providing feeding areas for a large number of bird species. This wetland system also acts as a sediment trap, protects against flooding, and provides underground water recharge. The Marshall wetland is, therefore, very important in terms of not only ecosystem health, but also as a fisheries and tourism area for the abundant wildlife. The Mesurado Wetland is also rich in wildlife, particularly birds. Several species such as the African spoonbill (*Platalea alba)* common pratincole (*Glareola nuchalis)* and curlew, Numenius arquata, are known to feed and inhabit this wetland. The Nile crocodile *(Crocodylus niloticus)* and the vulnerable African dwarf crocodile *(Osteolaemus tetraspis)* also inhabit this wetland.

Although Liberia is endowed with rich natural resources, its value as a tourist destination is largely underdeveloped particularly due the lack of facilities in the country, such as transportation networks and accommodation. The country's landscape and biodiversity, including that of its wetlands, have a great potential for attracting tourists. The rich biodiversity of wetlands promotes ecotourism activities such as bird watching, adding to the economy of the country.

6.4.2 Pressure on Wetland Resources

Wetlands are under significant pressure from human activities due to the inherent poverty and lack of basic facilities for all in the country and the fact that wetlands provide a number of important resources such as fertile land, agricultural products and food. This leads to direct physical destruction of this important resource as well as pollution of the water resource. The mining of sand for construction projects from wetlands, such as Lake Piso, is also a major threat to this important habitat type as is the construction of developments within the delineation of the wetlands.

Due to the inadequate provision of basic water and sanitation services in Liberia most wetlands are used as areas for sanitation where washing and ablution practices take place. Wetlands in urban areas are also at risk for dumping of waste due to the lack of efficient removal services. Large-scale pollution also comes from commercial industries which

surround the wetlands, with chemicals emanating from oil refineries, paint factories and rubber plants.

Wetlands are, furthermore, under threat from clearing for firewood and for cultivation. Mangrove trees, such as *Rhizophora harrisonii*, *Rhizophora mangle* and *Avicennia Africana*, are felled to use the wood for fuel or charcoal burning, especially in the Mesurado wetlands, while areas of wetlands are cleared for subsistence farming with rice. Additional crops such as cassava are also planted in the surrounding area. Run-off from fertilisers adds to the pressure on wetlands by eutrophication and the potential for alien invasive species to flourish. The water hyacinth (*Eichornia crassipes)* is an aquatic invasive plant which has adversely affected human activities such as fishing and water transport; also rice paddies; in the wetlands. The water hyacinth impacts heavily on small-scale fishing communities by physical interference and by de-oxygenation of the waters resulting in fish die-offs. This invasive plant also affects the ecological biodiversity by reducing or eliminating natural vegetation and related faunal species (EPPO, 2014).

Illegal hunting and unregulated fishing poses a big problem to the health and integrity of wetlands in Liberia, even those designated as RAMSAR sites, such as Lake Piso. Mammals, like antelopes, bushbuck, duiker and monkeys, frequent wetlands and are often exploited for food in these areas. This affects both the physical nature of the wetlands, as well as the biodiversity of these habitats.

A number of hydroelectric power schemes are planned for Liberia (CI, 2017). The development of hydroelectric power schemes also threatens the integrity of wetlands due to the dams and reservoirs required to ensure the provision of energy at peak times (see Figure 6.1 for existing and planned dams in Liberia). This has the potential for substantial alteration of the natural water flow which can affect ecological relationships and fragment the wetland ecosystem.

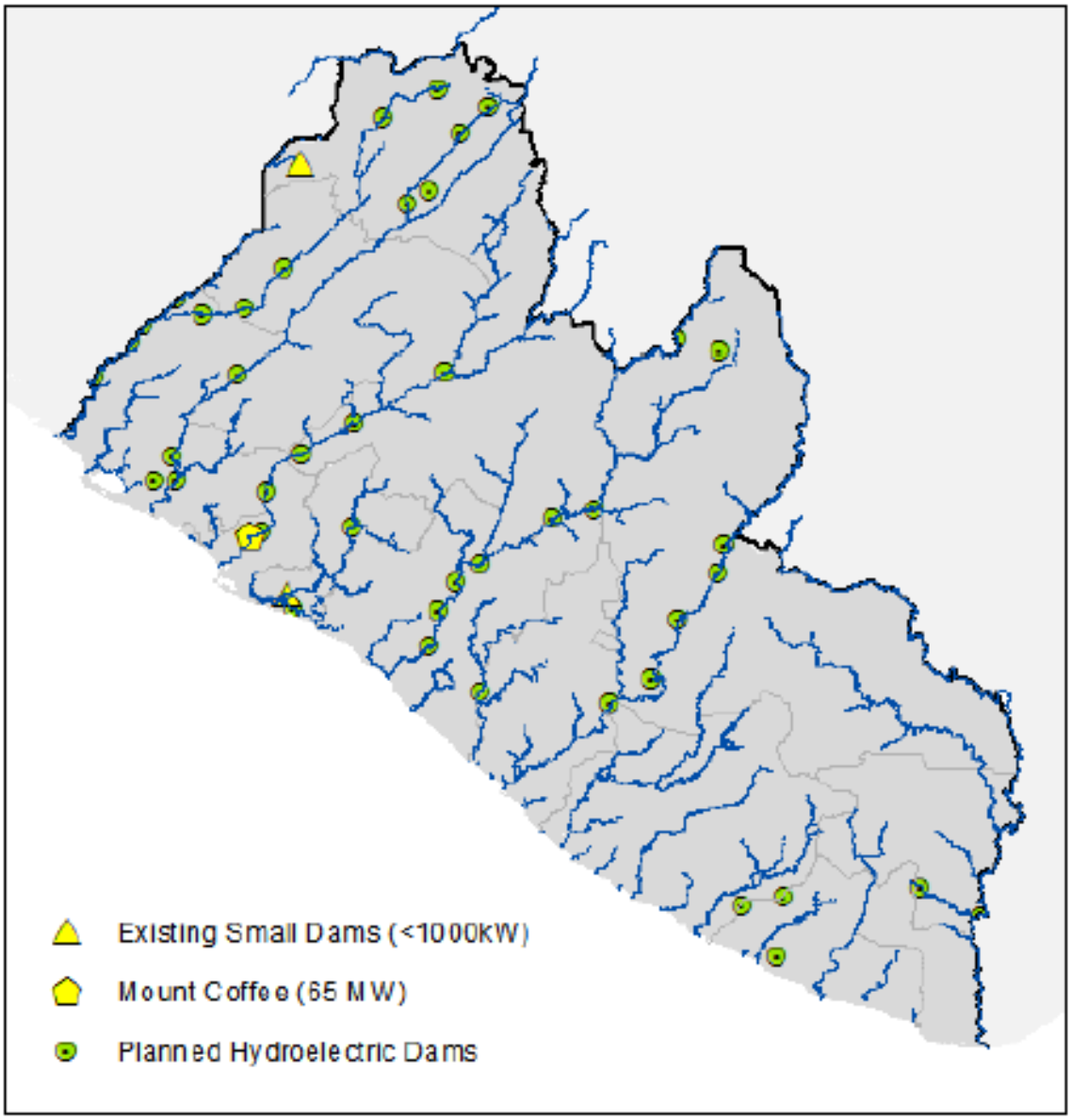


Figure 6.8: *Map of Existing and Planned Dams in Liberia (Source: CI, 2017)*

6.4.3 Government Responses to Challenges

The Liberian wetlands have been significantly impacted by the civil war, which ended in 2003. The wetlands in the urban areas were affected the most, being impacted by the largescale influx of people from the rural areas to the cities. These mangrove wetlands saw over harvesting of trees for firewood, indiscriminate fishing and agriculture, and significant dumping and pollution.

On the 2nd of November 2003, the Liberian government made a concerted effort to address the management of its wetlands by the accession and ratification of the RAMSAR Convention. A post-conflict assessment of the war on the wetlands was subsequently initiated which resulted in the production of a national report on the impacts of the conflict on the wetlands. Moreover, a National Wetland Policy was developed and adopted in

2006 and a National Wetlands Committee was established. The key principles underlying the Wetland Policy include:

- The health needs of Liberians are dependent on wetlands and their ecosystem services;
- The need for communication and education of Liberians with respect to their perceptions and attitudes towards wetlands and wetland uses;
- The need for an ecosystem approach to ensure the conservation of wetlands and their functions by the integration of wetland issues across all sectors;
- The conservation of wetlands through the co-ordination and involvement of all relevant stakeholders, including local people and the private sector;
- The role of the government in the conservation of the wetlands whilst considering the rights of the local people and their land ownership; and
- Management and conservation of Liberia's wetlands through continuous scientific research and expertise development.

In order to achieve the goals as set out in the policy, strategic priorities were acknowledged and included the following:

- Identify existing relevant legislation to enact the proposed policy and develop additional laws for those principles not covered by the programme which targets communities living in wetland areas as well as the relevant policy makers;
- Develop a national awareness;
- Include wetland issues into the national planning processes; and
- Promote international co-operation with neighbouring countries that share water resources through recognised joint projects and strategies.

Since Liberia subscribes to the intergovernmental treaty, the RAMSAR Convention, which provides a framework for the conservation and sustainable use of wetlands and their resources, it is, therefore, obligated to abide by the provisions as set out within the convention. This requires that Liberia ensures that its five RAMSAR wetlands of international importance are managed in a sustainable manner. But Liberian wetlands, including the RAMSAR sites, are under constant threat from various human activities.

6.7 CONCLUSION AND RECOMMENDATIONS

Two key recommendations are made concerning the protection and promotion of Liberia's biodiversity:

I. Strengthening Institutional Capacity and Cooperation

Environmental institutional capacity must be strengthened. Without strengthening interdepartmental/interagency cooperation Liberia will not be able to keep up with its obligations in terms of biodiversity protection. To develop and strengthen capacity, we to establish graduate programs in natural resource management, biodiversity conservation, and climate change etc. at different universities in Liberia.

II. Linking Biodiversity Protection and Economic Upliftment

Biodiversity protection provides an opportunity for less formal, nature-based community initiatives to act as economic engines and job creators.

CHAPTER 7: FRESHWATER, COASTAL AND MARINE RESOURCES

7.1 INTRODUCTION

This chapter looks at aquatic resources with focus on surface water, ground water and coastal resources. Major pressure on water quality are discussed and key management strategies are outlined.

7.2 SURFACES WATER RESOURCES

Relative to its small population, Liberia has rich water resources, with approximately 15 050 km² (14%) of the total area of Liberia comprising of surface water from rivers, lakes, lagoons, creeks and streams that drain to the Atlantic coast.

The country can be divided into two kinds of river systems: short coastal watercourses (the surface water in Liberia is supplied by six main watersheds with numerous other micro-watersheds or sub-watersheds as part of this system), which drain about 3% of the country; and major river basins, which are drained by rain-fed rivers discharging into the Atlantic Ocean.

Figure 7.1: *Water Draining Points in Liberia (Source: LHS Basins Survey Report, 2016)*

With 16 rivers draining its land, Liberia has one of the highest number of rivers in West Africa. The Cavalla River is the longest river in Liberia and is shared with Cote D'Ivoire, whilst the Mano River is shared with Sierra Leone. The Lofa, St John and St Paul rivers are shared in part with Guinea. Refer to Figure 7.2 for the major rivers and principal catchment areas of Liberia.

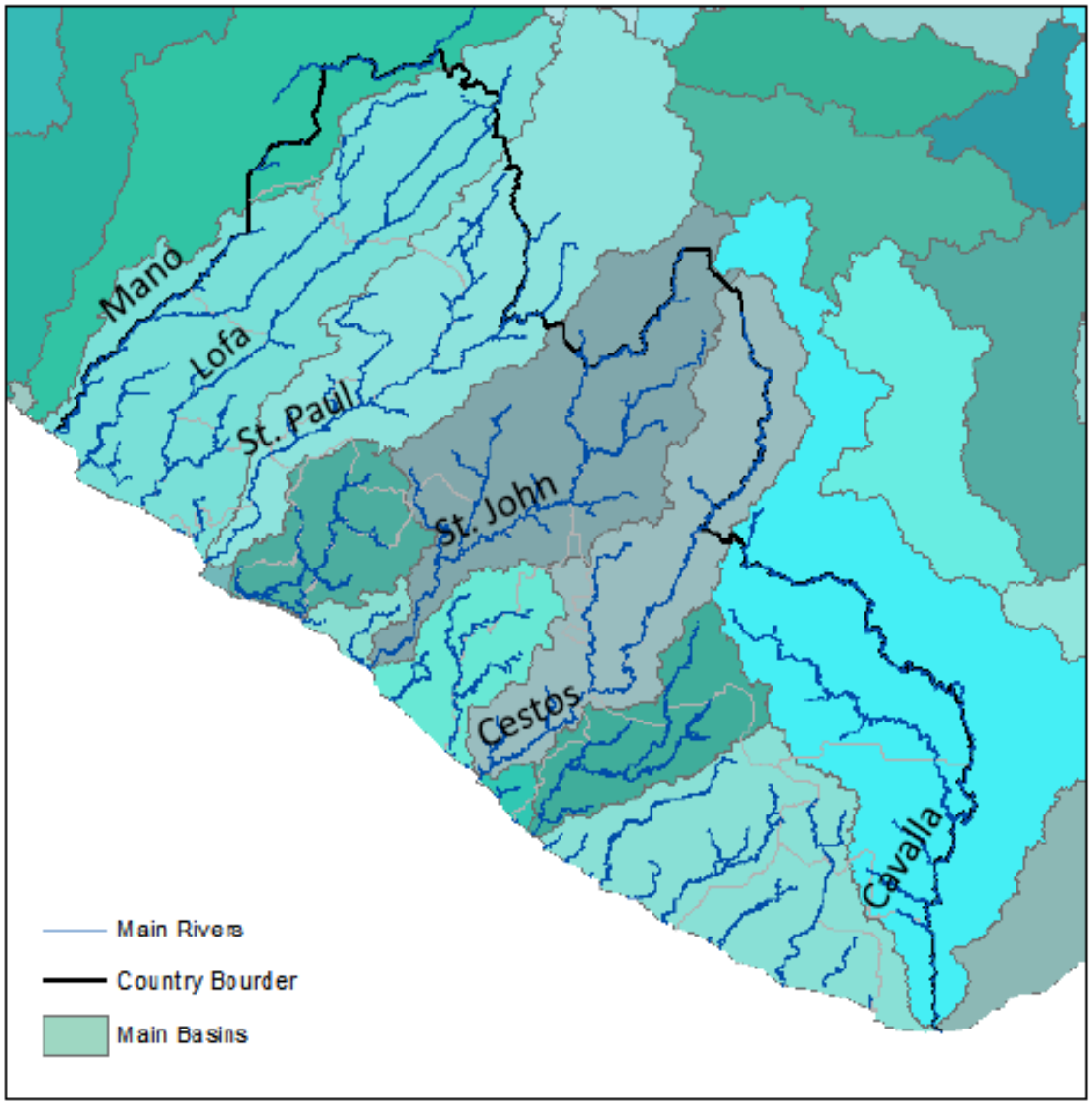


Figure 7.2: *Major Rivers and Catchment Areas in Liberia (Source: CI, 2017)*

The St. Paul River is the second longest river, feeding the hydro-electric plant in Mount Coffee. The same river also supplies the majority of the raw water to the capital city of Monrovia. The main watersheds and their characteristics are listed below in Table 7.1.

Table 7.1: *Major River Basins of Liberia (Source: Liberia Hydrological Survey, 1998)*

Basin	Area (km^2)	Annual flow (m^3/sec)
Cavalla	13,726	380
Cestos	10,000	60.3
Lofa	9,194	N/A
Mano	6,604	251
St. John	14,762	N/A
St. Paul	12,820	512.3

With the exception of the middle reaches of the Cavalla River, all the largest rivers flow from their headwaters in the southwest direction towards the Atlantic Ocean. The six

largest principal basins in Liberia are transboundary river basins, which can be defined as basins shared by two or more riparian states.

Liberia only has two major lakes, both of which lie along the Atlantic Coastline. Lake Piso is an oblong tidal lagoon and the largest in Liberia, covering 103 km^2. It is characterised by extensive wetlands and lowland forest vegetation. Lake Shepherd is also a long narrow lagoon with similar vegetation to Lake Piso. Apart from these two lakes along the coastline, a third one, namely Blue Lake, is characterised as a 300 ft deep man-made pond with the waters originating from iron ore mining activities. Today, Blue Lake is also a major tourist attraction in Liberia. Rainfall is the main contributor to the country's surface water bodies with average annual rainfall ranges from 4,500 mm at the coast to 2,000 mm being recorded inland (LHS, 2019). Freshwater resources cover 15 050 km^2 (14%) of the total area of Liberia, comprising rivers, lakes, lagoons, creeks and streams that drain to the Atlantic coast.

The state of the water resources of Liberia is beginning to hit a perilous point. Whilst some interventions have been made in improving access to safe water, there remain a list of challenges. These include, for example:

- Lack of stakeholders participation in the water sector;
- Proper coordination between various water sectors and communities;
- Water monitoring;
- Capacity building amongst government and water-using groups;
- A lack of strong governance and regulatory framework; and
- Poor financing in water infrastructure.

Adding to the list above, the sprawling and rapid urbanisation of cities exert a lot of pressure on the management of the country's water resources. Most often, these rapidly sprawling communities are not planned, and as such, the infrastructures and resources needed to support these communities are not available.

Liberia has abundant surface water supported by the mentioned six main watersheds that are the six major rivers of Liberia. These rivers drain much of the country's vast surface water. There are also some smaller rivers in the coastal zone that flow directly into the sea.

7.3 GROUNDWATER RESOURCES

Groundwater includes all water found beneath the surface of the earth. It is derived primarily by percolation of atmospheric or surface water and contained in pore spaces of permeable reservoir rocks; this makes it a replenishable resource unlike other resources of the earth. In any geological environment, groundwater chemistry is controlled by the chemistry of the infiltrating water, the chemistry of the porous media including the interstitial cement or matrix of the aquifer, the rate of groundwater flow and the permeability of the aquifer.

Liberia is characterised by an abundance of good quality groundwater throughout the country. This water is found in aquifers with rock bearing formations, permitting the

extraction of water by means of boreholes and dug wells. Groundwater supplies are recharged by the country's tropical rain and watersheds.

Groundwater resources of Liberia is the primary source of domestic water supply for residents. Groundwater is usually obtained by means of boreholes with handpumps and hand-dug wells. Very little information currently exists, though, on the state of the groundwater supplies and water quality. Most of the country's aquifers have not been mapped, as Liberia lacks resources to run proper hydro-geological tests. The potential for developing better technologies to extract more groundwater is high, as groundwater is readily available everywhere across the country. To a large extent, and especially in rural areas, water supply from groundwater is always reliable, except for the brief period during the dry season.

Plate 7.1: *Hand pump creates access to groundwater (Greencons, 2019)*[18]

7.4 COASTAL RESOURCES

Liberia is one of the most endowed areas of the West Coast of Africa in terms of river systems. There are 16 rivers in Liberia. Six (6) are considered major rivers in Liberia. They include the Mano River, Lofa River, St. John River, St. Paul River, Cestos River and the Cavalla River. These rivers enter the coastal zone from an extensive network of catchments basins transporting great quantity of sediments from land based industrial and agricultural activities, thereby contributing significantly to the country's pollution problems in the coastal and marine ecosystems. Land run-off is an important source of nutrients suspending matter to the coastal and marine environment. Excessive nutrient loading causes eutrophication and Harmful Algal Blooms (HAB). The rivers in Liberia also transport industrial, agricultural, mining and other wastes to the coastal zone.

Fishing as an agricultural activity started in 1956, when the Bureau of National Fisheries was established by an Act of the National Legislature under the Natural Resources Law

[18] This picture was taken in Bellah Yallah Village by Greencons in 2019.

of Liberia. The Act mandates the Secretary (Minister) of Agriculture to formulate rules and regulations (guidelines) to govern the National Fisheries Bureau from time to time which may be expedient for planning, development, and management of the fishing industry. Under this policy, all water bodies (reservoirs, ponds, streams, creeks, rivers, lagoons and oceans) within the Republic of Liberia are declared fisheries. Potential waters for the management and development of fishing purposes in Liberia have been identified to ensure fish sustainability for food security. For fishing purposes, the territorial waters extend to 200 nautical miles, or the Exclusive Economic Zone (EEZ). The fishery sector of Liberia has been discussed extensively in chapter 6.

7.5 THE MANAGEMENT OF LIBERIA'S FRESHWATER, COASTAL AND MARINE RESOURCES

In Liberia, the governance and institutional framework for managing water resources is still very poorly developed. It is still centralised for the most part. The Liberia Water and Sewer Corporation (LWSC) is still the largest sole producer, distributer and manager of the water resources for all urban cities of Liberia. This process sees the LWSC as producer, financier, infrastructure owner and regulator.

On the other hand, WASH activities are headed by the Ministry of Public Works, which oversees portable water and sanitation management including financing in rural Liberia. Some of the ministry's functions also cover urban and peri-urban slum communities. Financially, the Water and Sanitation Board has recently been commissioned. However, the board's roles, responsibilities and mandates are still unclear, as the board is presently working parallel to the WASH Commission. Together, these institutions manage the portable water and sanitation services of Liberia.

The Liberian Hydrological Service (LHS) was founded in 1972 with the role of mapping, locating and quantifying the amount of water currently available to Liberia, and determining the future water needs. Their functions are designed for both ground and surface water; however, most of its work in recent years have focused on developing the country's energy sector.

Other major actors in the water governance sector include:

- Ministry of Agriculture;
- Environmental Protection Agency (EPA);
- Liberia Maritime Authority (LMA);
- National Fisheries Authority (NFA);
- Ministry of Mines and Energy (MME); and
- Ministry of Transport (MoT).

The ambiguities inherent in the responsibilities, roles and functions of the above-listed ministries and agencies make management and improvement of service delivery in the water sector very convoluted (if not confusing). Consequently, the lack of organised governance and sound institutional frameworks all impact water availability and quality.

The recent Regional and International Water Resource Management Framework, an integrated sector management approach, seems to be the government's current preferred philosophy in terms of water management. This approach ensures that water should be managed at the lowest appropriate level. This means taking a basin approach, where appropriate and decentralising decision-making, usually with increasing input and role from various water stakeholders, and management decisions are being made. It is also believed that an integrated approach is necessary to consider the different interests, concerns and experiences in water resources and management. Mechanisms such as water resources commissions and councils have been envisioned as apex bodies to facilitate cross-sector inputs to water resources management.

The management of Liberia's rivers requires the establishment of individual management structures. Before the civil war, LHS had maintained a network of 28 hydrological stations and 13 hydrometeorological stations. In addition, LHS maintained only three (3) hydrogeological monitoring stations, which limited its capacity to identify and map aquifers and groundwater. These stations were, however, not restored after the civil crisis ended. Since 2011, LHS has been receiving assistance from the Norwegian Water Resources and Energy Directorate to upgrade the Liberian Hydrometric Network. Ten (10) hydrometric stations were placed within the principal river basins of Liberia and hydrological data has since been collected. Several rain gauges and one automatic weather station have also been strategically placed to collect the necessary data. A provisional hydro-meteorological database and database collection system are now operational through the LHS webpage and are accessible to users. These instruments provide needed water quality data, such as, but not limited to, daily water level records. The data from each station is monitored and analysed monthly. For example, the discharge measurement data is used to produce a rating curve graph to show the discharge rate at each hydrometric station.

The SoER (2006) proposed the hydrogeological investigation and mapping of groundwater and surface water, which may be at a slower pace. The goal of hydrogeological mapping is to provide information on the location of constructing wells that will produce water daily. In the absence of data on hydrogeological details, it is difficult to set up a borehole in rural Liberia. An understanding of the local hydrogeological environment is, therefore, needed to improve borehole and surface water site selection and increase success rates. The GoL has not yet implemented the latter proposal emanating from the SoER (2006).

In Liberia, the primary source of water used by its people is ground and surface water. These waters are treated by LWSC which provides piped-borne water to communities across Liberia. Both ground and surface water is considered in the section below, followed by a section that considers the management of both water bodies.

7.6 ACCESS TO DRINKING WATER

As per the Liberian National Legislative Act of 1973, LWSC is responsible for the provision of commercialised pipe-borne water and sewerage services to urban areas. Pre-war, Greater Monrovia had the most sophisticated system with an impounding reservoir, treatment plant, and distribution network. This system had a capacity of 8 million gallons

per day and served a population of about 200,000. Due to increased population in Greater Monrovia and the destruction of the White Plain during the civil war, the government is faced with significant challenges in terms of water shortages and water provision.

The Ministry of Rural Development is responsible for the Rural Water Programme to supply the rural areas of Liberia. Although there have been several implementing programmes for rural water supply, the implementation of water and sanitation activities in rural Liberia has been uncoordinated. This has resulted in pollution of water sources directly attributed to human activities, and the poor water quality has resulted in outbreaks of waterborne diseases, such as cholera, typhoid and diarrhoea.

Today, the infrastructure for water resource utilisation in Liberia consists of the Monrovia Water Supply System and over 10,000 handpump boreholes throughout the country which have been either dug or drilled. It is estimated that 3.75 m^3 is withdrawn per day from boreholes and dug wells, whilst during the wet season, the amount increases to 6.25 m^3 per day. Although it is the largest reticulated system in Liberia, LWSC is only able to supply around 25% of the safe drinking water that the city of Monrovia requires (EPA, 2017). It currently supplies approximately 3.5 million gallons of water per day. The total amount of water withdrawn from this supply system and its ancillary wells equates to approximately 5.028 km^3 per year. The St. Paul River is the principal source of water for the city of Monrovia, with the White Plains Water Treatment Plant also being situated on this river's bank. This source is supported by two LWSC-operated deep wells in Paynesville, and also supplemented by around 1,500 manually operated shallow wells, which are managed by the communities themselves.

LWSC now has a functioning presence in seven of the country's 15 county capitals; meaning just under 50% of the counties do not have well-developed water infrastructure on the national water platform. However, it should be noted that all 15 counties have access to some water and sewage facilities *via* services provided by Liberia's WASH sector. Refer to the figure below for the current functional water access points in Liberia.

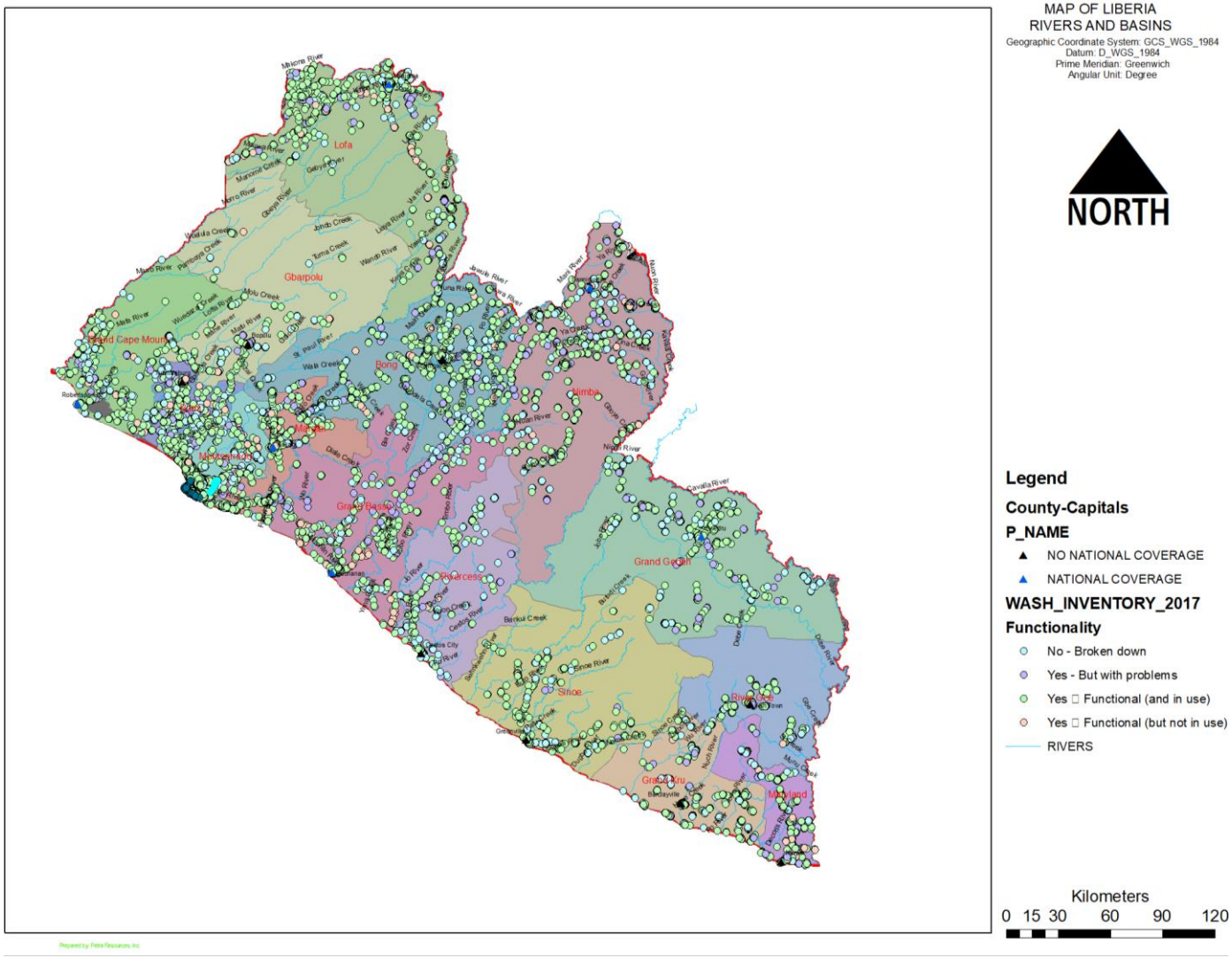


Figure 7.3: *Functional Water Access Points in Liberia (2017) (JSR, 2017)*

Figure 7.4 illustrates how some of Liberia's major cities and towns are located close to or along river basins, which assist in water provision.

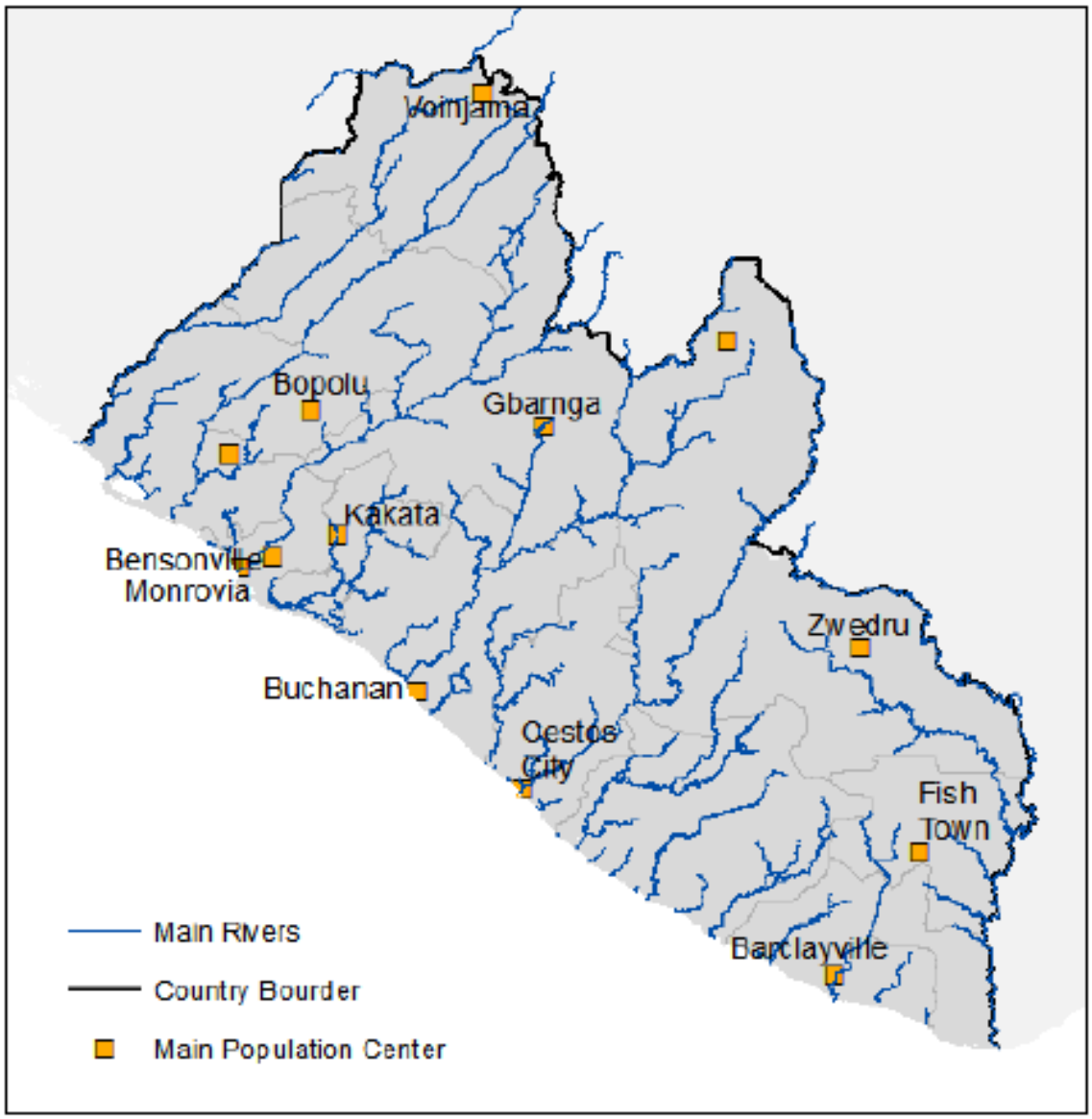


Figure 7.4: *Location of Major Liberian Cities in Relation to Rivers (Source: CI, 2017)*

LWSC has been operating two boreholes since 1993 in one of two sedimentary basins south of Monrovia. Since 1993, water has been trucked to other areas of the city and its environs, as the central system could only serve a small proportion of the city. The two (2) boreholes contribute about 100,000 US gallons per day to the water system. LWSC continues to face a challenge to improve and expand its service and delivery to the urban areas and the water supply to these communities is often disrupted due to the poor condition of the existing infrastructure. Private vendors have capitalised on LWSC's inability to supply adequate clean drinking water to the communities and has taken to marketing water to the general public primarily in the form of drinking sachets.

The Liberian Senate passed The National Water Supply and Sanitation Commission Act which holds the Water and Sanitation Regulatory Agency responsible for issuing licences

and regulating tariffs and service standards in Liberia. LWSC implements water tariffs for the provision and usage of water. The tariffs for the current year are depicted in Table7.2.

Table 7.2: *Water Tariffs in Liberia for the Year 2019*

Water	***Consumption per month in US$/m³***			***Calculation***
	15 m³	**50 m³**	**100 m³**	***Enter m³***
Tariff	0.49	0.67	0.70	
Fixed Charge	0.00	0.00	0.00	
Variable Charge	0.49	0.67	0.70	
Other Charges				
VAT				
Tariff reference date: 31 Aug 2015				

(Source: https://tariffs.ib-net.org/ViewTariff?tariffId=126&countryId=16)

Present official reporting mechanisms do not include financing for water resources management and development as a specific category, especially in the recently 2019/2020 national budget. There is no allocation for water programmes, except the administrative costs associated with the operational aspects of the largest water infrastructure. Financing from other sources, mostly private entities, is also small. Several financial commitments have recently been made, however. These include:

- United Nations Children Education Fund (UNICEF) $1m;
- USAID $500,000; and
- Norwegian Government (NVE) Technical Assistance Programme 2010- 2020.

Based on data from community consultations for this SoER, Greencons was able to confirm that rural community members do not pay for water. This is different in some parts of Monrovia, where some households pay for water – especially those connected or using the LWSC Network. However, whilst most (rural) community members claim not to pay for their water, many respondents did report making financial contributions towards protected well maintenance. The protected well installations require regular maintenance and repairs. The costs of the maintenance and repairs are borne either by the institution on the premises of which the well is located, or by the residents of the community with access to the well. For this, there are three (3) primary activities incurring costs:

- Ensuring that the area surrounding the well is clean and free of contaminants;
- Treating the well water with chlorine; and
- Repairing the protected well and its associated equipment, when needed.

A committee typically manages the maintenance needs of a protected well, and communities use different strategies to meet these needs. In some cases, the committee organises the community to provide labour for day-to-day maintenance and obtains chemicals free of cost from an NGO or the local hospital to treat the well water. In other cases, the committee collects funds ranging from LD10 (USD0.012) to LD50 (USD0.010) on a monthly basis from each household to cover regular maintenance costs. In the case

of repairs, the committee collects funds on an *ad-hoc* basis in amounts determined by the number of residents contributing and the cost of the repair.

As illustrated by Figure 7.4, the supply of water in Liberia seems to be abundant, yet it is a scarce resource. For instance, in large towns and cities such as Monrovia, water bodies have been used as dumping sites for waste. Also, in many cases, open toilets are built along riverbanks, polluting it for those living downstream, as is the case of the Mesurado River which may affect thousands of Liberians living downstream. From Figure 4.4, one may also be misguided to see many hand pumps in many villages; although the reality is that many of these pumps are broken. Even in communities where there are working ones, maintenance has become a major obstacle. Understandably, villagers rely on other water sources, most often open sources. As reported by the various communities engaged by Greencons in 2019, the major sources of water for community uses are creeks, running rivers and other smaller tributaries. Moving to different water points every morning in search of water has become a challenge, especially for women and children, or those of school-going age. However, water from such creeks, rivers and tributaries remain unsafe.

During Greencon's rural community consultations for this report, the quality of many villages' drinking water was discussed. Findings from consultations reveal a common complaint amongst many rural villagers regarding the lack of safe drinking water. According to many, most of the rivers and creeks that serve as their drinking water needs have either been polluted by farmers, or mines, and have frequently run dry due to, in their view, changing climate patterns. These, together with other activities such as waste disposal - most especially in urban and peri-urban communities and open defecation - have affected the surface water from being used as drinking water. When referring to water quality, most of the stakeholders commonly referred to the physical characteristics including smell, odour, taste, and colour.

There is no comprehensive report detailing the national water quality of Liberia, both for domestic and industrial water supply. The latest review of water classes in Liberia was published in 1987 by LWSC. The lack of data to quantify the kind of pollutants in drinking water is a serious challenge. Water bodies, including wetlands (already considered), form about 12% of the surface area of Liberia. The National Environmental Policy of Liberia (2003) acknowledges that supply and distribution of water are critical factors in the socio-economic development of the country.

Access to improved water resources is currently severely hindered by the fragmented governance and the inability of the regulatory authorities' ability to provide clean water supply and safe sanitation. It is estimated that 61% of people in Liberia still do not have access to safe and clean water (Neugarten *et al*., 2017). Whilst domestic demand for water is large, there is little infrastructure available for water reticulation, and only about 25% of the population has access to pipe borne water.

7.7 CONSUMERS OF LIBERIA'S WATER RESOURCES

Water resources are a critical input to agriculture, mining and electricity production. Yet, although the country has abundant water resources, little use is made of available water

resources. There is only limited hydro electricity generation, and because the manufacturing sector is small, the demand for water from that sector is also tiny.

The following section considers the factors, which consume Liberia's ground and surface water. These include agriculture, energy and mining.

7.8 AGRICULTURE AND MINING

The surface water usage by the agriculture and mining sectors is hard to determine. Most of the large agriculture and mining user consumptions are for concessionaires. Table 7.3 provides surface water usage by some of the country's agriculture and mining industries. It should be noted that these figures do not include groundwater, as these are a combination of atmospheric precipitation and surface water.

Table 7.3: *Surface Water Usage by Industry*

INDUSTRY	AVERAGE MONTHLY CONSUMPTION (M^3)
Agricultural: • Samy Darby • Golden Verillium • Firestone • Liberia Agricultural Company • Salala Rubber Corporation • Weala Rubber Corporation • Maryland Rubber Corporation	8,250,000
Mining Class A: • Arcelor Mittal Steel • Bea Mountain Mining Company • Kokoya Gold Mining Company Mining Class B: • 12 Companies Mining Class C: • 1,500 Licenses Exploration • 4 Drilling	15,000,000[19]

(Source:

https://www.usaid.gov/sites/default/files/documents/1860/201211%20LMWP%20SA%20Report.pdf)

The agriculture industry in Liberia has previously been dominated by traditional farming practices with 80% of farming activities focused inland. This traditional subsistence sector has sustained 75% of the Liberian population and has been characterised by low levels of production of crops such as rice and cassava. The agricultural system has predominantly depended on rain, with minimal amounts of water being withdrawn from other sources for irrigation.

Being mostly rain-fed and, except for swamp rice cultivation and vegetable farming and/or gardening, irrigation water withdrawal is generally thought to be negligible. Data available from FAO informs that agricultural water withdrawal in Liberia in the late 1900s was 60 million m^3 per year (55% of total withdrawal). No current data is available, although it can be assumed that this number has risen; especially with the noticeable agricultural expansion (industrial) over the last decade. Although these volumes were thought to be negligible and hence not really quantified, this might change with the expansion of large commercial plantations of products such as rubber, timber, cocoa, coffee and palm oil; industries and concessionaires using large volumes of water.

Considering mining, the need for water has increased as mining operations have intensified and became more industrialised following the last civil war (Wilson *et al.*, 2017). The mining industry requires vast amounts of water for the processing of the extracted minerals. There are currently two large scale mining operations in Liberia (two gold mines and two iron ore mines), but despite this, the water usage by this industry has not yet been quantified and no estimates are known for the various types of mining activities throughout the country.

[19] Numbers are estimates based on an estimate of 7500m^3 /day for consumption

7.9 ENERGY PRODUCTION

A 64 MW hydro-power plant at Mount Coffee is the largest consumer of water for energy production. Other noticeable water consumers are the 4 MW Firestone nine (9) hydro power dam and the 30 KW Yandohun hydro power dam on the Yando River in Lofa County. The water withdrawals from these systems are not known.

7.10 GROUND AND SURFACE WATER QUALITY

The National Public Health Law was revised in 2017 to provide for the protection and management of the water quality. Water quality and the management thereof rely on having the knowledge of the physical and chemical constituents of the water in question. It is understanding the point source and the non-point source of contamination and how these are managed in order to reduce the impact to the water quality.

The problem with Liberia's ground and surface water remains in the quality of such water. Coliform contamination seems to be the main water quality issue [(Liberia Water Producers Association (LWPA), 2017]. During the consultations for this SoER and NEAP, most of the end water consumers were only able to comment on the water's physical characteristics such as colour, smell and taste. Very few stakeholders were able to comment on the chemical qualities of the water; and very little could comment on potential point sources of contamination. It, therefore, makes sense that the only emphasis placed on water quality is from the national regulators. However, these are often fragmented as there are no national water regulations or standards.

The most comprehensive form of water quality monitoring (WQM) in Liberia was conducted within the Water Access Point Mapping exercise in 2017 under Liberia's WASH Programme. This project was to identify all water access points in the country and was highly focused on infrastructure and the availability of the resource. However, a small but quite resourceful jump was made to investigate the quality of water in rural areas. This focused on smell, odour, taste and colour (physical characteristics). Very little is known about chemical compositions. Another analytical survey was completed by NPHI in 2018, during which approximately 550 water access points were sampled. Most of the results confirmed the findings of the LWPA study in 2017. Water samples were analysed less than 24 hours after collection to ensure microorganisms remained alive when the analysis was done. Biological, physical, chemical analysis were done to determine parameters (drinking water quality indicators) out of range based on WHO Standards. Physical parameters analysed were pH, colour, turbidity and Total Dissolved Solids (TDS). Chemical parameters analysed were fluoride, iron, free chlorine and nitrate, whilst biological parameters analysed using membrane filtration methods were E-Coli and Coliform to detect the presence of faecal bacteria in drinking water.

Refer to Table 7.4 and Figure 7.5 for the data of the LWPA 2017 study.

Table 7.4: *The WASH Programme Water Access Point Mapping Exercise in 2017 (LWPA, 2017)*

COUNTY	TOTAL	SAFE (< 1 CFU/100ML)	INTERMEDIATE RISK (1-10 CFU/100ML)	HIGH RISK (>100 CFU/100ML)	VERY HIGH RISK (> 100 CFU/100ML)
Bomi	12	12	0	0	0
Bong	38	12	12	12	2
Gbarpolu	21	2	16	3	0
Grand Cape Mount	15	15	0	0	0
Grand Gedeh	26	23	3	0	0
Grand Kru	23	7	16	0	0
Lofa	21	21	0	0	0
Margibi	12	0	5	7	0
Maryland	20	16	1	2	1
Montserrado	22	3	4	9	6
Nimba	41	41	0	0	0
River Gee	30	30	0	0	0
Rivercess	24	24	0	0	0
Sinoe	38	31	7	0	0

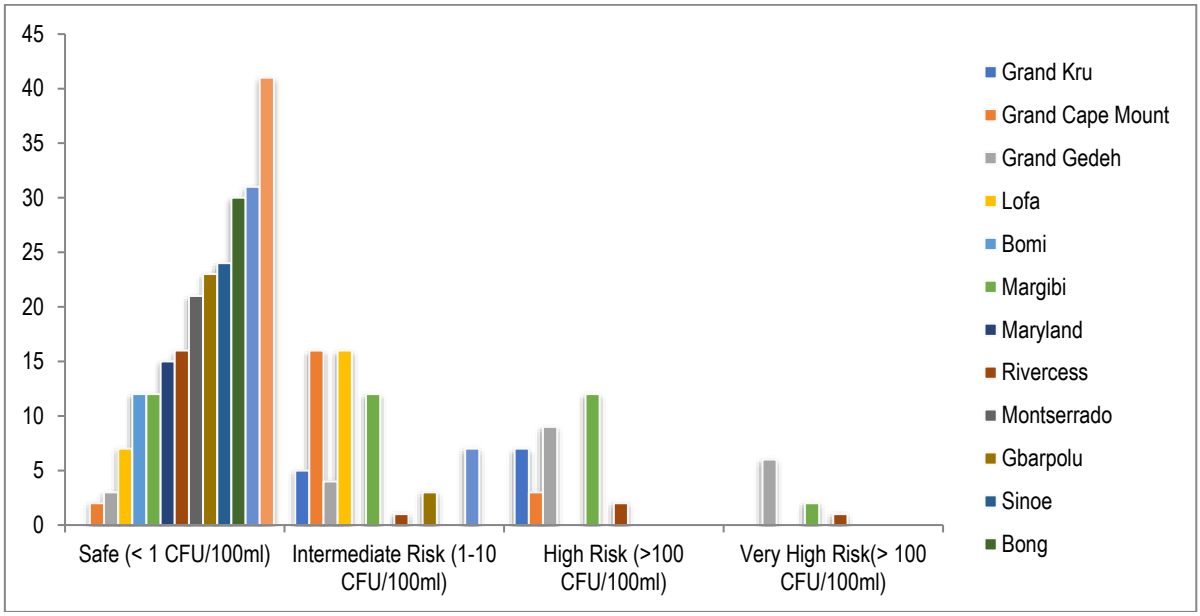


Figure 7.5: *The WASH Programme Water Access Point Mapping Exercise in 2017 (LWPA, 2017)*

Out of the total of approximately 550 samples that were tested as part of the NPHI study in 2018, 124 samples were tested and found positive for E. coli, constituting 22.5% of the samples. Moreover:

- 141 were tested and found positive for total Coliform, constituting 25.68% of the samples;

- 7 samples tested out of the total 549 samples were found to be out of the approved WHO range for pH reading representing 1.27%;
- 36 samples were tested and found to be out of the range for colour representing 6.55% out of the total samples;
- 20 samples out of the total amount of samples were tested and found to be out of the range for turbidity constituting 3.64%;
- 77 samples were tested and found to be out of the range for iron representing 14.02%;
- 67 samples were tested and found to be out of the range for fluoride representing 12.2% of the total samples tested; and
- 203 samples were tested to be out of the range for nitrate representing 36.97% of the samples.

Based on the laboratory analysis of the LWPA (2017) and the NPHIL (2018) studies, it can be concluded that the number one concern regarding portable water quality is nutrients (E. coli). Furthermore, acidification and alkalinity are impacts that are beginning to surface in water quality analysis - this is particularly noticeable around the large agricultural belts.

Reports of outbreaks of water-borne diseases are also frequent, whilst the LWPA Study (2017) revealed that this resource is also threaten by widespread E. coli bacteria. Other parameters are at or near threshold levels. These levels are compared to WHO drinking water quality criteria. Parameters examined included dissolved oxygen (DO), pH, conductivity, phosphorus, faecal coliforms, suspended solids, turbidity, chlorophyll-a and nitrogen.

Monitoring water quality in Liberia is a growing challenge and will continue to grow because of the high urban sprawling, demand to improve agriculture and the extractive industries as these sectors increase employment. However, these industries depend on the use of chemicals as part of their operations and these chemicals end up in waters.

All stakeholders participating in this SoER and NEAP agreed that water is a key resource and the quality must be good for all to achieve the maximum benefit from this resource. Therefore, every effort must be taken to mobilise resources, personnel and facilities to monitor the efficient and effective use of all waters (fresh, saline, brackish, ground, sea, etc.).

7.11 WATER SCARCITY AND/OR OVER-USAGE

Clean, drinkable water is a resource that many people in developed nations take for granted. Access to safe and quality water is a Human Right issue. Water is scarce when it is not sufficient, not safe for drinking, not acceptable, take more than a 30-minute round trip to fetch, and is unaffordable.

There is a lack of water quality data in Liberia. A study conducted in Montserrado County showed that 62% of families experience shortages of water between January to April annually (McClain and Paye, 2017). Liberia is one of the world's wettest countries but lacks vital networks to reach everyone with clean drinking water. A programme designed

to circulate quality drinking water to all Liberia is critical to the health sector of the country.

As one of the countries with the highest rainfall in the world, Liberia, with its high tropical rainfall and readily available supply of groundwater, seems to have an abundance of water. Water resources in the country are, however, becoming scarce. The renewable freshwater resources for Liberia have steadily declined over the years from 170,870 per capita in 1962 to 45,550 m^3 in 2014. The internal renewable freshwater sources, as defined by the internal river flows and groundwater from rainfall, are calculated per capita by using the World Bank's population estimates detailed in Table 7.5.

Table 7.5: *Renewable Internal Freshwater Resources Per Capita (in cubic meters) for Liberia (Source: AQUASTAT data, Food and Agriculture Organisation, 2014)*

Year	Value
1962	170,870
1967	152,214
1972	133,895
1977	116,246
1982	98,432
1987	91,282
1992	98,876
1997	84,801
2002	65,298
2007	56,933
2012	47,829
2014	45,550

Water is also used in Liberia for generating electricity. Liberia currently has three (3) hydropower plants in operation with a number more being planned. The 64 MW Mount Coffee Hydro Dam on the St Paul River has been recently refurbished after being severely damaged in the civil war and is now operational. A mini hydropower dam of 4 MW is in operation by Firestone on the Farmington River while a 30 KW micro hydropower dam is located on the Yando River. The water withdrawn from these rivers for the hydropower schemes is yet to be quantified.

7.12 POLLUTION PRESSURE ON GROUND AND SURFACE WATER RESOURCES

7.12.1 Overview

According to a recent report released by the World Water Assessment Programme (WWAP) of UNESCO (WWAP, 2018), as the demand of water increases drastically globally, the availability of fresh water in many regions is likely to decrease because of climate change and human activities. It predicts that these pressures will exacerbate economic disparities between individual countries, as well as between sectors or regions within countries. Much of the burden, it says, is likely to fall on the poor. The combination of both naturally occurring conditions and humanity's actions creates pressure on Liberia's water resources. Climate change and natural variability in the distribution and

occurrence of water are the natural driving forces that complicate the sustainable development of water resources (WWAP, 2018).

As with wetlands, water resources play a significant role in various sectors, such as human settlement, fisheries, agriculture and tourism, and have a great impact on the sustainability of a population and the economy of a country. Prior to the civil war in Liberia, its population was predominantly a rural one, sustaining their livelihoods primarily from agricultural, hunting and fishing activities. Settlements were centred at high altitudes around ponds, streams or rivers to sustain the water needs of the population. Exponential growth in Liberian cities is placing strain on resources, such as water supply and safe sanitation, and affects the health and status of aquatic ecosystems. It is estimated that the average domestic water requirement is approximately 13 million m^3 per year. This equates to a per capita requirement of 36 m^3 per person/year. Human encroachment and urban expansion into aquatic ecosystems and water resources such as mangroves, deltas, estuaries and coastal lagoons also add significant stress to these water resources. The pollution of water resources is also directly attributed to human action through farming, alluvial mining, etc.

The decline of river water quality has also become a primary ecological concern due to unsustainable anthropogenic activities within the topographic zone. Understanding the temporal or spatial variations is associated with water quality and assists researchers in establishing priorities for sustainable water management. Simultaneously, topography and animal waste discharge are considered important factors that affect watershed river water quality.

There are several aspects to consider in terms of the causes of water pollution; many of which have been discussed. Some also include, for example:

- Widespread use of fertilisers in agriculture;
- Improper dumping of solid wastes;
- Discharge of untreated wastewaters from domestic and industrial sources; and
- Naturally occurring geological formation.

All of these factors might explain why the overall surface water quality in Liberia is in a dire state. This is evident in the high usage of chemicals in the treatment of water to make it portable enough for domestic purposes. Unsurprisingly then, according to LWSC, water treatment is the second highest cost to energy for the operations of its facilities.
Five aspects of such pressure on water resources are considered below, namely topography and hydrology, urbanisation, water pollution, erosion and sedimentation, and water scarcity.

7.12.2 Urbanisation

As Liberia experiences more and more urban growth in its cities (creating more surface run-offs), surface water volumes increase. This also contributes to some of the issues associated with water quality. As most of the urban cities are surrounded by water resources, unfortunately many of these cities lack the infrastructure and management systems to extract and manage this resource in a more sustainable manner.

7.12.3 Water Pollution

Apart from the obvious human health concern, there are many reasons to assess water pollution as this relates to the country's ecology and biodiversity. For example, the trees and vegetation that rely on groundwater are likely to dry up after absorbing contaminated water. As a result, the loss of vegetation leads to an imbalance in the ecosystem. In addition, contaminated groundwater may seep into rivers and streams and lead to the loss of marine life, which is detrimental to the environment. Another a point to consider, is when groundwater is contaminated with reactive substances it may result in harmful chemical reactions that destroy the soil around the area. The consequences of damaged soil include poor plant development and bad soil quality.

The two (2) significant sources of pollution that affect surface water are point source and non-point source. Point sources have been the most exposed violators of water quality standards and include the visible discharge of waste (such as from sewage treatment plans or factories). Waste from such sources is relatively easy to collect and treat. Non-point source pollutants, such as run-off or seep into waterways from broad areas, have been mostly overlooked as a significant contributor to water contaminations.

General sources of pollution result primarily from a variety of human land-use practices and include the following:

Agriculture activities: Excess fertilisers, herbicides, and insecticides from agricultural lands and residential areas may seep into water. Chemicals used on farms settle on the ground, and when it rains, they mix with the rainwater and seep through the porous soil to reach the underground water. That way, the chemicals pollute the groundwater. Salt is also often a by-product of irrigation.

Landfills: Landfills are the places that garbage is taken to be buried, for instance, Wein Town. Landfills are supposed to have a protective bottom layer to prevent contaminants from getting into the water. However, if there is no layer or the layer is cracked, contaminants from the landfill (car battery acid, paint, household cleaners, etc.) can make their way down into the groundwater.

Atmospheric contaminants: Since groundwater is part of the hydrologic cycle, contaminants in other parts of the cycle, such as the atmosphere or bodies of surface water, can eventually be transferred into our groundwater supplies.

General industry: Oil, grease, and toxic chemicals from urban run-off and energy production.

Mining: The process of extracting minerals requires substantial amounts of water but also results in contaminated water which can impact both the surface and ground water in the receiving environment. The gold mines in Liberia use cyanide in the recovery process and this wastewater can have serious impacts on the receiving water sources (Wilson *et al.,* 2017). Local communities in the mining areas have reported contaminated drinking water sources from the country's mining concessions. Little information exists on the water quality of the discharged wastewater from these

mining operations. Acid drainage, especially from abandoned mines, is also a concern.

Hydroelectric power stations and their associated reservoirs and dams: Although these do not cause water pollution per se, they do impact on the environment by affecting the land use and by altering the natural habitats in the dam areas. Proper planning of future hydroelectric plants needs to be encouraged to ensure the most efficient and least destructive placement of the reservoirs and dams.

Construction activities: Sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks negatively affect water sources.

Storage tanks: Storage tanks containing gasoline, oil, chemicals, or other types of liquids can either above or below ground contaminate groundwater due to leakage of the storage tanks. If the contaminants leak out and get into the groundwater, severe contamination can occur.

Septic tanks: Bacteria and nutrients from livestock, pet wastes and faulty septic systems contaminate water sources. Septic systems are designed to slowly drain away human waste underground at a slow, harmless rate. An improperly designed, located, constructed, or maintained septic system can leak bacteria, viruses, household chemicals, and other contaminants into the groundwater, causing severe problems.

Human, animal and municipal waste: This is one of the most common sources of surface water pollution. The management of municipal waste has become a national concern. Poorly maintained waste systems and adverse weather incidents, such as flooding, are also significant primary sources of surface water pollution. For a municipal authority knowing the risks in the area and what to do about it is critical. The origins of surface water contamination are many.

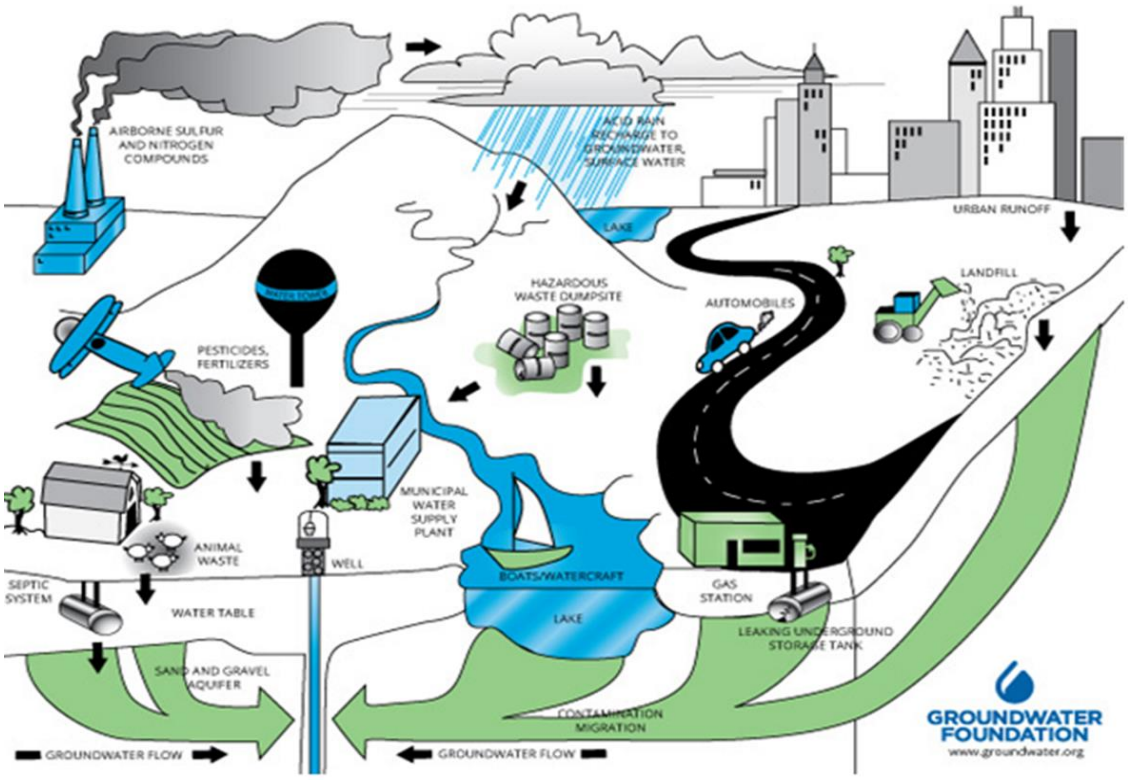


Figure 7.6: *Contamination of Groundwater in Liberia (Groundwater Foundation, 2019)*

The quality of freshwater may be evaluated from both a public health and an ecosystem health perspective, which are interlinked. As is typical of population growth, there has been human encroachment on aquatic habitats, such as estuaries, coastal lagoons and mangrove ecosystems. Low-lying areas of Liberia are predisposed to flooding. The country's existing ineffective water and sanitation infrastructure, inadequate and improper waste disposal, and other forms of pollution leave Liberia's water sources in a poor state.

In terms of drinking water, water pollution has become a serious concern in Liberia. The lack of a suitable and organised wastewater or SWM system in Liberia has resulted in much pollution and illegal dumping in the country, even in sensitive areas such as wetlands and other water bodies. The present haphazard approach to the management of human waste permits this wastewater to infiltrate and contaminate shallow aquifers which supply water to hand dug wells. The testing of the water quality of these wells showed the presence of coliform bacteria in most wells. This is a potential source of contamination and people drinking water from these wells are at risk of potentially contracting waterborne diseases.

As explained, a large percentage of the population is dependent on water from wells or handpumps. Due to the shallow nature of the water sources of the hand pumps, these wells are prone to contamination with outbreaks of diseases, such as cholera, dysentery, typhoid fever, malaria, giardiasis and amebiasis being common in the rural areas and during the rainy season in Liberia. A World Bank study found E. coli, an indicator of widespread faecal contamination in 58% of water across Monrovia. WHO reports show that over 18% of deaths in Liberia are related to waterborne illnesses, and only 25% of Liberia's

population have access to safe drinking water. Drinking contaminated water can have serious health effects. Diseases such as hepatitis and dysentery may be caused by contamination from septic tank waste. Contaminated water can lead to a severe impact on the environment, animals, and human beings. Drinking water contaminated with harmful chemicals and microbials affect humans or animals consuming hazardous substances. Health issues from drinking such water include amoeba, typhoid, diarrhoea, and even cancer.

It is imperative that the water quality of these wells be monitored regularly, as has been conducted by LHS under the MME. The Ministry of Health and Public Works, however, also maintain that it is responsible for the monitoring of the resource. This further highlights the need for the government to assign the monitoring of water quality to one agency in order eradicate the duplication of functions and to manage the water source more efficiently (LWSC, 2016).

7.13 TOPOGRAPHY AND HYDROLOGY

Foremost, topographical factors play essential roles in explaining spatial variation in water quality in Liberia. Topography mostly regulate water quality parameters. During the rainy season, for example, the topographic features are the main drivers that contaminate a watershed. Many chemicals, pollutants, minerals, and sediments are present where run-off carry the body of water to during precipitation. Most related studies have shown that higher slopes, length of slopes, size, shape and or elevation are associated with higher erosion rates, which subsequently increase the rate at which particular matter enters a water body, thus contaminating the water quality. Therefore, the forested mountain area, which has a higher slope or elevation, may export fewer nutrients than flat land (e.g. cropland) (Chen and Lu 2014). On steep slopes, high velocities cause erosion by sediment transportation into a watershed. Watersheds within Liberia's topographic features could be contaminated because of the torrential downpour of rain at mountainous areas (*cf.* Onafeso, Olusola and Adeniyi 2016) and could impact the quality of the basin.

Hydrology work has provided a better understanding of how water can become polluted as a result of the processes involved in the hydrologic cycle. Applied hydrology traditionally occupied floods, droughts, and assessment of water resources (LHS n.d.). Some of the main factors affecting the hydrological cycle are temperature, humidity, wind speed, and solar radiation. The direct measurement of evaporation, though desirable, is difficult but possible only at point locations. These factors severely impact water quality in the hydrologic cycle during a torrential downpour of rain, flooding as a direct consequence of run-off, or evaporation causing an increase of salinity and turbidity of water bodies. A hydrologic cycle is also impacted by climate change, enhancing extreme events (floods and droughts), which potentially increases water pollution problems on a worldwide scale. Increases in water temperature result in the reduction of oxygen solubility, thus reducing DO concentrations at which saturation occurs. Reduced DO levels will have an impact on the duration and intensity of algal blooms (Hosseini, Johnson and Lindenschmidt, 2017), thereby affecting the quality of a watershed.

7.14 EROSION AND SEDIMENTATION

Erosion and sedimentation have been identified as actions that are contributing to water quality changes. This is also evident with the increase of river sand mining, primarily due to the amount of sediment accretion that has occurred over time in these riverbeds. However, due to poor management of this resource (river sediments), the rivers are appearing to become more and more turbid.

7.15 GOVERNMENT RESPONSES TO CHALLENGES IN THE GROUND AND SURFACE WATER SECTOR

Over the last few years, the GoL focused on upgrading the country's WASH infrastructure and service provision. Despite this, Liberia still remains one of the sub-Saharan African countries with the lowest available WASH services to its people. The development of a five-year WASH Strategic Plan (2012-2017) focuses on providing universal, sustainable, and equitable access to safe drinking water, sanitation and hygiene for all; as well as eliminating open defecation (USAID, 2012).

Table 7.6: *WASH Sector Strategic Plan Goals for Liberia (Source: WASH)*

Sector	Sub-sector	Coverage 2015 (%)	Target Year 2017 (% Target)	2022 (% Target)	2030 (SDG % Target)
Water Supply	Monrovia	76	93	96	100
	Other urban		93	96	100
	Rural		67	80	100
Sanitation	Monrovia	17	61	80	100
	Other urban		61	57	100
	Rural		52	70	100

Various projects with immediate, medium- and long-term needs are underway in Liberia to provide clean drinking water and safe sanitation to the people of Liberia. Many of these projects are divided into urban and rural programmes and are guided and funded by international organisations in cooperation with the various agencies and ministries of the Liberian government. Some of these include:

- Monrovia Water Supply and Sanitation Rehabilitation Project;
- Urban Water and Sanitation Study for Monrovia and 3 towns of Buchanan, Kakata and Zwedru;
- Water Sector Reform Study;
- Urban Water and Sanitation Project; and
- The National Rural Water, Sanitation and Hygiene Programme.

In terms of improving access to drinking water in Liberia, over the last decade, several millions of dollars have been placed on infrastructural improvements and developments. Notable amongst them are provided in the table below.

Table 7.7: *Water Resources Infrastructural Investments (Source: Situational Analysis Report, Liberia Municipal Water Project, 2012)*

PROJECT TITLE	IMPLEMENTING INSTITUTION	FUNDING SOURCE	PROJECT VALUE
Urban Water and Sewage Project	LWSC	African Development Bank	$40.0m
Liberia Municipal Water Project	LWSC	USAID	$26.0m
Urban Water and Sanitation Project	LWSC	World Bank	$10.0m
WASH Sector	Various NGOs/ CBOs	Multiple Donor Partners	$462.0m[20]

As shown in table above, water infrastructure, and the necessary finance, have been included in national infrastructure investment plans for Liberia over the last decade. Whilst these infrastructural investments have reduced the lack of access to portable water supply in many parts of Liberia, the quality, reliability, and maintenance of the infrastructures remains a huge challenge.

Over the last couple of years, investment in infrastructures and programmes has seen a significant drop. This is a sad reality, as most of these infrastructures are still in dire state of repairs due to lack of maintenance.

In terms of managing Liberia's ground and surface waters, the GEF-funded "Mano River Ecosystem Conservation and International Water Resources Management (IWRM)" Project is currently being implemented by IUCN as the implementing agency. The executing agency at regional-level is the Mano River Union (MRU) Secretariat. The National Executing Agency in Liberia is the FDA.

The project is made up of two components:

i. COMPONENT1: Integrated Ecosystem Management
ii. COMPONENT 2: Sustainable Management of Transboundary Waters

- Target transboundary basin 1: Moa/Makona River Basin shared by Guinea 44%, Liberia 8.5% and Sierra Leone 47.5% (in an incremental way based on the BRIDGE initial activities);
- Target transboundary basin 2: Cavally River Basin shared by Cote d'Ivoire 54%, Guinea 5%, and Liberia 41%; and
- Apart from component 1, the main focus of the GEF: Mano Project is to promote a more comprehensive ecosystem approach to manage international waters as a means of achieving global environmental benefits. One of the structures that will help to promote a more comprehensive ecosystem approach in the management of international waters is the National Technical Advisory Team (NTAT) to be established.

[20] $462.0m was planned for WASH investment (2012 – 2017), a total of $168.0m was committed and a gap of $294.0m (JRS 3)

7.16 CONCLUSION AND RECOMMENDATIONS

Liberia, Guinea, Sierra Leone and Ivory Coast are the nations in the region that have water trans-boundaries amongst them. However, the management of the resource at a trans-boundary level remains weak, primarily due to specific uses within each member country. Clearly, the water resource potential of Liberia is encouraging, but still lacks adequate and proper management. In particular, there are significant gaps in drinking water quality standards. In the past, there has been a low level of development for various sectors such as the mining, logging and aquaculture industries. An integrated approach from all ministerial sectors needs to address the rural, urban, industrial and ecosystem needs for freshwater. The National Integrated Water Resources Management Policy was introduced in 2007.

There have been limited responses from government in the combat of quality drinking water. LWSC cannot meet the demand to distribute quality water to about 10% of its citizenry. From the recommendations presented in the SoER in 2006, the government still has not implemented many of its policies. Government contribution to the development of quality water is slow. Recent reports on Liberia from WaterAid state that the government requires vital networks to reach everyone with clean drinking water.

Across the spectrum, Liberians have expressed grave concern about the significant pressures on water resources currently facing the country. Occurrences in our country over the last three decades have provided policy leaders, scientists and engineers with many examples of the need for a nation-wide sustainable water resource management strategy.

Recent floods, high droughts during the dry seasons, pollution problems, waterborne infectious diseases, expansion of extractive industries, potential increases in water exports, climate variability and the impact of some of human activities clearly outline the major impacts to our water quality. This in turn often translates into increased water treatment costs. The above-mentioned occurrences and their impacts clearly demonstrate the need to develop a Liberia-wide sustainable water strategy for strong and effective coordination between our national and local authorities, addressing national and local practices and uses of the most precious natural resource, which is water.

Despite recent interventions including WASH programmes and steering committees, rehabilitation of the White Plains Water Treatment (WPWT) facility and replacement of major pipes and distribution infrastructure in Monrovia and its environs, the current management of our water resources continues to cause grave concern. Key systemic issues, such as overlapping mandates of Government agencies for the protection and management of water resources, as well as a lack of resource allocations for provision of water services outside Monrovia frustrate any possible quick wins and small victories in improving the management of our water resources.

Our current lack of coordination of the management and protection of water resources severely impacts the quality and service delivery of this basic human right for each Liberian – safe drinking water and adequate sewage services! In the absence of coordination and a clear mandate for any single agency as the lead regulator, NGOs,

industries and national government are all engaged in fragmented efforts to improve access to safe drinking water and manage water resources in Liberia.

Water Resource Management

During the preparation of this report, there were several issues related to both the management of the resource, and the technical information that is needed to inform the management system. Technical capacity and a lack of management systems make it very difficult to provide the resources needed for a resource that is nearly in a peril state. To help achieve a realistic approach to managing the water resources of Liberia, we as scientists and policy-makers must seek a strong and direct approach to understand the following:

- The status of its freshwater and resources and how they are changing;
- A more precise determination of water use for meeting future human, environmental, and wildlife needs;
- How freshwater and groundwater availability is related to natural storage and movement of water, as well as engineered systems, water use, and related transfers;
- How to identify water sources, not commonly thought to be a resource, that might provide freshwater for human and environmental needs;
- Forecasts of likely outcomes for water availability, water quality, and aquatic ecosystem health caused by changes in land use and land cover, natural and engineered infrastructure, water use, and climate;
- How much water do we have? How much water is available in our surface and ground waters?
- How much water do we use? Can we improve our knowledge of water use to gain a better understanding of our water needs, including the needs of our natural environment (fish, wildlife, and plant life)?
- Are there ways to get more water? How can we make use of water not thought to be a source of fresh water, such as saline waters or wastewater reuse?
- What can we do to avoid contaminating the water we have, clean up water that has been contaminated, or minimise transport of contaminated water?
- How variable is the amount and quality of water available for human and environmental use - floods and drought recurrence, effects of surface water and ground water on each other?
- How does changing land use/land cover influence hydrologic system dynamics? Timing and magnitude of stream flow and recharge?
- Can we better anticipate the effects of climate variability on water supplies and demand for water, for both humans and the environment?

In order to answer some of these questions and to improve the management of Liberia's water resources, the government is urged to:

I. Establish an integrated water resource management body, which should be sector-lead. In addition, remove water-related functions from all other statutory bodies and include them into the water resource use management sector;
II. Conduct a water quality assessment of Liberia;
III. Identify areas and contaminants of concerns and institute control measures;
IV. Improve pollution control/prevention management systems to improve water quality;
V. Address legal and compliance issues through building codes;
VI. Address discharge of untreated wastewater through infrastructure design and engineering;
VII. Increase wastewater treatment systems and provide incentives for connections;
VIII. Provide more investment in WASH infrastructure around the country;
IX. Develop WASH regulations;
X. Strengthen local institutional capacity; and
XI. Promote local skills development.

It is imperative that Liberia develops a comprehensive and sustainable national water strategy which establishes a collaborative vision, outlines costing, and articulates the guiding principles and management functions for water resource management and the provision of water services holistically across Liberia, rather than the current, piecemeal and selective approach for specific cities and towns.

What Strategy Achieves

The establishment of overarching water strategy and framework will facilitate and improve the planning and management of Liberia's water resources into the future. A comprehensive strategy aims to provide guidance on priorities, policies and approaches related to the management and use of our national water resources. Once completed, it becomes the framework for seeking and securing local, national and international participation in the management and development of Liberia's water resources. A well-articulated strategy also defines a nationally driven agenda for water resource management and provide a guiding and coordinating tool for international support to the sector. This in turn allows for efficiency and cost savings for physical infrastructure and human resources.

In this context, a review of the mandates of water sector regulators must lead the charge to champion the efficient management of the national water resources for improved quality of life, promotion of economic growth and better standards of living for future generations. The development of a national sustainable water strategy should be seen as a guiding mandate and the promotion of a basic human right.

Liberia's geographic landscape, history and economy have all been shaped by the existence and relationship with water courses. Its nation is known to have one of the highest levels of rainfall on the continent, however the country has not been able to maximize this natural endowment to the productive benefit of its national economy. With limited and outdated water service infrastructure continuing to hamper potential revenue

generation opportunities, the economic facilitation of a well-managed water resource cannot be provided. The national water strategy should also identify opportunities for the increased profitability of water resources.

Key Components

The strategy must detail what is required to sustainably deliver safe water to all parts of Liberia, through county specific strategies and approaches, incorporating the entire political sub-division, rather than merely county capitals. Holistically, it should include critical components, such as those listed below, and guiding principles to address these identified issues:

i. Mandate and legislation
ii. National grid and distribution
iii. Water pricing
iv. Science leadership
v. Integrated planning
vi. Quality control and assurance
vii. Preservation and conservation
viii. Public awareness

In addition to articulating the national guiding framework for sustainable water management, the strategy must also necessarily lay out costing for short, medium and long-term interventions expected to implement the national and sub-national strategies. These should serve as the blueprint for all water service delivery and water resource management interventions which will potentially follow.

The benefit from having an overarching strategy that is fully costed out includes:

i. Increased accountability due to broader stakeholder participation in governance;
ii. Enhanced environmental protection and a stronger foundation for economic productivity;
iii. Better positioning to meeting growing national and international expectations and obligations;
iv. Stronger national capacity to respond to local, national and regional threats and crises;
v. More effective responses to concerns with national dimensions including water exports and climate change; and
vi. Greater public acceptance and support for water management decisions.

The development of an effective water strategy can only be appropriately undertaken once there is comprehensive knowledge of the quantity and quality of total water supply and water usage across the length and breadth of the country. Once adopted, the sustainable water strategy will also require routine national reporting on water service delivery, the status of water sources, their usages and returns.

The following table provides more recommendations for improving Liberia's aquatic resources.

Table 7.8: *Recommendations for Improving the Management of Aquatic Resources*

THEMATIC AREA	SYSTEMIC ISSUES	DESIRED OUTCOME	TIMELINE
Mandate and Legislation	▪ Overlapping of functions ▪ Develop standards and regulations for water	▪ Adopt an integrated water strategy ▪ Develop a national water resource management plan at the county level ▪ Develop legislation to achieve SDG 6	6 months
National Grid and Distribution; including source water identification	▪ Lack of national water plans that address infrastructure ▪ Lack of knowledge of water needs for Liberia, including water for human consumption, environmental sustainability and industrial growth and development	▪ Preparation of a national water infrastructure map that covers all water infrastructures – ensuring that the land is even gazetted ▪ Identify all the potential water sources, quantity needs based on population and economic growth. Ensure water resource location is gazetted for current and future needs	12 months
Water Pricing	▪ Lack of standardize water pricing across the country	▪ Set a standardize water pricing for all customers regardless of where they are in the country; this is both for the use and need for portable water and surface water for industrial purposes	6 months
Science Leadership	▪ Lack of research knowledge on the water resources of Liberia	▪ Establish a detailed resource programme especially to the surface waters of Liberia to determine its quality and availability	24 months
Integrated Planning	▪ Lack of integrated planning for the sector – this leaves the resource very vulnerable and exposed ▪ Water resource management not integrated into national plans and agenda ▪ Water resource not part of climate change and impact vulnerability studies	▪ Prepare an integrated water resource management plan /programme; and include coastal defence ▪ Prepare a water vulnerability impact assessment report, and water resources management plan that specifically addresses the identified impact and ensure that mitigation costs are included in the document ▪ Work plan with identified timeline on addressing the impacts	12 months
Quality Assurance and Control	▪ Except for Lake Piso no other freshwater reserve is protected in Liberia	▪ All freshwater resources to be identified, quantified, and qualified (laboratory testing) to determine availability and quality	12 months

THEMATIC AREA	SYSTEMIC ISSUES	DESIRED OUTCOME	TIMELINE
		▪ Determine the amount of water needed for human, environment, and industry support. Set regulatory standards that should be met at all levels	
Preservation and Conservation	▪ Lack of water resources that are identified for preservation and conservation for current and future needs	▪ Identify water resources that should be set aside (preserve) for future needs; this should be cascaded to county levels as the minimum	24 months
Public Awareness	▪ Lack of public awareness to the use and management of water resources (management)	▪ Inclusion of public at the community level in the management of the water resources – if integrated management approach is accepted, include community management for basin and catchment areas	60 months

CHAPTER 8: SOIL AND GEOLOGY OF LIBERIA

8.1 INTRODUCTION

The geology of Liberia is largely extremely ancient rock formed between 3.5 billion and 541 million years ago in the Archean and the Neoproterozoic, with some rocks from the past 145 million years near the coast. The country has rich iron resources as well as some diamonds, gold and other minerals in ancient sediment formations weathered to higher concentrations by tropical rainfall (USGS, 1972). This chapter presents information on the soil and geology of Liberia with focus on the mineral potential of Liberia, current mining trends and potential impact to the environment.

8.2 GEOLOGY

A major programme, funded by the U.S. Agency for International Development (AID) and the Liberian Government, was carried out by the United States Geological Survey (USGS) and the Liberian Geological Survey (LGS) between 1965 and 1972. Aeromagnetic and total count gamma radiation surveys were carried out over the entire country in 1967–68. A total of 140 000 km were flown, mostly along north-south lines, 0.8 kilometres apart on land and 4 km apart over the continental shelf. Geological maps for each of the ten quadrangles covering Liberia were compiled from interpretation of the airborne geophysical data and aerial photos, supplemented by field traverses along the major river courses. The main outputs from this were systematic files of basic geological information, including samples, thin sections and chemical analyses, together with airborne magnetic and radiometric maps and accompanying short descriptive reports.

Subsequently in 2007, the geological, geophysical and mineral occurrence data were compiled into digital form and released as a series of four national maps. This digital compilation provides a comprehensive and readily accessible overview of Liberia's solid geology and known mineral occurrences and is an excellent basis for the identification of targets prospective of a wide range of metallic and non-metallic mineral commodities. Further processing of the legacy aeromagnetic data using modern software also has great potential for providing considerable additional geological detail and, thus, to highlight new exploration targets.

Liberia is underlain by the Man Shield, which comprises two major areas of Archean and Paleoproterozoic rocks. Both types of rocks are described below.

Archean Formations

Liberian age (2.5–3.0 Ga) Archean basement extending across central and western Liberia, is characterised by a granite greenstone association dominated by granitoid gneisses and migmatites. These are infolded with supracrustal meta-volcanic and meta-sedimentary rocks and intruded by a younger igneous complex. The supracrustal rocks form discontinuous narrow, elongate "schist belts". The metamorphic grade is generally amphibolite facies with greenschist facies dominating the schist belts (LGS, 1982).

The southern Archean part of the West African Craton is a granite-greenstone terrane, comprising older granitic gneisses and migmatites, with infolded supracrustal schist belts

and younger granite intrusions. The gneisses and migmatites are thought to have been metamorphosed at c.3.0 Ga during the Leonian Orogeny. The subsequent Liberian orogeny (2.5–3.0 Ga) resulted in deformation and greenschist facies metamorphism of the older gneisses and the schist belts. In Sierra Leone, the schist belts are typical of Archean greenstone belts, comprising basal ultramafic schists overlain by mafic amphibolites, which are succeeded by metasedimentary rocks and minor acid volcanic rocks. In contrast, the schist belts further east, in Liberia, are thinner, and are dominated by metasedimentary rocks including Banded Iron Formations (BIFs), which are important sources of iron and are associated with widespread placer gold mineralisation (Foster and Piper, 1993).

Proterozoic

The boundary between the Archean and Paleoproterozoic age rocks (Eburnean age province, 1.9–2.3 Ga) is not well defined in eastern Liberia but is generally considered to lie along the north-east-trending Cestos Shear Zone.

Most soils in Liberia are oxisols and ultisols which contain oxides of aluminium and iron and are very acidic (about pH 3-5). Given these classifications, the most concerning aspect of agriculture and crop production is that the crops planted on these soils lack sufficient plant nutrients, thus leading to inherent low soil fertility. Slash-and-burn agriculture is widely practised by the majority of the rural population who depend on this activity for their livelihood. However, deforestation is on the increase in Liberia, which increases soil erosion. This is often coupled with poor soil management with a resulting decline in agricultural productivity. Equally concerning is mining. Mining of iron ore, diamond and gold has removed vegetation cover substantially and exposes the soil to erosion. Table 8.1 below provides the various soil types within Liberia.

Table 8.1: *Liberia's Variable Soil Types (EPA, 2007)*

Soil	Liberian Classification	Area (%)	Area (ha)	Properties
Lateritic soils or Latosols	Kakata, Suakoko and Voinjama series	75%	8,352,750	Reddish brown, well-drained, deep profile, good structure, leached 10 cm topsoil, low cation exchange capacity, calcium deficiency, 4-6% organic matter, acidic, aluminium toxicity, productive agriculture soils, occurring in rolling hill, used for tree crops production
Lithosols	No data available	17%	1,893,290	High gravel content, low moisture retention, shallow, low humus and mineral content, and occur in hill and rugged terrain, medium agricultural potential
Regosols or coastal sandy soils	Clara town, Sinkor and Freeport series	5%	2,227,400	Well-drained, 60% coarse sand, very low water holding capacity, low humus, and few mineral nutrients, found in the coastal plains, low agricultural potential
Alluvia soils or swamp soils	Gbelle, Ballam, Grayzohn and Cuttington series	3%	22,740	Waterlogged, grey hydromorphic soils, poorly drained, thick dark layer of loamy-peaty organic material with relatively high humus and mineral contents

Liberia lies south of the tropic of cancer and only a few degrees north of the equator. The days vary in length. The tropical solar radiation is intense, and radiation is uniform throughout the country. The temperature remains warm throughout the country, and there is little change in temperature between seasons. With this said, it is a fact that the country's soil organic matter is in constant flux as it is sensitive to changes in the climate. The warmer the climate, the more pressure and threats are placed on the nation's soil resource. Said threats are likely to increase the loss of soil organic matter. This position is supported by scientific studies and facts. According to Smith *et al.,* (2005), modelling climate impacts over 50 years is sufficient to configure the significant loss of soil carbon. This means that to understand the nation's soils in totality, there must be solid scientific studies undertaken to validate the current state of the soils in Liberia, as well as inform planning and policy decisions relative to sustainable soil management.

Liberia's soil sector is relatively new in terms of gathering the basic fundamental data. The government is urged to fund more research so as to develop sustainable soil management tools. To date, little has been done to document data on Liberia's soil resource. However, previous studies, even though limited, had pointed out some basic information that could be used as a baseline. The latter studies, which this SoER builds on, argue the need for more independent research in order to showcase the significance of soils for national development. Key among the mentioned studies are:

- Status and Properties for Sustainable Soil Management in Liberia (EPA, 2007);
- Sector Scan: The Agriculture Sector of Liberia, Ministry of Foreign Affairs (December 2017);
- Terrain and Soil Baseline, Part 1, Vol. 3, Western Range, DSO Iron Ore Project, Arcelor Mittal Liberia Limited (September 2010); and
- The Soil Reconnaissance Study (1964).

The conduct of the above-listed studies has set the stage to argue for more research into the importance of Liberia's soils. Such studies can ensure that policymakers can begin to factor the sustainable management and protection of soils into national development planning.

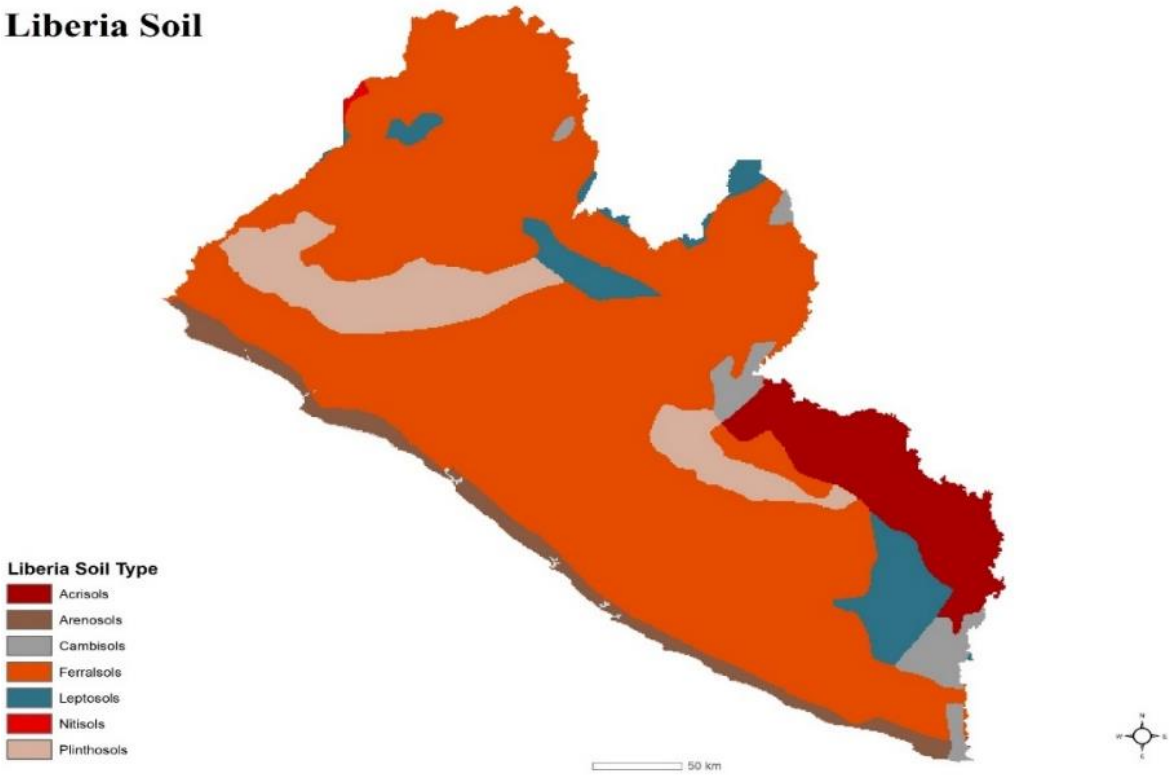


Figure 8.1: *Liberia Soil Map*

Source: https://www.arcgis.com/home/item.html?id=af37c984900c48618b158352fb41da4d

8.3 SOIL FUNCTIONS IN TERMS OF ECOSYSTEM SERVICES

Liberia's soil is important to consider, as it literally provides the foundation for agriculture, mining, the forestry sector, and all the produce that these sectors produce. Soils also make the greatest contribution to terrestrial carbon storage, and therefore, must be appropriately managed to prevent Greenhouse Gas (GHG) Emissions. Human activities have left a significant impact on Liberia's landscape and soils. Even soil that appear "undisturbed", have radically gone through alterations by man over time. The mere amalgamation of waste products in the fringe of aged settlements speaks to the increased valuation of soils enriched in organic matter and nutrients. It is, therefore, surprising that, reviewing the 2006 SoER, one comes to realise that the EPA barely seems to possess much data on the state of Liberia's soils (EPA, 2006).

Again, since the publication of the 2006 SoER, no further study or report has been published to understand the current state of Liberia's soil and identify threats that can be used as evidence to support the further development of a Liberian soil framework directive. Nevertheless, the current SoER intends on building upon such earlier work and improving awareness in this regard by having interviewed a range of stakeholders from the public and private sectors. These endeavours were meant to raise awareness on the importance of soil resources, as well as keeping the general public informed regarding key environmental issues surrounding soils. This also informs the public about the importance of Liberia's soils, and how to protect and enhance the soils for a more sustainable socio-economic development.

8.4 FACTORS AND THREATS INFLUENCING THE STATE OF SOIL

The main drivers of, and pressures on, the Liberian soils are those influenced by a range of human activities. The main contaminants for soils resulting from human-induced activities (such as farming or land-use practices, industries and waste management) are excess nutrients, metals, organic chemicals (which includes persistent organic pollutants) and man-made radioactive substances and pathogens.

Evidence has shown that the extractive industries, and in particular, the mining of iron ores and alluvial gold, have a proven negative effect on the soils from a contamination perspective (Chen *et al*.,1997; Lin and Herbert, 1997; Banat *et al*., 2005). This happens through the discharge of contaminants on land. Potential pollutants from industries include nutrients, metals, organic chemicals, and other unwanted substances (Dybowska *et al*., 2006). This, therefore, makes the industry one of the essentially critical threats pressuring Liberia's soils.

Like mining activities, the management of plantations can also adversely affect agricultural soils. As the attainment of high yield is often the primary goal of industrial plantations, fertilisers may be excessively used to sustain yield. The method, intensity and timing of site preparation employed in plantation agriculture can also impact the quality of the soil. In their review of the effects of plantation management practices on soil quality, Hu *et al*., (2007) pointed out that fertilisers and site preparation methods can significantly alter the physical, chemical and biological properties of the soil. Hence, excessive fertiliser usage and bad land preparation practices can negatively impact soil ecosystems and ultimately degrade the environment and inadvertently diminish the yield and quality of crops.

Pesticide is also widely brought in by plantations across Liberia and used to prevent pests from affecting the plantation. While these pesticides have prevented the farm from different plant diseases and increase healthy growth and productivity, it has been a serious challenge to the companies and threat to the environment. Companies have found it challenging to manage the expired pesticides and dispose of the containers in which these pesticides were store. The expired pesticides eventually find their way into the hands of local farmers and other people who eventually use them upon their crops, while others sell them across local markets.

In an inventory on obsolete pesticides and associated wastes conducted in 2018, coordinated by Green Cross Burkina Faso/Africa Regional Programme (GCBF/ARP) a number of agriculture plantations across Liberia was assessed for obsolete pesticide and associate wastes.

The project was meant for capacity strengthening and technical assistance for the implementation of Stockholm Convention National Implementation Plans (NIPs) in Africa's Least Developed Countries (LCDs) of the Economic Community of West African States (ECOWAS) Sub-region. The assessment objectives considered obsolete pesticides stock and associated waste detail information to enable Liberia to establish its Pesticide Stock Management System (PSMS) database.

The assessment which did not cover the entire country as a result of inaccessible road condition due to the rainy, particularly in the southeast with GVL in Sinoe County and Grand Kru, Maryland Oil Palm (MOPP) and Cavalla Rubber Corporation (CRC) in Maryland County, Cocopa Rubber Corporation in Nimba County, was still able to assess 5,009.4 litres and 1,467.39 Kg of obsolete pesticides.

The four categories of obsolete pesticides include: Fungicides, Insecticides, Herbicides and Growth Regulator. No contaminated site was seen/observed, nor was any reported. A total of 1,970 litres of Herbicide, 2,076 litres of Growth Regulator, 316.4 litres of Insecticide, 647 litres of fungicide and 1,467.4 kg of fungicide.

The associated wastes include the empty pesticide containers seen. The inventory recorded 1,957 pieces and 300 bags (50 kg) of chopped empty pesticide containers; quantity of chopped container in each bag unknown. The contaminated materials included 2,196 pieces.

The assessment covered a number of sites in the following localities:

- Firestone;
- WIENCO LIBERIA;
- LIBINC;
- LAC; and
- Sime Darby.

Within the framework of forest landscape maintenance and enhancement, it is important to emphasise that the level of soil fertility in plantations is unlikely to be restored to the level in natural forests, implying that the practice of replacing natural forests by plantations should be avoided by stakeholders in land use and management in order to maintain the ecosystem sustainability of the forest (Liao *et al*., 2012). According to Zheng *et al*. (2008) and Freier *et al*. (2010), plantations can potentially alter the biogeochemical cycles of ecosystems as a result of changes in tree species composition when compared with natural forests.

8.5 SUSTAINABLE SOIL MANAGEMENT

During the stakeholder engagements (refer to Chapter 1), many issues were flagged as challenges facing the sustainable management of the soil resource. Some of the highlighted challenges to sustainable soil management are:

- **Lack of knowledge amongst farmers of sustainable soil management:** Most households in Liberia rely on subsistence farming for their survival. This kind of farming involves shifting cultivation which basically reduces the land cover, thereby exposing the environment to deforestation and erosion. The consequence of this is the lowering of the productive capacity of the land, mainly nutrient depletion, leading to lower yield production;

- **Lack of legal and economic instruments for the promotion of sustainable soil management:** The formulation of laws and legal frameworks forms the basis for ensuring that every farmer places a premium on sustainable soil management practices.

Reforestation and the re-growth of forested land should be promoted. Using an economic instrument, such as economic incentives, could encourage the use of technologies and support agro-environmental studies to guide farmers through the provision of soil maps showing the various soil types that support crop growth; and

- **Limited use of technology in farming:** Most farming practices in Liberia are very traditional. Farmers do not use technology to their advantage. The traditional nature of farming is one that largely involves slashing and burning of fields without the use of machinery. Slashing and burning soil have proven to have a sturdy impact on the soil.

Land resources provide a variety of functions and services that can be used in support of ecosystem processes, livelihoods and food security. Some of the activities supported by land resources in Liberia include agriculture, forestry, tourism, human settlement, wildlife, mining, and industrial development. However, a combination of interlinked factors is presenting a threat to the sustainability of land resources within Liberia. These include, but are not limited to, unregulated mining, high impact logging, inappropriate agricultural practices, unplanned human settlements and industrial expansion.

In order to understand land in Liberia, it is important to understand the country's geological make-up. The following section provides some data on Liberia's geology, which illustrates why the country is so endowed with mineral resources.

8.6 CONCLUSION AND RECOMMENDATIONS

Liberia is blessed with enormous biodiversity and wildlife diversity. These natural resources are a source of livelihood for Liberians, which are important to the Liberian economy, and are important for achieving the goals outline in the culture, social, and political pillars of the pro-poor agenda. The forests and woodlands are equally contributing to the Liberian economy and human development. Nevertheless, there have been initiatives by the government to fight this pressure. Despites the policies and laws adopted, there are still challenges afflicting the sector. Considering the above mentioned, the following recommendations are proposed:

I. The national biodiversity policy should be formulated, and a biodiversity law implemented to provide a comprehensive regulatory structure that combines biodiversity conservation with the need to exploit the immense resources of the country's biodiversity for the pro-poor agenda.
II. Sharing of mechanisms and exchange of biodiversity recorded among Liberia's line ministry must be designed to ensure a strategic control and planning of all-important biodiversity areas.
III. The initiation of technical economic value approach to evaluate the forests and woodlands which are currently undervalued is paramount to the acquisition of comprehensive data that should be gathered by relevant authorities in order to ensure that informed decisions on the country's forest and woodland resources.
IV. The government should also start considering tree planting outside of the gazetted forests and areas affected by logging.

In order to promote best soil management practices in Liberia, the government is encouraged to:

I. Provide aid and budgetary support to the agricultural sector to enable the use of improved technologies;
II. Promote, nation-wide, best soil management practices. This could be achieved by conducting a general awareness and training programme aimed at farmers in order to inform them of the significant role of soil as a resource to sustaining production and crop growth;
III. Conduct a detailed and periodic soil survey in Liberia to guide land usage and related practices;
IV. Place a premium on afforestation of deforested land, as this should help to reduce desertification and excessive erosion, thereby ensuring that the major soil properties and fertility potential remain in tight for successive agricultural development;
V. Develop legislation to guide sustainable soil management across Liberia. Penalty systems could be introduced against violators; and
VI. Promote low-land development and integrated farming to reduce upland shifting cultivation; thereby increasing sedentary farming.

PART FOUR: EMERGING ENVIRONMENTAL ISSUES

CHAPTER 9: EMERGING ENVIRONMENTAL ISSUES IN LIBERIA

9.1 INTRODUCTION

This chapter looks at emerging trends in the environmental sector of Liberia. Major challenges are highlighted, and key government responses are presented.

9.2 INVASIVE ALIEN SPECIES

9.2.1 Overview

IAS are non-native to a particular ecosystem and whose introduction and spread cause, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health. Invasive species are considered as one of the biggest environmental challenges of the 21st century. They constitute the second cause of biodiversity loss and lead to high economic disruption and public health. Despite significant, financial and human investments made by countries and world conservation of biodiversity agencies, there are no strategies that lead to appropriate measures for sustainable management and control (Noba *et al.,* 2017).

9.2.2 The Importance of Considering Invasive Alien Species

There are many flora and fauna species that have invaded Liberia over the last several decades. Invasion here means accidental and unplanned introduction of plant and animal species (NBSAP, 2017). Invasive species are recognised as one of the leading threats to biodiversity conservation, and pose economic costs on agriculture, forestry, fisheries and other human enterprises. They also have the potential to impact on human health. Liberia has already recognised the need to control the introduction and/or impact of invasive species, like water hyacinth, and monitor their effects on the environment in general. As determined by the process, national guidelines are required for the control of weeds and vermin.

9.2.3 Fisheries and Invasive Alien Species

One of the most globally well-known water weeds is the water hyacinth (E. crassipes). It occurs in the coastal areas of Liberia. The water hyacinth is an exotic, free-floating aquatic plant with shiny, dark green, upper parts and a brilliant blue-purple flower with yellow markings. E. crassipes can form small colonies, “floating islands” or extensive mats that can cover thousands of hectares of previously open water. When invasive, water hyacinth forms a complete covering of the water surface that excludes most light and air for submerged organisms, thus, depriving them of essentials for survival. A significant reduction of general aquatic biodiversity and a change of fisheries results from invasion. The mats can also have serious mechanical impacts on water supply systems, drainage canals, inflows to hydropower generators, and movement of shipping and river flows. The hyacinth increases evapo-transpiration leading to significant water loss from reservoirs and other water bodies. The crowding of plants at the edges of water bodies prevents access to the water for collecting water or fishing.

9.2.4 Forestry and Invasive Alien Species

Of the many terrestrial flora and faunal species that have invaded Liberia over the decades, four main IAS plants were identified. These are *Chromoleana odorata, Acacia spp, Eichornia crassipes,* and *Lucaena leucocephala*. The ecological impact of *Lucaena* is not yet as serious as the first three, because it is still limited to the localities where it was originally introduced, but it colonises very rapidly. Acacia species introduced by the FDA in Zarwea and Grand Cape Mount County are rapidly spreading over the original forest and it requires quick attention lest the entire region becomes an acacia forest. Acacias were introduced in Liberia in the mid-1980s as plantation species. Following their introduction, many people planted them in the cities for shade. There has not been any survey to determine the acreage.

9.2.5 Agriculture and Invasive Alien Species

The most aggressive of these invasive species that is highly problematic for the forest and agricultural sectors in Liberia *is Chromolaena odorata. C. odorata* is a very widely distributed tropical shrub that is still expanding its range and is considered one of the world's worst weeds. It continues to spread due to its effective short- and long-distance dispersal. It can form pure stands where established, often in disturbed areas, grasslands, fallow areas and forestry plantations, and is highly competitive. It is viewed as a major environmental weed but is appreciated by some agriculturalists as it shortens fallow time in shifting cultivation.

The presence of *C. odorata* in West Africa was first recorded in a forestry plantation near Enugu, in south-eastern Nigeria in 1942 and is thought to have resulted from contaminated seeds of the forest tree *G. arborea* imported from south-east Asia in 1937. The weed has since then spread to other West African countries, including Liberia. No measure is currently in place to control or eradicate this species from Liberia or to manage its pathways.

9.2.6 Responses to Invasive Alien Species

By 2018, National compendium on IAS in Liberia was prepared and by 2020, priority measures will be in place to control and manage the spread and impact of IAS. Actions planned in the Revised NBSAP (2014) to achieve this target include:

- Identify and document alien species in prioritised ecosystems and determine the means by which they enter the country and what the sources are. Concerted and determined efforts are critical if the multiple pathways for invasive species are to be identified and controlled through improved border controls and quarantine;
- Promote integrated management of invasive alien species, including through better coordination with national and regional bodies for plant and animal health;
- Undertake research into effective control of IAS. Currently, Liberia does not have the capacity to control or eradicate IAS from the country; and
- Put in place robust monitoring systems of IAS.

9.3 ILLEGAL FISHING

The presence of the Atlantic Ocean at the southwest of the country provides plenty of fishing opportunities to thousands of Liberians living along coastal areas. The ocean serves as a major source of livelihood to coastal dwellers and supplies local markets located within cities that are geographically situated inland. However, the largely ungoverned waters of West Africa are plagued on a daily basis by large industrial vessels from presumably wealthier nations that plunder, at the expense of local fisherman, hundreds of tonnes of fish. A 2017 study estimates the cost of illegal, unreported and unregulated fishing in just six (6) West African countries at $2.3bn (£1.8bn) a year (NaFAA, 2018). Liberia, as a part of West Africa, is prone to such a loss.

The idea of coastal management is old, but the framework to implement this, is new to Liberia: with the NaFAA having just been created by an act of National Legislation on the 9th of October 2017. This institution functions as a fully-fledged autonomous body pursuant to the Public Authorities Law of the Republic of Liberia. NaFAA is required by law to:

I. Provide institutional and legislative frameworks for fishery management;
II. Develop effective international, regional, sub-regional and bilateral cooperation for fisheries management;
III. Enhanced monitoring, control, and surveillance capabilities; and
IV. Improve fish quality and value addition technologies for enhanced economic returns in fisheries.

A lot has changed since the formulation of NaFAA. Partnering with the Ministry of Defence, a lot of illegal activities occurring in deep sea have been curbed by the government. Today, fishermen have to acquire licenses before they are permitted to fish; a phenomenon which has been remarkably positive. For example, data provided by the Ministry of Defence shows the impact such licensing has had in just over two years. Arrests for illegal fishing have more than quadrupled, the range of coastguard patrols have doubled, and the government has recovered at least a million dollars in fines.
Table 9.1 provides some of the most recent fines and fishing infringements by several fishing vessels; data received from the 2011-present Division of Monitoring, Control and Surveillance (MCS) from NAFAA.

Table 9.1: *Fines and Fishing Infringements*

YEAR	VESSEL NAME	INFRINGEMENTS	PENALTY
2017	Labiko-2	Fishing with wrong gear	Fined and banned
2017	Hai- Lung	Entry without notification	Warned and released
2017	Benty-1	Exiting Liberia's EEZ without notification	Fined and under prosecution
2018	Guoji 808	Fishing in the EEZ	Fined
2018	Guoji 808 and 809	Exiting Liberia's EEZ without notification	Warned
2018	Six (6) semi-Industrial vessels	Fishing without License	Fined and obtained licenses
2018	Bonheur	Fishing without License	Fined and fish auctioned

[Source: Data provided to Greencons from the Division of MCS from NAFAA (2011-present)]

An increase in the arrest of illegal vessels and recovery of million dollars in fines is a sign that Liberia is taking practical steps in ensuring a proper monitoring mechanism is maintained across the country's coast lines. This, in return, will enhance the livelihoods of coastal dwellers and provide food for inland cities; thereby contributing to sustainable fishing and food security across Liberia.

9.4 HUMAN TRAFFICKING

Human trafficking is the forced trading of humans for a specific purpose. This might include sexual slavery (prostitution), or commercial exploitation. In Liberia, human trafficking exists and is a phenomenon, which is well known by the government and NGOs. In essence, there are two (2) types of trafficking in Liberia. The one involves victims being trafficked from and between rural and urban areas (i.e. in-country), whilst the second type is known as trans-national trafficking (IDLO, 2019). The latter involves victims being trafficked from or to Liberia from other neighbouring West African countries.

A recent report by the US (2019) confirms that rural-to-urban human trafficking in Liberia is the most predominant form of trafficking. The victims are usually the vulnerable and helpless, such as new-born children (or young children) and women. What has been found is that perpetrators of human trafficking are usually known people in the communities. In fact, many are often highly respected individuals who might even be related family members. The victims of such trafficking are usually taken to cities or larger towns where they are forced to either beg, engage in sexual activities for money (such as prostitution or sex slaves), or absorbed in economic sectors for which they are either not getting paid, or paid very little (*ibid.*). The latter range from small-scale rubber plantations, diamond mines to domestic work. Trafficking is worsened by the fact that birth registration remains low in Liberia, whilst many citizens still do not have identification documents. The promise of being taken to the city and to receive money and a job is often the reason traffickers can get away with this practice. In the end, of course, none of such promises are realised. We know, for example, that many of these victims end up becoming street prostitutes or beggars.

Trans-national human trafficking happens at the borders of the country. Most often, women and children are carried across either into Liberia, or from Liberia into other adjacent countries by organisations specialising in human trafficking (US, 2019). Rewarding employment opportunities are provided, which, in the end, of course, happen to be false bait. There seems to be an influx especially in young women from other West African countries who are being trafficked by their parents or forced into arranged marriages (*ibid.*). Such victims are then held in Liberia without any identification documents, making it very challenging for the government to identify these victims.

The GoL is well-aware of human trafficking, and several initiatives have been taken to curb this problem. For example, the country has established the National Anti-Human Trafficking Action Plan and Task Force in 2013 (US, 2019). Responses have also included new acting legislation, such as the 2005 Act to Ban Trafficking in Persons. The latter act, for example, criminalises specific forms of sex trafficking and every form of labour trafficking. There is also a Women and Children Protection Section (WACPS)

under the LNP, which is responsible for investigating trafficking cases. In addition to the LNP, particular sectors, such as the Liberian Immigration Service (LIS), also investigates trans-national trafficking (through the creation of the Anti-Human Trafficking and Migrant Smuggling Unit). More recently, the 2013-2018 Anti-Trafficking National Action Plan was reviewed with a new 2019-2024 National Action Plan which was finalised in March 2019 (*ibid.*).

A report by the US in 2019 recognises the GoL's efforts in confronting human trafficking. Yet, *albeit* the government's provisions and responses to the challenge, the GoL is still criticised for providing insufficient training to its task force members in anti-trafficking, whilst certain units lack resources and knowledge in this regard. The referred report notes that the GoL does not meet the minimum requirements for the elimination of trafficking.

9.5 CHEMICAL SPILLS AND CHEMICAL POLLUTION

9.5.1 Overview

Dangerous chemicals can be found everywhere, from household dust to the Arctic, putting human health, wildlife, and ecosystems at risk[21]. Chemicals are used in everything; from the agricultural to the mining sector; and there is more and more of it, as the production volume has increased more than 50-fold from 1950 to 2000. There are various ways for chemicals to affect humans and the environment, depending on the manner in which it is transported. Turbulent diffusion, for example, is one essential mode of chemical transport in both air and surface water (Bleam, 2012), responsible for humans and animals being exposed to chemicals in the environment daily. Chemicals are also transported to either surface water or groundwater through:

- Accidental discharge of chemicals pollutes the water table through leaching; and
- Contamination of water sources through washing of containers and accidental leaks.

Some additional factors associated with daily exposure to chemicals are production of food, smoke generated from solid fuels, sewage run-off, and the use of pesticides for plants. However, the dramatic increases in industrial development over the past three centuries have impacted human exposures to both natural and synthetic chemicals, and Liberia is of no exception. In combating the exposure to chemicals or other environmental pollutants, the use of the Environmental Health Risk Assessment has been widely used in the identification of potential hazards to human health. Therefore, the NEAP document could expand its operation in the creation of a database on chemicals used in Liberia using environmental health risk assessment methodology.

Globally, the ill-usage of chemicals affects the natural environment and contaminates water supply from natural and anthropogenic sources. The presence of toxic metals in the atmosphere is determined both by natural processes (e.g., weathering of rocks, volcanic eruptions, and forest fires) and by their supply from anthropogenic sources (e.g. industrial methods, traffic, etc.). Some toxic metals (e.g. zinc, copper) are considered necessary as trace elements for organisms to thrive, whilst others (e.g. lead, cadmium, chromium, and nickel) are deemed unnecessary and even harmful (Didwania, Swati, and Sadana, 2018)[8].

[21] https://www.documents.clientearth.org/library/download-category/chemicals/

In general, toxic metals and in particular lead, cadmium, and copper are considered dangerous to humans due to their poisonous effects. Research has shown that several chemical effluents have been identified in potable water, but there is no available data on the chemicals in water in Liberia. These contaminants reach drinking water supplies from various sources, including municipal and industrial discharges, urban and rural run-off, natural geological formations, drinking water distribution materials, and the drinking water treated process.

Research has shown that several chemical effluents have been identified in potable water, such as research work conducted in the Soniwein Community, which showed a traceable amount of iron in the groundwater (Chea and Dean, 2017). Furthermore, a spatial analysis study conducted along the Duport Road and in the Soul Clinic communities shows that nitrate distributed concentration and temperate has moderate to high spatial dependence, whilst peroxide, total dissolved solids, total alkalinity, and pH have weak spatial dependence. The Global Moran's Index for the Duport Road and Soul communities study results show that nitrate distribution and temperature were statistically significant (McClain, 2017). A comparative analysis of water quality between the water sample of Monrovia and Port Harcourt in Nigeria showed that 22% of the sample collected in Liberia (N = 204) had nitrate levels above the accepted range (Kumpel, *et al*., 2016). The EPA also revealed cyanide contamination of surface water at the MNG Gold on the 9th of November 2017, through a press conference (EPA, 2017). However, these results are inadequate to quantify the chemical content in Liberia's water. The quantification of the chemical content in Liberia's water must be geographically balanced.

9.5.2 Chemical Use Laws in Liberia

The new Minerals and Mining Law Mandate, Section 8.2, mandates all mining companies operating in Liberia to be responsible for restoring the terrain to its former state of any land distributed by exploration or mining. However, the law or regulation does not forbid a list of chemicals to be used in Liberia's geological terrain.

The EPA Act of 2002 provides the management of the environment, but with limited information on the usage of chemicals. For example, Section 56 (1) of the afore-mentioned act ("Act Adopting the Environment Protection and Management Law of the Republic of Liberia, 2002") prohibits the discharge of any hazardous substance, chemical, oil or mixture containing oil in any waters or any other segment of the environment, except in accordance with guidelines prescribed by the agency in consultation with the relevant mine ministry.

The National Environmental and Health Occupational Policy of 2010 defines a "hazardous chemical" as a chemical for which there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, or experience, which proves that acute or chronic health effects may occur in exposed persons or a chemical which is considered a health hazard. Thus, the procurement, distribution, storage, and use of such chemicals shall be regulated by the Ministry of Health (MoH). The new Liberia Minerals and Mining Law Section 8.2 mandates all mining companies operating in Liberia to be responsible for restoring to its former state the terrain of any land disturbed by exploration or mining (Mining, 2000). However,

neither the law nor regulation forbids a list of chemicals to be used in Liberia, although the EPA has a list of banned chemical for the mining industries.

An updated list of hazardous chemicals and local production chemicals shall be maintained by the Ministry of Health and the National Public Health Institute of Liberia, and all imported chemicals (those not covered by the list) shall first be approved by the Ministry and relevant stakeholders.

Section 56 (1) of the "An Act Adopting the Environment Protection and Management Law of the Republic of Liberia, 2002" prohibits the discharge of any hazardous substance, chemical, oil or mixture containing oil in any waters or any other segment of the environment, except in accordance with guidelines prescribed by the Agency in consultation with the relevant line ministry. Liberia is a party to several international conventions and treaties on the importation and use of chemicals. These Multilateral Environmental Agreements related to the Sound Management of Chemicals are presented below (EPA, 2013):

Table 9.2: *Multilateral Environmental Agreements (Source: EPA, 2013)*

Treaty	Adoption Date	Ratification Date	Objectives
The Vienna Convention on Protection of Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer	15 January 1996	Liberia has ratified all the amendments in the convention. For instance: 1 Jan. 1996 (London & Copenhagen Amendment); 30 Aug. 2004 (Beijing & Montreal Amendment)	Protect human health and the environment against adverse effects resulting from modifications of the ozone layer from anthropogenic emissions of substances proved scientifically to have high ozone-depleting potential
The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	Entered into force 5 May 1992	22 September 2004	1. To reduce transboundary movements of hazardous and other wastes to a minimum consistent to their environmentally sound management 2. To treat hazardous wastes and other wastes 3. To minimise the generation of hazardous wastes
Bamako Convention on the ban of the import into Africa and the control of transboundary movements of hazardous wastes within Africa (Bamako convention)	30 January 1991	16 September 2005	1. To protect by strict control the human health of African population against adverse effects which may result from hazardous waste by reducing their generation to a minimum in terms of quantity and or hazard potential 2. To adopt precautionary measures to ensure proper disposal of hazardous waste and to prevent the

Treaty	Adoption Date	Ratification Date	Objectives
			dumping of hazardous wastes in Africa
Stockholm Convention on Persistent Organic Pollutants (POPs)	23 May 2002	17 May 2004	1. To strengthen National Capacity and to enhance knowledge and understanding amongst decision-makers, managers, industry and the public at large on POPs 2. To develop a National Implementation Plan (NIP) to manage the elimination of POPs
Strategic Approach to International Chemicals Management (SAICM)	2006	2006	1. Achievement of the sound management of chemicals throughout their life cycle so that, by 2020, chemicals are produced and used in ways that minimise significant adverse impacts on human health and the environment

9.5.3 Chemical Use in Liberia

Chemical usage in Liberia is of two kinds - the agricultural and mining industries. According to the Liberia National Situation Report on the Sound Management of Chemicals (EPA, 2013b), it is noted that obtaining updated and precise data on the import, export, use, production and disposal of chemicals is challenging. If data becomes available, such data is usually in most cases obsolete.

There are several ways how chemicals can pollute the environment. Water percolating through soil and aquifer pores transports chemicals along flow paths. Turbulent diffusion is another essential mode of chemical transport in both air and surface water (Bleam, 2012). Chemicals are also transported to either surface water or groundwater through accidental discharge of chemicals, which pollutes the water table through leaching. Contamination of water sources through washing of containers and accidental leaks are other ways of environmental pollution.

In Liberia, agrochemicals and chemicals used for the extraction of minerals are alarming, but there seems to be little control. There seems to be no reliable data on the volumes, or types, and approval of the management of agrochemicals in Liberia. Liberia has never conducted an inventory of its agrochemical stock, import, usage, and export; and thus, the degree of potential environmental and health risks posed by these agrochemicals is unknown.

In all, some information on chemicals used by category exists for agricultural chemicals, but records differ between departments/databases and are not up to date. The National Situation Report on the Sound Management of Chemicals reports that in 2010, MoA imported pesticides worth a total value of US$154,000. According to the MoA, all

pesticides are introduced into the country, as no manufacturing of agrochemicals is taking place in Liberia. It has to be noted that all of these pesticides are for distribution by the MoA's extension offices located in each of the 14 MoA District Offices and are intended for small-scale farmers.

Commercial farmers and plantations import their agro-chemicals themselves through distributors. Therefore, detailed information on the use of agrochemicals by commercial farmers might be available through the Bureau of Inspection, Valuation, Assessment and Control, agrochemical distributors, or the commercial plantations. Considering the porous border, the MoA also believes that (illegal) pesticides might be entering the country without any controls.

However, with significant commercial farms or companies, the management of pesticide containers is expected to be clearly stated in their environmental management plans to the EPA. Usually, these companies indicate that they will liaise with the appropriate MoA office to guide the disposal of the containers.

9.5.4 Kinds of Chemicals

9.5.4.1 Agro-Chemicals

Agro-chemicals is the common name given to chemicals (fertilisers, pesticides, insecticides, etc.) used in agricultural to enable plant development and protection. Although initially used to progress crop production, misuse of chemicals has now started affecting the environment. Apart from the outward effects on crops and the food chain, agrochemicals have an extensive area of application. Due to this inadequate usage, agrochemicals leak into the surrounding land and water bodies, therefore, having a widespread effect.

According to the Liberia National Situation Report on the Sound Management of Chemicals of 2013, it is noted that, it is very challenging to obtain up-to-date and accurate data on the import, export, usage, production and disposal of chemicals in the country, and if data is available, it is in most cases outdated (EPA, 2013b). This means reliable data on the volumes, types, approval, and suspension, etc., aspects on the management of agrochemicals in Liberia is not readily available. Still, the following list of agro-chemicals currently documented for usage in Liberia was obtained from the government:

Table 9.3: *Agro-Chemicals Used in Liberia*

Nr	NAME OF CHEMICAL	TYPE	USAGE	QUANTITY IMPORTED
1	Glufosinate-AMM Basta 15	L	Herbicide	14,930
2	Triclopyr-foxil	L	Herbicide	53,720
3	Glyphosate, supremo 41.0	L	Herbicide	77,310
4	Hexaconazole, Anvil	L	Fungicide	5,000
5	Folliar, grofast	Kg	Fertiliser	8,925
6	Deltamtrin,DECIS 2.5 EC	L	Insecticide	16,923
7.	Compound NPK 15:15:6.4	Kg	Fertiliser	3,250
8.	Sodium Chlorate	Bag	Herbicide	200
9.	Dimethoate, Logor	L	Insecticide	1,000
10.	Ethoxysulfuron, sunrise	L	Herbicide	1,000,000
11	Cypermethrin, Apature 5. Sec	L	Insecticide	20,000

Nr	NAME OF CHEMICAL	TYPE	USAGE	QUANTITY IMPORTED
12	Cypermethin 5.5 11t	L	Insecticide	30
13	Mancozeb. COZEB 80 WP	L	Fungicide	400
14	Slow, Simplot 18-7-9+3mg	Kg	Fertiliser	207,650
15	BL Decta 2.8 Dec	L	Herbicide	12
16	Sulfuric acid	pcs		4
17	Foliar, agroleaf powder	Kg	Fertiliser	36
18	Compound, NPK 12:12:7:3	Kg	Fertiliser	303,050
19	Compound, HBO	Kg	Fertiliser	575
20	Farmon 500(cholothalonil 50%)	Kg	Fungicide	2,000

(Source: Pers. Comm. with the Manager for the Environmental Impact Assessment Parameter of Concern at the EPA, 2019)

Pesticides are often used by farmers for crop pest and disease control in combination with other methods of prevention and control or used when other methods have failed or considered inapplicable. The use of pesticides contaminates both water bodies and the atmosphere. Concerning their effect on crops, unnecessary use of such chemicals generates a significant amount of deposits. These residues cause nutrient disparity and quality reduction of agricultural produce. The residues lead to long-term ill effects on the health of organisms that consume them. For example, pesticide residues in food have been linked to being one of the causes of asthma in humans. The impacts on agro-chemicals affect the soil (residual effects, alter pH levels and increase nitrate content) and water bodies (contaminate water, promote the growth of algae, eutrophication, alter chemical properties of water). In this or similar cases, the use of agrochemicals at appropriate applications, quantities, and methods for the environment are conceivable options.

The impacts of agro-chemicals are as follows:

Effect on Soil:

- They may kill helpful bacteria
- Increase nitrate content in the soil
- Alter pH levels
- Kill soil organisms
- Unnatural growth effects
- Residual effects

***Impact* on Water:**

- Make water unfit for consumption
- Agro-chemicals in water diffusing with more abundant water bodies promote the growth of algae
- Excess chemicals lead to Eutrophication
- Lead to water pollution, thereby affecting aquatic animals
- Alter the chemical properties of water

9.5.4.2 Mining Sector Chemicals

Liberia is endowed with an impressive stock of mineral reserves and has traditionally relied on mining, namely iron ore, gold, and diamonds, as a significant source of income. The recent growth in the mining sector has the potential to contribute significantly to employment, income generation, and infrastructure development. However, the

development of these mineral resources has significant environmental impacts that often go unnoticed. Currently, there are four (4) large-scale industrial mines (two in gold production and two producing iron ore) operating in Liberia with several others in exploration and mine development for both gold, but mainly iron ore. The metal is extracted from the mine and processed through the plant to produce a concentrate. Tailings, or waste material, are then deposited in a Tailings Storage Facility (TSF).

The gold operation employs the Conventional Carbon-in-Leach (CIL) method using sodium cyanide, which comprises of the following:

- A crushing and milling circuit;
- Gravity circuit to recover coarse-free gold;
- A CIL leaching and absorption circuit, in which cyanide leaches the gold from the crushed ore and carbon recovers the gold from the leachate slurry by absorption;
- A tailing thickener to recover water (and therefore reclaim cyanide) from the tailings before it is discharged to the tailing storage;
- An acid wash followed by an elution circuit to strip gold from carbon; and
- Electro-winning of the gold from the elutriate solution and smelting of the loaded electrodes to produce gold.

These mining and mineral processing technologies require sufficient energy, water, and chemical reagents as sources for operations; thus, polluting groundwater, watercourses, and habitats from spills and leakages of toxic or hazardous substances significantly. The mining of these minerals is associated with substantial environmental impacts ranging from landform degradation, pollution of air quality, loss of biodiversity, and watercourse contamination. The latter is a serious challenge in the mining sector because of the climatic condition of Liberia.

Mining companies are responsible for making their mines operate safely. Governments, miners, and their unions are responsible for making sure the companies do that. Many of the chemicals used in the mining sector are documented, as mining companies report the list of chemicals in their respective annual audit reports - especially for gold processing. According to the EPA (Pers. Comm. with the Manager for the Environmental Impact Assessment Parameter of Concern at the EPA, 2019), some of these chemicals include:

I. Activated carbon;
II. Borax decahydrate;
III. Caustic soda;
IV. Copper sulphate;
V. Ferric chloride;
VI. Flocculant;
VII. Hydrated lime;
VIII. Hydrochloric acid 30-33%;
IX. Leach acid;
X. Lead nitrate;
XI. Silicate;
XII. Soda ash;
XIII. Sodium cyanide;

XIV. Sodium meta bisulphate;
XV. Sodium nitrate; and
XVI. Sulfamic acid.

These listed chemicals are, for example, used by the Bea Mountain Corporation and the MNG Gold Mine in the country. During the mining of gold, the ores are crushed and mixed with either of the listed chemicals with cyanide widely used to precipitate gold. Cyanide is used to separate gold from ore, a similar method currently in use by the Liberty Gold Mining Company in Bong County. Cyanide, in its pure form, has no colour and smells like bitter almonds. It may lose this smell when it combines with other chemicals. It can be used in powder, liquid, or gas forms. Cyanide spill can cause immediate contamination of surface water, affecting drinking water and causing significant concerns for human and animal health. Cyanide is entirely soluble in water and has a short half-life in solution; it was swiftly washed away through the river system and cannot present for the long-term in the environment. Some incidents of cyanide spilled in Liberia occurred at the MNG Gold Liable polluting water resources killing fishes and affecting inhabitants.

Heavy metals such as arsenic, mercury, cadmium, uranium, and lead are harmful to people even in minimal amounts. Because many minerals are found together at mine sites, it is often hard to know which metal may be causing health problems. Arsenic is usually found with gold and widely used in Liberia for the extraction of gold but there are no records.

Mercury is naturally occurring metal that is highly toxic and exists in three forms: metallic mercury, inorganic, and organic mercury. Mercury is released in the environment as a by-product of industrial or mining processes. A low level of mercury in water resources is potentially hazardous. Exposure of mercury is associated with Minamata disease, extremities, deafness, poor vision, drowsiness. The exposure of mercury is through inhalation, ingestion, or dermal (Friis, 2012).

The danger of chemicals is that it can affect human physical health, brain functioning and even human emotion. In March 2016, an accident at New Liberty Gold mine released by-products of the mining process into a nearby river that serves villages downstream, affecting people and organisms in the water. Rashes were also noticed on teenagers due to the water contamination. No medical tests have been conducted on these villagers who have reported similar effects. On the 14th of April 2016, shortly after the leak, the EPA took appropriate action against the company. Another incident occurred at the MNG Gold in Kokoya, Bong County, through an accidental spillage of cyanide into surface water, affecting people and some of the fish in the water.

Related to the management of chemicals, potential environmental impacts from artisanal mining are similar to those of industrial mining. A particular associated challenge with artisanal mining, but also general mining, are landslides due to ill-management of minerals extracted.

Table 9.4: *Types of Pollution from Mining and Methods of Transportation (Source: Friis, 2012)*

Types of Pollution	Transport methods
Ground and surface water pollution and siltation of rivers	➢ Acidic mine drainage ➢ Oil vehicle and machinery oil spillage ➢ Lack of suitable storage/disposal sites for mining tailing or chemical products ➢ Releases of Mercury and Cyanide used for gold extraction ➢ Sediment to surface
Soil pollution	➢ Oil spillage from machinery ➢ Releases of Mercury from gold extraction ➢ Proper disposal storage sites for chemicals and wastes ➢ Poor management waste
Air pollution	➢ Burning of wastes resulting in emissions of dioxins and furans ➢ Releases of Mercury from gold extraction ➢ Dust pollution

The use of these chemicals needs immediate attention as the improper application of these chemicals lead to environmental hazard. It is clear that the oversight of EPA, demanding that wastewater from mines' tailing dams should be detoxified before it is released into the environment (point source discharge), is very significant.

The various types of pollution from mining and the methods of transporting these chemicals are listed in Table 9.4 (refer to Friis, 2012).

9.5.5 Chemical Problems and Challenges in Liberia

The threat of chemicals affects human physical health, brain, emotion, etc. In March 2016, an accident at New Liberty Gold Mine released cyanide and arsenic, as well as by-products of the mining process into a nearby river that serves villages' downstream affecting people and organisms in the water. Skin rashes were noticed on teenagers due to the spill. Several mothers confirmed that their children were still afflicted by similar rashes. No medical tests have been conducted on villagers who have reported similar effects. On the 14th of April 2016, shortly after the leak, the EPA took appropriate action against the company. Another incident occurred at the MNG Gold in Kokoya, Bong County, through an accidental spillage of cyanide into surface affecting people and some of the fish in the water.

Chemical usage in the agricultural and mining sectors continues to pose serious environmental and human health problems in Liberia. However, there is a lack of proper management and no available data on chemical evaluation and water-quality. The EPA needs to collaborate with the NPHIL to begin to determine the levels of exposure. Another major problem in Liberia's mining sector is landslides due to ill-management of minerals extracted during mining activities.

The agricultural sector is also responsible for the degradation of land from fertilisers used, and the atmosphere from the use of pesticides. However, there is limited information on the chemicals used in Liberia's agricultural sector.

9.5.6 Healthcare and chemicals

Chemicals enter the water supply from natural and anthropogenic sources. Several chemical pollutants have been identified in drinking water. These contaminants reach drinking water supplies from various sources, including municipal and industrial discharges, urban and rural run-off, natural geological formations, drinking water distribution materials, and the drinking water treating process.

Chemical contaminants for which epidemiologic studies have reported associations include the following: aluminium, arsenic, disinfection by-products, fluoride, lead, pesticides, and radon. Health effects reported have included various cancers, adverse reproductive outcomes, cardiovascular disease, and neurological disease.

9.5.7 Chemical Spillage and Poisoning

In 2017, the bottom portion of a tailings dam at the Kokoya/MNG Gold Mine in Kokoya ruptured, resulting in the spillage into the environment of tailings slurries containing toxic cyanide. The EPA, together with MME, dispatched a technical team to assess the incidence. The findings revealed that the tailings flowing out of the dam contained 0.966 ppm of free cyanide, which was above the permissible free cyanide concentration in industrial wastewater according to the International Finance Corporation (IFC) and Liberia water quality standards. It was established that the nearby Sein Creek, used by the residents of Sayewheh Town, was impacted by the tailings flowing from the dam. Water samples collected at the creek showed elevated levels of free cyanide of 0.310 ppm, which is also above the permissible level of free cyanide in surface water. It is, therefore, not surprising that 36 people from Sayewheh Town who came into contact with the creek were affected. The management of MNG has blocked the

spill with rocks from the mine, thus limiting the flow of tailings slurry into the Sein Creek. MNG also supplied food and water to the town following the accident.

Subsequent to this incident, the dewatering activities at the TSF have seized and the company processed a discharge permit with the EPA to enable the company to continue the dewatering process. Furthermore, government technicians (comprising a crises management team from members of the EPA, MME, NPHIL and NDMA) assisted the laboratory of MNG-Gold in optimising the company's technique for detecting free cyanide. Previously, MNG-Gold had been using a titration method, which is very cumbersome and less accurate than other instrumental techniques. A new optimised technique was used which adopted the EPA sampled preparation procedures, followed by instrumental analysis. The new approach was tested by both teams from the government and company and the results were very promising.

As one of the mining companies in Liberia, in 2018 Bea Mountain violated the EPA's permit requirement in the application and control of cyanide (which is, of course, a dangerous chemical) discharged from its TSF in compliance with the Liberia Water Quality Standards. Contrary to the requires standards, the mine violated its permit requirements by discharging four times the allowable amount of cyanide discharge limit. The EPA acted swiftly on complaints from residents of the nearby community and fined the mine for deterrence to potential violators (Harmon, 2018).

9.6 PROLIFERATION OF GSM COMPANY TOWERS

9.6.1 Overview

Two forms of radiations exist: government controlled and government uncontrolled Radio Frequency (RF) radiations. Government controlled radiation including radiations from sources under government manipulations and influence, such as power plants, smoke detectors, medical treatment sources, etc. This type of radiation is not much of a problem in modern day Liberia since the nation is mostly not familiar to them.

Although the issuance of operation licenses to cell phone companies is being done by the Ministry of Post and Communication in Liberia, the rampant and uncontrolled building of cell phone towers in residential communities warrant the classification of radiation from cell phone tower to be labelled as uncontrolled radiation.

Uncontrolled radiation, which is the import of this reassessment, is of immense public health significance because of its impact on human population. Radioactive emission from uncontrolled sources includes but not limited to cell phone and Radio Frequency RF/MW devices of many types.

The RF spectrum which is used by mobile phone companies is regulated by the Liberia Ministry of Post and Communication; a government body with responsibilities that is similar to the UNFCC in America, and other similar regulatory agencies that exist in other countries around the world that has international radio agreements.

The unhealthy effects from RF/MW radiations are related to an almost infinite combination of each of the five following factors:

- **Frequency Range**- Certain radio frequencies are absorbed in the body more than others. A typical example is the new riot control weapon the USA National Security Apparatus-Pentagon is currently using which operates in the Super High Frequency (SHF) region. This frequency is about 15 times higher than a conventional microwave oven. Although SHF is not absorbed into the skin, it boils perspiration on the skin causing pain.
- **Duration/Limitation**- How long one is exposed to the radiation or how long the transmitter is "one."
- **Distance-** Cell phone tower energy level and hence its degree of radiation decreases as the distance covered between the tower and affected target increases. Cell phone towers erected in and around residential areas are extremely dangerous to those living around that area because of the high energy level they radiate to those living nearby. The safest distance in terms of energy emission is 10-microwatts/m^2.
- **Power Level-** This is measured in microwatts, milliwatts and watts. One microwatt is a millionth of a watt; one milliwatt is one-thousandth of a watt, for example. 1,000 milliwatt is one (1) watt. Cell phone tower power levels are often in the 100-milliwatt to 4-watt class. In the past, older bag type cell phones carried around by people were up near 4 watts of power, getting a strong signal was no problem. Today's pocket cell phones are in the 100-milliwatt area. Reducing the power goes with size reduction and a smaller battery. This also reduces cell phone size, which actually is beneficial.
- **Susceptibility -** Like tobacco smoke, one cannot tell if they will or will not become ill from RF exposure. But RF heating of body tissues and DNA alteration (mutation) happens to 100% of the people exposed to RF and cell phone tower radiations. The amount of heating is determined by the combination of the four (4) factors above. The immune system is responsible for cleaning up mutant DNA but cannot clean out all the defective DNA and dead cells it come across. Modern medical science knows there are limits to how much of an assault on the body the immune system can deal with.

9.6.2 Ecological Survey Findings

An Environmental Impact reassessment survey team with specialty in ecology and Environmental Impact Assessment (EIA), conducted a floral and fauna survey of communities located around seven cell phone towers-Felela, Weala, Cuttington University, Gull Farm, Phebe, and Zeanzu[22].

These towers are located in two counties in Liberia-Bong and Margibi counties. The findings of this survey were:

a) That these cell phone towers are responsible for the disappearance of bees around these communities. It was proven that the radiation emitted by these towers could be responsible for the disappearances of bee colonies around these communities as a result of a phenomenon ecological now known as Colony Collapsed Disorder (CCD). Radiation

[22] *This data is taken from a researched work "ENVIRONMENTAL IMPACT REASSESSMENT LIBERIA'S CELLPHONE COMPANIES: ROBBING PETER TO PAY PAUL" Cuttington University College of Natural Sciences, Suakoko District, Bong County, Liberia.*

was also documented to have been responsible for the diversion of the flight plan of many of other insect pollinators including bees. One cell phone tower erected at Cuttington University Campus; bees were observed to be diverting their flight plan by some 45-degree off the cell phone tower. The research was able to collate and compare bee cultivation information from residents of Plato, Felela and Weala communities-all at close proximity to cell phone tower. Bee cultivation and production in and around these communities diminished and, in some cases, (Plato) disappeared some two years after the construction of cell phone towers around those communities. Some residents say it has taken them close to a decade since they last engage in bee farming. Bees mostly affected by this type of radiation are the *Apis quadrifasciata* and *Apis scalaris*.

b) That repeated exposure to Cell phone tower radiation was responsible for heightening the risk of certain health disorders. Information obtained from self-administered psychosocial questionnaire during the survey indicates that, locals residing around such towers were discovered to be displaying erratic and unpredictable behaviour that cannot be correlated to their past behaviour. Long exposure to cell phone radiation has been related to repetitive stress behaviour which can lead to continuous manufacture of heat shock proteins within cells. These radiations produced by cell phone towers are the same as those of the microwaves in the microwave oven. Heat shock proteins if produced too often or for too long, are known to initiate cancer and increase resistance to anti-cancer drugs. Studies have shown that even at low levels of radiation, there is evidence of damage to cell tissue and DNA, and it has been linked to brain tumours, cancer, suppressed immune function, depression, miscarriage, Alzheimer's disease, and numerous other serious illnesses.

c) The survey also noted that most crops of economic importance are also known to have suffered under the influence of cell phone tower radiation, which affect soil microorganism. Soil microbes present in the soil or close to it are continuously being killed by electromagnetic radiations, which generate heat. Consequently, plants that grow on such soil are also killed due to such radiation because of the loss of the symbiotic relationship between these microbes and those crops. Cell phone towers continuously transmit radiations even when nobody is using a cell phone.

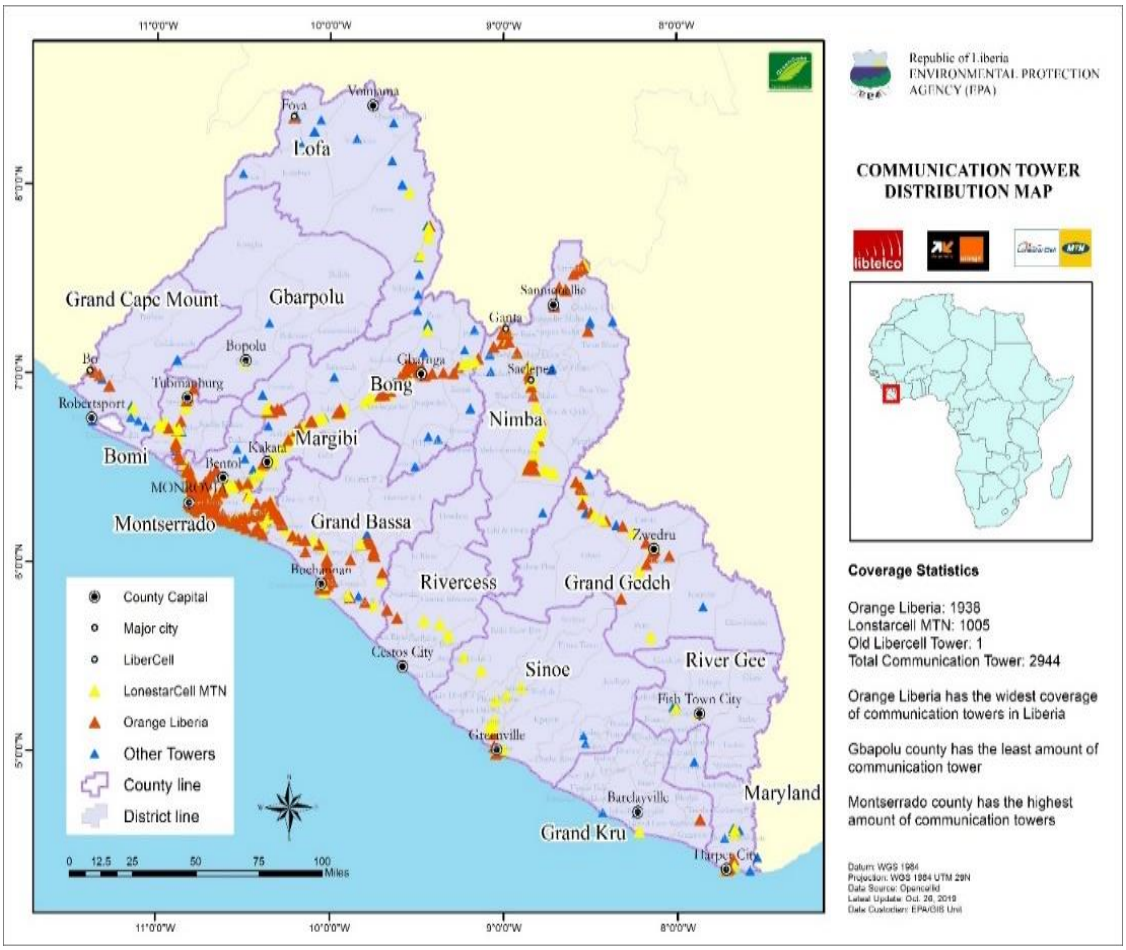


Figure 9.1: *Map of Liberian GSM Companies Locations and Coverage*

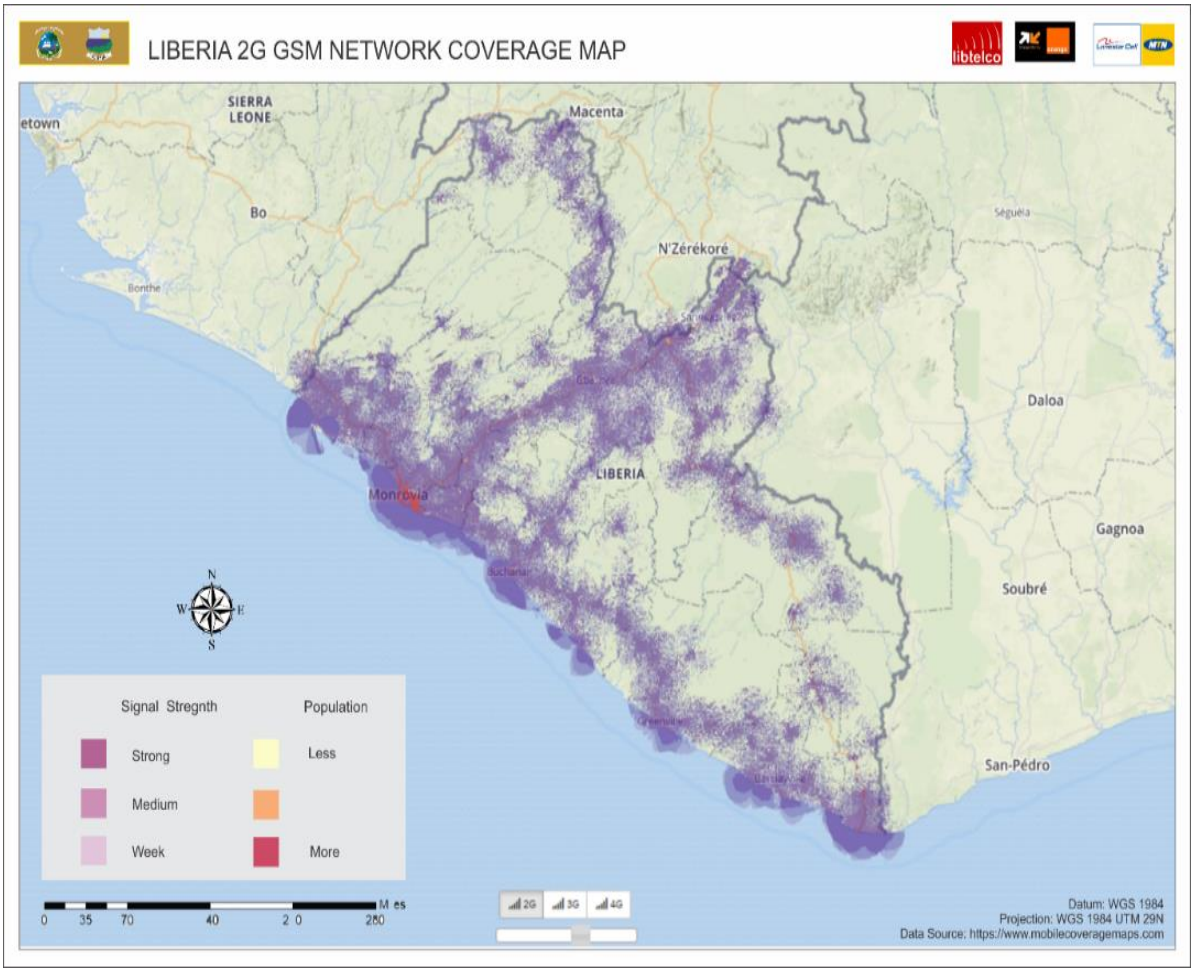


Figure 9.2: *Map of Liberian GSM Companies Network Coverage Impacts*

9.7 WASTE MANAGEMENT IN LIBERIA

9.7.1 Overview

In this second State of the Environment Report, it is extremely critical to go through the process with analytical and realistic review of current environmental conditions, especially SWM which is fundamentally a driver for an unsustainable environment in Liberia. The impact from the civil conflict destroyed existing infrastructures and stretched thin what was salvaged after the war and left the country virtually lacking an organised framework to manage waste. During this period of hostilities, there was a major drove of migrants fleeing the war zones into urbanised communities for safe havens and greener pastures. Fleeing migrants had no time to observe basic procedures for waste management.

Uncontrolled waste can impact the scenery of cities or communities driving investors away. The consequences are more acute: public health crisis, economic stagnation or decline, and social decadence and in some instances, political instability. Unmanaged solid waste can cause human induced impact to climate change from the burning of garbage and other sundries. Estimates show that in Monrovia garbage generated in 2004 were about 145,000 tons/years per circa 1 million population (UNDP, 2006). Projection for 2019 Monrovia population of over 1.5 million people generating solid waste at 0.65kg/cap/day cumulates to 987 tons/ day (Poyry Environment GmbH, 2011).

Solid waste is defined as the range of garbage arising from animal and human activities that are discarded as unwanted and useless but may be recyclable and reusable or compositing and renewable through several technological processes. Hence, SWM is the process of collecting, treating and disposing of solid material that is discarded because it has served its purpose, or it is no longer useful. Solid wastes in Liberia are principally generated from commerce, agriculture, households, hospitals and industries in a given area and may be handled in a variety of ways. Landfilling is typically a practise for wastes disposal in Liberia.

Solid waste by its chemical and reactive characteristics, at the very least, severely impacts the environment, and can be toxic and dangerous to public health, human well-being and other organisms; it certainly carries litany of other negatives and impedes economic growth and social integration if it goes unmanaged and unabated (Koffa, M, 2018).

The 2006 Liberia's state of the Environment report identified overarching problems for SWM as inadequate legislation, lack of substantial investment, lack of financing and human resources, lack of appropriate technology and an effective mechanism to coordinate stakeholders (UNDP, 2006). These problems still remains unresolved. The impacts are visible by the huge piles of solid waste dumped in market-places, along public streets and slum communities. There are challenges to achieving proper management of solid waste in Liberia. With a steady population growth and more purchasing power, there are increased consumption patterns and a sliding economic growth; hence, the generation of solid wastes will continue to be on the rise especially in the domestic waste category.

Intervention by the International Labour Organisation (ILO) in 2007 was aimed at building capacity for waste recycling and reuse. This was the first pilot project to set up Community-Based Enterprises (CBEs) to take over primary waste collection in the capital city, Monrovia. Door to door solid waste collection is on the increase within the Monrovia and Paynesville Cities corporation domains. The service is provided by CBEs duly registered with the respective cities. Over 100 CBEs received trainings tailored to helping managers and owners develop their approach to capacity building and doing better business. The expectation is that CBEs will transform and gain maturity and eventually expend their capacity both geographically and horizontally. CBEs operating in Monrovia City Corporation (MCC) are restricted to perform services to households and small businesses within a confined jurisdiction. CBEs in Paynesville City Corporation (PCC) municipality can loosely choose their clients from any community they wish to serve.

Door-to-door waste collection services outside Greater Monrovia (PCC, MCC, and BCC) is not organised or integrated as would be done in a typical SWM system. Rural communities practise waste management through a government managed framework known as the Community-led Total Sanitation[23] (CLTS) approach.

We were not privileged to find any information or study done on the general composition of solid waste for Liberia. However, Monrovia solid waste composition were studied between 2004 and 2007. Noticeable increase in the composition of plastics from 13% in 2004 to 17% in 2007 is a mark for concern. Plastics is used for packaging almost every items purchased on the local Liberian market. Waste pickers will refuse to collect plastics due to low incentive paid by private firms for recycled plastics.

[23] CLTS – Community-led Total Sanitation is the government of Liberia strategy for rural dwellers to manage community sanitation, safe drinking water and their environment.

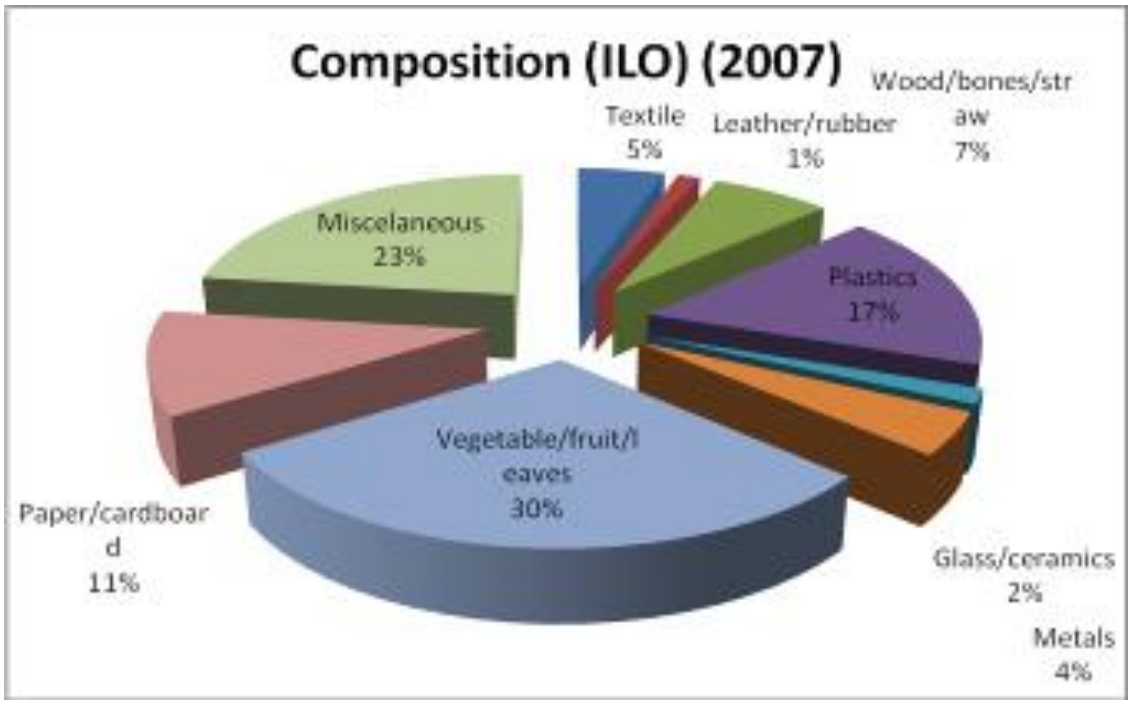


Figure 9.3: *Composition (ILO), 2007*

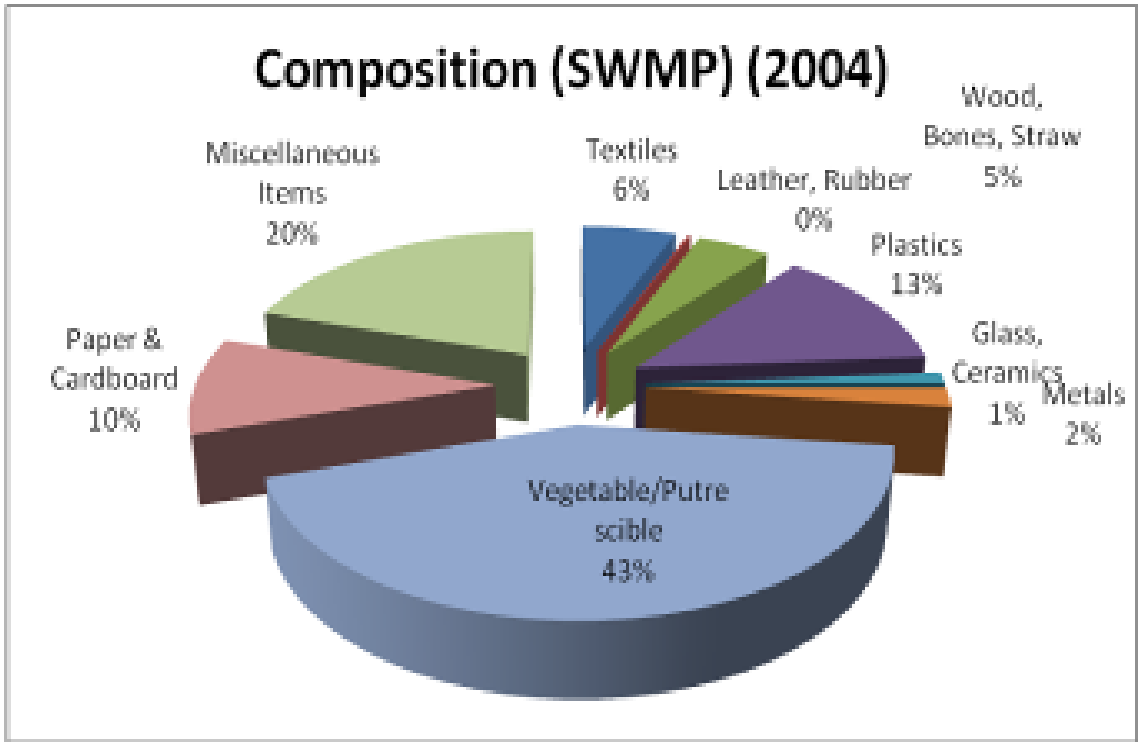


Figure 9.4: *Composition (SWMP) 2004*

From an environmental performance perspective, plastics are the dominant litter around public places. Littering and flying tipping is a huge problem across Liberia indicating that a large section of the urban and rural societies have poor waste management values.

The most significant change in the composition of waste is the increasing organic component of vegetables, fruits and leaves (putrescible) that could be recovered (use for composting or generation of gas) rather than being disposed at the landfill.

Electronic waste (E-Waste) is a growing phenomenon in Liberia. E-waste comprising damaged cell phones, computers, radios, etc. are directly disposed of into the general solid waste stream.

Plate 9.1: *Electronic waste: cell phones, computers, radio*

There is currently no regulation on the control and disposal of used tyres in Liberia. From the outlook, used tyres importation is spiralling. There seems to be no one collecting these tyres from the waste stream at the moment.

Tyres are usually burned by individuals in opened air as a means of disposal. Burning tyres releases pollution to the atmosphere. The bad practice has to be stopped with urgency.

Liberia current five-year development agenda: Pro-Poor Agenda for Development and Prosperity (PAPD, 2018) aims to bring prosperity to all its citizens - leaving no Liberian behind. Prosperity and rising income levels will increase access to goods and services with direct link to increasing domestic waste generation. The PAPD, however, is not categorically clear on national targets for waste management and, therefore, does not set a clear strategy to address existing national waste management challenges. Waste management at sub-national levels are focused on a few municipalities with Monrovia, the Capital city of Liberia being the epic centre.

The country has struggled to put in place a form of SWM system in some urban settlements after the civil conflict that lasted for 14 years. By 2005, efforts by the Government and UNDP were aimed at removing uncollected waste piles in Monrovia and its environs. Liberia has a history of not having a robust and effective SWM system. Waste management situation has become worse as a result of this and other sundry events. The challenges of managing municipal solid waste has escalated and has reached a point of epidemic, which has drawn public and national attention, especially from the vantage point of densely populated cities such as the Cities of Monrovia, Paynesville and others.

9.7.2 Hazardous and Infectious Waste

During the Ebola outbreak in Liberia, huge concerns regarding collection, transportation and final disposal of waste generated at Ebola Treatment Units (ETUs) and Community Care Centres (CCCs) were raised. Due to the high volume of infectious waste generated from these facilities safety protocols for managing waste were introduced. The waste management infrastructure in Liberia at the time could not cater to the waste generated in these centres. Solid waste generated onsite were burned or incinerated at the centres. The main challenge was with the collection and disposal of sewage, which included faeces, and waste-water from showers and laundry at ETUs and CCCs. **S**afety protocols were introduced to minimise potential hazards

related to the handling and management of sewage[24] generated from the ETUs and the CCCs. Faecal matters generated at ETUs and CCCs were stored in septic tank, lined latrine, holding tank or poly tank under concentrated doses of chlorine. Collection and transportation of the sewage were strictly controlled. The sewage were transported to the Liberia Water and Sewer facility in Monrovia for storage.

Plate 9.2: *Disposal site at Liberia Water & Sewer Facility at Fiamah*

The container (digester in the background-red arrow) of faecal sludge was in 2017 assessed by a team of local water quality experts. The content was found to be non-harmful and could, therefore, be discarded through the partially functional sewage treatment plant.

9.7.3 Hospital and Pharmaceutical Wastes

The number of hospitals, clinics and pharmacies have grown across Liberia in the last few years. The number of clinics and pharmacies are spiralling. This implies that waste generation in health-care facilities have also increased. To reduce the challenges, the Ministry of Health instituted a protocol to guide waste management in all health-care facilities in Liberia. Infectious wastes are separated from regular waste types in colour coded containerised at the facility level. Sharps are containerised in perforated proof bins; utensils may be cleaned by sterilisation and the general waste placed in labelled bins.

Dealing with health-care waste is a challenge for both small and large health-care centres. Waste management infrastructures (especially, incinerators) in medical facilities are often non-functional. As a result, there are often piles of wastes waiting for disposal in the backyards of

[24] *Sewage in the context of this document refers to* ***black water*** *(excreta, vomit, blood spills) from the latrines and* ***grey water*** *(from showers, laundry, kitchen) but not* ***storm water*** *which is dealt with separately through a parallel drainage channel and connected to a soak away pit.*

healthcare facilities. The challenge is even greater with disposal of amputated body parts and expired medications in huge quantities.

9.7.4 Regulation for Waste Management

The EPA is the regulatory agency for the holistic management of environmental issues to include SWM in Liberia. An Act of Legislature passed in 2003 created the EPA of the Republic of Liberia. The mandate is to protect and manage the environment, as well as the natural resources of Liberia as enshrined under Article 7 of Chapter II of the Constitution of Liberia. Liberia constitution guarantees every person in Liberia the right to life, and by extension, the right to a clean and healthy environment that supports that life; committed to the pursuance of social and economic development, but without undermining the ecosystem's renewal and re-supply process (EPA, 2006). Such mandate includes but is not limited to SWM and sanitation. The EPA as an autonomous Agency is charged with the responsibility to regulate environmental protection and management and ensure SWM and liveable sanitary conditions (EPA, 2010). It became fully operational in 2006.

While Liberia, through the EPA can boast of some noticeable and incremental progress in the environmental regulatory policies and enforcement realm, particularly in the SWM sector, it still remains a daunting task, which profoundly threatens the public health, impacts social integration and economic growth to some extent.

Several government institutions have roles and responsibilities for managing municipal solid waste:

1. The Environmental Protection Agency (EPA) is the coordinating and monitoring body responsible for policies and guidelines of SWM. Pursuant to section 39 of the SWM Standards of the EPA Law, the EPA shall, in cooperation with relevant ministries, agencies, city and county governments, and in consultation with other stakeholders in the community, and after public hearings, develop and publish national guidelines for SWM. The Environmental Policy of Liberia commits the Government to ensure a clean and healthy environment by protecting its territory against all forms of pollution: air, water, coastal, industrial, and land.
2. The Ministry of Public Works confirms structural integrity of waste management infrastructures. (i.e. Whein town landfill and the waste transfer stations engineering were approved by the Ministry of Public Works).
3. Ministry of Internal Affairs manages cities budgets that may include money for waste management. Offices of mayors are structured under the Deputy Minister for Urban Affairs at Internal Affairs.
4. Ministry of Health/National Public Health Institute of Liberia ensure that public health concerns around SWM are address. The enforcement of the Liberia Public Health Law[25] is largely overseen by the both institutions.
5. The Ministry of Finance Development Planning plays a pivotal role where donors' findings are involved with SWM on a much larger scale. Several intervention projects on SWM (i.e. Emergency Infrastructure Project –Supplementary Component; Emergency Monrovia Urban Sanitation Project and the now Cheesemanburg Landfill Urban Sanitation (CLUS Project)) were co-financed by government and donors.

[25] Public Health Law of Liberia is a set of approved rules and responsibilities for managing basic sanitation and controlling the spread of diseases in communities and public places.

6. The role of cities is to manage the day-to-day operations of municipal solid waste. Cities have in their structures, departments for SWM.

SWM is a challenge in Liberia but became exacerbated during and immediately after the civil conflict from 1989-2003 (AEW[26], 2017). Urban settlements grew exponentially with little or no framework or capacity to manage waste generation at such magnitude.

Liberia is one of the contracting parties to the Basel Convention which obligate its members to ensure the reduction of trans-boundary movement of waste consistent with sound environmental practices. The country's progress towards assessing legal and institutional frameworks and identifying gaps towards attainment of sustainable inventory of hazardous and other wastes has been sturdily progressive. Working with the UNDP, UNEP and other National stakeholders Liberia conducted several workshops to raise awareness and recommended steps for initiating actions. Liberia EPA plans to organise a chemical management committee comprising of national institutions; conduct national inventory on production and importation of hazardous materials and to formulate national policy framework and domesticate the regulation of hazardous materials.

9.7.5 Solid Waste Management Infrastructure

Municipal SWM infrastructures have begun to develop with concentration in the capital of Liberia. In 2009, investment from the Liberia Trust fund[27] supported the construction of two solid waste transfer stations and a landfill.

Plate 9.3: *Left: Stockton Creek Transfer Station (truck dumping without using the ramp); Right: Fiamah Transfer station, with waste spilling out of the protected bay*

Stockton Creek TS in the south and Fiamah TS in the North of Monrovia are infrastructures for SWM. The thinking is that these transfer stations' operators would keep the facilities tidy at all times, to ensure that waste that comes to the stations are offloaded into bays containing larger containers. These containers are intended to be collected and transported by long-haul equipment from the stations to the landfill on a regular basis (Poyry Environment GmbH, 2010).

Whein Town Landfill is Liberia's first known engineered solid waste disposal site. The landfill was operationalised under the Monrovia Urban Sanitation (MUS) Project 2010. Whein Town

[26] Africa Environmental Watch
[27] Liberia Trust Fund is a Donor funded account manage by the World Bank and Government of Liberia for development purposes.

landfill is an inter-medium landfill to what is hopefully the main landfill to be constructed under the CLUS[28] Project in Cheesemanburg near Monrovia.

Plate 9.4: *Whein Town Landfill Site*

Introduction of the two (2) transfer stations and three weighbridges into the Monrovia's waste management operation is an elevation in the mechanism to improve efficiency and accountability in the system. These infrastructures are operated under approved environmental management plan[29] (EMP) backed by existing frameworks: The National Environmental Policy of Liberia 1999; Environment Protection Agency Act of 1999 and the Environment Protection and Management Law of the Republic of Liberia 1999.

Solid waste infrastructure in greater Monrovia caters for less than half of the daily generation. The following infrastructure are available:

- 1 Engineered landfill (Whein Town Site)
- 2 waste transfer stations
- 3 weighbridges
- 120 – lesser skips (waste bins)
- Huge number of dysfunctional incinerators at clinics and hospitals

In spite of the investment by donors and government, Liberia's waste management infrastructures and practices have not improved according to plan. Other cities around the country have not benefited from government and donor interventions to address the challenges

[28] CLUS Project is funded by the World Bank and the Government of Liberia with the aim of constructing an engineer landfill for Liberia.

[29] Environmental Management Plan (EMP) specific objectives include: (i) Describe and assess the existing environmental and social setting that would be affected or impacted by developing and commissioning of the SWTS in Monrovia and its environs; (ii) Identify and assess the types and magnitude of the likely potential environmental and social impacts of these activities; and (iii) Provide an EMP with the recommended measures to prevent or mitigate the potential impacts.

in managing municipal solid waste generated in the respective areas. Cities like Buchanan, Kakata, Gbarnga, Gumpa, Zwedrew and Voinjama are some of the few populated settlements yet to receive support for management of solid waste.

9.7.6 Solid Waste Collection, Transportation and Disposal

Liberians and residents living in Liberia practise several methods of waste handling from primary to secondary collection, transportation and disposal. Waste management planning and waste regulation or enforcement structure at national level are not being consolidated and strengthen. A few cities are struggling to enforce weak ordinances through non judicial means. At the household levels in rural communities, women, as part of their daily job, pile up and collect waste from their individual homes and empty same into pits dug in backyards for the purpose. In larger communities where service is absent, waste is dumped generally overnight in vacant lots and along streets or may be used to fill abandon pits. In locations where waste collection services are available, (i.e. Monrovia and Paynesville) ordinances do not require compulsory subscription to services. The backlash of the situation is generally an environment littered with waste.

Community Based Enterprises owned by private individuals are actively collecting waste from door to door in some urban settlements.

Wheel-barrows are the common tools deployed for waste collection by CBEs. However, some CBEs have started the deployment of motorised equipment for waste collection in Monrovia and Paynesville cities. The advantage of using motorised equipment is to have a fast turnover of larger quantities of waste from points of collection to the transfer stations. Waste collected by CBEs are emptied into large waste bins owned by the cities or instead carried to the waste transfer station nearby.

Plate 9.5: *Collection of waste by CBE*

Waste dumped at the transfer stations is collected and transported by contractors hired by the cities. It is observed that waste transported from the transfer stations to the landfill in larger vehicles are often done to the displeasure of other commuting vehicles. Long-haul vehicles transporting waste are left uncovered and waste are flying from these vehicles and most of the time spill leachates that contaminate the air along streets. It will require the introduction of specialised vehicles or appropriate measures to curb the existing problems. Monrovia and Paynesville cities have sought to privatise the municipal waste collection and disposal. However, a number of private operators have had management challenges and threats of receivership or liquidation. These encounters have risked private waste management firms from securing financial assistances from banks.

Waste collection system designed for Greater Monrovia is capacitated to handle about half the generation per day. Liberia's estimated per capital waste generation is climbing. Estimates from pre-war period shows a 0.5kg/cap/day (UNDP, 2006). Further study in 2011 indicates a slight increase between 0.52kg/day – 0.65kg/day (Poyry Environment GmbH, 2011).

Disposal of municipal solid waste is principally landfilling. This may be by control means or by simply dumping in an open pit as is the case for rural dwellers.

Plate 9.6: *Waste dumped in Palm Grooves Cemetery (source: Greencons)*

Other unapproved habits of waste disposal in Monrovia have generated concerns amongst residents. Considerable amounts of waste are dumped in graveyards as in the case of Liberia's popular Palm Groove Cemetery. As stated in the last state of the environment report, open dumping is the most commonly used method for most urban settlements (UNDP, 2006). Residents find it easier and under the cover of night to dump waste in open lots, wetlands or near surface water sources.

At medical centres in Liberia, solid waste is separated from sharp and biological material and then incinerated. Residues from incinerators are often buried on site at medical facilities. These are huge concerns for ground water pollution as the pits are not lined for protection of subsurface water.

9.7.7 Studies of Waste Management in Liberia

Several studies regarding various levels of SWM have been carried out in Monrovia. The 2011, SWM in Greater Monrovia Concept Development Report Phase II[30] funded by the World Bank was aimed at exploring options to address SWM in greater Monrovia. In 2016, feasibility studies of integrating waste to energy was carried out by Norconsult[31] NVE.

9.7.8 Impacts of Poor Solid Waste Management

If solid waste is not properly managed, the discarded materials, some of which are food products, newspapers and other biodegradable materials get to rot and decompose under

[30] SWM in Greater Monrovia Concept Development Report Phase II discusses the SWM development options for the city of Monrovia for the next 20years.
[31] Norconsult NVE 2015 feasibility study on waste to energy in Greater Monrovia, Liberia

improperly, unhygienic and uncontrolled conditions, which after a few days of decomposition, creates a foul smell that produces bad odours and becomes breeding grounds for different types of diseases and infestation. Poor management of solid waste can lead to an increase in cases, such as acute diarrhoea diseases, malaria, acute respiratory diseases, typhoid, and cholera; all which are very prevalent in Liberia. By evidence from the top 10 causes of death reported by Centres for Disease Control and Prevention CDC (Centre for Disease Control and Prevention, 2019).

Figure 9.5: *Top ten causes of death*

Toxic waste, on the other hand, such as metal, hazardous waste, and chemicals when released in the environment can cause biological and physicochemical problems to the environment and may alter the productivity of the soil from which foods are produced. Toxicity may cause inflammation making the disposal process even more risky. When hazardous waste like pesticides, unwanted batteries containing lead, mercury or zinc, cleaning solvents, radioactive materials, old computer and cell phones, e-waste and plastic are mixed up with paper, and other scraps are burned dioxins and furan gases are produced. These toxic gases have a potential to cause various diseases, including but not limited to cancer and other life-threatening diseases.

From an economic perspective, it is a direct and indirect cost burden to the national government since most of the patients who cannot afford, or have insurance, end up in government run clinics/hospitals and the government shoulders the financial burden. Hence, it is a good idea from a cost benefit analysis perspective to treat the problem at the source, thereby saving the government thousands of dollars if not millions. The current state of poor SWM threatens the government's Pro-Poor Agenda, since no nation or community succeeds in its economic growth, social development and political stability if the situation of this magnitude is unabated.

Waste management is amongst one of the major challenges facing citizens. To date, the indiscriminate disposal and mass burning of waste, which seems to continue without management interventions, have turned many areas into environmental slumps. According to

several residents, the challenge is often that there is no designated site for garbage disposal. As a result, community-generated waste is often disposed of in the open, particularly used plastics. The investigations found that specific waste, such as those from bottled water and plastic sachets, is often the major cause of concern. Compounding this issue is the fact that there are no statures or laws in place to regulate waste disposal. Accordingly, waste disposal is discretionary to an individual's preference or behaviour and family-dependent. This has led to the mass dumping of waste in many areas visited. Waste is also frequently dumped in wetlands, rivers, creeks, beaches and other surrounding areas. Many residents are of the opinion that local government has a responsibility in establishing waste management schemes in order to reduce the risk that poor waste management poses to the environment and the communities' well-being.

Plate 9.7: *Site assessments by Greencons across Liberia highlighted waste pollution in and around Lake Teedeh (left) and coastal area-Buchanan(right)*

Lake Teedeh (only recorded man-made lake in Saniqualle City, Nimba County, Liberia) once a site of popular attraction for wildlife, including birds, reptiles and fishermen is now a scene of garbage piles and smoke generated from burning refuse. Waste disposal has become so intense that it threatens the health and existence of the lake. Waste disposal can reduce dissolved oxygen in lakes and rivers and makes the body of water uninhabitable for fish and other freshwater creatures. The size of Lake Teedeh is plummeting as a result of the volume of waste disposed of on its banks and by extension climate change. This is generally the same for most surface water bodies across Liberia. Urgent concrete actions are needed to assess the state of Lake Teedeh and other vital surface water bodies in Liberia.

From the data collection and consultations, with specific focus on SWM, it was gathered that the lead agency (EPA) as a regulatory instrument, has made significant progress in the coordination and the responsibilities of each entity's role to avoid what once was a fragmented, self-driven, duplicating and overlapping function within the sector. It is established that the EPA continues to advance this coordination through sectoral engagements, such as workshops, and conferences as mandated. From the participants' perspective, there was an overwhelming consensus especially by MCC, PCC and others who established consensus on coordination and responsibilities. According to EPA's regulations, each municipality is responsible to arrange the collection of solid waste in their locales, and the timely disposal of solid waste to a central depository site.

With respect to the 1973 Municipal Act of Liberia to which policies and legislative provisions on waste management should be reviewed and revised where possible, the EPA stressed that everything is being done to do so in compliance to the 1973 Municipal Act.

The issues of mandatory facilities that produce a lot of waste, such as factories and hospitals should install and operate incinerators for burning their combustive waste fractions, still remain an issue for most participants, especially for those who were not too certain if that was the case for all the entities that need incinerators had them and how operational they are, especially the hospitals/clinics. There were concerns over who monitors these entities. However, the research points to the section of Environmental and Occupational Health and Safety at the MoH are most likely responsible for such evaluation, but all efforts to reach and obtain information failed. Participants frowned at the lack of effectiveness in this sector as most of this hazardous waste is often found in wetlands and on beaches. Participants also complained about the crematory facilities where bodies are burned, and the entire communities are engulfed with horrible odours; the question was asked where the ashes were preserved – most likely they are dumped in open spaces or water bodies.

Regarding waste disposal sites, as it stands, Liberia does not have a functional, engineered sanitary landfill. Whein Twon Landfill is not operating as designed, which by all standards is even more problematic to public health by releasing uncontrolled leaks and odours. Research revealed that the Government of Liberia and MCC had acquired a 100-acre land situated near Cheesemanburg Township as a replacement for the Whein Town landfill. But the delayed of funds postponed the development of the new sanitary landfill until 2019 when the project resumed under the Cheesemanburg Landfill Urban Sanitation (CLUS) Project. Whein Town Landfill is in Paynesville City and supports Monrovia waste disposal.

The need for a thorough environmental and public health impact study of solid waste and sewage on the environment is greatly needed, but as of yet, no record exists to show whether such study was ever done. EPA, as the regulatory agency, could not speak to such study.

The issue of well-coordinated public awareness and education on waste management backed by intensive capacity building initiatives has not been quite robust. EPA has programmes that reach out to the secondary and tertiary educational school system. The majority of the participants and some government entities, as well as NGOs, lamented that such exercises are not robust and have not reached most communities – there is a need for communities to be educated on the issue of SWM. However, many agreed that there is a need for the programme to be extended beyond Monrovia.

9.7.9 Emission from Solid Waste

Liberia's contributions to global GHG emissions stand at 1.89 Mt CO2 equivalent (EU, 2016). This amount is very small compare to other developing countries, globally. However, it is a concern for Liberia's growing economic development that could spiral with emissions.

Dealing with increasing cases of fire caused by anonymous individuals, especially during the dry seasons (November – April), is a challenge for most cities in Liberia. Smoke from burning solid waste releases furans and dioxins into the atmosphere. The most severe cases of emission releases were reported from the Whein Town landfill site where consistently in 2016, 2017 and 2018 fire gutted the landfill and lasted for several weeks, respectively. Residents in the surrounding of the landfill complained of air pollution and residues from smoke at the time of the fire incidences.

Leachate generation from municipal solid waste is often in high amount as a result of the high level of rainfall experienced in Liberia. Delayed collecting of waste piled up in market-places

results to decomposition and release of leachate flowing on the surface and eventually into the ground. A leachate collection and treatment system is in place at Whein Town Landfill. Leachates flow by gravity through a piping channel into ponds lined with High Density Polyethylene (HDPE) and eventually through an engineered wetland released into a natural stream. Functionality of the system is often a challenge.

Environmental Management Plans (EMPs) require the conduct of semi-annual environmental audits of Whein Town Landfill and the two (2) transfer stations in Monrovia. The EMPs oblige the operators to manage the facilities in accordance with the requirements outlined by the Environmental Protection Agency of Liberia. Environmental audits were conducted between 2013 and 2014 respectively. After these, there has been no audit carried out since.

9.7.10 Progress Made on Recommendations from the Last State of the Environment Report 2006

In 2006, the SoER was completed with baseline recommendations to address and improve SWM in Liberia. The current SoER has examined in terms of what is working, and the challenges reported at the conclusion of this second state of the Environment Report 2019. In order to validate these baseline recommendations against progress after ten years, the research engaged in consultation with appropriate and relevant government institutions, residents, NGOs and private institutions. The stakeholders' consultation involved the following: EPA of Liberia, MCC, PCC, Ministry of Mines and Energy (MME), Ministry of Public Works (MoPW), Ministry of Health (MoH), MoA and City Alliance (CA).

Table 9.5: *Progress toward SoER 2006 Recommendation*

Progress towards recommended actions from the SoER 2006	**Progress to target**	**Traffic light indicator**
Excavations in mining areas should be maintained and protected and pose no danger to people and domestic animals	Opened pits increasing for artisanal miners	
Use of mercury should be well regulated	EPA showing progress	
Environmental impact assessment for mining areas; there should also be an institution of public health standards; use of protective shields	EIA, ESIP for mining sector investment	
Legislation for rubber production in Liberia into finished products	Law enacted	
Campaign to identify historical sites, monuments in every parts of Liberia	Partially done	
Return to blacksmithing as a means of inducing appropriate technology	Practice lost	
Refurbishing of the Sanniquellie house of the Organisation of African Unity and memorials; W.V.S. Tubman, Sekou Toure and Kwame Nkrumah	No action	
Construct more museums and return the National Archives Building on Tubman Boulevard to the rightful bureau of the Government	Only National museum rehab in 2018	
Transport union to acquire land all over the country for parking lots	Partially done	

Table 9.6: *Indicator for Traffic Lights*

	Description of the indicators
Traffic light indicator	Little or no action were observed to have been carried out during the period under review for this report
	Substantial progress made towards the recommendations in the 2006 State of the Environment report for Liberia
	Some initial steps taken to address the recommendations in the 2006 State of the Environment report for Liberia

9.8 HAZARDOUS WASTE

The discharge of hazardous waste is a serious concern in Liberia, which not only pollutes the environment, but also puts the health of the surrounding communities in danger. A case study to illustrate this was during the period of the Ebola crisis (2014-2015), when the Fiamah Site in Monrovia was used as the central location to deposit all hazardous waste materials for all by-products that derived from Ebola activities, including fluid and other parts. During this time, it became a serious concern to the surrounding community, which provoked protests in the community to stop such discharge in the community's fear of contamination and health threats.

9.9 DISASTER MANAGEMENT

9.9.1 Overview

Environmental degradation is affecting some parts of the country significantly. The result of activities such as farming, plantations and mining (amongst others), compounded by population expansions (especially in Monrovia) is that large swathes of land are being degraded significantly to a point where these can no longer support plant life as a result of soil erosion and deforestation. Coastal erosion also has become a major problem in the coastal areas in Liberia, leading to an increasing number of displaced households and damaging property and infrastructure. Such erosion further increases due to changing weather conditions and human activities.

Between April and June of 2018, the National Disaster Management Agency (NDMA) of Liberia recorded more than 6,000 human victims of fire, flood and heavy rainstorm incidents. These disasters occurred across several counties of Liberia and continue to render many communities severely vulnerable. Vulnerability in this regard can be referred to as the characteristics that limit an individual, a household, a community, a city, a country or even an ecosystem's capacity to anticipate, manage, resist or recover from the impact of a natural or other threat [National Disaster Risk Management Plan (NDRMP), 2012].

Various factors in Liberia in particular make its residence very vulnerable to the effects of disasters. Some of these include, but are not limited to, the civil war, which devasted the social, environmental, economic and political landscapes of Liberia. Fighting and looting displaced nearly one million Liberians, destroyed the country's infrastructure and wiped out the country's health and education systems. The agricultural system was also disrupted by the displacement of farming communities during this time. The war was truly devastating to the economy and left the country with an enormous task ahead to address the challenges of recovery. Another factor is the country's weak system of governance, with a government who lacks capacity and sufficient resources to provide adequate social services to the public. This leaves the people vulnerable and, hence, unable to cope with any shock that comes their way; be it internal or external.

All these factors might explain why many people in Liberia remain vulnerable and, therefore, unable to withstand the impacts of a hazard irrespective of its size, frequency and geographical coverage. The risks of economic, social and environmental losses as a result of disasters are high, also given the high pressure on environmental resources in areas such as in Monrovia where there is a high density of people.

The most common hazards which continue to affect Liberians, and which are today aggravated by the past conflicts and current (resulting) poverty are epidemics, floods, tropical storms, fire, tidal abnormalities, erosion and the possibility of droughts in future.

The following section considers some of the most noticeable and well-documented disasters in the last few years related to floods, gas leakage, coastal erosion, fire risks and explosions and mining-related disasters. These environmental disaster events deserve mentioning for erosions, illicit artisanal mining, oil spillage, chemical leakage, landslides, gas leaks, explosions, illegal discharge of cyanide among others; all have a direct impact on public health. These disasters, therefore, illustrate the direct link between environmental protection and public health.

9.9.2 Floods

Floods are recurring issues in Liberia due to the country's high rainfall. However, the effects of floods are worsened by poverty, but also the location of human settlements and resulting soil erosion factors. In 2018 alone, the NDMA's emergency response and recovery joint field assessments recorded many floods which affected thousands of residents across the country. For example, a flood on the 17th of July 2018 affected more than 19,000 people in Montserrado County. Of those people affected by the flood, the assessment recorded more females bearing the brunt of the disaster than men: a ratio of 1:0.68. Several communities and 813 people in Margibi County were also affected and cut-off from roads and essential social services from the same flood. Two days thereafter, a flooding event also occurred in Grand Bassa County, which affected 2940 people. These assessments by the NDMA called upon humanitarian assistance during this time.

9.9.3 Gas Leakage

According to a government report released by NPHIL (2018), on the 14th of November 2018, a chlorine gas spillage/leakage accident occurred in a chicken soup factory in Montserrado County for which more than 20 people had been treated at local health facilities. Cylinders containing chlorine gas were being packed for possible shipment when the gas began to leak out due to pressure. As a means of containing the disaster, the EPA, NPHIL and the police sealed the cylinders into a container and transported them to the Disco Hill's safe burial and healthcare waste site for isolation. Subsequent to this disposal, community engagements followed regarding awareness of chlorine and its effect, as well as disposal mediums for this. Still, subsequent to many failed negotiation attempts with the communities in order to dispose the gas, NPHIL and the technical working group decided to relocate the gas back to the White Plains Water Treatment Plant where the tanks were received by the LWSC and stored at the White Plains Water Treatment Plant.

9.9.4 Coastal Erosion

Maryland County Coastal Erosion of Shepherd Lake: Coastal erosion is a particular concern in Liberia. In Maryland County, coastal erosion at the Shepherd Lake has posed threats to tourism and nearby communities in the county in the last few years. Coupled to this is the fact that there are major sand mining operations and open defecation at Lake Shepherd. The area is, thus, used as an illegal sand-mining site, which is to the detriment of the environment. Unless the local and national governments enforce the laws, the threats to the environment will continue in the wake of the water bodies being polluted.

9.9.5 Human Settlements Along Coastal Erosion Zones

West Point Informal Settlement in Monrovia remains a pending disaster, as the settlement is next to the sea with coastal erosion which continues to affect the community. The township of West Point is located on a peninsula, which is situated along the Atlantic Ocean between the Mesurado and Saint Paul rivers. Home to approximately 75,000 people, West Point is one of Monrovia's most densely populated slumps. Dozens of residents over the years been forced to leave their homes due to heavy sea erosion, flash floods and high sea-level rise resulting in the degradation of the coastline and beaches. Environmental degradation has gradually caused part of the peninsula to erode into the ocean. The government's Risk Assessment Department at the Disaster Agency of Liberia refers to the risks of coastal erosion at West Point as being clearly visible and recommends a national decision to safeguard the estimated 75,000 people living in the township. A risk assessment was done by the afore-mentioned department in Power Plain, Kru Beach and Fanti Town, three major communities of West Point. The findings indicate that these particular communities are the most vulnerable, as the assessment observed that the corridor that once connected these three (3) communities has been cut off due to coastal sea erosion.

The community also lacks proper sanitation and public toilets, with estimations revealing that there are four (4) public toilets in the area. Pay-toilets are available, although residents cannot afford these. Therefore, public defecation is common. In fact, the beach surrounding West Point is often used as a lavatory, creating health hazards as the water is also used for fishing. Evidently, the improper disposal of waste and open defecation all add to the hazard facing the slump community of West Point. These situations could eventually lead to the outbreak of biological hazards like cholera, malaria and diarrhoea.

The situation at West Point is worsened by the fact that there is no nearby fire hydrant to ensure prompt responds to fire outbreaks in the highly clustered community. The risk assessment department also highlights that the community is prone to violence as a result of many ghettos and growing number of narcotic drug smugglers in the community.

Much is being done by the government to find solutions to West Point. For example, in 2017, Liberia's Disaster Management Team visited the West Point Community to meet with a local voluntary organisation working with disaster victims in the area. The organisation is called the Disaster Victims Association and is a Community-Based Organisation working in West Point to carry out disaster awareness, advocacy for victims and networking in disaster response and recovery. Current recommendations by the government's Risk Assessment Team point to the immediate evacuation of some residents; mainly those who are in close proximity to the sea. Resettling the community is not a new recommendation. In fact, an experiment in the 1970s to move people from that township failed as residents returned, despite squalid living conditions. People simply moved back to fish and make a living as informal shopkeepers and service providers close to the city centre.

Despite failed past efforts, resettlement has become inevitable in August 2016, when over 6,000 persons in West Point were affected by heavy sea erosion and flooding. This lead the government, through the National Housing Authority and Monrovia City Corporation and Ministry of Internal Affairs, to relocate 64 families to the Voice of America (VoA) Community in Brewerville (Montserrado County). VoA served as host to over 200,000 IDPs and 25,000 Sierra Leone refugees during the hay days of the Liberian civil war. Subsequent to the relocation, the government assessed the relocated families and found that there was a significant loss of sustainable livelihoods due to the relocation. One reason for this is the fact the host

community lies 10 km away from the beach, hampering access to fishing. Another recommendation has also been made to end sand mining activities in the already hazardous terrain of West Point.

9.9.6 Land Slide and Mine Collapse

In 2019, a land slide occurred at the SSF Rock Crusher Site, situated in Tower Hill along the Monrovia-Robert Field Highway in Margibi County. The mining activities have exposed the top-soil, thus allowing lose soil to slip downward from a height of about 12 m. An assessment of the disaster revealed that the main mining pit was less than 100 ft from the paved highway which leads to the national airport. The findings indicated that this could have severely endangered vehicles and could have posed serious risks to casual labourers. The disaster team also noticed that there had been no caution sign of the presence of the mining pit.

The Nimba Landslide - In many parts of Liberia, artisanal mining methods remain very common, yet dangerous. Workers on these mines are sometimes endangered because of the depth they excavate underground in search of minerals with no regard for safety. The issue of miners working in these unsafe circumstances is aggravated when such mining sites are illegally operated. This was exactly what occurred on Friday, the 8th of February 2019 when an illegal mine in Gbanipea, Tappita Statutory District, Nimba County collapsed and entrapped about 40 people in a pit. Initially, five (5) people were confirmed dead, with the number rising to eight (8) people a few days later. A total of 10 dead bodies were recovered on the 22nd of the same month.

Plate 9.8: *The collapsed mine (Source: NMDA Gbanipea Situational Report, 2019)*

A government team from NDMA reacted to the incident and provided rescue and medical services. The search and rescue operation was coordinated by the Armed Forces of Liberia, greatly assisted by the LNP in keeping the mining site secure during this time.

Plate 9.9: *Rescue operations at the collapsed mining site (Source: NMDA Gbanipea Situational Report, 2019)*

Not only did the incident at the collapsed mining site cause environmental damage, it also illustrated how environmental degradation can cause serious health problems to the affected communities, as decayed bodies had to be properly removed and deposited.

9.9.7 Fire and/or Explosions

Although bush fires are known to be a serious environmental and health risk, fire and explosions can have a devastating effect not only on the environment, but also communities' health. To illustrate this, in 2015 a fire explosion at the Same Darby Facility not only injured several people, but also reportedly impacted drinking wells and nearby water bodies. This was the second incident at the company's plantation in a years' time, bringing to question the company's health and environmental safety programme. Similarly, in June of 2015, an overheated boiler at the plant of the LAC Rubber Processing Plant in Buchana, Grand Bassa County, exploded, injuring 17 workers and causing panic in the surrounding community. Such an incident goes to the core of hazardous waste control and environmental safety in the work-place.

9.9.8 Army Worms

Another type of environmental disaster which illustrates how environmental degradation processes can affect the health of communities is the caterpillar invasion in Karluway District in 2019. Following the reported case on the 7th of January 2019, a local government-led task force was quickly formed involving, amongst others, the MoA and MoH. The team visited the site and collected specimens for verification. Photographs of the caterpillars were captured and forwarded to the relevant ministry to properly identify the species and to provide technical support in addressing the situation. The caterpillar was identified as the *Achaea catocaloides* that invaded Liberia in 2009 in Bong and Nimba counties. Similar caterpillar invasions had been recorded in Liberia in 2010, 2012, 2014 and 2016. On the 26th of January 2019, the aforementioned taskforce disclosed that the outbreak started in Saykliken, Maaken and Karloken communities and had spread to 11 communities in the region.

Plate 9.10: *The feeding of caterpillars on forest trees (Source: MoA-Joint Technical Support Team Report on Assessment of Caterpillar invasion in Karluway District, Maryland County, 2019)*

The invasion led to the destruction of trees of economic importance, food and crash crops. Caterpillars were also found feeding on Dahoma trees in the forest. Most farmers and community dwellers had limited knowledge of this caterpillar, neither of its devastating implication on their livelihoods - especially agriculture. The invasion inhibited farmers in the affected areas from continuing land preparation activities (clearing and brushing) and polluted water sources.

The rate of the spread of the pest infestation was overwhelming and required quick attention for containment. In response to the disaster, the government provided great assistance to the communities in terms of water and food support, but also in creating awareness about the invasion in the affected communities. During the disaster, the National Agro-input Dealers Association of Liberia (NAIDAL) also volunteered their services and formed part of a government assessment team.

9.9.9 What has been Done to Respond to these Challenges?

In October 2012, the Liberia Disaster Risk Management Policy was developed. The policy establishes an institutional and operational framework with one objective being to provide an overall direction for integrating disaster risk reduction into development, recovery and humanitarian response policy and plans.

The policy largely focuses on:

I. Creating a foundation for the development of an effective and functional legal, institutional framework and good governance for disaster risk management;
II. Providing the basis for sound risk management disaster national and local organisation, capacity enhancement and clear allocation of roles and responsibilities;
III. Providing overall direction for integrating disaster risk reduction into development, recovery and humanitarian response policy and plans;
IV. Contributing to national risk management applications for sustainable national development; and
V. Strengthening disaster preparedness for effective emergency and recovery response.

The policy also recognises human-induced disasters as a result of war, refugees, IDPs, chemical and harmful elements. Similarly, it also recognises human epidemics in the county, including cholera, measles, Yellow Fever, and Lassa Fever.

Likely the most important aspect of the policy is the establishment of a National Disaster Management Technical Committee (NDMTC). The policy requires the committee to have subcommittees responsible for different sectoral/thematic areas including food and agriculture, water and sanitation, education and child protection, health services, environment, shelter and refugees, early recovery and infrastructure. The policy requires each technical group to be led by a government line ministry or agency supported by a UN agency and/or NGOs/private sector. UN agencies, NGOs/Community-Based Organisations (CBOs), private sector and donor representatives are, therefore, all members of the NDMTC. The NDMTC is convened by the NDMA, which ensures to the overall coordination of disaster response in Liberia in close consultation with the NDMTC and its sub-committees.

Table 9.7 provides the government-assigned agencies for specific hazards and disasters.

Table 9.7: *Government-Assigned Agencies for Specific Hazards and Disasters (source: NDMTC)*

Hazards/Disasters	Agency/ies
Floods	Ministry of Internal Affairs, MME, MoH, EPA, MPW, City Corporations and the Liberia National Red Cross Society (LNRCS)
Refugee Crisis	Ministry of Internal Affairs (MIA) and LRRRC
Pests and Droughts	MoA, EPA and MoH
Wildfires	Liberia National Fire Security (LNFS); Ministry of Justice (MoJ) and other service providers, such as the National Port Authority (NPA)
Epidemics and Other Health Hazards	MoH and LNRCS
Terrorists	Ministry of Defence; MoJ; Ministry of National Security (MNS) and National Security Agency (NSA)
Desertification, Environmental Degradation and Landslides	EPA; MME; MoA and FDA
Oil spills and Exploration at Sea	MME; EPA; MoA; MIA and the Liberia Maritime Authority (LMA)
Chemical and Industrial Accidents	EPA; MME; MoH; City Corporation and MoA
Economic Shocks	Ministry of Commerce and Industry (MoCI); MoA; NaFAA and MIA
Road, Aviation and Rail Disasters	Ministry of Public Works (MPW); Ministry of Transport; MME; MoH and EPA

9.10 CONCLUSION AND RECOMMENDATIONS

If managed properly, Liberia's economic development trajectory that is envisaged in the PAPD 2023 plan will likely generate a considerable environmental pressure. This pressure however will be enhanced by Liberia's growing population. Provided that this situation occurs, the emerging issues that were discussed in this chapter could get worse. Consequently, new

pressure may emerge while the already existing pressure may take a new turn. However, to address the new expected environmental issues that may emerge, the following recommendations should be considered and developed for implementation:

I. The government should promote the recovery and re-use of electronic equipment in order to reduce the electronic waste load.
II. In order to increase the access of incinerators by all health care facility in the country, policy measures that encourages such investment be developed and implemented.
III. Green economy should be the core of the Liberian government national economic development priorities.
IV. To improve solid waste management, a properly corresponding and integrated management approach should be developed, hence implementation in order to reduce pollution loading of water systems and project the risks of surface water eutrophication, water quality degradation and lower the high costs of waste management.
V. The appropriate quantification and documentation of waste, including electronic waste should be promoted in order to ensure better risk management, appropriate disposal and better allocation of management responsibilities.

10. GENERAL CONCLUSION AND RECOMMENDATIONS

Environment and Economics

The Pro-Poor Agenda recognises the importance of environmental sustainability in the multisectoral approach towards national development. However, in this light, Liberia's long-term development blueprint, which is the vision. The 2030 framework is underpinned by the principle of sustainable development and the recommendations set forth below should ensure the actualisation of the principle.

- Adopt an integrated approach that addresses access to and management of natural resource; mainly land, water and forest, building infrastructures and access to markets, access to production inputs, the development of livestock and fisheries sub/sectors. More attention has to be paid to public investment in the sector, as well as to reinforcement of technical capacities of MoA to be able to deliver services aimed at improving sustainable agriculture for food and nutrition security. There is also a limited private investment for food crops production (low agriculture).
- It is recommended that policies need to incorporate intangible cultural heritage or symbolic cultural values into their conceptualisation of local cultural valuation, along with better tangible cultural heritage or utilitarian cultural values.
- Given the potential of the tourism sector to spur socio-economic growth and development, the government is advised to conduct a Strategic Environmental Assessment to determine the magnitude and scope of environmental and social impacts resulting from the development of the tourism industry in Liberia. Based upon the findings of such an assessment, an Environmental and Social Management Framework (ESMF) can be developed to safeguard environmental and social values from the negative impacts that could emerge from tourism development and management. Such a framework can strongly inform land-use planning and building regulations to guide sprawling developments along coastlines, valleys and protected areas in support of development of tourism facilities.
- The national government should institute varieties of fiscal measures to compensate environment-friendly initiatives, including the green infrastructure or technology, green financing, and discourage undertakings that are infamous for degrading the environment by accurately meting out penalties based on the "polluter pays" principle.
- Encourage customers to make eco-responsible lifestyle choices and buying decisions. It will increase public attention on the environment friendliness of manufacturing practices and product ecological effects and inspire companies to follow environmentally sustainable standards.

Socioeconomic Status, Poverty, Gender and Environment

There are complex relationships between socioeconomic status, on the one hand, deprivation and gender, and on the other hand is climate. Because of these variables the exclusion many Liberians experience exacerbate their marginalisation and their tendency to degrade the setting. The following guidelines should be put in place to tackle these exclusions and avoid degradation of the country's environment.

- Gender mainstreaming is the systematic process of institutionalising gender analysis and equity values in issues recognising preparation and implementation of development

strategies and legislation for the development strategies and legislation for the benefit of children, boys, women, men and other marginalised groups with a view to achieving gender equality and equity (GoK *et al.,* 2005).

- Mainstream poverty-environment interconnects with national and county growth planning, policy making, budgeting, programme execution and monitoring through financial and technical assistance (Drakenberg *et al.,* 2009) and strengthens public institutions' capacity to tackle negative nexus manifestations between the two variables. An important vehicle for this would be to finalise the formulation of a national environment policy on which all sectoral environmental laws would be anchored.
- Educating young, socio-economic marginalised children. Providing equal educational opportunities for the socio-economically disadvantaged, the disabled, and the girl child in Liberia is important. While other issues such as Free Primary Education (FPE) and Free Tuition Secondary Education (FTSE) should be the necessary first steps, although other issues such as onerous household duties and cultural practices such as the FGM and early childhood marriage tend to scheme to keep girls out of school. Particular focus should be put on drafting in minority communities when promoting girl child education. However, if the socio-cultural impediments tend to militate against girls' education, affirmative measures should be taken to address these injustices.
- Sensitise men and women in matters of gender and the environment. Women's exploitation is so deeply rooted in cultures and psyches, that it remains invisible. Stereotypical gender roles are imposed by hierarchical family, social, economic and educational institutions. Consequently, both men and women need to be more mindful of the need to create a more equal society as true development suffers where half the population is shut out of the formal economy. Training in environmental and gender sensitivity for women and men, especially lawmakers, politicians and institutions, would enable them to discard their stereotypical views of the environment and women, as well as retrogressive cultural practices involving environmental degradation and the consignment of parts of society.

Climate Change and Variability

For Liberia, like the rest of the world, climate change and weather are having adverse impacts. They have intensified environmental degradation, decreased agricultural production and food security, increased flooding incidences, landslides, droughts, disease epidemics, damaged physical infrastructure and reduced the risk of competing natural resources. Even though the susceptibility to such impacts is discrete and context-specific, it has the potential to contribute to substantial economic costs that could impede the achievement of the Pro-Poor Agenda for development and prosperity.

The national adaptation plan offers a broad coordinated, structured mechanism for government, private sector, civil society and other stakeholders to incorporate climate change and variability considerations into national development planning and implementation at different levels. While the trajectories of future climate change and the impacts of variability in Liberia are uncertain, institutes are required to prepare for uncertainty as a justification for inaction, and adopt proactive approaches to plan for the uncertain future. The following guidelines need to be adopted in addition to formulate a national climate change strategy and enact climate change law:

- Identify and capitalise on future opportunities posed by climate change and uncertainty

(such as carbon trading).

- Establish specialised institutions and centres of excellence that will allow Liberia to enunciate feasible strategies for mitigation and adaptation.
- Develop early warning systems and connect climate change with reduced risk of disasters at all rates.
- Increase coordination of climate change adaptation strategies and mitigation initiatives at the state, city and community level to increase monitoring and reporting.

State of Liberia Geographical and Biological Environment

Liberia is blessed with enormous biodiversity and wildlife diversity. These natural resources are a source of livelihood for Liberians, which are important to the Liberian economy, and are important for achieving the goals outlined in the culture, social, and political pillars of the Pro-Poor Agenda. The forests and woodlands are equally contributing to the Liberian economy and human development. Nevertheless, there have been initiatives by the government to fight this pressure. Despite the policies and laws adopted, there are still challenges afflicting the sector. Considering the above mentioned, the following recommendations are proposed:

- The national biodiversity policy should be formulated, and a biodiversity law implemented to provide a comprehensive regulatory structure that combines biodiversity conservation with the need to exploit the immense resources of the country's biodiversity for the Pro-Poor Agenda.
- Sharing of mechanisms and exchange of biodiversity recorded among Liberia line ministry must be designed to ensure strategic control and planning of all-important biodiversity areas.
- The initiation of a technical economic value approach to evaluate the forests and woodlands which are currently undervalued is paramount to the acquisition of comprehensive data that should be gathered by relevant authorities in order to ensure that informed decisions on the country's forest and woodland resources.
- The government should also start considering tree planting outside of the gazetted forests and areas affected by logging.

In order to promote best soil management practices in Liberia, the government is encouraged to:

- Provide aid and budgetary support to the agricultural sector to enable the use of improved technologies;
- Promote, nation-wide, best soil management practices. This could be achieved by conducting a general awareness and training programme aimed at farmers in order to inform them of the significant role of soil as a resource to sustaining production and crop growth;
- Conduct a detailed and periodic soil survey in Liberia to guide land usage and related practices;
- Place a premium on afforestation of deforested land, as this should help to reduce desertification and excessive erosion, thereby ensuring that the major soil properties and fertility potential remain in tight for successive agricultural development;
- Develop legislation to guide sustainable soil management across Liberia. Penalty systems could be introduced against violators; and

- Promote low-land development and integrated farming to reduce upland shifting cultivation, thereby increasing sedentary farming.

Emerging Environmental Issues

If managed properly, Liberia's economic development trajectory that is envisaged in the PAPD 2023 plan will likely generate a considerable environmental pressure. This pressure, however, will be enhanced by Liberia's growing population. Provided that this situation occurs, the emerging issues that were discussed could get worse. Consequently, new pressure may emerge while the already existing pressure may take a new turn. However, to address the new expected environmental issues that may emerge, the following recommendations should be considered and developed for implementation:

- The government should promote the recovery and re-use of electronic equipment in order to reduce the electronic waste load.
- In order to increase the access of incinerators by all health care facilities in the country, policy measures that encourage such investment be developed and implemented.
- Green economy should be the core of the Liberian government's national economic development priorities.
- To improve solid waste management, a properly corresponding and integrated management approach should be developed, hence implementation in order to reduce pollution loading of water systems, and project the risks of surface water eutrophication, water quality degradation and lower the high costs of waste management.
- The appropriate quantification and documentation of waste, including electronic waste should be promoted in order to ensure better risk management, appropriate disposal and better allocation of management responsibilities.

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ANNEXURE A: PARTICIPANTS OF THE VALIDATION WORKSHOP ON THE 23 AND 24TH OF JUNE 2020

Environmental Protection Agency (EPA)
State of the Environment Report (SoER) and National Environmental Action Plan (NEAP) National Validation
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ANNEXURE B: COMMENTS AND RESPONSES FROM STAKEHOLDER VALIDATION WORKSOP VIA ZOOM

NAME	INSTITUTION	COMMENT	CONSULTANTS RESPONSE
Anthony Kollie	Ministry of Mines & Energy (MME)	Agro-chemical dealers in Liberia should now focus their attention of importing environmentally friendly chemicals into Liberia. Furthermore, the Gov't of Liberia should monitor the various borders around Liberia for harmful Agro-chemicals entry into the country.	This was already addressed within the report
Octavius T. QUARBO Assistant FAO Representative for Programme	Food and Agriculture Organization (FAO)	**Fisheries** ➢ FAO would strongly recommend to change the structure of the "aquatic resources" section. We should create a section on water (water resources, water quality, etc.), a section on "fisheries and aquaculture resources" (marine and inland, fisheries management and stock assessment, IUU, post-harvest infrastructure and aquaculture) and would move "wetlands" to the forestry sections. It makes less coherence to talk about drinking water and IUU fishing in the same section. That way, a lot could be added on fisheries green smart post-harvest infrastructure and techniques, climate change friendly aquaculture, etc. ➢ A review from NaFAA (National Fisheries and Aquaculture Authority) is strongly advised, as a lot more work has been done and is needed in the fisheries and aquaculture sector (as stated during the online validation). **Forestry** ➢ It is gratifying to see that the EPA is including Payments for Ecosystem Services in the report, however, no links were made with the ongoing national REDD+ program or the project level REDD+ work in the protected areas	This has been adequately addressed where required. A lot more work from NaFAA and fisheries related issues has been added within the document as recommended. The consultants recognize this comment but It is expected that the next SoER will build on this current National Forest Inventory of Liberia as the document was not completed, validated and published upon the completion of this SoER. The correct date for the inventory has also been revised.

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		of Liberia. Explicit links between the two should be made in the document along with recommendations for how these benefits could be shared with local communities. FAO would recommend that the authors engage with the National Benefit Sharing Trust Board and make recommendations based on the experiences of the board.	The issues have been addressed in 5.4.3 of the NEAP report and further recommendation on the importation and banned of chemicals have been stressed in the document as well.
		➢ The authors of the document recognize the national forest inventory but have inserted the incorrect dates in the document. The inventory began in 2018 and not in 2010. In addition, the SoER tends to quote a number of different values for forest cover, none of which are relevant. We encourage the authors to reach out to Mr Saah David (fawasa@gmail.com) and Mr Isaac Teah (inkteah@gmail.com) both from the FDA RIU as they are directly involved in the inventory and the preparation of the final NFI report. The EPA document would benefit from including information from the inventory.	Liquid waste is mentioned which talked about hazardous waste. The section title has been revised waste instead of solid waste
		➢ With regards to figures 6.2 through to 6.6., we understand that they are included to illustrate land use change for the period covered by the report, however, the 5 maps can be replaced by one single map highlighting land use change on an annual basis by simply colouring the annual change. The Hansen data used for the maps in fact includes the annual change as a specific layer. The current maps include repetition of change data between 2001 and 2013, ideally change data between 2007 and 2018 should be included.	These have been recommended within the NEAP
		Other Observations	This has been adequately addressed
		➢ Under the section 5.4.3 of the document, there is no mention that relates to animal. In addition to the below, it is good to mention that there are a lot of chemicals especially acaricides/insecticides used to treat ectoparasites such as ticks and lice. Some acarcides like	

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		chlorinated hydrocarbons Ex DDT are non-biodegradable and are banned by many countries. We are not sure if such regulation exist in Liberia if not this document should consider as recommendation to regulate the type of acarcides to be used in the sector to avoid environmental contamination. ➢ Only solid waste management is mentioned and we didn't see Liquid waste management which is key for a number of issues including protection of public health from various diseases. ➢ The liquid waste management should consider treating laboratory and public health facility wastes. There are many that needs to be securely treated to avoid unnecessary exposure of the public with infectious materials. ➢ The solid waste management from animal/livestock perspective should also consider proper carcass disposal in cases of disease outbreak to avoid environmental contamination. ➢ It is advised that the Liberia Land Authority be included to lead "land governance" issues/activities captured under the NEAP summary table	
Annika Hillers	Wild Chimpanzee Foundation (WCF)	➢ The current valid law is the National Wildlife Conservation and Protected Area Management law from 2016 ➢ There was a Wildlife Crime Task Force established in 2019, which is led by FDA ➢ Did the team have access to the FDA/LFSP tourism action plan? ➢ Will be good to also involve/mention the Liberia National Tourism Association (LINTA) ➢ Some ecotourism pilot projects are in the pipeline with FDA and conservation partners, tourism exchange visits involving FDA, EPA, MICAT and LINTA as well as local communities around Sapo NP and Grebo-Krahn	This has been cited within the SoER report Since the below establishment on wildlife exceed the reporting period of the SoER, such information will be captured within the next SoER report

NAME	INSTITUTION	COMMENT	CONSULTANTS RESPONSE
		NP have been conducted last year with the Ivorian tourism board and Tai NP	
Dr. James Dolo	Central Agriculture Research Institute (CARI)	To prevent the hunting of our wild animals, GoL needs to empower the livestock and aquaculture sectors which would serve as perfect alternative sources of protein for the population.	This has been recommended in the report and within the NEAP
Nick Benitos Goll	Environmental Protection Agency (EPA)	The information about the establishment of the Wildlife Crime Task Force is good to note. However, this report covers the period 2007-2018.	The information is appreciated, however, establishment of the Wildlife Crime Task Force will be a part of the next SoER as it is recent and does not fit within this period of reporting
Targan Daye	Environmental Protection Agency (EPA)	These health statistics have been updated long ago. Much was not said about communicable diseases which is prevalence in Liberia and is an environmental risk diseases. communicable diseases should be considered in this report	This was already addressed within the report
R. Baiyezenah W. Brown	Environmental Protection Agency (EPA)	I did not hear something on rail transportation	Addressed, Rail transportation has been adequately address under the transport section of the report.
J. S. Datuama Cammue :	Environmental Protection Agency (EPA)	Access to communication especially radio is actually available to the population	Addressed as required
Henry Smith; Aboyomi Grant, Sr.;	Environmental Protection Agency (EPA)	The report should comprise discussion on the following: ➢ Minimizing Agricultural waste ➢ Oil Spill Contingency Plan ➢ Water and Disaster management ➢ There should be a stand-alone recommendation on plastic waste ➢ People living with disabilities should be considered ➢ Conversion of waste at the legislative level through Public private Partnership	Addressed adequately with the NEAP where required.
Teddy Taylor	Environmental Protection Agency (EPA)	Awareness be spelt out clearly in the NEAP so that there can be awareness on behavioral change	Addressed
Daniel Tarr	Liberia Maritime Authority (LMA)	There is a discrepancies between Liberia Maritime Authority and National Maritime Authority.	This has been corrected within the report

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		Liberia Maritime Authority is the preferred. The SOER looks good to me. However on pages 38 and 45 of the NEAP, we have to consider GHG emissions from shipping and Ballast Water Management Convention respectively	This has been addressed as required
Tenneh Coleman	Environmental Protection Agency (EPA)	**Table 9.7** Issues regarding flooding. The City Corporations and public work should be included because they deal with zoning laws and city ordinances **Section 6.2.2** Concern on 19 protected areas	Addressed
Austin S. Wehye	National Fisheries & Aqua Culture Authority (NaFAA)	Fisheries Sections (SoER & NEAP)	All comments adequately addressed
Emma Scot and Michelle Villeneyve	Fauna & Flora International (FFI)	NEAP - entire document	All comments adequately addressed
Blamah Goll	Forestry Development Authority (FDA)	NEAP - entire document	All comments adequately addressed
Konikay Nimeley	Forestry Development Authority (FDA)	NEAP – Forestry Section	All comments adequately addressed