LIBERIA - ENVIRONMENTAL THREATS & OPPORTUNITIES

118/119 ASSESSMENT

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Acronyms

AfDB	African Development Bank
AGRHA	Action for Greater Harvest
AFORNET	African Forestry Research Network
ANAFE	African Network for Agroforestry Education
BI	Birdlife International
BNF	Bureau of National Fisheries
CA	Conservation Agreement
CARI	Central Agricultural Research Institute
CBD	Convention on Biological Diversity
CDCS	Country Development Cooperation Strategy
CFMB	Community Forest Management Body
CI	Conservation International
CITES	Convention on International Trade in Endangered Species
COPAN	Consolidation of Liberia Protected Area Network Program
DELTA	Development Education and Leadership Teams in Action
DEN-L	Development Education Network Liberia
DFID	Department for International Development (United Kingdom)
DO	Development Objective
EBA	Endemic Bird Area
EC	European Commission
EEZ	Exclusive Economic Zone
EITI	Extractive Industries Transparency Initiative
ENNR	East Nimba Nature Reserve
ESIA	Environmental and Social Impact Assessments
EPA	Environmental Protection Agency
ERADRO	Environmental Relief and Development Research Organization
ETOA	Environmental Threats and Opportunities Assessment
EU	European Union
EUTR	EU Timber Regulation
EXPAN	Expanding the Protected Area Network Program
FAA	U.S. Foreign Assistance Act
FACE	Farmers Associated to Conserve the Environment
FAO	Food and Agriculture Organization
FDA	Forestry Development Authority
FED	Food and Enterprise Development Program
FFI	Fauna and Flora International
FLEGT	Forest Law Enforcement, Governance and Trade
FMC	Forest Management Contract
FORNESSA	Forestry Research Network for sub-Saharan Africa
FTI	Forestry Training Institute
FUP	Forest Use Permit
GCM	Global Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Fund
GIS	Geographic Information System

GIZ	German Agency for International Cooperation
GOL	Government of Liberia
GPS	Global Positioning System
HICD	Human and Institutional Capacity Development
IBA	Important Bird Area
IR	Intermediate Result
ITCZ	Inter-Tropical Convergence Zone
IUCN	World Conservation Union
IUU	Illegal, Unreported and Unregulated
JICA	Japan International Cooperation Agency
LAFA	Liberia Artisanal Fishermen Association
LCDF	Liberia Community Development Foundation
LEITI	Liberia Extractive Industries Transparency Initiative
LFI	Liberia Forestry Initiative
LFSP	Liberia Forestry Support Program
LISGIS	Liberia Institute for Statistics and Geo-Information Services
LPIS	Liberia Land Policy and Institutional Support
LRCFP	Land Rights and Community Forestry Program
LUP	Land Use Planning
MDA	Mineral Development Agreement
MIA	Ministry of Internal Affairs
MLME	Ministry of Lands, Mines and Energy
MOA	Ministry of Agriculture
MOU	Memorandum of Understanding
NACUL	National Charcoal Union of Liberia
NBC	National Bureau of Concessions
NGO	Non-Governmental Organization
NOCAL	National Oil Company of Liberia
NORAD	Norwegian Agency for Development Cooperation
NRM	Natural Resource Management
NTFP	Non Timber Forest Product
PROSPER	People, Rules and Organizations Supporting the Protection of Ecosystem Resources
PRS	Poverty Reduction Strategy
PUP	Private Use Permit
REDD	Reduced Emissions from Degradation and Deforestation
RSPO	Roundtable on Sustainable Palm Oil
SAMFU	Save My Future Foundation
SADS	Skills and Agricultural Development Services
SCNL	Society for the Conservation of Nature in Liberia
SDI	Spatial Data Infrastructure
SDI	Sustainable Development Institute
SEC	Society for Environmental Conservation
SIDA	Swedish International Development Agency
STCRSP	Smallholder Tree Crop Revitalization Support Project
STEWARD	Sustainable and Thriving Environments for West Africa Regional Development Program
TSC	Timber Sale Contract
UL	University of Liberia
UNDP	United Nations Development Program

UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commission for Refugees
UNMIL	United Nations Mission in Liberia
UNODC	UN Office on Drugs and Crime
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USG	United Sates Government
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VPA	Voluntary Partnership Agreement
WARFP	West African Regional Fisheries Program
WFP	World Food Program
WMO	World Meteorological Organization
WRI	World Resources Institute

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Executive Summary

Liberia hosts tremendous tropical forestry and biodiversity resources. Liberia is home to two of the largest forest blocks remaining in West Africa, which are estimated to account for half of the remaining Upper Guinean rainforests in West Africa. Liberia is also recognized as a global hotspot for biodiversity. The strongholds of these biodiversity and forest resources coincide with areas of low population pressures and limited access. The natural resources of Liberia provide critical ecosystem services to maintain soil fertility for agricultural production; ensure reliable water flows for drinking water, irrigation, and hydroelectric power generation; provide habitats for plant and wildlife species used for subsistence and livelihoods; and, serve as carbon sinks that help regulate climate.

The biodiversity and forests of Liberia face mounting pressures as the country continues to rebuild after the long civil conflict: the natural resources are regarded as an important catalyst for growth and development. Governmental initiatives suggest that Liberia will continue to prioritize economic development, job creation and poverty reduction, over sustainable conservation of natural resources. The emerging, increasing influence of the private sector on natural resource management is a concern, particularly in the forestry, minerals, and agricultural sectors.

The major threats to biodiversity and tropical forests in Liberia include both direct and indirect factors related to:

- Ecosystem degradation and conversion;
- Overexploitation of species and other natural resources;
- Poverty and population growth; and,
- Institutional and management challenges.

Many natural resources are over-exploited, and the environment faces increased degradation from unsustainable agricultural practices, fuel wood and charcoal demands, mining, pollution, and a variety of other anthropogenic factors. Poverty and population growth add to the stress.

Liberia's natural resources suffer from ineffective protection, which can be attributed to a variety of policy, capacity, and governance barriers. Legal and regulatory provisions intended to protect forests and biodiversity are neither well understood nor widely implemented. Weak enforcement of conservation regulations has resulted in uncontrolled use of forest and biodiversity resources, due to a lack of technical and operational capacity, and very few management plans have been developed. Protected areas are easily accessible for illegal activities and the market value of their resources is important. In general, other stakeholders (e.g., NGOs, private sector) are not being sufficiently mobilized for managing resources, and conflicts over land tenure and access to resources persist. In addition, the human resources and baseline data are inadequate for effective natural resource management and biodiversity conservation. The lack of coordination between governmental agencies and ministries is compounded by the absence of comprehensive land use planning in Liberia.

The USAID/Liberia Mission has recently finalized a new Country Development Cooperation Strategy (2013-2017). Although the USAID focal counties are not the premier hotspots for forestry and biodiversity in the country, the environmental considerations presented in this assessment should help with the implementation of that strategy across the entire USAID/Liberia portfolio. Mission activities can ease drivers of deforestation, biodiversity loss, and natural resource degradation. USAID/Liberia currently supports programs in democracy and governance, health, education, environment, agriculture,

energy and infrastructure. Most USAID/Liberia programming areas could be leveraged to positively influence natural resource management. For instance, to the extent that USAID/Liberia's democracy and governance activities help to stabilize the political context and promote progress towards effective and equitable governance, these activities can also facilitate effective, transparent and accountable institutions. In the health sector, there are opportunities to strengthen the implementation of water and sanitation projects by increasing consideration of water sources, watersheds and solid waste management. USAID/Liberia also provides support to family planning activities, a long term indirect driver of environmental degradation. Educational programming could include forest, biodiversity, water and sanitation themes into projects at all levels, and communities of practice for higher education could promote the sharing of best practices and the creation of new knowledge. As infrastructure for energy and transportation networks expands, careful planning is needed to mitigate the potential adverse effects of opening new areas to resource extraction due to increased accessibility. In the agriculture sector, there are opportunities to promote agro-forestry, and to model the most environmentally sustainable methods of rice cultivation.

The Mission has a strong recent history of direct engagement in biodiversity protection and sustainable forest management that focuses on the promotion of community forestry in rural communities. Nonetheless, there are significant cross-cutting needs that remain. A country-wide evaluation of the projected cumulative impacts of current and anticipated land use changes from the minerals, forestry, and agricultural sectors would help to inform the entire USAID/Liberia portfolio. The specter of land use changes from resource extraction highlight the lack of comprehensive land use planning in Liberia, which would help to balance economic growth and sustainable natural resource management. The lack of robust natural resource data and limited data accessibility hampers project planning and implementation across all USAID/Liberia program areas. Finally, opportunities exist to integrate education, training, behavior change, awareness, capacity building, and decision-making related to the environment as a complement to other programming results.

As the CDCS is being implemented, the continued examination of environmental considerations into programming decisions is strongly encouraged; a detailed list of opportunities and recommendations for USAID/Liberia is provided in Table 10. Some suggestions involve relatively minor modifications to incorporate natural resource themes or to prioritize sites near protected areas, while other suggestions may require larger investments to accomplish.

Introduction to Expanded ETOA

Legal Requirement

U.S. Agency for International Development (USAID) environmental compliance is directed by U.S. policy and law. The Foreign Assistance Act (FAA) of 1961, Section 117, requires that the President take fully into account the impact of foreign assistance programs and projects on environment and natural resources (Sec 117 (c)(1)). Section 118 states that each country development strategy statement or other country plan prepared by USAID shall include an analysis of (1) *the actions necessary in that country to achieve conservation and sustainable management of tropical forests*, and (2) *the extent to which the actions proposed for support by the Agency meet the needs thus identified*. ADS 201.3.8.2 states that this is a mandatory analysis for country strategic plans. Section 119 of the FAA relates to Endangered Species. It states that "*the preservation of animal and plant species through the regulation of the hunting and trade in endangered species, through limitations on the pollution of natural ecosystems and through the protection of wildlife habitats should be an important objective of the United States development assistance*" (FAA, Sec. 119 (a)). Furthermore it states, "*Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of* (1) *the actions necessary in that country to conserve biological diversity* and (2) *the extent to which the actions proposed for support by the Agency meet the needs thus identified*" (FAA, Sec. 119(d)).

Purpose and Objectives

This work will be conducted in two phases: Phase one will 1) implement the mandatory 118/119 Environmental Threats and Opportunities Assessment (ETOA), identifying important linkages across sectors and new initiatives with respect to environmental conditions and threats which USAID/Liberia must be aware of during implementation of the new Country Development Cooperation Strategy (CDCS); 2) examine the current state of environmental knowledge in Liberia and make recommendations for major data gaps that need to be filled; and, 3) assess Liberian human and institutional capacity in key institutions responsible for natural resources data collection and management. Phase one will also develop the implementation plan and detailed budgets for Phase two.

USAID Liberia will implement a second phase in FY 2014-2015 to 1) conduct specific natural resource management studies to fill the data gaps and ensure that data is available for GOL decision makers to encourage more environmentally sound policy while pursuing the rapid economic growth of the country; and, 2) build human and institutional capacity for data collection and management through partnership with key individuals and institutions for each study. The provision of data on natural resources and increased capacity of Liberian individuals and institutions to collect and manage this data will support the achievement of Intermediate Result (IR) 2.2 'Natural Resources Managed Sustainably", under Development Objective (DO) 2 "Sustained, Market Driven Economic Growth to Reduce Poverty" of USAID/Liberia's Country Development Cooperation Strategy (2013-2017). Increased natural resource data from the second phase of this investment will also contribute to the achievement of other IRs and DOs within the CDCS, by informing environmental impact assessments and other activities, particularly within the Economic Growth portfolio.

Methods

An initial 118/119 analysis for Liberia was conducted in 2005 (USAID 2005), followed by an extensive update in 2008 that was produced by a team of specialists and included field verification (USAID 2008). This document updates the 2005 and 2008 documents by adding additional insights and suggestions based on recent studies, documents, and team interviews and field visits. As noted in previous ETOAs, the lack of quantitative NRM data continues to hamper not only environmental analysis to support Natural Resource Management (NRM) in Liberia but also these types of assessments as well.

This assessment was conducted by a team of natural resource specialists:

- Beth Hahn (team lead) works for the US Forest Service (USFS) as an ecologist, and has a background in wildlife research. She has conducted natural resource assessments for USAID Missions in Angola, Nigeria, Zambia, Madagascar, Tanzania, and the West Africa Region.
- Jim Barber works for the USFS as a Geographic Information System (GIS) and Remote Sensing Specialist with additional background experience in soil science and rangeland ecology. He has conducted trainings for USAID in geospatial analysis, information management policy, and land-use planning in Indonesia, Laos, and Vietnam.
- Darren Johnson is an independent consultant with a background in forest management and conservation. He has more than 15 years of professional experience in North America, Asia and West Africa with a focus on technical forestry, ecological assessments and community based natural resource management implementation and training.
- Harnon Whymah Garbo works for the Liberian Non-Governmental Organization (NGO) Farmers Associated to Conserve the Environment (FACE) as a program officer, and for the University of Liberia as a Biology Lab Demonstrator. She has worked in natural resource management, with an emphasis on forest research and community engagement. In addition, she has a background in herpetology research.

The team conducted open-ended interviews with more than 60 individuals (Annex B), including representatives from Government of Liberia (GOL) Ministries, traditional leaders, USAID/Liberia staff, corporations, multilateral and bilateral donors, international and local NGOs, and universities. In addition to meetings with key stakeholders, the team reviewed documents and websites (see References). Finally, our assessment included two field visits, which allowed for some exposure to the mangroves and upland forests of Lake Piso Multiple Use Reserve in and near Robertsport, and the inland forests of Gbarnga.

USAID/Liberia

Background on USAID/Liberia activities

With the exception of a few years during civil conflict in the 1990s to 2003, the U.S. has provided steady assistance to Liberia since 1952; programming has historically emphasized education, health, and rural and urban development. U.S. assistance has evolved through distinct phases since the end of the war. In the immediate post-conflict period (2004-2005), USAID focused efforts and resources on reintegrating ex-combatants into society, facilitating the return of internally displaced persons and refugees, and providing basic social services through NGOs. In the transitional period of 2006-2008, USAID focused on helping the Liberian government rebuild and demonstrate progress in key areas: Security; Justice; Health; Education; Governance; Infrastructure; Economic Growth; and, Agriculture.

In 2009, USAID shifted its emphasis from recovery to long-term development: establishing a stable democracy; changing the culture of impunity, systematic corruption and poor governance; closing severe gaps in access to quality education and health care; expanding economic opportunity through agricultural enterprise and natural resources management; and, helping to rebuild essential infrastructure and sources of renewable energy.

Current USAID/Liberia programming

In FY2013, USAID Liberia's assistance of $169 million USD focused on professionalizing Liberia's military and civilian security forces, consolidating and sustaining democratic progress, building the capacity, transparency, and accountability of governance institutions, promoting broad-based and environmentally-sustainable economic growth, improving access to high quality educational and health services, and responding to the emerging problem of narcotics trafficking in West Africa (CBJ 2013). In each sector, assistance has concentrated on helping Liberia build local capacity to plan, implement, and sustain its own development efforts. Health and Education program within the Investing in People program area received the largest portion of funding ($70.5 million USD), followed by the Governing Justly and Democratically program ($40.4 million USD), Economic Growth ($38.9 million USD), and Peace and Security ($19.4 million USD).

USAID Liberia, primarily through the Economic Growth team, has a strong recent history of direct engagement in biodiversity protection and sustainable forest management that focuses on the promotion of community forestry in previously neglected rural communities. The Land Rights and Community Forestry Program (LRCFP; 2007-2011) strengthened the legal and policy environment for secure and equitable community rights to forest lands, and improved partner and stakeholder understanding of this legal and policy framework through activities at the community level in four pilot clan areas in two counties. LRCFP improved the capacity of communities, the GOL, and nongovernmental partners to implement sustainable community-based natural resource management and increased environmentally sustainable and socially equitable options for greater economic security and increased incomes. FY 2012 was a transitional year for biodiversity-focused community forestry in Liberia. USAID/Liberia funded the U.S. Forest Service to implement an eight-month bridging activity, the Liberia Forestry Support Program (LFSP). LFSP continued LRCFP's work in northern Nimba County to assist communities, the Liberian Forestry Development Authority (FDA), and its partners to improve the management of three community forests and one nature reserve and the conservation of their biodiversity. LFSP also worked to increase existing and create new economic opportunities in and around the forest communities, with a particular focus on forest and agricultural-based livelihood opportunities.

In FY 2012, USAID Liberia launched a significant new community forestry initiative, the People, Rules and Organizations Supporting the Protection of Ecosystem Resources (PROSPER) Program (2012-2017), that builds on LRCFP and LFSP investments. PROSPER is intended to introduce, operationalize, and refine appropriate models for community management of forest resources for local self-governance and enterprise development in targeted areas of the country. The three primary objectives of the activity are to: 1) Expand educational and institutional capacity to improve environmental awareness, natural resource management, biodiversity conservation, and environmental compliance; 2) Improve

community-based forest management leading to more sustainable practices and reduced threats to biodiversity in target areas; and, 3) Enhance community-based livelihoods derived from sustainable forest-based and agriculture-based enterprises in target areas. PROSPER is working at national, landscape and community levels, including 10 sites in Nimba and Grand Bassa counties. The challenge going forward will not only be to sustain this effort but to also extrapolate the successes to other areas of the country where communities and the forests in which they live are still closely linked. Several Liberian NGOs are collaborating with PROSPER--in community forest management, livelihood, and education and outreach activities—including Development Education Network Liberia (DEN-L), Sustainable Development Institute (SDI), Save My Future Foundation (SAMFU) and the Society for the Conservation of Nature of Liberia (SCNL).

Another important Economic Growth component is agriculture, where programming has targeted the improvement of food security strategy, and increased economic growth through market-led agricultural development In FY 2012, USAID Liberia also began the five-year, $75 million Food and Enterprise Development (FED) project, working with the GOL to increase agriculture productivity, profitability and access within the rice, cassava, vegetable and goat value chains, to improve nutrition and strengthen food security. FED is focused on four priority counties (Grand Bassa, Bong, Nimba and Lofa) and two secondary counties (Margibi and Montserrado). FED is working with a range of partners (public and private) throughout these four value chains, to improve productivity, strengthen access to inputs and services, and create market linkages, with a particular focus on women and youth. The long term objectives of the FED program are to: (1) Increase agriculture productivity and profitability and improve human nutrition; (2) Stimulate private enterprise growth and investment in agriculture; and, (3) Build local technical and managerial human resources in agriculture and related industries.

Another relevant Economic Growth team project is the Road Infrastructure to Support Enterprise program, which aims to improve rural roads and to build capacity of Liberian road contractors. In addition, USAID Liberia is working through the Liberia Energy Sector Support program to advance national energy policy goals for rural, renewable power; support regulatory reform to spur private sector investment; and pilot projects in small hydro and biomass energy generation. Direct support is also provided to the international management contractor bringing new investment and improved operations to the Liberia Electricity Corporation. Liberia has recently been named as a focal country in the USG Power African initiative, though the effect of this announcement on programming remains to be determined.

With respect to the sustainable management of tropical forests and biodiversity, USAID/Liberia has a variety of relevant programming:

- The Democracy, Human Rights and Governance team is working through the Governance and Economic Management program to improve GOL financial management and policy implementation, to strengthen in-country training for GOL civil

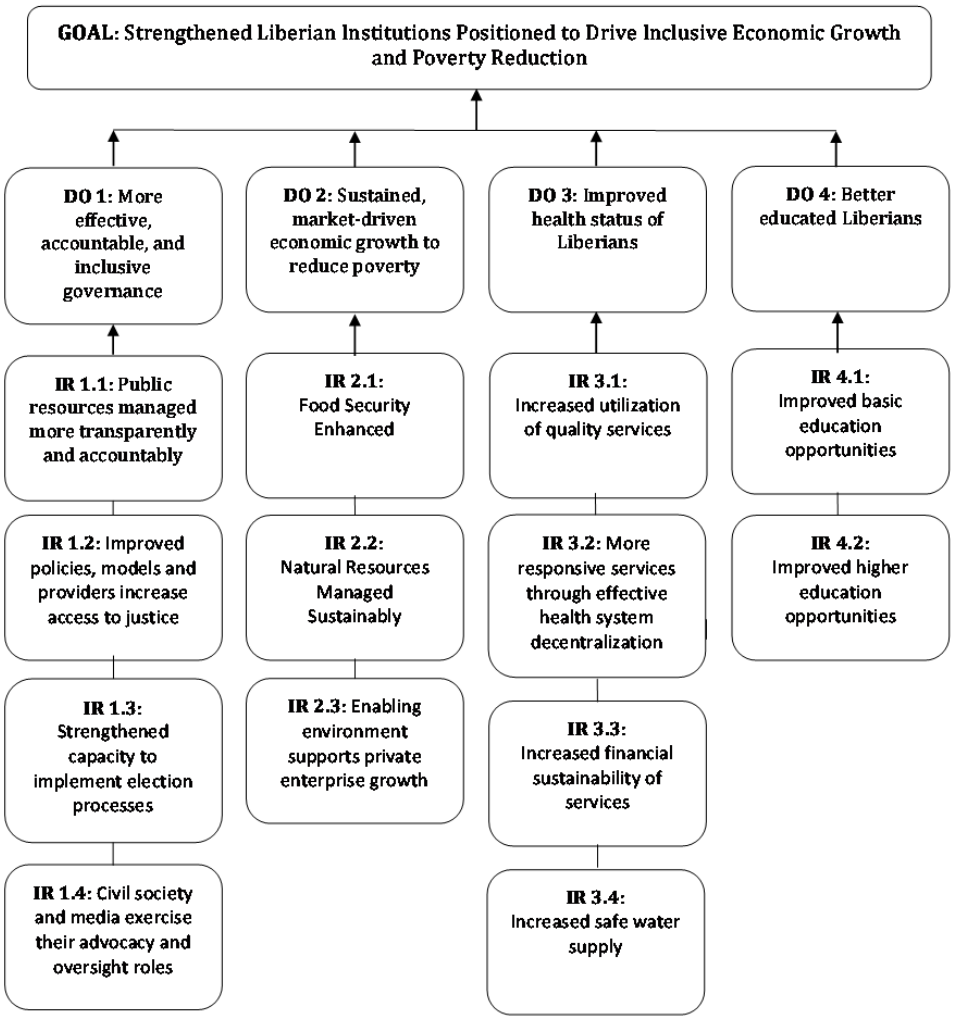
servants, and to reform concessions management. Other relevant efforts include the Land Conflict Resolution Program, and support to civil society and the media to increase civic participation in public affairs.

- The Health team is largely focused on controlling infectious diseases (e.g., malaria, HIV/AIDS) and decreasing maternal and child mortality, though some programming is directed toward establishing safe water and sanitation infrastructure. Water and sanitation projects include:
- The Liberia Municipal Water Project is supporting the design, execution and operation of water supply infrastructure improvements in three secondary cities, Robertsport, Sanniquellie, and Voinjama by assisting local and national authorities in developing plans for urban water supply and sanitation improvements, implementing short and medium-term water supply infrastructure improvements, and re-establishing local capability to sustainably operate and maintain the water supply improvements. At the conclusion of the four-year project in 2015, the goal is to have helped establish improved water supply access in each city, with infrastructure managed by locally based entities capable of financially and technically sustaining the service.
- The Improved Water, Sanitation and Hygiene Project focuses primarily on small-scale water supply, sanitation and hygiene improvements in rural communities, schools and health facilities, promoting hygiene behavior change and point-of-use drinking water treatment, increasing community knowledge and use of potable water supply and storage technologies, and promoting sanitation through community led total sanitation. Additionally, the project aims to improve enabling environments for water and sanitation at national, county, district, and community levels.
- The Education team is working with the GOL and other donors to rebuild its educational system at all levels, with support for curricula development, recruitment and training of teachers, instructional and learning resources, data systems, and policy reform.

New Country Development Cooperation Strategy (CDCS)

USAID Liberia has recently completed a new CDCS for the period 2013-2017 (Figure 1; USAID 2013a). The overall strategic goal by the end of the CDCS period is *Strengthened Liberian Institutions Positioned to Drive Inclusive Economic Growth and Poverty Reduction*. To help Liberia build these foundations, human and institutional capacity development (HICD) will be a core, cross-cutting strategic priority for the entire portfolio, including NRM-related objectives IR 1.1 and IR 2.2. USAID Liberia will continue to focus assistance in six highly populated counties that surround the country's key development corridors: Bong, Grand Bassa, Lofa, Margibi, Montserrado, and Nimba.

Figure 1. CDCS Results Framework for USAID Assistance to Liberia, 2013-2017.



Relevant USAID/West Africa programming

The Sustainable and Thriving Environments for West Africa Regional Development (STEWARD) program is a forest conservation and sustainable livelihoods program focusing on transboundary Priority Zones in the Upper Guinean Forest ecosystem. STEWARD is funded by the USAID/West Africa (WA) Regional Office, and is being implemented by the U.S. Forest Service Office of International Programs. STEWARD was conceptualized in 2005-2006 as USAID's regional program for conserving the biodiversity of the Upper Guinean Forest of West Africa, and is currently in its third phase (2011-2015).

STEWARD has three objectives: 1) Conserve biodiversity and improve rural livelihoods in critical transboundary landscapes in the Upper Guinean Forest Ecosystem; 2) Produce harmonized policies and legal frameworks for natural resource management in a regional context; and, 3) Contribute to sub-regional and national strategic plans on climate change in the Mano River Union states. STEWARD's site-based work focuses in Priority Zones that were identified based on their high biological significance; their transboundary locations; their potential for integrating conservation, livelihoods and NRM; and, because of their political, economic and social significance. These areas include Priority Zone 1: Sierra Leone (Outamba-Kilimi National Park), Guinea (Madina Oula, Soya and Ouré Kaba sub-prefectures); and,

Priority Zone 2: Guinea and Côte d'Ivoire (Mount Nimba), Liberia (Nimba Nature Reserve). An additional potential priority area is Priority Zone 3: Wonegizi Mountains (Liberia) and Ziama Biosphere Reserve (Guinea). STEWARD's Priority Zone 2 coincides with USAID/Liberia investments in the PROSPER program.

Country Profile

The Republic of Liberia is located at latitudes 4°21' N and 8°33' N of the equator and longitudes 11°28'W and 7°32'W. Liberia covers 111,369 km^2, and is located entirely within the humid Upper Guinean Forest Ecosystem in West Africa on the Atlantic Coast. Within its borders, 15,050 km^2 consist of water, and the remaining 96,319 km^2 are land. The perimeter of Liberia is 2,551 km, and it shares a border with three countries. Côte d'Ivoire is to the east with a shared border length of 598 km; Sierra Leone is to the west with a shared border of 370 km; and Guinea is to the north with a shared border of 540 km. Liberia is bordered to the south by the North Atlantic Ocean, with a coastline of 579 km from Cape Palmas at the southeastern border with Côte d'Ivoire heading northwest beyond Robertsport to the Mano River on the border with Sierra Leone. The area of Liberia's Exclusive Economic Zone (EEZ) is 229,700 km^2, extending 370.4 km (200 nautical mi) seaward from shore. The width of the continental shelf is generally limited by the 100 m isobath, being wider off central Liberia. The major sea ports are Monrovia in Montserrado County and Buchanan in Grand Bassa County.

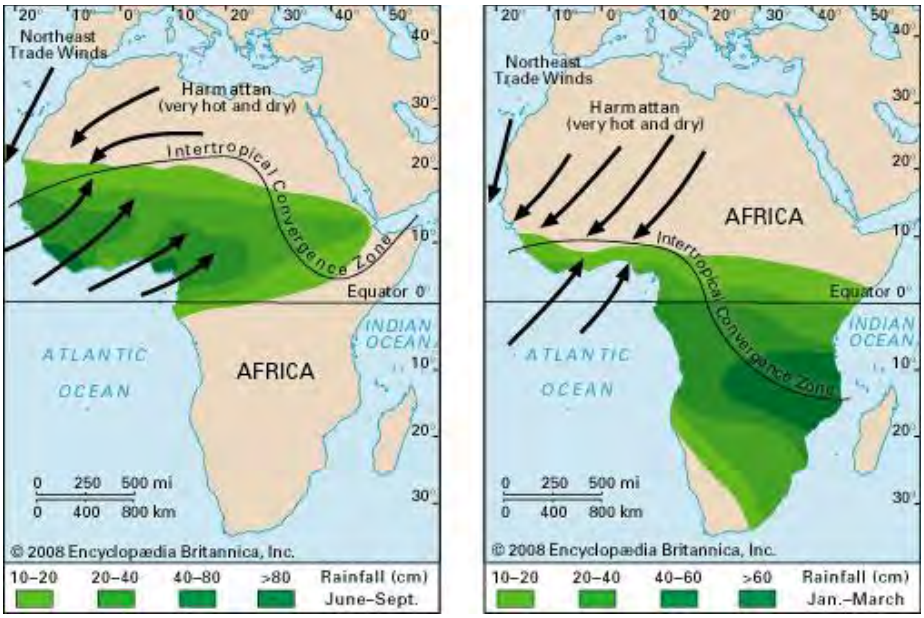
Biophysical context

Climate

Liberia's climate consists of two separate climate regimes: the equatorial climate regime restricted to the southernmost part of Liberia, where rainfall occurs throughout the year, and the tropical regime dominated by the interaction of the Inter-tropical convergence zone (ITCZ) and the West African Monsoon. Because of Liberia's coastal location, the southwesterly flow of the monsoon prevails most of the year, maintaining a thin layer of moist marine air near the surface, although the Harmattan Wind typically intrudes for brief periods during the winter in coastal areas. This interaction of the ITCZ with the monsoon flow produces the summer wet season-winter dry season characteristic of a tropical climate (Figure 2; Stanturf et al. 2013).

The tropical climate of Liberia is hot and humid throughout the year, with little variation in temperature (mean daytime temperatures: 27^0-32^0C; mean nighttime temperatures: 21^0-24^0C). There are two distinct seasons in Liberia, dry (November-May) and wet (May-October). Annual rainfall amounts are 4000-5000 mm along the coastal belt, declining to 1300 mm at the forest-savanna boundary in the north (Bongers et al. 1999). The seasonal variation in rainfall has a critical influence on the vegetation (Lawson 1996). Liberia exhibits a fairly high average relative humidity throughout most of the year ranging from above 80% along the coastal belt with lower humidity in the interior portion of the country. During the Harmattan season (December-March), the dust-laden winds blown in from the Sahara can reduce the relative humidity to 50% or lower.

Figure 2. Seasonal patterns of ITCZ and Monsoon Rainfall in West Africa. (Encyclopedia Brittanica)

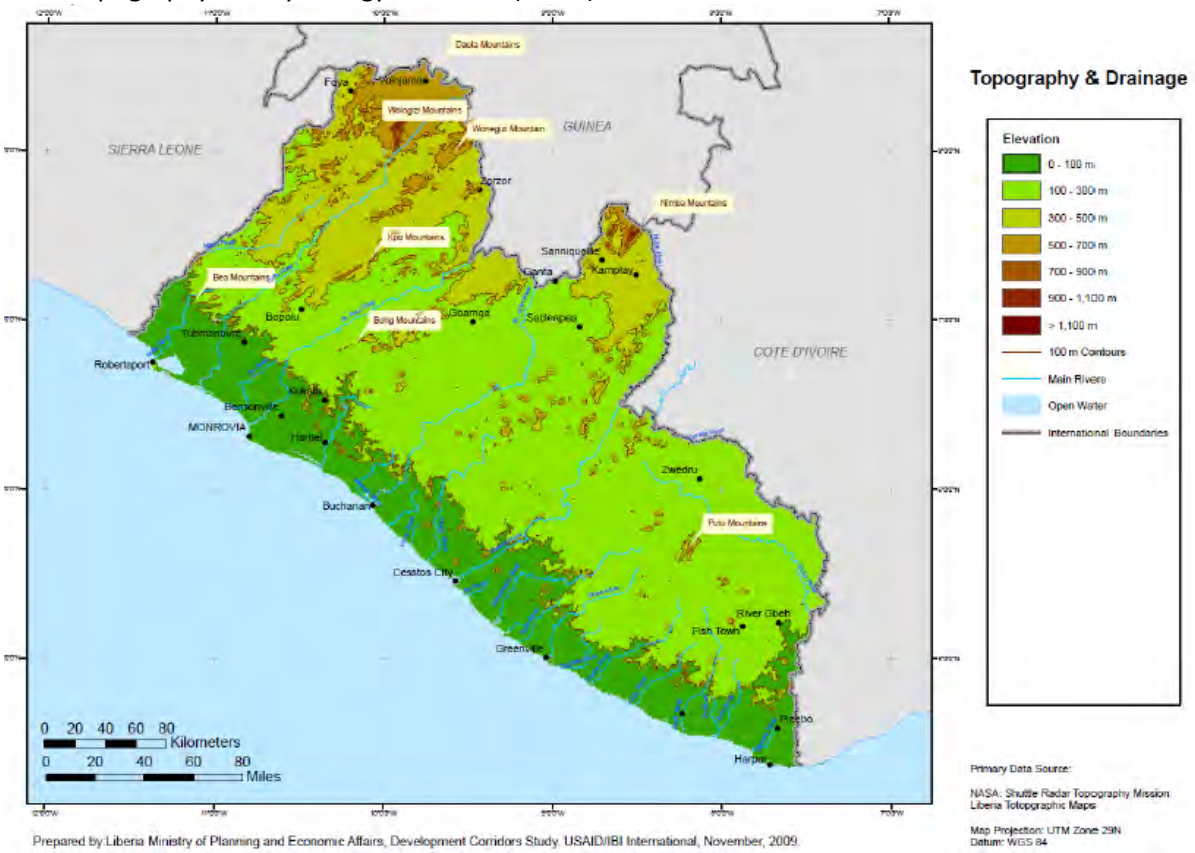


Physiography

Four physiographic regions, corresponding largely to increasing elevation, are apparent in Liberia, and roughly parallel to the coast (Figure 3; Gatter 1988):

- Coastal Plains— The Coastal Plain, lying at sea level to about 30 m in elevation (average elevation about 15 m above mean sea level) varies from 16-40 km in width. The Coastal Plain coast is about 560 km long and is formed by powerful pounding surf, with sand bars and long beaches that consist of a nearly unbroken sand strip, salt and freshwater lagoons, and a few promontories.
- Rolling Hills—The belt of Rolling Hills, lying at about 200-330 m elevation (average about 92 m), is parallel to the Coastal Plain and has numerous hills (e.g., Bomi Hills, Mount Barclay, Mount Gibi), valleys, and waterways. Rivers flow rapidly in this region over bedrock bottoms and have numerous rapids within their channels.
- Mountain Ranges and Plateaus—The Mountain Ranges and Plateaus lie behind the belt of Rolling Hills. Nearly half of the interior of Liberia lies between 200-330 m in elevation in this region. Major mountain ranges, consisting of long ridges aligned along a southwest-northeast axis, are the Mano River Mountain, Gibi Range, and Putu Range, whose summits reach 700 m. Summits in the Bong range reach 500 m in elevation. Other ranges include the Bea and Tienpo. The greatest width of this zone is about 128 km between the Lofa and St. Paul rivers in the northeast.
- Northern Highlands—Two disjunct areas form the Northern Highlands. The Wologizi Range is in northeastern Lofa County, which is variously reported as reaching 1335-1380 m in elevation at Mt. Wutivi, the highest point in Liberia (UNDP 2006). The other highland area is the Nimba Mountain range, in northeastern Nimba County, which reportedly reaches maximum heights of 1,305 or 1,385 m on the Liberian side of the border (Gatter 1988; EPA 2007); the range is shared by Côte d'Ivoire, Guinea, and Liberia.

Figure 3. Topography and hydrology of Liberia (NASA).



Soils

Liberia lies wholly within the Humid Agro-Ecological Zone that stretches from West to Central and East Africa. Rainfall throughout the zone exceeds a mean of 1,500 mm/yr and temperatures range between 24^0-28^0C with a growing period of more than 270 days. Dominant soils are Ferralsols and Acrisols (FAO classification; these are respectively, Oxisols and Ultisols in the USDA Soil Taxonomy). Large areas of Liberia (75% of the country) are Ferralsols (Deckers 1993) that are highly weathered soils with low fertility and low capacity to retain nutrients (low cation exchange capacity). They are suitable for surface farming techniques (traditional agriculture) and provide valuable materials for road construction. They are well-drained with good physical structure; their deep rooting depth makes up for their relatively low water-holding capacity (Van Wambeke 1974). Acrisols are less weathered than Ferralsols but still low in mineral nutrient reserves. The presence of a subsurface layer of clay accumulation may impede internal drainage and makes them more susceptible to erosion (Bationo et al. 2006). About 4% of Liberia is covered by Gleysols (Histosols) that are typical of swamps and areas in the floors of valleys waterlogged during the rainy season. These soils have high humus content and suitable for cultivation of swamp rice, with proper water management (Brandolini and Tigani 2006).

Hydrography

Freshwater bodies cover 15,050 km² (14%) of the total area of Liberia. These include rivers, lakes, lagoons, creeks and streams that drain to the Atlantic coast in a general northeast–southwest direction.

Rivers— There are six major rivers, the Mano, Lofa, St. Paul, St. John, Cestos and Cavalla (Cavally). Combined, these rivers drain approximately 66% of the country, with short coastal watercourses draining about 3% (UNEP, 2004). The Cavalla River is the longest river and is shared between Liberia and Côte d'Ivoire. The St. Paul River is the second longest river and provides the majority of the raw water for the capital city Monrovia. Waterfalls, rapids, rocks and sandbanks occur frequently in upstream sections of most rivers, inhibiting river traffic, and limiting navigation inland to distances of 30-40 km. During the rainy season there is often severe flooding in the coastal plains (UNICEF 2006)

Lakes—There are only two major lakes in Liberia: Lake Shepherd (7,284 ha) located in Maryland County; and, Lake Piso, which can be more accurately described as an open coastal lagoon, in Grand Cape Mount County. Both lakes are situated adjacent to the Atlantic Ocean.

Wetlands—Near the coast many kilometers of tidal riverbanks (3,092 km), rivulets (645 km), and smaller tributaries (>1,000 km) are (or were) covered with mangroves that can reach 30 m in height. An estimated 600,000 ha of freshwater wetlands (swamps) occur in Liberia with only about 3% (20,000 ha) under cultivation (DAI 2008). Little is known about the specific values of freshwater wetlands in Liberia, from their role in providing medicinal plants, and other products, to their role in providing ecosystem services such as water quality enhancement, flood control, and critical fisheries habitats. Similarly, little is also known about saltwater and brackish wetlands and their importance to artisanal as well as commercial marine fisheries.

Liberia is party to the Convention on Wetlands of International Importance, and has five designated Ramsar Wetland Sites covering a surface area of 95,879 ha (Table 1). Liberia has numerous brackish wetlands, three of which have been declared Ramsar sites (wetlands designated as internationally important under the Convention of Wetlands): Lake Piso; Marshall Wetlands; and, Mesurado Wetlands. Other identified coastal wetlands include the Bassa Bwa Lagoon and the mouths of the Mano, Lofa, St. Paul, St John, Cestos, Sehnkwehn and Cavalla rivers (Ramsar.Wetlands.org, 2013). Liberia does not support extensive freshwater wetlands because the terrain slopes fairly constantly from the high northern border to the sea. Two small freshwater wetlands have been designated as Ramsar sites: Gbedin Wetlands and Kpatawee Wetlands.

Table 1. Ramsar Wetland Sites in Liberia

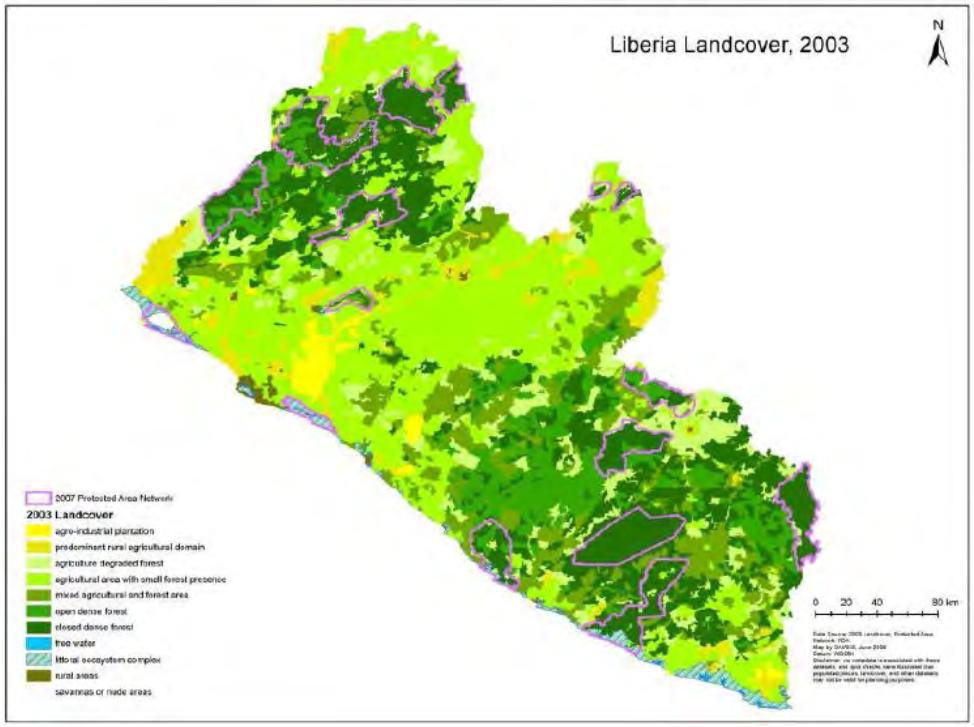
Site	County	Area (ha)	Management	Threats
Lake Piso	Grand Cape Mount	48,953	FDA/EPA	Unregulated fishing; sand mining; hunting; shifting cultivation
Gbedin Wetlands	Nimba	25	EPA	Conversion to rice farming; hunting; logging; mining; fertilizers, pesticides
Kpatawee Wetlands	Bong	835	EPA	Conversion to rice farming; potential hydropower development; hunting
Marshall Wetlands	Margibi	12,168	EPA	Mangrove harvest; dynamite fishing; pollution
Mesurado Wetlands	Montserrado	6,760	EPA	Fuel wood collection; pollution; unregulated fishing; intense pressure from nearby settlers

Coast—The coastline of Liberia is 579 km in length, extending from the western border with Sierra Leone to the eastern border with Côte d'Ivoire. Approximately 90% of the coastline consists of sandy beaches that vary from 20-25 meters wide at the narrowest, to 60-80 meters at the widest beaches along the southeastern extent. The coastline is punctuated with lagoons, estuaries, bays and brackish wetlands.

Land Cover and Vegetation

Liberia is situated within the Upper Guinean Forest that extends from Guinea at the northwestern extreme to the eastern limit in Cameroon. The Upper Guinean Forest is fragmented and Liberia is estimated to account for more than half of West Africa's remaining Upper Guinean tropical forest (Figure 4). The climax vegetation over most of Liberia is forest, which covers about 4.39 million hectares or 45 percent of Liberia's land area (FDA, 2006). The most recent forest classification (2006) included 2.42 million hectares of closed dense forest, 1.02 million hectares of open dense forest and 0.95 million hectares of agriculture/degraded forest (Table 2).

Figure 4. Liberian land cover in 2003, interpreted from satellite remote sensing (FDA)



There are three general types of forest (Cole 1968; Vooren and Sayer 1992; Mayers et al. 1992): (1) Evergreen or mixed evergreen/semi deciduous moist forests of western Liberia where there is a distinct dry season (under 100 mm rain/month); (2) Wet evergreen forests of eastern Liberia where the dry season is very short or absent; and, (3) Submontane (or montane) forests found in the highest hills in Liberia, above about 800-1000 m, although this zone is poorly-differentiated from the contiguous lowland forests. Swamp and riparian forests can be found embedded within the moist evergreen and semi-deciduous forests. An extensive zone of degraded forest occurs near the coast and extends inland in central Liberia, separating the moist and wet forest blocks. The degraded forest is mostly managed for shifting cultivation, and typically shows a mosaic of fields with scrubby and forested fallows. "Farm bush", the degraded secondary growth derived from forest that follows slash-and-burn agriculture, is

increasingly the most dominant vegetation type in this zone.

Table 2. Land cover condition (Bayol and Chevalier 2002)

Land Cover Class	Area (ha)	Total Land Area (%)
Closed dense forest	2,424,078	25.3%
Open dense forest	1,013,993	10.6%
Agriculture degraded forest	949,615	9.9%
Mixed agricultural and forest area	1,317,873	13.7%
Agricultural area with small forest presence	3,042,091	31.7%
Predominantly rural agriculture	436,747	4.6%
Agro-industrial plantations	178,294	1.9%
Savanna or bare soil	13,312	0.1%
Littoral ecosystem complex	161,390	1.7%
Open water	7,649	0.1%
Urban	46,047	0.5%

Human context

Political Context

Founded in 1847, Liberia is the oldest republic in Africa. Many years of minority rule and inequitable distribution of resources resulted in a civil conflict that lasted from 1989 to 2003. Following an interim transitional government, elections for a national government were successfully conducted in 2005, and the new government under President Ellen Johnson Sirleaf embarked on an ambitious program of policy reforms to spur reconstruction and recovery. The GOL moved quickly to stabilize the economy and put the country's finances on a firmer footing. Under sponsorship of a multi-donor initiative, effective controls were instituted on government finances and procurement, allowing the lifting of UN sanctions on timber in 2006 and restoring crucial foreign exchange revenues.

Major policy initiatives were undertaken, demonstrating high-level commitment to strengthening governance and the rule of law. The Sirleaf Administration signaled early on that it intended to put governance of the country's natural resources wealth on a new footing. It passed the National Forestry Reform Act in 2006 to strengthen oversight and regulation of the forestry sector and renegotiated all forestry contracts. It revised concession agreements in iron ore mining, rubber, and oil palm plantations. In 2008, it joined the Extractive Industries Transparency Initiative (EITI) to strengthen its systems ensuring transparency and accountability in managing revenues generated from natural resource-based activities.

Notwithstanding these accomplishments, the gains that have been made are fragile and much more remains to be done to consolidate and sustain them. While the GOL's policy commitments have sent important signals of responsible intent, actual implementation has been uneven and slow, and some reforms appear to have stalled. Judicial reform is moving slowly. Corruption persists and there is a low prosecution to conviction ratio. Reforms and delivery of public services are seriously hampered by severe staff shortages in government and low capacity across all sectors. In 2012, Liberia scored below the 40th percentile on the six elements of governance measured in the World Bank's Governance Indicators data sets; and, scored below the 20th percentile on the measures rule of law, government effectiveness and regulatory quality. On the 2012 Transparency International's Corruption Perceptions Index, Liberia ranks 75th out of 176 countries.

Liberia concluded a second round of national elections in 2011 which returned President Ellen Johnson Sirleaf to office for another six years.

Socioeconomic Context

The period of civil war was one of widespread destruction and great hardship. More than 200,000 Liberians died, and more than one million people were displaced to refugee camps in neighboring countries; families were shattered and entire communities were uprooted. Commercial and productive activities were disrupted as warlords looted and vandalized the country. People fled their farms, mining and rubber plantations closed, manufacturing shut down, and services ground to a halt. Basic infrastructure, including roads, water and electricity supply, schools, health clinics, was destroyed. Social, political, and economic governance systems at all levels dissolved as government functions were disrupted and skilled individuals left the country. Gross Domestic Product (GDP) fell by 90 percent between 1987 and 1995, the most massive economic collapse recorded anywhere since WWII.

The total population in Liberia is estimated at 3,989,703—with 44% under the age of 15—in a country the size of Tennessee. One-third of the population lives in the capital of Monrovia and surrounding Montserrado County. Liberia harbors a number of refugees, most of whom fled conflict in Côte d'Ivoire; the current estimate as of December 1, 2013 is more than 54,000 refugees (UNHCR 2013). Both annual population growth rates (2.6%) and annual urban growth rates (3.4%) are high (CIA 2013). The division between urban and rural is substantial, with those who live in Monrovia commanding much greater access to basic services than do those who live in the rural areas.

By any measure, Liberia is one of the poorest and least developed countries in the world, and among sub-Saharan African countries (Table 3). Liberia's 2013 Human Development Index score places it 174th out of 186 countries. According to GOL figures, nearly 64% of Liberians, or 2.5 million people, live below the poverty line, and 48% live in extreme poverty (Republic of Liberia 2008a). The 2013 Liberia Comprehensive Food Security and Nutrition Survey estimates that more than one in three Liberian households has an "unacceptable" food consumption pattern, i.e. one that cannot sustain an active and healthy life (World Food Program 2013). Other health indicators are also poor: average life expectancy at birth is 58 years (2013); infant mortality is 70 deaths per 1,000 live births (2013); and, maternal mortality rate is 770 deaths per 100,000 live births (2010). HIV prevalence among adults aged 15-49 years is 1.5% (2009). Adult literacy rates average 61% (2010). Poverty and underdevelopment are not the only challenges. Liberia emerged from its protracted civil war as a deeply divided country, its social fabric torn by ethnicity, religion, geography, and history. There are 16 ethnic groups, and Christianity (85%), Islam (12%), and indigenous religions (3%) are practiced.

Table 3. Economic and related development indicators for Liberia (CIA World Factbook).

Indicator	Value
GDP, PPP, 2012	$2.72B
GDP, PPP per capita, 2012	$700
GDP annual growth rate, 2012	8.3%
Electricity from fossil fuels, 2009	100%
Electricity from hydropower, 2009	0%
CO_2 emissions (Mt), 2010	738,600
Urban access – improved sanitation, 2010	29%
Rural access – improved sanitation, 2010	7%
Urban access – improved water, 2010	88%
Rural access – improved water, 2010	60%
Total railways, km, 2008	429
Total roads, km, 2000	10,600
Paved roads, km, 2000	657

Since the end of civil conflict, the GOL has been rehabilitating the badly damaged road network, electricity connections, and water supply, and rebuilt and reopened schools and health clinics all over the country. Access to clean water and sanitation facilities, and a functional transportation network, remain challenges. Peace, improved security and responsible macroeconomic management have combined to fuel an upturn in the economy, and annual growth rates averaged over 6% from 2006 to 2010. Agricultural production has resumed, and includes rubber, coffee, cocoa, rice, cassava, palm oil, sugarcane, and bananas. Of those employed, 68 percent work in the informal sector; rates of informal employment are much higher in rural than urban areas, and much higher for females than males. Half the total working population is employed in the agricultural sector, including forestry and fishing, and a quarter is employed in wholesale/retail trade. The next largest sectors are manufacturing and education. Over 70 percent of the rural working population is involved in agriculture, but even in urban areas 15 percent of workers are engaged in agriculture (GOL Liberia Labor Force Survey 2010).

Liberia has substantial renewable and non-renewable natural resources, including iron ore, gold, diamonds, timber, rubber, palm oil and cocoa. Iron ore reserves estimated at over 3.4 billion metric tons are hugely valuable given rising prices and resurgent steel production. In addition, the country recently granted several offshore oil exploration licenses. Forest resources, which brought in over 80% of Liberia's foreign exchange earnings before the war, represent not only direct income but also indirect benefits in the form of biodiversity and ecosystem services. Rising commodity prices have made these natural resources ever more valuable assets. If sustainably managed, these resources offer the prospect of reliable foreign exchange earnings in the future.

Legal Instruments

International Agreements

Liberia is signatory to numerous international treaties and protocols related to natural resource management:

- African Convention on the Conservation of Natural Resources
- Biosafety Protocol
- Convention on Biological Diversity (CBD)

- Cartagena Protocol on Biosafety
- UN Framework Convention on Climate Change (UNFCCC)
- Ramsar Convention on Wetlands of International Importance
- Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES)
- Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region
- Forest Law Enforcement, Governance and Trade (FLEGT) Voluntary Partnership Agreement (VPA) with the European Union
- Convention to Combat Desertification
- Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal
- Convention on the Conservation of Migratory Species of Wild Animals
- Convention on the ban of the Import into Africa and the Control of Trans boundary Movements and Management of Hazardous Wastes within Africa
- FAO International Undertaking on Plant Genetic Resources
- International Convention for the Prevention of Pollution from Ships
- International Convention for the Prevention of Pollution of the Sea by Oil (Members of International Maritime Organizations)
- International Treaty on Plant Genetic Resources for Food and Agriculture
- International Tropical Timber Agreement
- Kimberley Process Certification System
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- Stockholm Convention Stockholm Convention on Persistent Organic Pollutants
- United Nations Convention on the Law of the Sea

National Legislative and Policy Framework

Constitution

The current Constitution of Liberia came into force in 1986, and results in a system of government heavily modeled on the federal government of the United States. The Constitution is largely silent on the issue of natural resources and sustainable development. However, Article seven of the Constitution states: "The Republic shall, consistent with the principles of individual freedom and social justice enshrined in this Constitution, manage the national economy and the natural resources of Liberia in such manner as shall ensure the maximum feasible participation of Liberian citizens under conditions of equality as to advance the general welfare of the Liberian people and the economic development of Liberia."

Additional language relates to land and property rights:

- "All persons are born equally free and independent and have certain natural, inherent and inalienable rights, among which are the right of enjoying and defending life and

liberty, of pursuing and maintaining the security of the person and of acquiring, possessing and protecting property, subject to such qualifications as provided for in this Constitution." (Article 11)

- "Every person shall have the right to own property alone as well as in association with others; provided that only Liberian citizens shall have the right to own real property within the Republic." (Article 22)
- "Private property rights, however, shall not extend to any mineral resources nor beneath any land or to any lands under the seas and waterways of the Republic. All mineral resources in and under the seas and other waterways shall belong to the Republic and be used by and for the entire Republic." (Article 22)

Relevant Laws and Policies

Environmental Policy

- National Environment Policy of Liberia (2002) sets the policy framework for environmental management in Liberia. The policy goal is "to ensure long-term economic prosperity of Liberia through sustainable social and economic development, which enhances environmental quality and resource productivity on a long-term basis that meets the requirements of the present generation without endangering the potential of future generations to meet their own needs".
- Environmental Protection & Management Law (2002) is the principal piece of legislation covering environmental protection and management in Liberia, forming parallel legislation to the EPA Act. It provides the legal framework for the sustainable development, management and protection of the environment by the EPA in partnership with relevant ministries, autonomous agencies and organizations. It also stresses inter-sectoral coordination while allowing for sector specific statutes.
- Environmental Protection Agency (EPA) Act (2003) established the institutional framework (including the creation of the EPA) for monitoring, coordinating and supervisory authority for the sustainable management of the environment in partnership with regulated Ministries and organizations and in a close and responsive relationship with the people of Liberia; and to provide high quality information and advice on the state of the environment and for matters connected therewith.

Land

- Liberia Land Commission Act (2008) authorized the creation of the autonomous Land Commission in 2009 to propose, advocate and coordinate reforms of land policy, laws and programs in Liberia. The initial tenure of the Land Commission is five years.
- Land Rights Policy (2013); The Policy provides the Land Commission's policy recommendations for land rights in Liberia, centered on four basic types of rights: (1) Public Lands – lands designated for future use; managed in the public interest; and which is not Government Land, owned by a community and used or managed in accordance with customary practices and norms, or owned as Private Land. (2)

Government Lands - land owned by the Government and used for the buildings, projects, or activities of the Government, including, but not limited to, lands on which are located: the offices of ministries, agencies, and parastatal bodies; military bases; roads; public schools and public universities; public hospitals and public clinics; public libraries and public museums; public utilities; and airports. (3) Customary Lands – land owned by a community and used or managed in accordance with customary practices and norms, and may include, but is not limited to: wetlands, communal forestlands, and fallow lands. Customary Land rights, including the rights of ownership, use or management, are equally protected as Private Land rights, whether or not the community has self-identified, established a legal entity, or been issued a deed. (4) Private Lands - land owned by an individual or private entity, in which management and use decisions are based solely on formal law (i.e. statutes, regulations, executive orders, and court decisions), where the owner enjoys the full bundle of land rights, which include, but are not limited to, the right to: exclude all others, use and possession, own natural resources on the land (e.g. forest), and to transfer all or some of the rights through sale, lease, concession, gift, donation, will, or any other lawful means. In accordance with the Constitution, the Governments owns mineral resources "on or beneath" Private Land (e.g. gold, diamonds, oil, iron ore). In addition, a Protected Area is land which may fall under the Government Land, Customary Land, or Private Land categories but which must be conserved for the benefit of all Liberians.

Transparency

- The Liberia Extractive Industries Transparency Initiative (LEITI) Act was passed in 2009, to establish a secretariat and steering committee for Liberia to enter the EITI process. Liberia became the first African country to be fully EITI compliant, and the first anywhere to go beyond the minerals and energy sectors to include forestry and agriculture under the EITI. LEITI focuses on improving transparency and promoting sustainable use of revenues generated from natural resources. Under this process, all revenues paid by operators and received by government are routinely published and reconciled. All concession agreements are also made available at LEITI office and online. In addition, LEITI is currently carrying out an audit of the processes to allocate/award concession agreements to ensure that these processes are in full compliance with Liberian legislation.
- Public Procurement and Concessions Act (2005) regulates all forms of public procurement and concessions (including forest concessions), establishes the Public Procurement and Concessions Commission, provides for institutional structures for public procurement and concessions, and stipulates methods and procedures for public procurement and concessions.

Forestry

- Act Creating the Forestry Development Authority (FDA) (1976) authorized the creation of the FDA by the Legislature in 1976, and was amended in 1988 and 2006.
- National Forestry Reform Law (2006) provides comprehensive reforms for the Liberian forestry sector, with specific reference to commercial, conservation and community forestry.
- National forestry policy and implementation strategy (2006) describes the main directions for forestry development in Liberia over the coming years and updates earlier policies to take into account the national forestry law of 2006.
- FDA Ten Core Regulations (2007) were essential to resuming commercial logging in Liberia. The 10 regulations are as follows: Public Participation; Forest Land Use Planning; Pre-qualification; Tender, Award and Administration; Pre-Felling Operations; Benefits Sharing; Forest Fees; Chain of Custody; Penalties; and, Rights of Private Land Holder.
- Guidelines for Forest Management Planning in Liberia (2007) provide instructions to help foresters and logging companies prepare the forest management plans required under the Forest Management Contracts (FMC), Timber Sales Contracts (TSC), or other FDA commercial contracts, including commercial logging in community forests.
- National Forest Management Strategy (2007) summarizes the FDA philosophy for managing the national forest endowment.
- Code of Forest Harvesting Practices (2007) provides guidelines to help foresters and logging companies select practices to be followed when carrying out harvesting operations under FMCs and TSCs.
- Regulation on the Commercial and Sustainable Extraction of Non-Timber Forest Products, FDA Regulation No. 111-08 (2009)
- Act to Establish the Community Rights Law with respect to Forest Lands (2009) aims to empower communities to fully engage in the sustainable management of the forests of Liberia by creating a legal framework that defines and supports community rights and responsibilities in the management and use of forest resources. This law is the major piece of legislation governing community forestry and various activities are envisaged, including the possibility for commercial activity and conservation of forested areas. Two key aspects, which are currently unclear in the legal framework, are expected to be clarified by the Land Commission: (1) there is currently no clear definition of what is classified as a "community", whether there are particular characteristics or how the extent of the community should be defined; and, (2) the process for identification and recognition of customary ownership, in order to establish an identified area of community forest, is ascribed to the FDA and is unclear. FDA is presumably expected to work with the Land Commission and the Ministry of Lands, Mines and Energy (MLME) to develop a policy and operating procedures for the establishment of customary ownership. The Community Rights Law sets out in some detail the governance structures to be established to oversee community forestry, though some regard the procedures for establishing community forest areas as overly complex and expensive. There is need for considerable capacity building at the community level to understand

the various provisions, and ensure that communities are aware of their rights and responsibilities. The USAID/PROSPER project has developed a publication to increase public awareness of this law and the implementing regulations to support informed decisions regarding the management of community forests and forest resources. The various aspects of the framework governing community forestry can create confusion. The Community Rights Law specifically states that, in cases of conflict between the provisions of the Community Rights Law and the National Forestry Reform Law, the Community Rights Law shall take precedence. However there are provisions in legislation relating both to the forestry sector, and land ownership, which may conflict with the provisions of the Community Rights Law (e.g., bidding requirements for small-medium scale commercial logging; community revenue entitlements).

- Regulations to the Community Rights Law with Respect to Forest Lands (2011)
- Chain Saw Milling Regulation, FDA Regulation No. 115-11 (2012)
- There is currently no legal framework to cover accounting or trade of carbon credits.

Protected Areas

- Protected Forest Area Network Law (2003) expanded the existing area of Sapo National Park (via Sapo National Park Act), established the East Nimba Nature Reserve (Nimba Nature Reserve Act), and identified nine other sites to be considered for protected area status, including a range of options offering varying degrees of restriction on permitted activities. The 2006 forestry reform law establishes 30% (1.5 million ha) of the forest area to be protected as conservation areas. Currently less than 5% is under protection.

Wildlife

- Wildlife and National Parks Act (1988) covers the policies and objectives, the administration, and the establishment of protected areas, as well as their management including plans, and prohibited acts; controls on hunting (including areas, seasons, methods); and the establishment of protected species. The Act also specifies a list of fauna species that are totally protected. This has been updated by the Draft Hunting Regulations.
- The FDA has drafted a comprehensive Conservation and Wildlife Management Law which is reported by interviewees to have been forwarded to the President. Under this draft law protected area network creation process has been expanded to reference community rights and participation.

Fisheries and Aquaculture

- National Fisheries Regulations (2010) address the following issues for the marine fisheries sector: fisheries conservation and management; requirements for fishing and operating fishing vessels; licensing and authorizations; conditions and requirements for

fishing, transshipment and the use of ports; information, records, returns and registers; monitoring, control, surveillance and compliance; and, offenses and penalties and repeal of regulations.

- The Bureau of National Fisheries (BNF) has indicated that they are drafting an aquaculture development policy and implementation strategy.

Water

- National Integrated Water Resources Management Policy (2007) covers two broad areas: (1) Water resources management: Covering the management framework including policy objectives, principles and strategies for the monitoring, assessment, allocation and protection of the resources and management framework. (2) Water resources use: Covering the policy objectives, principles and strategies for the development and use of water for domestic water supply, water for agriculture, water for industry and other water uses such as hydropower, recreation and water for maintenance of productive ecosystems.

Mining

- New Minerals and Mining Law (2000) addresses mineral ownership, administration, eligibility for rights regarding exploration, mine and quarry operation, environmental protection, common licensing provisions, protected zones, occupant and owner rights, public use of mining infrastructure, environmental considerations, trade, inspections, fiscal and other provisions.
- National Mineral Policy (2010) provides a framework for the sustainable management of the country's mineral resources and to guide interventions by government institutions as well as other stakeholders. It sets out the expectations for the sector to contribute not only to the revitalization of Liberia's economy but more broadly to social regeneration and the enhancement of a democratic culture
- The Ministry of Lands, Mines and Energy (MLME) is developing a Sand Mining Policy.

Petroleum

- The Petroleum Law (2002) is currently under revision to better incorporate the emerging oil and gas sector; drafts are with the Liberian Legislature for approval.
- National Petroleum Policy (2012) aims to manage Liberia's petroleum resources in an environmentally responsible manner, to optimize returns for Liberia and ensure equitable benefits to the people of Liberia now and in the future. Provisions address the following themes: resource ownership and boundaries; legal framework and institutional oversight; good governance, transparency, and accountability; licensing and contracting; work program and operations; state participation and fiscal regime; revenue management; local content; and, health, safety, environmental and social impacts.

Agriculture

- The National Rice Development Strategy of Liberia (Republic of Liberia 2012a) aims to improve food security and achieve self-sufficiency through the doubling domestic rice production by 2018. Rice is a staple cereal crop in Liberia with great social and political significance. Demand far exceeds local production, however, which requires high imports and affects the country's trade balance and foreign exchange. The components of this strategy include: land and water management (including "drainage infrastructures for swamps"; increased availability and accessibility of smallholders to farm inputs such as fertilizers; enhancing post-harvest quality improvements; increasing market access; institutional capacity building; and, mechanization.

Institutional Framework

Liberia

Independent Agencies

Forestry Development Authority (FDA)

The FDA was created by an Act of the Legislature in 1976, which was subsequently amended in 2006 with the adoption of the Forestry Reform Law. The FDA provides forestry planning, develops forestry policy, administers and enforces the forestry laws, administers concession agreements, calculates forestry fees, carries out reforestation and forest research and training, monitors the activities of timber companies, and sets up and administers national parks. The "3 Cs" approach—Commercial, Community, Conservation—emerged during the forestry sector reform process that began in 2004, and aims to ensure a balance of different approaches and use of forest resources. The current organizational structure of the FDA consists of an Administrative Department and four Technical Departments:

- Forest Conservation Department. This department is responsible for conserving the biodiversity of Liberia's forest ecosystems, and ensuring their ability to provide a wide range of goods and services for the Liberian people in a sustainable manner. The Department is headed by a Technical Manager, and has three divisions - Wildlife Management, Protected Areas Management and Awareness, and Ecotourism. Primary tasks include: to manage existing protected areas in accordance with the National Forest Reform Law of 2006; to conduct social and biological surveys of proposed protected areas; to develop and implement income generation activities in rural communities around protected areas; to develop a new Wildlife Management Law and raise awareness throughout Liberia on extraction of all protected wildlife species in Liberia; to ensure conservation at the landscape scale of biodiversity and maintain ecological services as consistent with the 3 C philosophy; to develop collaborative agreements with neighboring countries to establish trans-boundary conservation areas; and, to augment protected area management plan framework for trans-boundary areas including goals, roles and responsibilities cooperation.
- Commercial Forestry Department, which is structured into three divisions: Contracts Administration; Chain of Custody; and Environmental Impact Assessment. The FDA uses

a system of forest management that allows the private sector to manage the extraction of timber (e.g., as forest concessions) in return for payment of royalties, fees and taxes. Commercial forest management is carried out through the use of a Forest Resources License, which includes the four legal instruments:

- Forest Management Contracts (FMCs) are restricted to Public Lands, must be awarded on the basis of competitive bidding, and are typically valid for up to 25 years. FMCs apply to concession areas of at least 50,000-400,000 hectares, primarily for large-scale, export-oriented logging. In addition to forest management planning document, a business plan, an environmental impact assessment and a social agreement with local forest-dependent communities is required. New FMCs become effective with the signature of the President of Liberia and ratification by the Legislature. There are currently seven active FMC concessions in Liberia encompassing an area of 1,008,179 ha (LEITI Database, 2013).
- Timber Sale Contracts (TSCs) are restricted to Public Lands, must be awarded on the basis of competitive bidding, is valid for a three-year term, and are limited to areas of 5,000 hectares or less. TSCs do not require a forest management plan, but the operator must file annual operation plans, and comply with all environmental and forestry laws. TSCs can be awarded for the purpose of allowing forestland to be cleared for agriculture or for establishment of plantations. There are currently eight active TSCs in Liberia totaling more than 39,000 ha (LEITI Database, 2013).
- Forest Use Permits (FUPs) may apply to public or private land, and are not for commercial timber extraction. Activities permitted under a FUP are limited to: charcoal, tourism, research and education, harvesting of Non Timber Forest Products (NTFPs), and timber extraction for local community use. The size and duration of the permits vary with the number of users; for exclusive use of a particular resource to the permit holder, the size cannot exceed 1000 ha and the term is limited to two years, while general permits for multiple users may be issued with longer duration and broader scope.
- Private Use Permits (PUP) allow private landowners to utilize commercially viable forest assets located on their property. In August 2012, President Johnson Sirleaf established a Special Independent Investigating Body to investigate allegations related to the issuance of PUPs to commercial logging companies (Republic of Liberia 2012b). The report found that contrary to the original intent, PUP issuance had become a mechanism for communities distributed in sections, clans, chiefdoms and districts across the country to engage in commercial forestry in violation of the law. From 2010 to 2011, 63 PUPs were issued by FDA covering approximately 2.5 million hectares (Republic of Liberia 2012b). In August 2012, President Johnson Sirleaf ordered a halt to PUP logging operations and exports (Executive Order No. 44) and suspended staff at the FDA and the MLME; there are currently no active PUP concessions in Liberia.
- All operators who obtain a forest resource license are subject to annual compliance audits and they must provide timely information, under Section 18.13 of the Forestry Law. In theory, each year the FDA publishes, under Section 3.4(b): 1) the volume

available for harvest for each contract; 2) the volumes and monetary values of the harvested, processed, and exported forest products by species; 3) the fees and taxes assessed and paid; 4) nature and monetary value of benefits provided to each community and; 5) violations and penalties assessed and actually paid. At the time of writing these documents were not available for reference.

- Community Forestry Department. This department is charged with the responsibility of encouraging "the *governance and management of forest resources in designated areas by communities for commercial and non-commercial purposes to further their livelihoods and development"* (2006 National Forestry Reform Law). Divisions include Community Forestry Extension Services and Mobilization, Community Empowerment and Community Forestry Resource Planning. The Department's major tasks include: Identifying, profiling and gazetting of community-based forest resources; allocating community forest areas on the basis of land-use planning; preparing management plans for the community forests; designing and delivering extension services to community forest users groups; monitoring and evaluating the performance of community-based forest resource management projects; designing appropriate public awareness programs for community-based forest management programs; and, providing assistance to communities for poverty reduction through alternative livelihood activities. There are currently 10 community forest agreements with more than 40 pending applications. A Community Forestry Agreement is a written agreement between a forest community and the Forest Development Authority that establishes a forest community within a specified area to access, use, manage, protect and benefit from forest resources in a sustainable manner.
- Research and Development Department. The main objective of this department is to conduct forestry research both in the primary and secondary forest. The department includes several divisions: GIS and Remote Sensing; National Reforestation; Statistics and Database Management; and, Social, Economic and Forest Research. The Department is responsible for: carrying out feasibility study in proposed protected areas, forest concession areas and in rural communities living around the fringes of the forest; formulating project proposals to develop the sector, and review ongoing projects to determine their status and recommend to management for corrective actions; conducting socioeconomic surveys for all Timber Sale Contract and Forest Management Contract and identify needs of communities in that area; establishing and maintaining a database for timber and non-timber forest products; assessing all afforestation and reforestation plantations in the country including the identification of degraded sites for afforestation and reforestation activities; and, providing geographic and remote sensing information through the production of maps using available satellite imagery.

Environmental Protection Agency (EPA)[1]

[1] EPA: http://www.epaonline.org/

The EPA was authorized by the EPA Act in 2003, but did not become functional until late in 2006, with a board of directors and Policy Council. EPA is charged with implementing the Environment Protection and Management Law, a framework environmental law that envisions the development and harmonization of sector-specific laws. EPA serves as the principal authority for managing and regulating environmental quality (including environmental and social impact assessments), and it is directed to coordinate all activities relating to environmental protection and the sustainable use of natural resources. It also promotes environmental awareness and oversees the implementation of international conventions related to the environment. EPA departments include: Administration; Finance; Planning; Compliance & Enforcement; and, Intersectoral Coordination.

Land use planning is the joint responsibility of the EPA and line ministries, under the terms of the Environmental Protection and Management Law. On this basis, the EPA should be well positioned to facilitate land use planning between sectors as well as within the specific area of interest of each line ministry. The responsibility for ensuring sustainable use of forest resources is attributed both to the FDA and the EPA. These agencies are also expected to collaborate to ensure effective land use planning and implementation of management strategies to integrate competing demands and ensure sustainable use of resources. A Memorandum of Understanding (MOU) was signed in 2007 in which both agencies agreed to collaborate on overlapping or complementary duties and obligations. However it is not clear how the MOU is expected to be operationalized. The FDA has greater presence outside of Monrovia, including a larger fleet of vehicles for travelling to forested areas. In addition, the EPA plays a key regulatory role in sustainable forest management, while the FDA has a potential conflict of interest because of its role in facilitating commercial forestry and forest revenue generation.

Liberia Extractive Industries Transparency Initiative (LEITI)[2]

The LEITI Secretariat was established by GOL law in 2009, and has oversight responsibilities for reporting revenues from extractive industries. Unlike EITI initiatives in other countries, LEITI also monitors revenues from agriculture and forestry, in addition to mining and energy.

Liberia Institute of Statistics and Geo-Information Services (LISGIS)[3]

LISGIS was established in July 2004 with the passing of the National Statistics and Geo-Information Act, and was created from the Department of Statistics in the Ministry of Planning and Economic Affairs. LISGIS is responsible for compilation, analysis, publication and dissemination of all data (including geos-spatial information) from individuals, as well as GOL Agencies, NGOs, and universities in the country.

Land Commission and potential new "Land Agency" or "Land Ministry"

The Land Commission was established in 2009, with a five-year mandate, to set policy for customary ownership and tenure security, improved land-administration and development of land resources. Strategic objectives include: 1) equitable and productive access to land, especially for marginalized groups; 2) land tenure security, including on customary lands, and the rule of law in land dealings and dispute resolution; 3) effective land administration and management; and 4) promotion of investment in

[2] LEITI: http://www.leiti.org.lr/
[3] LISGIS: http://www.tlcafrica.com/lisgis/lisgis.htm

and development of land resources. In a 2013 speech, President Sirleaf proposed to form a "Land Agency" or "Land Ministry" that would strip away the responsibility of managing land from the MLME and combine it with other land-related functions into another agency. At present, the President and other GOL parties have not decided how that body will be established or structured, including: (1) Which land tenure mechanisms should be located at that agency (e.g., deeds, cadastre, land dispute resolution)? (2) Which mechanisms should remain with existing ministries and institutions (e.g., MLME, FDA, MOA, NOCAL, MIA)? (3) What type of resistance to the shifting of resources and authority is likely to occur and what type of interventions will help overcome that resistance?

National Bureau of Concessions (NBC)
The NBC was established in 2011, and is responsible for monitoring the performance of the source of the GOL primary revenue base, including natural resource concessions.

Relevant Ministries, Institutes, Corporations

Ministry of Agriculture (MOA)[4]
The MOA—established in 1972—plans, administers, and supervises agricultural programs and provides extension services. It also trains local farmers in improved agricultural practices and provides farm inputs to increase food security. The Ministry conducts inspections and enforces rules and regulations governing the agriculture sector, including compliance with Liberian environmental standards and legislation by agricultural concessions companies (e.g., rubber, oil palm). The Ministry also implements agricultural programs, protects farming interests, encourages investment in the agricultural sector, and monitors overall activities including the movement of agricultural commodities into and out of the country. The Ministry also regulates the harvesting of botanical species by herbalists and other farmers as a part of shifting cultivation practices. The MOA includes four departments: Administration; Planning and Development; Technical Services; and, Research and Extension. The Quarantine Service within the Technical Service department is charged with oversight, is weak of invasive species.

> *Bureau of National Fisheries (BNF)*[5]
> The BNF is housed within the MOA to regulate fishing activities in the Liberian waters. The BNF has three divisions (Marine, Research and Statistics, and Aquaculture) that are closely aided by an administrative section. The BNF is charged with the responsibility of managing and developing fisheries and aquaculture in Liberia. The role of the BNF is to implement fisheries policy; formulate guidelines, rules and regulations to govern national fisheries and aquaculture for its planning, development and management. More specifically the BNF promotes the sustainable development of the fisheries sector in Liberia, balancing the needs of ecosystem health, food security, economic growth and social development within a framework of good governance. Combatting illegal, unreported and unregulated (IUU) fishing at the national, regional and international levels is a priority for Liberia. BNF collaborative efforts include work with NGOs to conduct outreach and education; mangrove conservation management with the EPA; producing maps with LISGIS; and, coordinating enforcement efforts with the LCG and UNMIL.
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> *Central Agricultural Research Institute (CARI)*
> CARI is an agricultural research facility that is slowly recovering from the civil conflict. CARI was

[4] MOA: http://www.moa.gov.lr/
[5] BNF: http://www.liberiafisheries.net/

amongst the GOL institutions hardest hit by the protracted civil conflict, because it served as the base for three successive warring factions, then was home to over 10,000 displaced persons for five years, and finally became an UNMIL sector base. Current emphases include rice, cassava, and yam improvement; maize, fruits and vegetable screening and evaluation; animal husbandry; and, aquaculture.

Ministry of Lands, Mines and Energy (MLME)[6]
Established in 1972, the MLME maintains jurisdiction over the management and extraction of mineral, water, and energy resources in Liberia. The Ministry of Lands, Mines and Energy includes the following departments: (1) The Department of Lands, Surveys and Cartography, including the Liberian Cartographic Service and the Bureau of Lands and Surveys; (2) The Department of Mineral Exploration and Research, which consists of the Liberian Geological Survey and the Liberian Hydrological Service; (3) The Department of Mines and Mineral Resources Development and Conservation, which consists of the Bureau of Mines and Bureau of Economic Forecast and Mining Concession Appraisal; (4) The Department of Energy, which consists of the Bureau of Hydrocarbons and the Bureau of Energy Technology and Policy Development; (5) The Department of Planning and Development; (6) The Inspectorate Division; and, (7) The Department of Administration. There are currently 5 types of mining licenses issued in Liberia: (1) Exploration licenses, between a licensee and the GOL granting exclusive rights to explore in a License Area. (2) Class B mining licenses, which cover areas ≤ 100 acres, exclusively for the exploitation of secondary mineral deposits. (3) Gold dealer licenses. (4) Diamond dealer licenses. (5) Mineral development agreements (MDAs).

Ministry of Public Works[7]
The Ministry of Public Works is responsible for the installation of infrastructure required for waste management delivery services, including solid waste collection and disposal and storm sewers. The Ministry of Public Works has a key role in ensuring that rural and urban latrines are strategically placed in order not to pollute sources of drinking water.

National Oil Company of Liberia (NOCAL)[8]
Established in 2000, the mission of NOCAL is to develop Liberia's hydrocarbon potentials for national self-sufficiency and sustainable development.

Liberia Electricity Corporation
The Liberia Electricity Corporation was created in 1973 to generate, transmit, distribute, and sell electricity throughout the country at reasonable rates. In July 2006, electricity was restored to parts of Monrovia for the first time in fifteen years.

Liberia Petroleum Refining Corporation[9]
The Liberia Petroleum Refining Corporation oversees the processing of crude oil into finished petroleum products for the Liberian market.

Liberia Water and Sewer Corporation[10]

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[6] MLME: http://www.molme.gov.lr/
[7] Ministry of Public Works: http://mpwliberia.com/
[8] NOCAL: http://www.nocal.com.lr/
[9] Liberia Petroleum Refining Corporation: http://www.lprclib.com/
[10] Liberia Water and Sewer Corporation: http://www.lwsclr.com/

The Liberia Water and Sewer Corporation is responsible for the generation and distribution of water to the public and maintaining a supply of safe drinking water. It is also responsible for providing for wastewater collection and disposal.

Liberian Coast Guard

The mission of the Liberian Coast Guard is to enforce law and make enquiries, examinations, inspect, search, seize and affect arrests within the Liberian Exclusive Economic Zone, in order to prevent, detect, and suppress violation of the Laws of the Republic of Liberia. In these efforts, the LCG collaborates with a variety of Government Agencies, including BNF, Liberia Maritime Authority, National Port Authority, Bureau of Immigration and Naturalization, and others.

Monrovia City Corporation

The Monrovia City Corporation oversees municipal waste, and the provision of environmental health and sanitation.

Universities

Liberia is home to a number of universities, community colleges, and vocational institutes. The civil conflict in Liberia severely affected higher education throughout Liberia, and all of these institutions are in a recovery and rebuilding phase, which is coinciding with rapidly increasing demands for education and training. Capacity is an enormous issue with respect to faculty, curricula, students (adequate primary and secondary education), infrastructure (buildings, equipment, textbooks, computing resources), and funding.

Public

- University of Liberia (UL)[11], Monrovia, Montserrado County
  - William R. Tolbert, Jr. College of Agriculture & Forestry
  - T. J. R. Faulkner College of Science & Technology
  - University of Liberia-Pacific Institute for Research and Evaluation (UL-PIRE)
- William V. S. Tubman University[12], Cape Palmas, Maryland County
  - College of Agriculture and Food Sciences
  - College of Arts and Sciences

Private

- African Bible College University, Yekepa, Nimba County
- African Methodist Episcopal University, Montserrado County
- African Methodist Episcopal Zion University, Montserrado County
- Cuttington University[13], Suacoco, Bong County
  - College of Agriculture and Integrated Rural Development
  - College of Natural Sciences
- Stella Maris Polytechnic[14], Monrovia, Montserrado County
  - Agriculture College
- United Methodist University, Monrovia, Montserrado County
  - College of Agriculture

[11] University of Liberia: http://www.universityliberia.org/
[12] Tubman University: http://www.tubmanu.edu.lr/
[13] Cuttington University: http://www.cuttington.org/
[14] Stella Maris Polytechnic: http://smp.edu.lr/

College of Arts & Sciences

Community colleges (partial list)

Bong Community College, Bong County
Grand Bassa Community College, Grand Bassa County
Grand Gedeh Community College, Grand Gedeh County
Trinity Bible Community College, Margibi County
Lofa County Community College, Lofa County
Nimba County Community College

Others

Booker T. Washington Institute, Kakata
Brewerville Institute of Technology
African Christian Theological Seminary[15], Monrovia
Liberia Baptist Theological Seminary[16], Paynesville
Smythe Institute of Management and Technology
St. Clements University College, Paynesville

Forestry Training Institute (FTI)

The FTI is a technical vocational school that offers practical training in forestry and related areas towards an associate degree. FTI is located in Tubmanburg, Bomi County. The school trains technicians to work in the forestry sector both in public and private institutions in the country. As with other educational and training resources in the country, FTI is struggling to rebuild post-conflict capacity at all levels. During the LRCFP, FTI worked with Virginia Polytechnic Institute, and completed a self-assessment of their forestry programs to develop new, targeted strategies for program expansion and capacity building in the forestry section (USAID 2010). Our team agrees that the comprehensive suggestions and conclusions of that assessment are still valid and present a blueprint for program improvement at FTI.

Liberian NGOs and Civil Society

Action for Greater Harvest (AGRHA)

The Mission of AGRHA is to "Ensure Sustainable Food Security for Rural Liberian Households". The vision is "A Liberia where rural Liberian households create sustainable food security for themselves".

Association of Environmental Lawyers (Green Advocates)[17]

Founded in 2001, Green Advocates is Liberia's first and only public interest environmental law organization. It is dedicated to protecting the environment, advancing human rights protection and advocacy through sound environmental policies, and giving voice to rural, indigenous, and tribal peoples who have been denied the benefits of natural resource extraction from their tribal and ancestral lands. Green Advocates works to build strong environmental laws, enforce existing laws, and empower citizens to participate in environmental decision-making.

Development Education Network-Liberia (DEN-L)[18]

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[15] African Christian Theological Seminary: http://actsonline.hpage.com/
[16] Liberia Baptist Theological Seminary: http://www.lbtseminary.org/
[17] Green Advocates: http://www.greenadvocates.org/
[18] DEN-L: http://den-l.com/

DEN-L aims to create a Liberia at peace with itself and its neighbors' through building a constituency of people-to-people formations in pursuit of grassroots empowerment, economic justice, democratic development and gender equity for a just and peaceful Liberia. Broad objectives include: To contribute to the building of a peaceful Liberia through an empowered society at all levels; To contribute to the empowerment, human rights and equality of women and girls as Liberian citizens in all aspects of their lives; and, To strengthen and maintain DEN-L as an effective, efficient organization committed to a Liberia at peace with itself and its neighbors. DEN-L provides training in development, democratic participation and equality to community leaders, national and international institutions, public officials and corporations in Liberia.

Environmental Relief and Development Research Organization (ERADRO)
ERADRO promotes rural extension services to address health problems linked to environmental factors. Its activities include environmental research, community organization, public education on health and hygiene, and waste disposal programs in schools and communities.

Farmers Associated to Conserve the Environment (FACE)
Mission is to help empower local farmers to engage in modern, stable farming practices that are sustainable, environmental friendly, and have the propensity to yield significant positive net income. FACE is involved in seed rice multiplication and mangrove conservation. The focus is to promote stable, modern farming systems in order to improve food production and enhance the natural environment.

Liberia Artisanal Fishermen Association (LAFA)
LAFA was established in December 2009 as a national umbrella of all fishing association representing the interest of fishing communities in the nine coastal counties of Liberia, with over 33,000 fishers, and 114 fishing communities along the coast of Liberia. LAFA's activities cover wide areas, which include fishing, fish processing and preservation, fish trade and marketing.

Liberia Chainsaw and Timber Dealers Union (also known as the Pit sawyers' Union)
The Liberia Chainsaw and Timber Dealers Union manages the supply of timber to domestic markets, and is fully recognized by the GOL and the international community. The Union also conducts trainings across Liberia. The Union receives funding from a small proportion of all timber sales.

Liberia Community Development Foundation (LCDF)[19]
LCDF has the objective to objective of seeking funds and material donations to support education and local development in Liberia. LCDF implements short and long-term community integrated development projects in conjunction with local community people to enable them alleviate poverty and secure lasting improvement in their quality of lives. LCDF's aims are to: (1) Organize basic business management training programs; (2) Effect micro credit programs; (3) Develop intensive agriculture programs; (4) Upgrade health and sanitation in local communities; and, (5) Provide education to the disadvantaged/underprivileged.

National Charcoal Union of Liberia (NACUL)
NACUL is an umbrella organization of charcoal stakeholders in Liberia. NACUL advocates on behalf of charcoal producers, sellers and buyers, and works closely with FDA to monitor charcoal production.

Rural Integrated Center for Community Empowerment (RICCE)[20]

[19] LCDF: http://www.liberiandevelopmentfoundation.org/

The mission of RICCE is to empower rural residents to build vibrant self-sustaining communities through peace building initiatives, networking, advocacy and poverty reduction. RICCE works in several program areas, including: rights monitoring; biodiversity conservation advocacy; women's empowerment; agriculture; health promotion; peace building; and, community development.

Save My Future Foundation (SAMFU)[21]
SAMFU was founded in 1987 with the mission of facilitating and promoting sustainable community-based natural and human resources management and development. Currently, SAMFU runs two core programs: Extractive Resource, Human Rights and Conflict Management; and, the Endangered Marine Species Conservation Programs.

Skills and Agricultural Development Services (SADS)[22]
SADS was founded in 1998 as a campus-based organization at the UL with the goal of improving environmental awareness and education of students. SADS is focused on implementing a wide range of education and developmental programs designed to improve social services in areas such natural resource governance, advocacy, human rights, and rural livelihood skill development in Liberia

Society for Environmental Conservation (SEC)
The SEC's objective is to increase community awareness of Liberia's rich biological sites from both a conservation and sustainable planning perspective. SEC works in the areas of alternative energy, biodiversity, climate change, development, ecotourism, environmental education, environmental justice, forests, global warming, sustainable agriculture/farming, watersheds, wetlands and wildlife protection, using a variety of methods from lobbying and advocacy to formal education methods and organizing grassroots actions.

Society for the Conservation of Nature in Liberia (SCNL)[23]
Founded in 1986, SCNL is the oldest environmental NGO in Liberia. Its conservation projects include the creation and maintenance of protected areas, wildlife conservation, biomonitoring, and the use of socioeconomic surveys. With support from Forest Partners International and the Philadelphia Zoo, SCNL carried out a project on bushmeat and species conservation from 2002-2004 that included a planning workshop, a media campaign, and a post-campaign survey of public opinion. They are the local partner for Birdlife International (BI), and have conducted bird inventories in several forest areas, and produced a list of Important Birds Areas in Liberia.

Sustainable Development Institute (SDI)[24]
Established in 2002, the SDI works to transform decision-making processes of natural resource management so the benefits are shared equally. SDI's work aims to create space for the participation of local communities in decision making processes on natural resources. SDI works to support and enhance their contributions to those processes and strengthen mechanisms that will ensure that communities receive a fair share of the benefits derived from natural resource exploitation. Program areas include community rights and corporate governance; forest governance; community land protection; and, media and visibility.

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[20] RICCE: http://www.ricce.org/
[21] SAMFU: http://www.samfu.org/
[22] SADS: https://sites.google.com/site/sadsliberia/home
[23] SCNL: http://www.scnlib.net/
[24] SDI: http://sdiliberia.org/

International Engagement and Cooperation

During the 2011-2012 fiscal year, donors provided $340 million USD in funding to support key programs of the GOL's development agenda. These included security, infrastructure and basic services, education, health, rule of law and governance. The projected disbursements for the 2012 and 2013 fiscal years increased to more than USD $566 million by 17 development partners. The 2013 fiscal year budget introduced what is known as the Medium-Term Expenditure Framework. This mechanism allows the GOL to plan the use of the country's resources for a 3-year period, and is aligned with the national development agenda contained in its five-year Agenda for Transformation and Liberia Rising 2030 Vision. The GOL has identified that infrastructure development is essential to achieving economic transformation and has therefore made infrastructure, particularly power, roads and ports, the main area of concentration in its national development strategy.

Multilateral Donors

African Development Bank (AfDB)[25]

Since the mid-1990s, AfDB has provided funding for a variety of projects and sectors in Liberia. Relevant projects include a large urban water supply program focusing on infrastructure and urban sanitation; Technical Assistance and Capacity Building to LEITI starting in 2014; and the Smallholder agricultural productivity enhancement and commercialization project that began in 2013. The overall objective of the Smallholder Agricultural Productivity Enhancement and Commercialization project is to reduce rural poverty and household food insecurity on a sustainable basis. The specific objectives are to: expand irrigable land and improve land husbandry, intensify production, and increase value added and market access; and, improve technology generation, dissemination, adoption, coordination, management, and implementation capacities at the MOA and other key institutions. Activities to be undertaken to achieve these objectives will mainstream gender perspective.

European Commission (EC/EUROPEAID)[26]

EC assistance is concentrating on the rehabilitation of basic physical infrastructure and the provision of social services such as education and health as well as on governance issues, in particular providing institutional support and strengthening the capacity of public institutions. Actions will also take account of crosscutting issues, primarily capacity building, conflict-sensitive development and human rights, youth, environment as well as HIV/AIDS. Relevant past investments have included support for the establishment of the transboundary Gola Forest in Liberia and Sierra Leone ("Across the River"); final gazettement is still pending. The European Union (EU) adopted the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan in 2003 to combat illegal logging. The Action Plan includes several measures to stop the demand for illegal timber and reduce the supply of illegal timber. Two important measures of the action plan are the Voluntary Partnership Agreements (VPAs) and the EU Timber Regulation (EUTR). The VPA is a bilateral agreement between the EU and a wood exporting country, to ensure that timber and timber products exported to the EU come from legal sources. The agreements also help timber-exporting countries to improve their forest governance by increasing public participation in forest sector regulation and reducing illegal logging. The EUTR, effective March 2013, prohibits the sale of illegal timber or timber products within the EU. Following earlier ratification by the EU and Liberia, the Liberia VPA officially entered into force on December 1, 2013. Under the VPA, Liberia will now develop a Legality Assurance System to verify the legality of its timber exports based on existing Liberian laws.

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[25] AfDB: http://www.afdb.org/en/countries/west-africa/liberia/

[26] EC/EUROPEAID: http://ec.europa.eu/europeaid/where/acp/country-cooperation/liberia/liberia_en.htm

Food and Agriculture Organization of the United Nations (FAO)[27]
FAO established an office in Liberia in 1977. FAO's projects and activities are aligned with Liberia's medium-term strategy, the Agenda for Transformation. With the GOL and development partners, FAO is supporting the implementation of development-oriented and emergency-related interventions aimed at scaling up agricultural production, enhancing food security, building capacities of relevant government agencies and farmers, and introducing new technologies and crops for the purpose of increasing production, strengthening the agriculture-based rural economy, and bolstering monitoring and coordination of the Food Security and Nutrition Program. Current projects include:

- Agriculture Infrastructure Development Project (For Strengthening Food Crop Value Chains in Lofa and Bong Counties)
- Enhancing Resilience to Climate Change by Mainstreaming Adaption Concerns into Agricultural Sector Development in Liberia (Global Environmental Facility in Bong and Grand Gedeh Counties)
- Support to Reduce Post Harvest Losses and Improved Income of Fishers through a Product-Centered Community Support Fishery Model (Grand Bassa County)
- Poultry Production Support to Farmers Households (Lofa County)
- Technical Assistance Under the South-South Cooperation with the Government of The People's Republic of China in Support of Liberia's National Program for Food Security (Bomi, Bong, Grand Cape Mount, and Montserrado Counties)
- Establishment of Database and Forest Information System for Liberia's Forestry Sector (Montserrado County)
- Improved Food and Nutrition Security for Ivorian Refugees and Host Families in Liberia (Grand Gedeh, Maryland and Nimba Counties)

Global Environment Facility (GEF)[28]
Since joining the GEF, Liberia has received GEF grant funding or co-financing for 14 national and 14 regional and global projects (four in biodiversity, three in climate change, two in international waters, two in persistent organic pollutants, one in land degradation, two multi-focal areas).

United Nations Development Program (UNDP)[29]
The UNDP in Liberia supports the GOL in the implementation of its Poverty Reduction Strategy (PRS). UNDP's Annual Work plans have been aligned with the four strategic pillars of the PRS which include: 1) Enhancing National Security; 2) Revitalizing the Economy; 3) Strengthening Governance and Rule of Law and; 4) Rehabilitating Infrastructure and Delivering of Basic Social Services. UNDP's activities in Liberia fall within six corporate thematic areas, including Environment & Energy. The UNDP Energy and Environment Program aims to mainstream environment and climate change in national development priorities and strategies.

United Nations Environment Program (UNEP)[30]

[27] FAO: http://www.unliberia.org/doc/FAO.pdf
[28] GEF: http://www.thegef.org/gef/sites/thegef.org/files/publication/Liberia%20-%20Fact%20Sheet.pdf
[29] UNDP: http://www.lr.undp.org/

UNEP's post-conflict capacity-building program was ended in December 2007. Liberia has since reverted to being serviced remotely by the UNEP Regional Office for Africa.

United Nations Mission in Liberia (UNMIL)[31]

UNMIL was established by Security Council resolution 1509 (2003) on September 19th, 2003. Its mandate is to: (1) support the implementation of the ceasefire agreement and the peace process; (2) protect United Nations staff, facilities and civilians; (3) support humanitarian and human rights activities and; 3) to assist in national security reform, including national police training and formation of a new, restructured military. In 2003 UNMIL consisted of more than 15,000 UN military personnel, police officers, and civilian support staff. UNMIL began reducing personnel in 2006. According to UN Security Council Resolution 2066 (2012), the current UNMIL mandate is to continue to support GOL to consolidate peace and stability in the country and to protect civilians. UNMIL is steadily continuing the drawdown of personnel, and is expected to have 3,750 military personnel remaining in July 2015, while at the same time providing training and support to the Liberia National Police.

World Bank[32]

In past years, the World Bank has supported more than 30 projects in Liberia that have impacted many sectors such as agriculture, education, transportation, energy, and water, supply and sanitation. Projects related to NRM include:

- The Smallholder Tree Crop Revitalization Support Project (STCRSP) is operating from 2013-2016, and will increase access to finance, inputs, technologies and markets for smallholder tree crop farmers in Liberia (cocoa, coffee, oil palm and rubber), and to develop a long term development program for the tree crops sector in six of the country's main tree crop producing counties (Bong, Nimba, Grand Gedeh, Grand Bassa, Montserrado and Margibi).
- The West African Regional Fisheries Program (WARFP), which began in 2009 and will operate through 2014, supports a combination of regional cooperatives, national reforms and local education and empowerment. The goal is to help West African countries work together to manage their shared fisheries resources. Since its inception in 2009 WARFP has supported Ghana, Cape Verde, Guinea-Bissau, Liberia, Sierra Leone and Senegal. In Liberia, BNF is currently engaged in activities designed to improve the management and regulation of fisheries in Liberia in line with the PRS. WARFP has developed artisanal and industrial databases known as the Dashboard, though existing information for the artisanal database is sparse. The Ecosystem Approach to Fisheries is a partnership between BNF and FAO which is conducting baseline assessments for the small scale fisheries and developing a management plan for small scale coastal fisheries adding value to the local fishery.
- The Biodiversity Conservation through Expanding the Protected Area Network in Liberia (EXPAN) was initiated in March of 2011 and will conclude in 2014. The project's

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[30] UNEP: http://www.unep.org/disastersandconflicts/CountryOperations/UNEPsPastActivities/Liberia/tabid/54625/Default.aspx

[31] UNMIL: http://www.un.org/en/peacekeeping/missions/unmil/

[32] World Bank: http://www.worldbank.org/en/country/liberia

objective is to contribute to the conservation of Liberia's globally significant biodiversity by: (1) providing better representation of ecosystems within Liberia's current protected area network; and, (2) enabling active conservation and sustainable use of biodiversity with local communities. The project includes the planned creation and gazettement of two additional protected areas (Grebo and Grand Kru).

- Technical assistance program with the Liberian Water and Sewer Corporation.

World Food Program (WFP)[33]
WFP has been present in Liberia since 1968, and provides assistance in Liberia through a countrywide Protracted Relief and Recovery Operation in all 15 counties

Bilateral Donors

Department for International Development (DFID)[34] *– United Kingdom*
DFID works closely with the Liberian Government and international partners to further the country's recent progress with security and prosperity. Additional project funding is being invested in the health sector, infrastructure, water and sanitation, and human and institutional capacity building.

German Agency for International Cooperation (GIZ)[35]
GIZ is represented by a regional office in Sierra Leone, and since 2010 has focused investments to support the government and private sector, specifically with developing and expanding road building and other infrastructure. GIZ is also funding the *Regional resource governance in the extractive sector in the fragile states of West Africa* project, which aims to advise Liberia, Sierra Leone, Côte d'Ivoire, and Guinea on how to manage their natural resources more efficiently and more sustainably by altering the political and economic incentive structures. Targeted support for actors at local, national and regional levels should help to improve the state of public revenues and produce greater benefits from the minerals sector in terms of poverty reduction and sustainable development.

Irish Aid[36]
Irish Aid focuses on strengthening Liberia's health systems and basic primary health care services. Additional support is provided to a consortium of aid agencies, to increase sustainable access to water, sanitation and hygiene services for poor people and communities.

Italian Development Cooperation Program[37]
Italy has provided support to improve food security through better agricultural marketing strategies, and to reduce vulnerability of widows and IDPs to food price fluctuations; other investments have targeted capacity building for medical education, literacy, and vocational skills training for women and girls.

Japan International Cooperation Agency (JICA)[38]

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[33] WFP: http://www.wfp.org/countries/liberia
[34] DFID: https://www.gov.uk/government/world/liberia
[35] GIZ: http://www.giz.de/en/worldwide/325.html
[36] Irish Aid: http://www.dci.gov.ie/what-we-do/countries-where-we-work/othercountries/liberia/
[37] Italian Development Cooperation Program: http://www.cooperazioneallosviluppo.esteri.it/pdgcs/italiano/iniziative/Paese.asp?id=68
[38] JICA: http://www.jica.go.jp/liberia/english/index.html

JICA's support to Liberia is primarily focused on 1) improvement in maternal health, and 2) urban facilities restoration. JICA projects in Liberia are under the responsibility of the JICA Ghana Office.

Norwegian Agency for Development Cooperation (NORAD)[39]
Norway's development cooperation with Liberia is dominated by assistance to the energy sector. Five-year plans have been made to build expertise and know-how in energy institutions, and substantial work for building the electricity network is under way. Initially the work is focused on the capital Monrovia. Additional development priorities include security and humanitarian aid. NORAD is also providing funding for the Ecosystem Approach to Fisheries project implemented by FAO. This project aims to improve food security through development of sustainable fisheries management regimes, through capacity-building, promoting standardized data collection and monitoring, supporting policy development and management practices consistent with ecosystem-based principles and contributing to an expanded knowledge base.

Swedish International Development Cooperation Agency (SIDA)[40]
SIDA's priorities in Liberia include democratic governance and human rights (including sexual and gender-based violence), and improved agricultural development, private sector and trade. SIDA supports a major market development project that will facilitate for small-scale farmers to access markets and become part of the value and supply chains. The project takes the perspective of poor people and aims to create opportunities for market development that contributes to poverty reduction.

USAID/Liberia[41]
For nearly six decades USAID has been working in Liberia on rural and urban development, health and education. Today, the USAID bi-lateral mission in Liberia is the Agency's second largest in Africa, and is engaged in a range of programs positively impacting millions of Liberians. A summary of past and current programming emphases was described earlier.

U.S. Fish and Wildlife Service (USFWS)[42]
Funding from the USFWS International Affairs Program is currently supporting three projects: (1) Strengthening leadership for conservation in Sierra Leone and Liberia through Research and Training on the Western Chimpanzee; (2) Strengthening West African Chimpanzee conservation through rebuilding national capacity and improved monitoring in the Sapo-Tai region, Liberia; and, (3) Conservation of chimpanzee habitats: an entertainment-education strategy for protecting Western chimpanzees in post-war Sierra Leone and Liberia. Previous project activities have targeted Leatherback, Hawksbills and Olive Ridley sea turtles (technical capacity building in scientific techniques, methodologies and community involvement; community projects to monitor and protect nesting habitat in River Cess and Grand Bassa Counties; community outreach efforts such as marine nature clubs with school youth, and community action plans to conserve turtles and their habitat); the pygmy hippopotamus (capacity building of senior government wildlife authority staff, NGO personnel and university staff in strategic planning, field techniques and wildlife monitoring; development of an IUCN Species Survival Commission-endorsed Pygmy Hippo Conservation Strategy; determination of current distribution of and threats to the pygmy hippo; and increased awareness about this evolutionarily distinct and endangered species); and, the

[39] NORAD: http://www.norad.no/en/countries/africa/liberia--405945
[40] SIDA: http://www.sida.se/English/Countries-and-regions/Africa/Liberia/
[41] USAID/Liberia: http://www.usaid.gov/liberia
[42] USFWS: http://www.fws.gov/international/

West African chimpanzee (rebuilding capacity by developing an applied research program at Sapo National Park, and revision of core conservation curriculum at the country's two universities).

International NGOs

BirdLife International (BI)[43]

BI in Liberia is represented by their local affiliate, SCNL. BI/SCNL has conducted bird inventories in several forest areas, and produced a list of Important Birds Areas in Liberia (IBAs).

CARE Liberia[44]

CARE fights poverty and injustice in 86 countries around the world to help the world's poorest people find routes out of poverty. CARE also delivers emergency aid to survivors of war and natural disasters, and helps people rebuild their lives in the aftermath. In Liberia, CARE focuses on food security, water and sanitation, women's economic empowerment and environmentally sustainable farming. CARE works with the MOA to build their capacity in training farmers in more sustainable and effective practices. Over 70% of the people involved in some of these projects are women, enabling them to become stronger figures in their communities, and feed their families.

Conservation International (CI)[45]

CI was established in Liberia in 2002 with an initial mission to help establish a protected area network with funding from The Critical Ecosystem Partnership fund. CI - Liberia's focus is now primarily on the East Nimba Nature Reserve (ENNR) Protected Area which is located in northern Nimba county. In Nimba County CI works collaboratively with several partners, including but not limited to, commercial mining company ArcelorMittal, local government agencies and the USAID/PROSPER project. An innovative tool being used by CI to promote biodiversity conservation is a mechanism known as a "conservation agreement" (CA). These are long-term agreements ensuring more sustainable results. These agreements are by way of their associated trust funds enable the financing of protected areas. The funds can include and consolidate revenues from corporate offsets, carbon credits, and other sources. The Nimba Conservation Agreement is currently being negotiated and includes 6 communities adjacent to the ENNR. In the implementation of its CA implementation CI hopes to build the capacity of local conservation NGOs (SADS, RICCE, SCNL, FACE, SAMFU) while simultaneously linking the strategy to government priorities to facilitate the extrapolation of Conservation Agreements nationally.

Flora and Fauna International (FFI)[46]

FFI has operated in Liberia since 1997, and currently has a five-year mission (2013-2018) to make a measurable improvement to the status of biodiversity and ensuring resilient ecosystems through supporting good environmental governance, building capacity and supporting conservation-friendly livelihood strategies. Past efforts have included support to re-establish Sapo National Park, developing a rapid ecological assessment tool to identify and prioritize sites for inclusion in the protected area network, leading field activities for the Liberian National Forest Re-Assessment, conducting a variety of floral and faunal surveys, capacity building in key GOL organizations, and facilitating the development of laws related to community rights and forestry. In the 15 years since FFI's arrival, geographical focus of on-the-ground activities has broadened from the Southeast, to include Nimba Mountains and Lake Piso, both recognized biodiversity hotspots. Current FFI projects include: (1) Developing a pro-poor Reduced

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[43] BI: http://www.birdlife.org/africa/partners/liberia-society-conservation-nature-liberia-scnl
[44] CARE Liberia: http://www.careinternational.org.uk/where-we-work/liberia
[45] CI: http://www.conservation.org/where/africa_madagascar/liberia/Pages/liberia.aspx
[46] FFI: http://www.fauna-flora.org/explore/liberia/

Emissions from Degradation and Deforestation (REDD) structure in Liberia and creating real world pilot projects to guide national policy development (2009-2014); (2) Building Capacity of the Next Generation of Liberian Conservation Professionals (2012-2016); (3) Developing Management Instruments for Liberia's Protected Area Network (2013); (4) Coordinating the National Interpretation of the Roundtable on Sustainable Palm Oil's (RSPO) Principles and Criteria (2013-2016); (5) Strengthening community management of Liberia's mangrove ecosystems for the benefit of local residents, Liberian fisheries, regional biodiversity and the global climate; (6) Developing a cross-sectoral environmental governance platform for the Nimba mountains (2010-2014).

Global Witness[47]
Global Witness investigates and campaigns to prevent natural resource related conflict and corruption, and associated environmental and human rights abuses. Program areas include corruption, conflict, environmental governance, and accountability and transparency. Global Witness's investigations revealed how President Charles Taylor used diamonds and timber to bankroll brutal campaigns against the people of Liberia and neighboring Sierra Leone. Global Witness continues to work with local civil society groups to ensure that the country's natural resources are managed fairly for the benefit of all.

Greenpeace[48]
Greenpeace is an independent global campaigning organization that acts to change attitudes and behavior, to protect and conserve the environment and to promote peace. Greenpeace has worked to develop a methodology for defining high carbon stock forests, which helps to prevent deforestation from palm oil production. Golden Agri-Resources, one of the world's largest palm oil producers, has agreed to this approach, which will be implemented in all of their subsidiaries, including Golden Veroleum in Liberia. Greenpeace has also collaborated with Liberian NGOs, including SDI and Green Advocates, to work on issues related to PUPs, Community Forestry Management Agreements, and community land use rights.

Wild Chimpanzee Foundation (WCF)[49]
WCF aims to enhance the survival of the remaining wild chimpanzee populations and their habitat, the tropical rain forest, throughout tropical Africa. WCF focuses on education, conservation and research projects. In Liberia, WCF is working in Sapo National Park and Grebo Forest.

Private Industries in the NRM Sector

While natural resource wealth provides important economic opportunities for Liberia, it is associated with major environmental challenges and benefit sharing obstacles. Balancing national priorities—economic development, job creation and poverty reduction (including through forestry, mining, agro-industrial and oil concessions)—with sustainable conservation of natural resources will be an enormous challenge for the GOL. Corporate social responsibility will be an essential element of agreements that will require monitoring by LEITI and other stakeholders, but also provides potential opportunities to leverage both economic growth and sustainability. To date, the GOL does not have a solid record of benefits sharing mechanism with local communities.

[47] Global Witness: http://www.globalwitness.org/campaigns/conflict/post-conflict/liberia
[48] Greenpeace: http://www.greenpeace.org/international/en/
[49] WCF: http://www.wildchimps.org/index.htm

During the civil conflict, all major mines were closed and the mineral sector's contribution to the economy essentially ended. In 2010, Liberia made significant progress in reviving the mining sector, and annual contribution to economic growth is rapidly rising, largely due to iron ore production (0.9% in 2010, 3.7% in 2011, 10.4% in 2012). Mineral commodities produced include cement, diamond, and gold. Undeveloped mineral resources include base metals (e.g., cobalt, lead, manganese, nickel, tin) and industrial minerals (e.g., dolorite, granite, ilmenite, kyanite, phosphate, rutile, silica, and sulfur). Most of the mining companies produce fairly extensive biodiversity assessments for the areas in which their concessions are located, providing a much needed source of quantitative and spatial data on the country's natural resources (e.g., Marshall and Hawthorne 2013). An estimated 49 Licenses have been issued since 2008, totaling an area of 1,996,637 ha (LEITI Database, 2013).

The industrial agriculture sector in Liberia, primarily oil palm and rubber, has seen tremendous growth in the awarding of concession agreements over the last 5 years. This rapid growth has not been without its challenges. Beginning in 2012 several of the commercial oil palm companies have become embroiled in land disputes with rural communities. Several rural communities have alleged that concession agreements were reached between the GOL and private companies without their Free Prior and Informed Consent (FPIC). This has resulted in disagreements with respect to where concession boundaries and community or customary land coincide or overlap. There are currently seven oil palm concession contracts in place or under negotiation, totaling 348,196 ha (LEITI Database, 2013). Rubber plantations have long been established in Liberia. The Firestone plantation in Liberia is the largest in the world (48154 ha) and was established in 1926. For the most part the large rubber plantations in Liberia appear to avoid significant conflicts with the communities in and around their concessions. There are currently four rubber concession contracts in Liberia totaling 164,501 ha (LEITI Database, 2013).

The oil sector is also a fairly recent addition to Liberia's natural resource management portfolio. The Liberia Basin consists of 30 oil concessionary blocks; to date 10 of these blocks have been leased, and all are located adjacent to Liberia's coastline. The GOL requires environmental and social impact assessments (ESIAs) for all offshore oil exploration, and exploration is limited to areas 25-80 km from the coast and depths of 200 m to protect fisheries. There are currently five production sharing contracts, though the total area for exploration has not been reported (LEITI Database, 2013).

According to the LEITI database, the following private corporations are currently operating in the natural resources sectors in Liberia:

Agriculture – oversight by MOA

- LIBINC Oil Palm Inc.
- Liberia Forest Products Inc.
- Liberia Agricultural Development Corp
- Equatorial Palm Oil (Liberia) Inc.
- Sime Darby Plantation
- Salala Rubber Corp.
- Golden Veroleum
- Maryland Oil Palm Plantation
- Cavalla Rubber Corporation
- Liberia Agricultural Company
- Firestone

Forestry – oversight by FDA

- Alpha Logging & Wood Processing Inc.
- Mandra Liberia/EJ&J Investment
- Liberia Tree & Trading Company
- Euro Liberia Logging Inc.
- Geblo Logging Company
- International Consultant Capital

- Atlantic Resources Limited
- Tarpeh Timber Corporation
- Akewa Group of Companies
- B&V Timber Company
- Bargor & Bargor Enterprises
- Bassa Logging Company
- Sun Yeun Logging Corporation
- Ecowood Inc.
- Liberia Hard Wood Corp.
- Thunder Bird

Minerals – oversight by MLME

- Acquarian Commercial Holdings Inc.
- African Gold Mining Company (Liberia) Ltd
- Afro Minerals Inc./Kana Hills
- AmLib United Minerals, Inc.
- ArcelorMittal
- Archean Gold
- Ascension Resources Corp.
- Bea Mountain Mining Corporation
- BCM International
- BG Minerals (Liberia) Ltd..
- BHP Billiton (Liberia) Inc
- Birimian Gold Limited
- Bopolu Commercial Limited
- Bukon Jedeh Resources Inc.
- BAO CHICO Resources Liberia Limited (China Henan International Corporation Group Co. Ltd.)
- China Union Investment (Liberia) Bong Mines Co. Ltd
- Global Mineral Investment LLC.
- Hummingbird Resources Inc.
- Deveton
- INDO Gold Liberia Ltd.
- Investment Development Corporation
- Iron Resources Limited
- Ironbird Resources Inc.
- Jamu Resources Incorporated
- Jonah Capital (BVI) Ltd.
- Knights Group Incorporated
- Konblo Bumi Inc.
- Liberia Development Initiative
- Middle Island Resources - Liberia Ltd
- Mount Belle Resources Liberia Ltd
- Noya Mining Company Ltd
- Pedsam Mining Limited
- Planet Mines & Minerals (Liberia) Limited
- Putu Iron Mining Company
- Salmec Resources limited(formerly Belle Resources Ltd.)
- Shankil Resources (Liberia) Inc.
- Sinoe Exploration Limited
- Southern Cross Investment Limited
- Superior Mineral Resources Inc.
- Tawana Resources Liberia
- Thackett Mining Inc
- Tietto Minerals (Liberia) Ltd.
- Treco Mining Company
- Voila International Inc.
- West African Resources (Lib) Corp. Limited
- West Peak Iron Ltd
- Western Cluster Limited
- Winestock Dev Liberia Corp
- Yousseff Diamond Mining Company

Oil – oversight by NOCAL

- African Petroleum
- Anadarko Liberia
- Broadway Consolidated/Peppercoast
- Chevron Liberia
- Oranto Petroleum

Status and Management of Natural Resources in Liberia

Ecosystem Diversity

Forests Resources

General Characterization

Liberia is the only country in the Upper Guinean Rainforest of West Africa that once was covered entirely with rain forest. The most recent forest classification (2006) included 2.42 million hectares of closed dense forest, 1.02 million hectares of open dense forest and 0.95 million hectares of agriculture/degraded forest (Figure 5). All forest resources in Liberia, with the exception of forest resources located on communal forests and forest resources that have been developed on private or deeded lands through artificial regeneration, are held in trust by the Republic of Liberia under the 2006 National Forestry Reform Law.

Figure 5. Extent of forests in Liberia and their management classification (FDA 2007).

Estimates of deforestation rates are variable and suffer from a lack of data. Between 1990 and 2005, forest area in Liberia has been reported as being reduced by 22% (FAO 2005). This equates to an average annual rate of deforestation of 0.9% over that period. A 2008 forest change analysis in Liberia performed by a partnership between the FDA, CI and South Dakota State University notes the average deforestation rate increasing from 0.2% in 1986-2000 (Christie et al. 2007*)* to 0.35% in 2000-2006. Comparatively, in 2006 the National Forest Policy and Implementation Strategy (FDA 2006) cited the annual rate of deforestation in Liberia at approximately 12,000 ha, or 0.3%. Most recently in 2009 a report commissioned by Liberian NGO Green Advocates estimated an annual deforestation rate during that year of between 0.5 and 1% (Shearman 2009). Unfortunately in the absence of current, reliable data, it is difficult to ascertain the trend and accuracy of deforestation estimates.

A very recent global-scale analysis provides some clarity on recent deforestation patterns in Liberia (Hansen et al. 2013). In the period from 2000 to 2012, Liberia lost 395,500 ha, and gained 108,400 ha of total forested area. Excluding water, this equates to a total forest loss of 4.1 percent of the land area. Patterns of forest loss varied with tree cover over the 12 years analyzed: areas with 51-75 percent tree cover lost the most forest (230,500 ha), followed by areas with 76-100% tree cover (154,700 ha). Annual data will soon be released on the WRI Global Forest Watch portal, which will allow for the calculation of annual deforestation rates during that time period.

Economic Value of Forests

The forest economy is extremely important across Liberia, particularly in the rural areas. Many communities are dependent on timber and non-timber forest products, both for use within the community and for domestic and international trade. Estimates are that about 70 percent of Liberia's rural dwellers earn a living from forests and forest-related products (Soloh 2005). Biomass resources—

primarily firewood and charcoal—meet 99.5% of the Liberian population's energy needs for cooking and heating and are thus vital to basic welfare and economic activity (Milbrandt 2009).

The production of timber for export is carried out at an industrial scale in two main regions of the country: the south east (e.g. Grand Bassa, Sinoe, River Cess, Grand Gedeh) and north (e.g. Lofa, Gbarpolu, Grand Cape Mount). Forest production in the formal sector is mainly destined for export to markets in Asia and Europe. According to SGS data (personal communication), timber export permits in 2013 were issued to India (15,271 m^3; 32% of total permits); China (8,806 m^3; 18%); Thailand (7,561 m^3; 16%); Turkey (7,885 m^3; 16%); France (2,358 m^3; 5%); Greece (949 m^3; 2%); Germany (537 m^3; 1%).

Commercial timber production was carried out in very high levels in the 1980s, and again from the late 1990s until UN sanctions were imposed in 2003. During this period, logging activities were carried out at unsustainable levels of harvesting and considerable revenues were generated. However, various studies have identified that logging prior to 2003 was characterized by poor governance, corruption and financial mismanagement. There was no transparency regarding revenues generated from the sector, but analysis of volumes of timber from Liberia reported by importing countries, and the Concession Review process in 2004, indicated millions of dollars in unpaid taxes. Any revenues collected were held by individuals or the central government and benefits were not shared with communities. Following the reform process and lifting of sanctions, timber exports have been slow to resume. The revenues received by the government are recorded in the a chain of custody system and verified by the LEITI reporting mechanism. The relatively low levels of commercial logging activity mean that revenues are very low compared to original FDA projections, and many concessions have not paid the area-based fees stated in their concession agreements (land rental and/or annual bid premiums). There have also been problems identified in the operation of the benefit sharing mechanisms (e.g., National Benefit Sharing Trust) which are described in the National Forestry Reform Law and regulations (Halton 2013).

The domestic market of timber is almost entirely supplied by Chainsaw Milling. Domestic production and consumption is estimated to exceed timber exports, a situation which is particularly acute at present, due to both the low levels of timber exports and industrial scale operations, and to a building boom as the country continues its reconstruction, which have increased domestic demand. The domestic sector is a major source of employment, particularly in rural areas. The networks of chainsaw operators, traders and domestic timber dealers are estimated by the Liberia Chainsaw & Timber Dealers Union to number over 15,000 across Liberia. In addition, each team of chainsaw operators will be supported by crews of cooks and transport workers, so the wider employment of the sector is very significant.

The production and sale of charcoal is another major source of employment. The vast majority of the Liberian population is dependent on charcoal as a source of energy for cooking. At the time of the 2008 census, an estimated 85% of households were dependent on charcoal, and a study in 2010 estimated that 4million bags of charcoal per annum are consumed in Monrovia alone. NACUL estimates that over 10,000 people are involved in production and trade of charcoal, representing a significant source of livelihoods across the country. Despite the significance of the charcoal sector, it is currently not formalized or regulated, although there is dialogue on this issue between FDA and NACUL. The FDA has negotiated with charcoal producers to introduce a levy on sacks of charcoal being moved around the country (particularly the large volumes transported into Monrovia) but enforcement is weak, and there are reports of corruption in the collection mechanisms (Halton 2013).

Non Timber Forest Products (NTFPs)—such as bushmeat, honey, medicines (*Alchornea cordifolia, Xylopia staudtti, Hugaruna* and *Piptadeniastrum africanum),* colorants, bamboo and rattan cane (Calamus *deeratus, Raphia palma-pinus)* used for furniture construction—play an important role in the livelihoods of many rural communities. Although there are many constraints challenging NTFP value chains—namely that GOL structures have little experience promoting NTFPs, infrastructure is poor, local business ethic is weak, rural credit is scarce, and trader networks are underdeveloped—NTFPs are thought to provide significant income to rural producers (Lebbie et al. 2009; USAID 2009a). There is interest in the harvesting and trade of NTFPs, which could offer sources of economic activity from forests without loss of forest cover. A number of community forestry and conservation projects have focused on identifying NTFPs and exploiting these as a source of income and employment (e.g. USAID 2009a). There are several large programs starting in the agricultural sector focusing on tree crops and improving market linkages to boost trade in these commodities. These tree crop programs are focused on smallholders and will initially target rehabilitation or replanting of existing stands, but as the situation in relation to land tenure in rural areas is clarified, it is likely that this will expand into new areas. There is a significant, but unquantified, trade in bushmeat for domestic and regional markets. The full economic and ecological impacts are unknown.

There is currently no legal framework for identification or trade of carbon credits in Liberia, though the development of such legislation is expected. As such, the lack of a legal framework means that there is currently no mechanism for sharing of benefits from carbon trade with communities in the affected area.

Aquatic Resources

General Characterization

Liberia's coastal zone is characterized by a mosaic of sandy and rocky shores, mangroves and fresh-water swamps, grass/shrub savannas on sand, and coastal forests. Mangroves characterize the coastal wetlands of Liberia and cover a small area along the coast and typically occur at all river mouths, estuaries, riverbanks, at the edges of lagoons, and in widespread areas of coastal swamp. Mangroves are estimated to cover 0.5% of the land surface of Liberia, which is equivalent to a 50 km-wide belt extending along the total length of the coastline (Gatter 1988). Nearly 58% of Liberia's 4 million population lives within 40 miles of the coast, which puts extensive pressure on this ecosystem for food, land, mineral and other resources.

Fisheries and Aquaculture

Fishing is the predominant occupation for those living within the coastal zone. Fishing provides 65% of the animal protein needs of the country and contributes around 3.2% to Liberia's GDP. In 1984—the last period for which any data is available—an acoustic survey of the country's marine resources indicated a total biomass of about 800,000 metric tons consisting of an estimated 12 pelagic and 13 demersal species. Liberia's continental shelf area has considerable marine fish species. The most common of these are *Engraulis encrasicolus, Sardinella aurita, Decapterus* Spp*. Caranx* Spp*.* and *Ethmalosa fimbriata*. The main oceanic pelagic resources are tuna and tuna-like species such as yellowfin tuna, bonito and marlin. Demersal fish species such as Lutjanidae, Sparidae and *Dentex* Spp. are also found in the marine waters of the country and are harvested on a commercial basis. Crustaceans such as shrimps, crabs and lobsters are less abundant but are of much higher value than finfish species, and are targeted for the export market. BNF requires licenses for industrial fishing; artisanal fishing; and, inland fishing. A recreational (sport) fishing license is under development.

The commercial marine fishery in Liberia includes bottom trawlers targeting demersal fish and shrimp,

purse seiners and long liners targeting off shore tuna resources and crab vessels. Several on-shore cold storage facilities support the fishery. All industrial fishing vessels fishing in Liberian waters must carry "observers" and Vessel Monitoring Systems. The observers assigned to each ship monitor and submit their findings to the database managed by WARFP. Industrial Fisheries are regulated and fishing vessels that fish in Liberian waters and companies that import fish are required to pay taxes to the GOL. In addition, fishing vessels, as well as vessels importing fish, are required to land their catches under inspection at the fishing pier in the Free Port of Monrovia. All transshipment activities must also take place under inspection in port.

Artisanal fisheries are a key sector of marine fisheries in Liberia, providing food and livelihoods to coastal communities throughout the country. Recent surveys indicate that there are approximately 3,300 canoes and more than 11,000 fishers operating actively from 114 fish landing sites along the coastline.

Inland fisheries account for approximately 25% of fish consumed by rural dwellers. Inland fishing activities take place in all Liberian fresh water bodies, particularly Liberia's six major rivers and Lake Piso. Fishing is conducted from shore and dugout canoes at the artisanal level only, using a variety of fishing gear, including hook and hand line, fishing net and, traditional trap. Highly damaging methods involving dynamite continue to be practiced.

Aquaculture in Liberia is currently very limited, occurring for the most part as small, freshwater ponds. There are approximately 1,050 small scale fish farmers and three fish hatcheries (Klay Fish Hatchery and Farmers Resource Center in Bomi County, Duoyee Fish Hatchery in Grand Gedeh County and, Tasah Fish Hatchery in Bong County). The hatcheries are under the supervision of the Division of Aquaculture and Inland Fisheries within BNF.

Species Diversity

Many descriptions of Liberian taxonomy start by acknowledging the paucity of sampling and data. There have been no comprehensive taxonomic studies in the country. Foreign natural history expeditions began in 1841 for plants (with some herbarium samples collected by naval surgeons in the late 1600s), and in 1880 for wildlife with Johann Büttikofer and Carolus Franciscus Sala, and continued until the recent political conflict. An increasing number of surveys have been conducted since peace was re-established in 2003, driven by stakeholders ranging from Liberian students to international commercial mining operations and NGOs (e.g., Sambolah 2007) or surveys related to concessions (e.g., ArcelorMittal 2010). Many of these efforts are relatively small in spatial or temporal scale, or may lack statistically valid sampling designs, while others serve as important data sources.

Despite shortcomings in data, however, the 1999 GEF West African Conservation Priority Setting Exercise identified Liberia as the top priority country for conservation purposes because of extensive forests of exceptionally high biological importance and species endemism. For instance, the Rapid Assessment Program of Conservation International conducted surveys in 2005 in North Loma, Gola and Grebo National Forests. During one month of data collection, 969 total species were recorded: 60 species of conservation concern, six new species discoveries, 18 new species records for Liberia, and 147 species endemic to Upper Guinean forests (Barrie et al. 2007; Hoke et al. 2007). Similarly, rapid botanical surveys conducted in northern Nimba County in 2010-2012 documented 31,775 records from 249 samples, consisting of 1,530 species, including 120 species that are of highest conservation concern because of extreme range restrictions (Marshall and Hawthorne 2013). Additional surveys conducted in northern Nimba related to an iron ore concessions also revealed significant wildlife diversity, which was

greater within the East Nimba Nature Reserve compared to areas outside the protected area, including sites that had previously been mined (ArcelorMittal 2010).

Liberia is estimated to be home to 150 mammal, 615 bird, 162 native fish, 74 amphibian and reptile, and more than 1,000 described insect species. Botanical data is sparse, but Liberia is thought to host more than 2,000 flowering plants, including 240 timber species. Most of the information available concentrates on those species of particular economic or aesthetic importance to people, especially large mammals and birds. Most species, including many plants, small mammals, reptiles, amphibians, fishes, and invertebrates, remain relatively undocumented.

Larger mammals and reptiles are relatively well known in terms of their distribution within Liberia. Along with birds, their protection forms the core of the Liberian conservation strategy. There is already some capacity within Liberia to identify these animals. They do not need special resources beyond field guide books and they are well known to local hunters, so increasing capacity is relatively easy. NGOs such as CI and FFI have been assisting FDA with inventory and monitoring. FFI has created an online clearinghouse for information about Liberian flora and fauna, including a bibliography of resources. These efforts have resulted in improved understandings of species distribution and abundance, particularly in protected areas such as Sapo National Park (e.g., Miller 2009; Vogt 2011).

Endemic species include one bird (Liberian Greenbul *Phylastrephus leucolepis*); three amphibians (African True Toad *Amietophrynus taiensis*, Liberia Nimba Toad *Nimbaphrynoides liberiensis,* Gbanga Forest Treefrog *Leptopelis bequaerti)*; one reptile (Liberian Worm Snake *Typhlops leucostictus*); three crustaceans (Dwarf River Crab *Liberonautes nanoides*, Grand Bassa River Crab *Liberonautes grandbassa*, Lugbe River Crab *Liberonautes lugbe*); one mollusk (*Bellamya liberiana)*; and one plant (African Pine *Tetraberlinia tubmaniana*).

Of particular interest for forest conservation are the endangered species listed by World Conservation Union (IUCN) and protected by FDA within Liberia (Table 4; Annex C).

The Regional Action Plan for the Conservation of Chimpanzees in West Africa (Kormos and Boesch 2003) estimated a population size of 1,000-5,000 West African chimpanzees *Pan troglodytus verus* in Liberia. This action plan identified several areas in Liberia that are exceptionally important sites for West African chimpanzee conservation:

- Taï-Grebo-Sapo-Cestos complex in Côte d'Ivoire and Liberia, with an estimated population of 8,000 West African chimpanzees. This priority area also represents an opportunity to protect other endemic species such as pygmy hippos (Hexaprotodon liberiensis), zebra duikers (Cephalophus zebra), Jentink duikers (Cephalophus jentinki), and forest elephants (Loxodonta africana cyclotis).
- Nimba Mountains of Guinea, Côte d'Ivoire, with an estimated population of 450 West African chimpanzees.
- Lofa-Mano-Gola Forest complex in Sierra Leone and Liberia
- Wonegizi forests.

A national action plan for the pygmy hippopotamus *Choeropsis liberiensis*, listed as endangered on the IUCN Red List, was recently completed (FFI and FDA 2013). The pygmy hippopotamus is a regional endemic, restricted to the Upper Guinean Forests of West Africa. The species has lost an estimated 75%

of its former range and now occurs in seven remnant fragments across Sierra Leone, Guinea, Côte d'Ivoire and Liberia. Within Liberia, the current range is restricted to the southeast (Sapo National Park; Krahn-Bass National Forest; Grebo National Forest; Grand Kru-River Gee), northwest (Gola National Forest), and a small portion of the Lofa region in the far north (Wonegizi National Forest; FFI and FDA 2013). Strategic conservation efforts have been constrained by a lack of understanding of distribution, population trends and ecology, but the largest remaining habitat persists in Liberia and Côte d'Ivoire. Two months of surveys from 2008 in Sapo National Park, thought to be a stronghold for the species, documented the pygmy hippo in seven camera-trap photographs (Collen et al. 2011).

Birds, like larger mammals, are flagship species for Liberian conservation. A total of 615 species have been recorded from Liberia, of which some 125 are Palearctic migrants (Robertson 2001). Amongst these are 21 species of global conservation concern, only three of which are not resident: *Circus macrourus*, *Falco naumanni* and *Gallinago media* are all rare or uncommon migrants from the Palearctic. The remaining species of global conservation concern are all species of forest habitats. Fourteen of these are also species of restricted-range. Liberia also lies entirely within the Guinea–Congo Forests biome, and 184 species characteristic of the biome have been recorded. The Liberian greenbul *Phyllastrephus leucolepis*, discovered in 1981, has only ever been recorded from a limited area in the east of the country, while *Malimbus ballmanni* is almost entirely confined to Liberia, its range extending just into western Côte d'Ivoire and eastern Sierra Leone. All of this underlines the ornithological importance of Liberia's forests. In addition, the coastal wetlands are important overwintering habitat for migratory water birds. BI and their local partner SCNL have been active in developing a list of priority sites for bird conservation and incorporating these into the national conservation strategy.

The forests of Liberia are of high importance for the protection of the Upper Guinea flora and endemic plant species. Although the flora of West Africa is fairly well-known, the Liberian flora has been less well studied than that of neighboring countries, and local capacity for botanical inventory and monitoring is low; Liberia does not have a herbarium to serve as a reference collection. Current conservation strategy emphasizes habitat quality, and assumes that the best areas for protecting mammals and birds also conserve Liberia's flora. This is unlikely to be the case, but in the absence of plant distribution data, it is not possible to conduct the gap analyses needed to pinpoint additional conservation needs.

The Liberian coast is critical habitat for four endangered species of sea turtle, three of which nest on the beaches (Green, Leatherback and Olive Ridley), and one in estuaries (Hawksbill). Estuaries are also important habitat for threatened West African manatees. Protection for these species along the coastline and in Liberian territorial waters presents complex problems for law enforcement.

Liberia's continental shelf provides habitat for a variety of marine species including mollusks, crustaceans, demersal and pelagic species. However, Information on the historic and current distribution and abundance of these species, including endemism, is nonexistent. Moreover, there have been no stock assessment surveys conducted in more than twenty years to determine the level of exploitation of the fisheries resources. There are no research facilities to study the dynamics of the ecological factor affecting the fisheries environment- the productivity of ecosystem, pollution levels and nutrient load, species diversity of the various fish communities and harvesting pattern of commercial species. In 2010 Liberia began participating in the World Bank West Africa Regional Fisheries Project, which aims to strengthen the capacity of Liberia to govern and manage targeted fisheries, reduce illegal fishing and increase local value added to fish products.

Other groups of species such as freshwater fish, small mammals, amphibian, reptiles, insects, fungi, and non-vascular plants can all be described as poorly-known and lacking in local taxonomic expertise. For the most part, these species are not included in the national conservation strategy and cannot be included in gap analysis for protected areas because of a lack of inventory and distribution data. Without systematic inventories, the uniqueness of Liberian flora and fauna can only be surmised.

Species conservation

A search of the IUCN Red List for Vulnerable; Endangered; Critically Endangered; Extinct in the Wild; and, Extinct yielded 47 plant and 102 animal species (Annex C) in Liberia. From this listing, 16 animal species are critically endangered; four plant and 33 animal species are endangered; and, 43 plant and 53 animal species are vulnerable. Six plant and 86 animal species are considered too deficient of data to facilitate evaluation by IUCN.

IUCN's Red List still provides information to guide priorities for habitat and species conservation. For example, the list calls attention to the plight of many fish species: 10 species are considered critically endangered and 19 fish species are classified as endangered. Other declining species from marine, coastal, and freshwater habitats include West African manatees, sea turtles, and several rare crabs. Similarly, many imperiled species found in terrestrial habitat highlight the importance of sustainable forest management, including chimpanzees, duikers, and pygmy hippopotamus. Similarly, the economically valuable timber resources of Liberia include species that are now considered threatened and vulnerable (Table 4).

Table 4. The threatened and vulnerable timber species of Liberia (FDA)

Scientific name	Trade name
Entandrophrama utilis	Sipo
Entandrophrama angolensis	Tiama
Entandrophrama candolei	Kosipo
Entadrophragma cylindricum	Sapele
Heritiera utilis	Niangon
Khaya anthotheca	Khaya
Lovoa trichiodes	Lovoa/dibétou
Tetraberlina tubmaniana	Tet/sikon
Tieghemella heckelli	Makore
Lophira alata	Ekki/iron wood
Triplochiton scleroxylon	Wawa/obeche
Piptadeniastrum africana	Dahoma
Chlorophora regia	Iroko
Aniegre robusta	Aniegre
Holea celiata	Abura

Protected Area Network

Liberia's Protected Forest Areas Network, as mandated by the National Forest Reform Law of 2006 and described within the National Forest Management Strategy addresses Liberia's conservation objectives, provided that the following additional considerations are taken into account:

- Inclusion of other Key Biodiversity Areas based on a gap analysis to extend the PA network to the maximum area as allowable under the law;
- Encouragement of connectivity between protected areas;

- Integration of other potential land uses;
- Protection of critical environmental services such as watersheds and carbon storage; and,
- Opportunity for additional change based on availability of information.

The 2006 forestry reform law establishes 30% (1.5 million ha) of the forest area to be protected as conservation areas. Currently less than 5% is under protection. The 2013 Land Rights Policy Section 5.1.4 stipulates that "Government Land includes Government Protected Areas which are owned by the Republic of Liberia and must be conserved and managed for the benefit of all Liberians. Government Protected Areas will not be sold, leased, or granted as a concession, and any attempt at such a transfer is prohibited". There is a 10% conservation fee currently being levied on forest concessionaires by the FDA. The funds go directly into the Government treasury, administered by the Ministry of Finance.

Currently, there are three designated protected areas: Sapo National Park, East Nimba Nature Reserve, and Lake Piso Multiple Use Reserve (Table 5). Sapo National Park was established in 1983 and consists entirely of lowland rainforest, including swampy areas, dryland and riparian forests. Satellite images analyses looking at the 'edge effect' of roads and settlement have shown that Sapo is at the core of the least disturbed forest in the country, and remains reasonably connected by forested corridors to several other forest blocks to the north, west and south east containing some of the largest remaining intact blocks of the threatened Upper Guinean Forest, it provides a stronghold for several globally endangered species, including the pygmy hippopotamus, the West African chimpanzee and the zebra duiker. East Nimba Nature Reserve was established in 2003, and protects high closed tropical forest and forms a strong hold for a number of species known to be endemic to the Nimba area. The Lake Piso Multiple Use Reserve includes diverse ecosystems, and hosts a number of important wildlife species including migratory birds (such as herons, plover, flamingo and ibis) and resident bird species (such as Copper-Tailed Glossy Starlings, Rufus-Winged Illadopsis, African Pied Hornbill, Double-Spurred Francolin, Pied Crows and the Spur-Winged Goose). Several important mammalian species can be found in the area, including Forest Buffalo, Black Duiker, Yellow-Backed Duiker, Maxwell's Duiker, West African Chimpanzees, Olive Colobus, and the Lesser Spot-Nosed Monkey.

Proposed protected areas have also been identified through a comprehensive prioritization exercise that was conducted to harmonize the biological, social, political, economic and cultural significance of potential protected areas (Table 5; Table 6). This prioritization process included the following considerations: Biodiversity Richness; Biodiversity Endemism; Level of Threat; Existence of socio-economic and biodiversity data; Possibility for corridor or trans-boundary area creation; Potential/ availability for funding; Other land use opportunities; Management capacity; Uniqueness of habitat; and, Population density. Efforts to officially gazette the proposed protected areas will involve a "community mapping" approach. The maps will be useful to resolve land conflicts and inform dialogues and negotiations between communities, government agencies and conservation organizations. Management plans will result from these participatory processes and may involve the establishment of co-management schemes with the local communities and pilot the establishment of community resources management areas for the exclusive management by fringe communities. All communities within and fringing each proposed PA will be mapped. The community natural resource management committees will be established and supported to participate in reserve management planning. Two management plans will be prepared in collaboration using community participatory approaches and data from biological surveys and community outreach programs. Many of the proposed protected areas include sites that are currently designated as National Forests (Table 5; Table 6).

Table 5. Designated and Proposed Protected Areas in Liberia.

Site	Status	Area (ha)	Oversight
Sapo	Designated National Park	180,363	FDA
East Nimba	Designated Nature Reserve	13,500	FDA
Lake Piso	Designated Multiple Use Reserve/Ramsar site	97,159	FDA/EPA
Wonegizi	Proposed National Park; Partially in N. Lorma Natl Forest	29,894	FDA
Gola	Proposed National park; Largely in Gola Natl Forest	97,975	FDA
Kpo Mountains	Proposed; Located partially within Kpelle Natl Forest	83,709	FDA
Wologizi	Proposed; Located largely within North Lorma Natl Forest	107,533	FDA
Grebo	Proposed; Located largely within Grebo Natl Forest	97,136	FDA
Nimba West	Proposed; Located largely within W.Nimba Natl Forest	10,482	FDA
Bong Mountain	Proposed	24,822	FDA
Foya	Proposed	164,628	FDA
Grand Kru-River Gee	Proposed	135,100	FDA
Margibi Mangrove	Proposed	23,813	FDA/EPA
Senkwehn	Proposed	80,348	FDA
Zwedru	Proposed	63,715	FDA

Table 6. National Forests in Liberia

Site	**Area (ha)**	**Management**
East Nimba	28,966	FDA
Gbi	32,930	FDA
Gio	66,969	FDA
Gola	206,995	FDA
Grebo	260,462	FDA
Kpelle	174,828	FDA
Krahn-Bassa	513,962	FDA
Lorma	71,226	FDA
South Lorma	43,506	FDA
West Nimba	12,950	FDA
Yoma	2,649	FDA

Transboundary conservation

Liberia is located at the core of the Upper Guinean rainforest, and therefore plays an important role in transboundary conservation. A variety of transboundary sites have been identified as conservation priorities, but most areas are not fully protected and subject to a variety of threats:

- The Nimba Highlands are a transboundary mountain range on the border between Guinea, Côte d'Ivoire and Liberia, stretching over 40 km and rising to 1,752 m in altitude. In Liberia, the Nimba Highlands are managed in the East Nimba Nature Reserve (13,560 ha), and the West Nimba National Forest (10,482 ha), which are dominated by a semi-montane and deciduous forests. The Nimba Mountains in Guinea and Côte d'Ivoire were declared a Strict Nature Reserve in 1944, and the reserve extends over a total area

of 17,540 ha, with 12,540 ha in Guinea and 5,000 ha in Côte d'Ivoire; this area was designated as a Biosphere Reserve in 1980 and a World Heritage Site in 1981. This transboundary area is designated as a priority zone in the USAID/West Africa STEWARD program, which overlaps with USAID/Liberia investments in the PROSPER community forestry program.

- Gola Transboundary Peace Park aims to unite the Gola Forest Reserve in Sierra Leone and the Lofa and Foya Forest Reserves (i.e., proposed Gola National Park) in Liberia.
- The Wonegizi Mountains are proposed as a National Park in Liberia, and situated in the north-west of Liberia along the international border with Guinea, contiguous with the Massif du Ziama Biosphere Reserve in Guinea. This transboundary area was considered as a potential priority zone in the USAID/West Africa STEWARD program.
- The proposed Grebo protected area situated in the southeast of the country and is contiguous with the Forêt Classée du Cavally and Taï National Park in Côte d'Ivoire. Grebo is also located in close proximity to Sapo National Park, and thus formal designation would represent an opportunity to create a significant biological corridor between these protected areas across this border.

Conservation Outside of Protected Areas

More than 97% of Liberian territory is located outside of the protected area network. Conservation efforts outside of the protected area system have been very limited. Although many areas in Liberia have been identified as proposed protected areas through extensive stakeholder processes (Table 5), "proposed" status confers no formal resource protection, and legal designation has remained elusive, despite investments from the donor community in the Consolidation of Liberia Protected Area Network Program (COPAN) and Expanding the EXPAN projects of the World Bank and partners.

Designations from external groups exist which may facilitate conservation efforts. For example, five Ramsar Wetland sites of International Importance have been designated in Liberia (Table 1), some of which overlap with existing protected areas. Similarly, Bird Life International has identified nine Important Bird Areas (IBAs) in Liberia, covering about 630,267 ha or six percent of the land area of the country (Figure 6; Table 7); Cape Mount IBA is also classified as a Marine IBA. IBAs are key sites for conservation that are small enough to be conserved in their entirety and are often already part of a protected-area network. Three Liberian IBAs are legally protected (Nimba, Cape Mount, and Sapo); four IBAS are located within existing National Forests or proposed protected areas (Wologizi, Wonegizi, Lofa-Gola-Mano, Grebo); and two have no form of legal protection (Zwedru, Cestos:Senkwen). Liberia is also host to one Endemic Bird Area (EBA), the Upper Guinea Forest; EBAs are globally significant regions of the world where the distributions of two or more restricted-range species overlap. Although IBAs and EBAs are identified on the basis of their significance to bird conservation, these sites are partly selected by their distinctive biophysical conditions and habitat characteristics, which are also important to other taxa and ecosystem function.

Figure 6. Location and size of Important Bird Areas in Liberia (BirdLife International)

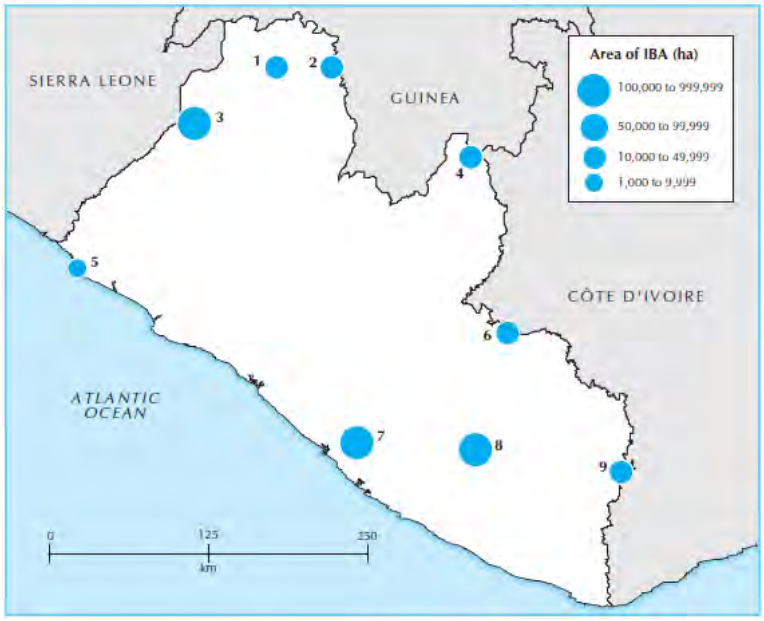


Table 7. Important Bird Areas in Liberia: Map reference, name, area.

Map #	Name	Area (ha)
1	Wologizi mountains	20,200
2	Wonegizi mountains	20,235
3	Lofa-Gola-Mano Complex	210,650
4	Nimba mountains	20,240
5	Cape Mount	4,560
6	Zwedru	15,000
7	Cestos: Senkwen	146,800
8	Sapo National Park	180,432
9	Grebo	12,150

Climate Change

Potential climate change impacts in Liberia were recently evaluated for USAID/Liberia by Stanturf et al. (2013). Much of the information presented here is from that reference, although some interpretations on threats and opportunities have been included based on our stakeholder interviews. Attitudes about climate change varied considerably among stakeholders, depending on level of awareness, understanding, and overall concern about potential impacts to ecosystem goods and services. In general, concern and adaptation strategies for potential climate change impacts are focused primarily in the agricultural sector, especially due to uncertainties and shifts regarding the seasonality and extent of rainfall. These same rainfall trends are apparent across all of West Africa (Jalloh et al. 2013). Coastal environments are also subject to potential sea level rise and increased storm surge. Potential impacts to forest resources are less well known.

Modeled Impacts

Because of the complexity of correctly reproducing a number of key features of the atmospheric circulation patterns over West Africa, projections of rainfall by climate models are mixed and uncertain.

For instance, modeling projections of among three representative meteorological stations in Liberia—Monrovia, Nimba, and Sapo National Park—provided mixed and inconclusive results, though the general trends are for a warmer and wetter climate in most of the country by 2060 (Stanturf et al. 2013). For temperature, predicted changes by 2060 suggest that increases in high temperatures will be less than 2°C throughout the country but average low temperatures (i.e., nighttime temperatures) will increase more than 2°C in the interior. During the wet season (May to August), the expected increase in rainfall will likely be focused along the coast with inland regions experiencing normal to slightly reduced rainfall. 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).

Vulnerabilities

Assessing the vulnerability of natural and social systems in Liberia is made difficult by the lack of current data. Stanturf et al. (2013) modeled current and future climate to 2060 using statistical down-scaling from Global Circulation Models (GCM) incorporating weather data from the World Meteorological Organization (WMO) reporting stations in surrounding countries.

Social systems

A Social Vulnerability Classification was constructed from 18 spatially referenced variables based upon county-level 2008 census data or other reports of 12 social attributes, and used the current condition of the population as a starting point for determining vulnerability to potential climate change conditions. By combining the aridity change with social vulnerability, they predicted where the strongest climate change effects would be experienced, and found that populations in Grand Cape Mount and Bomi Counties will experience the most climate change.

Agriculture

Effects of climate change on agricultural production are the most likely in the interior counties of Bong, Lofa, and to a lesser extent Nimba. These were the primary agricultural areas before the conflict; these areas are the most likely to experience higher temperature maxima and altered rainfall patterns under the projected future climate. Upland rice, the predominant cropping system, will be impacted by changes in seasonality of precipitation. Cassava, on the other hand, is adapted to high temperatures, drought and erratic rainfall.

Forests

Even though projections of precipitation change are too model-dependent to say that climate change will impact tropical forests in Liberia directly, the change in aridity may indicate where forests are most at risk from the combined effects of human disturbance and climate change. The change in aridity (from statistical downscaling) indicates that forests in eastern Liberia are the most likely area to be impacted by the “drier” climate in 2050.

Coastal

Coastal ecosystems are at risk from sea-level rise, with projected increases over the next century from less than 1 m to over 2 m. In addition to the general rise in mean sea level, storm surges will impact most urban areas of Liberia. Mangroves also provide many ecological goods and services for Liberia’s coastal communities. Reduction in area of the mangrove wetlands could result in a loss of buffering capacity from violent storm surges; increased coastal erosion; exacerbated terrestrial flooding; and, reduced supplies of coastal timber, fuelwood, and medicinal plants.

Fisheries

Little is known about the inland fishery in terms of rates of exploitation, diversity and status of fishes exploited, number of fishers, and state of the aquatic ecosystem, thereby making projections of climate change impacts virtually impossible beyond broad generalizations. Precipitation and evapotranspiration changes, including an increase in extreme events (e.g., exacerbated floods, extreme drought), could affect inland waters, causing changes in magnitude and timing of high and low river flows. These kinds of hydrological variability could adversely affect fish habitats, reproduction, growth, recruitment, and mortality. Projections of change to the marine fishery are likewise premised primarily on generalization because of a lack of information on that resource. The most prominent effect of climate change on marine productivity and ultimately the fishery could be increased sea temperatures, though a full mechanistic understanding of temperature-driven marine upwelling is lacking. A recent study that developed a national-level vulnerability index specific to food security policies measured relative vulnerabilities to a decline in coral reef fisheries due to climate change and anthropogenic disturbances, and concluded that Liberia was among the most vulnerable countries (Hughes et al. 2012). Liberia's vulnerability was attributed to very high sensitivity to declines in coral reef fisheries and the very low levels of adaptive capacity.

Current state of Liberian NRM data

Liberian NRM data is not very abundant and those data that do exist is not well documented or easily available. Data is currently being held by a variety of government agencies and ministries (e.g., LISGIS, FDA, MLME), donor organizations (e.g., UNDP, World Bank, USAID), and NGOs (e.g., SAMFU, CDI, CI, FFI, WRI). The previous ETOA (USAID 2008) provided a thorough description of the poor state of information management in Liberia. In our view, not much has improved or changed with respect to NRM data in Liberia since 2008; in some respects, coordination of information sharing may well have gotten worse.

Although strictly environmental data—such as land cover or hydrology—is important, the availability of relevant, non-environmental data (e.g., population, roads) provide critical context to inform NRM decisions. A complete census of all NRM data and information could not be accomplished as part of this mission. The information presented below is a compilation of information gathered from interviews, web searches, and other comprehensive reports. We have chosen to present our findings in two general data categories: spatial (mapped data) and inventory (field-acquired data). Inventory data will often have a spatial component, such as Global Positioning System (GPS) plot locations or survey boundaries. A common classification (i.e., definitions such as "forest") link between the spatial maps and inventory data can serve as an important mechanism to leverage the information gained from spatial and inventory data.

Spatial Data

As part of their Liberia Land Policy and Institutional Support (LPIS) Project, USAID/Liberia has reported on the current state of spatial data infrastructure in Liberia (Musinguzi 2013a). This is a thoroughly researched and valuable resource where the current state of all spatial data in Liberia is summarized as…

> *"…collected without using any specific standards and there is a lot of duplication in spatial data collection efforts. There is a general lack of documentation for spatial datasets in the custody of various agencies. Thus,* ***it is not possible for a potential data user to search, discover and understand the type and quality of spatial data existing somewhere in any of the institutions in Liberia.****"*

Musinguzi also identified some general reasons for data accessibility problems in Liberia (2013a):

1. *Lack of coordination; Because of no institutional mandates for capture, custody and maintenance of spatial datasets, different institutions are collecting data according to their own needs and methods.*
2. *No data standards; including data collection methods and documentation (i.e., metadata) on the appropriate uses of such data.*

The data accessibility issues stated above were reiterated by many of the stakeholders we interviewed and they confirmed that acquiring spatial data from GOL Ministries was difficult, time-consuming, and sometimes impossible. There is no spatial data policy for Liberia; as such, there is no consistency with respect to the concept of "public" data and unencumbered access to GOL data.

Musinguzi's report (2013a) details the types of spatial data collected and managed by GOL Ministries. The bulk of environmental spatial data is managed by the LISGIS, the FDA, and, to a lesser degree, the MLME. LISGIS is typically identified as the leading GOL institution and clearinghouse for the management and dissemination of geospatial data, which was repeated in our meeting. However, our team was unable to acquire copies of their data during our visit, nor was a data dictionary identifying specific data layers and attributes available. However, Musinguzi (2013a) identified a number of datasets in the possession of LISGIS (Table 8).

Table 8. Datasets in the custody of LISGIS (Musinguzi 2013a)

Dataset	Remark
Administrative Boundaries	This is collected using handheld GPS and includes counties, districts, clans and settlements. The files are stored as ESRI shape file vector polygons.
Road Network	This is collected using handheld GPS and is stored as ESRI shape file vector lines. Topological information such as nodes and segments are included but are defined by the Ministry of Public Works.
Land cover	This is compiled from satellite imagery and stored as ESRI shape file polygons
Hydrography	This is compiled from satellite imagery and stored as ESRI shape file lines
Population	This is stored in the form of ESRI shape file points corresponding to settlement area centroids. A point is plotted at the center of a settlement and the population for the settlement is entered as an attribute in the theme attribute table.
Topographical base map	Base maps were acquired from the Liberian Bureau of Cartographic Services in the Ministry of Lands, Mines and Energy as hardcopies. They were scanned, geo-referenced and are supplied as raster images. The data dates back to 1960s and 70s and covers ~70% of the country.
Satellite imagery	These are high resolution images for urban areas for which other vector datasets are extracted
Health facilities	Point data showing the location and type of health facility
Education: Schools	Point data showing location of schools and other attributes such as enrollment
Other layers	LISGIS plans to capture other data layers such as land use, land parcels, addresses and utilities.

Our team also identified additional data within their geospatial filing structure (i.e. beyond Table 8), including digital elevation models. The quality of the above data was not evaluated, but we presume low to moderate quality with incomplete or no documentation.

The FDA is the managing body for forested lands in Liberia. The FDA has a staff of qualified GIS analysts that manage its data but according to Muzinguzi (2013a),

> *"The FDA does not continuously compile a national dataset of forest cover or land cover as it is the case with similar agencies in other countries. Instead, most of the spatial data collection activities initiated by FDA have targeted concession areas. FDA therefore maintains scattered forest inventory datasets around concession areas as well as other datasets that are relevant to the management of forest."*

Our interview time did not allow for a technical discussion with FDA analysts to ascertain the depth and quality of spatial data managed by the FDA. However, based on interviews with NGOs (e.g., FFI, CI), the FDA has the best available data and readily shares data with other stakeholders.

Several Bureaus and Departments within MLME also manage geospatial data, including topographic maps and hydrologic surveys conducted by the Department of Lands, Survey, and Cartography. However, many of these resources are scanned paper maps without sufficient attribute information. Our interview with MLME mining staff suggested that they have high quality mineral exploration data, but it was unclear whether these data are produced by the private sector mining corporations or collected by MLME.

Other environmental spatial data collected by NGOs or international donors are not archived or managed by GOL Ministries. LISGIS does not function as a centralized 'clearinghouse' for these data. Examples include the USGS and the GeoCommunity. A full examination of these data was beyond the scope of this mission, but we suspect that similar problems with data standards and consistency exist.

One significant shortcoming in spatial data is the absence of a map showing all current concessions for minerals, timber, and agricultural plantations. During our interviews we heard repeatedly of overlaps between concessions, and between concessionaires and communities. A comprehensive concessions map is recognized by all stakeholders, including GOL Ministries, as essential information for effective land use planning. This is a recognized gap and discussions are underway with the NBC, other GOL Ministries, and the larger NRM stakeholder network to develop GIS capacity in the NBC to enable mapping of concession areas.

Inventory Information

During most interviews with GOL Ministries, donors and NGOs, there was strong consensus regarding the lack of inventory data for a range of environmental variables. For instance, there are major data gaps for faunal and floral taxonomic taxa, as described previously. Similarly, inventory data on basic biophysical characteristics is also non-existent or very coarse. This includes soil characteristics, hydrologic features, and meteorological data that would be useful for sub-national environmental assessments and analysis. The only soil survey conducted for Liberia was a reconnaissance survey completed in 1951 at a very coarse scale (USDA 1951). However, there was considerable laboratory analysis conducted on the physical and chemical properties of soils that could be very useful if a more refined soils map were to be developed.

The first forest inventory of Liberia was conducted in 1968 (Sachtler 1968). Many Liberian NRM professionals still consider this the only thorough inventory in existence. There have been several assessments of Liberia's forest cover since then (Hess and Trainer 2006; Shearman 2009), and GeoVille GmbH and Metria AB (2011) provide a relatively comprehensive evaluation of these assessments. Useful

inventory information, especially with respect to forest resources, requires a robust classification system to compare and contrast data classes with respect to important metrics such as merchantable volume or wildlife habitat suitability. Moreover, the chosen forest classification needs to be linked to the map unit design process to generate spatial depictions of forest resources. With respect to the recent forest assessments (Hess and Trainer 2006; Shearman 2009), GeoVille GmbH and Metria AB (2011) concluded:

> *"that despite several ambitious studies to assess the forest cover and condition in Liberia, none of the reviewed reports have used a forest classification methodology that provides an objective and comprehensive assessment of the extent of the forested area of Liberia. Available timber volumes and allowable annual cuts at the level of detail and accuracy needed for forest management planning and assignment of concessions are thus also currently lacking*."

Critical Data Gaps for Effective NRM and Possible Intervention Opportunities

One of the critical environmental spatial layers currently available is the mapping effort conducted by Bayol and Chevalier (2004). This is the most comprehensive national land cover/land use map data that is available for Liberia. However, there are some limitations with these data that limit their usefulness for sub-national or local-level analysis, as noted by GeoVille GmbH and Metria AB (2011). Because this data layer was produced in 2004, an updated land cover and land use database of adequate thematic and spatial resolution is warranted to reflect current forest conditions. This effort would be most useful in natural resource management efforts if coupled with a strategic forest inventory and monitoring system. These efforts should use a common forest classification system so that forest classes can not only be mapped adequately using current remote sensing technologies but also so that forest classes are meaningful for a variety of comprehensive natural resource interpretations (e.g., timber volume, carbon estimates, biodiversity metrics, wildlife habitat suitability). The FDA mentioned that a Terms of Reference has been written for development of an updated land cover map but the status of this proposed project is unclear.

This classification, mapping, and inventory effort should utilize current forest cover mapping efforts as is being done by World Resources Institute in their Global Forest Watch Program. Analyses of forest cover change are most useful if they are coupled with data that describe forest cover change (e.g., from primary forest to agricultural land) and the implications for forest resources can be quantified using inventory metrics associated with those classes. U.S. Government (USG) agencies such as USGS and the USFS have extensive expertise in this work and are prospective partners.

Additional baseline biophysical spatial layer development is needed. This should include improved terrain mapping and development of a higher resolution digital elevation model (DEM) than the current SRTM 90 meter DEM. Other biophysical layers needed for effective NRM include hydrologic and wetland mapping, especially given the GOL emphasis on promoting swamp rice cultivation to reduce upland shifting cultivation. A spatial layer depicting site productivity is also needed. Although detailed soil mapping is appropriate for this need, the likelihood of producing a product of sufficient accuracy and precision in the near future is low. Instead, a site productivity map derived from terrain modeling of topography produced from an improved DEM, along with geologic, climate, and hydrologic information may suit the immediate needs of the agricultural sector. The site productivity classification scheme and the map unit design process would need to be devised by stakeholders who would be the beneficiaries of these data. USG agencies such as the USGS and ARS would be prospective partners for this effort

The details of charcoal production and distribution—as well as the social, economic and environmental effects—are largely unknown. During the short field visits outside of Monrovia included in the ETOA itinerary (Annex A), charcoal was the largest apparent commodity for distribution and sale second only

to cellphone scratch cards. There are no data reflecting the production (amount, harvest sites, species), distribution, and market analysis (use, profitability, livelihoods).

The absence of wildlife population data will hamper successful implementation and monitoring of the potential new Wildlife Law. A statistical survey of population numbers, critical habitat requirements, along with monitoring criteria for managed species will be necessary. These data will help clarify the impact of many associated practices, including the effects of bushmeat hunting.

As noted in this document and others, geospatial information management capacity and data dissemination in Liberia is poor. The Spatial Data Infrastructure (SDI) proposed by Musinguzi (2013a,b,c) should be supported to promote improved information management and build capacity for geospatial data utilization and understanding. A good example of base-mapping and a national spatial data infrastructure currently being developed and supported by USG agencies (among other nations) and the US private sector is the Indonesian Geospatial Information Agency and the One Map initiative.

There are several elements that are missing in the Musinguzi proposal from an NRM perspective, including several of the above elements to address critical information gaps (e.g., land cover/land use, wetlands, and site productivity). In our opinion, the SDI proposal as presented may be too large for the current political climate and funding mechanisms to accept all its recommendations. This proposal might best be presented in a phased approach:

1. Establish an SDI oversight committee and a technical working group to determine the scope, timing, roles, and responsibilities of Liberia's SDI implementation. Pursue legislation that makes information management and coordination legally binding, knowing that formulation and passage of such legislation may take as long as implementation of the following phases.
2. Construct comprehensive core datasets and publish those on a publicly accessible data server. This would essentially be a prototype of how inter-agency coordination and cooperation in the development and management of spatial data would happen. The initial core dataset would only be comprised of less than 10 easily compiled datasets that would be beneficial to all stakeholders involved.
3. Expand the core dataset to include a data dictionary of all geospatial library data needed by GOL Agencies and Ministries and determine data steward responsibilities. Establish SDI best practices for data dissemination and analysis.

At a minimum, some sort of geospatial consortium should be established in Monrovia to promote collaboration among stakeholders with respect to the sharing of geospatial ideas and data. This consortium would be composed of geospatial analysts and technicians (i.e., not managers). It should be structured to facilitate open discussion of geospatial issues and challenges with the primary goal of improving data coordination between GOL Ministries and other stakeholders. Such a consortium would also help build geospatial capacity among participants and likely lead to the generation of new and higher quality data.

Liberian human and institutional capacity for NRM data collection and management

The human and institutional capacity for effective NRM is quite variable. Most donor agencies and NGOs have identified capacity as a major impediment for GOL Agencies and Ministries to implement their mandates. Capacity, however, is a multifaceted concept that includes far more than funding, workshops,

training and equipment such as computers or trucks. Capacity can be generalized into physical or intellectual categories, but components of natural resource management capacity include NRM policy, education, a culture that promotes a dedication to civil service, and continuing education for professionals.

Our brief assessment of Liberian NRM human and institutional capacity yielded interesting and surprising results. We often found a dearth of personnel, skills, and equipment, but we also found incredibly competent and skilled people in some of the least likely places. There are certainly "diamonds in the rough" scattered amidst the Liberian NRM landscape, but one thing that stood out for us is that the majority of Liberians—whether working for the GOL or NGOs—are passionate about their country and the natural resource challenges it faces. If passion and willingness to learn can be considered the seed bed for capacity, there is certain fertile ground to be sown.

Although we interviewed many different NRM stakeholders (Annex B), we did not meet with any county or local-level government institutions. These entities may also be potential partners HICD and data collection studies.

NRM Policy

The comprehensiveness of many of Liberia's NRM laws highlights the fact that capacity, at least from a policy perspective, is achievable. Although there may be some gaps and flaws, these legal instruments provide a solid foundation for good NRM. One important NRM law that is currently waiting for passage in the legislature is the draft Wildlife Law. This important legislation is critical for managing, regulating, and protecting both endangered and abundant fauna. Additional regulations are needed for the forestry sector, which currently exist in draft form but require regional consultation prior to final approval: abandoned timber, confiscated timber, timber in transit, imported timber and third party access in concession areas. Also, consultations on draft PUP regulations have begun, but national consultation is not yet complete and county-level engagement is also required. As many of our interviewees noted, even with the finalization of these wildlife and forestry laws and regulations, the challenges of implementation and enforcement remain.

The Education System

Because of the civil conflict during the 1990s, education of Liberia's youth was stalled. As society has been rebuilding, the main focus of improving the primary and secondary education system is to instill basic literacy skills for students, and there has been little opportunity in the curriculum for environmental education and ethics. As Liberia recovers from this lost generation, incorporating environmental themes into primary and secondary education systems should become a priority. For post-secondary education, staffs at the University of Liberia, Cuttington University, and the Forestry Training Institute are well aware of the challenges in preparing students for careers in NRM. Each institution is revising their curricula to better reflect comprehensive and emerging issues such as geospatial sciences and climate change, but they all acknowledge that their teaching staff may not be appropriately trained for these topics. Among the Liberian professionals that we interviewed, we noted that most of the high-capacity individuals able to effectively manage their programs were educated outside of Liberia (e.g., Ghana, South Africa, United States).

Key Liberian Institutions Responsible for NRM Data Collection, Management, and Analysis

A variety of Liberian agencies and ministries are responsible for different aspects of NRM data collection, management, and analysis. There was a difference in opinion among these stakeholders whether Liberian universities are adequately preparing students for careers in environmental sciences.

However, one unanimous point among GOL stakeholders was the lack of incentives for young professionals to pursue a career in civil service. The earning potential in the private sector or NGOs is considerably higher than what the GOL can offer and therefore, recruitment for these agencies or ministries is very difficult. Even if young professionals are hired into civil service, once they are trained and gain some skill, they leave soon after for better paying jobs. The resulting rapid turnover rate is a considerable drain on already meager resources.

We present a synopsis of the capacity "insights" gained through our stakeholder interviews. Although a common refrain was the lack of physical capacity (e.g., trucks, fuel, computers) to collect, manage and analyze NRM data, we were specifically interested in evaluating intellectual capacity.

EPA
The EPA staff that we interviewed was very straightforward in their admission of internal capacity issues. They seemed to have a solid understanding of their mandate and were very passionate about it. They felt their field staff had the technical knowledge to adequately perform their jobs. Although this may well be true for collecting data, we question whether EPA staff has the requisite skills to adequately review the quality and quantity of ESIAs completed by government certified consulting companies. The EPA fully acknowledges deficiencies in internal capacity for geospatial data management and analysis.

FDA
The FDA stressed their desire to hire new, young staff so that they can be mentored by current staff that is reaching retirement eligibility but current funding does not make this possible. They also identified a need for some training opportunities and short courses to build capacity in protected area management and conservation. A point of frustration for FDA is that there is a significant amount of donor funding being directed towards FDA work but for which FDA receives little, if any, capacity improvement from those investments. In addition, this same donor funding has reduced the annual appropriations from the GOL for their operations. The FDA appears to be one of the few GOL institutions that has internal geospatial capacity and data.

LISGIS
The strength of the LISGIS is in demographics and census data, not in environmental data collection and management. The LISGIS geospatial staff is relatively small compared to the other departments. The GIS skills within LISGIS appear to be primarily cartographic with limited analytical capability. They do feel that they are a geospatial resource available to all GOL institutions but they acknowledge that fundamental remote sensing and image interpretation skills are lacking within their staff.

MOA
The largest identified gap at the MOA is insufficient training for field assessments of concessionaires. Palm oil is a relatively new industry in Liberia, with a rapidly expanding footprint, but there is a fairly limited understanding of the industry within MOA. There is also a lack of soil chemistry skills and a lab for which to analyze soils. The MOA has no geospatial capacity within its staff. Capacity to address current and potential threats from invasive species is also weak. Outstanding needs include an expert review of species worldwide that are capable of successfully establishing in Liberia (i.e. risk assessment), and the development of a reporting system for key invasive species considered to present significant risk.

MLME

The MLME concedes that they are severely affected by 'brain drain' and those personnel who are trained and qualified leave for higher paying jobs in the private sector. The same is true for recent university graduates in mining sciences and engineering; civil service cannot compete with private sector wages so the ministry is having a difficult time maintaining a quality staff. MLME appears to have adequate geospatial capacity but coordination with LISGIS has not been good and they acknowledge that MLME, MOA, FDA need to be using the same map to improve coordination of concessions.

Land Commission
Although the Land Commission does not collect or manage NRM data, their role in land tenure issues is paramount to effective natural resource management. Currently, they rely solely on LISGIS for GIS support but with the forthcoming establishment of a new Lands Agency, there will be a strong need for geospatial skills to manage any national cadastral survey.

NGOs
Within Liberian NGOs, there are incredibly skilled NRM professionals in a wide spectrum of disciplines for data collection and analysis, but these jobs tend to be short-term. The majority of skilled "permanent" personnel are generally not Liberians. Liberians working on longer-term contracts with NGOs tend to possess good management and communication skills rather than technical NRM skills.

Cross-Cutting Capacity Issues

There are very few individuals who are taking a holistic view of NRM in Liberia. There is little mention of the need or benefits for cross-sectoral land use planning. Each agency or ministry seems to be relatively focused on specific environmental issues and how to address them within their mandates. However, a better understanding of landscape ecology will help to strategize the use of limited resources for the most benefit. This lack of a landscape-level perspective leads to widespread misunderstanding of environmental effects. Although most NRM professionals in Liberia understand direct effects, we observed that indirect or cumulative effects of NRM activities across large landscapes are rarely acknowledged.

A landscape-level perspective is inhibited by a lack of inter-agency coordination. NRM professionals from different agencies or ministries do not appear to have opportunities to collaborate with their colleagues in informal, problem-solving activities. The interaction between NRM professionals is reactive to pressing issues or information needs strictly as a result of daily business needs. The capacity to provide an atmosphere of proactive, mutually beneficial collaboration is absent and as a result, there are many missed opportunities to develop a bigger picture perspective of NRM in Liberia.

As noted earlier, spatial data in Liberia is lacking and of those data that exist, the quality is generally poor or unknown. Our assessment from interviewees is that those skilled in GIS software are limited, and the use of GIS is primarily as a cartographic and map-making tool. In most GOL institutions, GIS is not being used as an analytic tool to support any landscape level planning or environmental effects analysis. These observations were also documented by Musinguzi (2013a):

> *"Development and maintenance of spatial databases requires specialized skills in spatial data capture, database management, IT/application development, image interpretation/analysis and GIS modeling. These skills are substantially lacking in Liberia and evidence of ongoing efforts to address the capacity gaps was not noticed. We identified that most agencies that have acquired GIS software have used it essentially for mapping and graphically displaying their resources/assets."*

Possible Capacity Development Interventions

Successful capacity building initiatives are accomplished by using mentors and building long-term relationships. Short-term trainings with intensive coursework and field experience may be effective tools, but only if they are preceded by preparatory work and followed by a period of implementation and evaluation. This has been reiterated in the Country Development Cooperation Strategy (USAID 2013): *"The Mission's experience over the past nine years confirms that successful capacity development requires strategic patience and persistent commitment over extended timeframes"*

Based on our interviews and research, we believe that, before a significant investment is made in capacity building for GOL institutions or individuals, an assessment of the recipient(s) should be done. The ability of certain individuals and the willingness, collectively by institutions, to comprehend and put into practice any training materials, are factors that need to be considered. Because of their lack of basic education skills, some individuals may not be good candidates for further training, or training should be tailored to their ability. In addition, some institutions, because of current leadership or their operations history, may not be good candidates for investment for limited capacity building funds. Therefore, we suggest a capacity assessment of the recipients be conducted prior to any future investment.

There is an abundance of institutional knowledge regarding natural resources in-country, including both Liberian nationals working for various GOL Ministries and NGOs, but there are also many expatriates with tremendous knowledge about Liberian NRM. However, there doesn't appear to be a mechanism for sharing knowledge between practitioners (i.e., "community of practice"), especially between GOL and NGO counterparts. The Liberian Forest Initiative (LFI) provided this platform through 2006, but that collaboration no longer appears very active. An invigoration of a forum such as LFI with a new focus on comprehensive environmental issues may be warranted.

Intellectual capacity needs across all NRM disciplines are great in most GOL agencies and ministries. Our interviews and research have led us to the conclusion that there are a few key institutions and partners that may be the best place to currently invest resources. In our estimation, the EPA appears to be well positioned to make progress on improving their NRM capacity. Although their 5 year strategic plan (EPA 2011) has been stalled due to funding, in our opinion it contains some excellent goals to be more successful at implementing their mandate. Notable goals include, among others:

- Deploy more and better trained field staff at the local level to ensure environmental compliance
- Establish better environmental education and public awareness campaigns
- Develop effective planning, monitoring, and reporting mechanisms
- Implement multi-lateral environmental agreements to address cross-cutting issues (e.g., climate change, ecosystem management)

Because their mandate is to work across all GOL Agencies and Ministries with respect to NRM, the EPA would be a good partner to eventually help build capacity across all sectors. Another GOL cross-cutting partner could be the emerging new Land Agency (which may logically absorb the existing Land Commission). Because issues of land rights and land tenure are at the root of most environmental conflict in Liberia, this is a logical choice for intervention. Based on information garnered from our interview with the Land Commission, this may well be the place to intervene with land use planning initiatives.

One NGO that appears to be good candidate for short-term interventions to improve NRM capacity is the Development Education Network – Liberia (DEN-L). DEN-L provides trainings for development and democratic participation, but their training model could be adapted to focus on environmental problem solving among diverse groups. The Development Education and Leadership Teams in Action (DELTA) training program "*is a one-month training divided in phases (phases one to four) spread over a period of one year. Each phase is one week and between the phases, (time, about three months) for participants to practice the learning."* Because of the length of the program and the requirement for "homework", we believe that this model could be successful in building NRM capacity and promote collaboration opportunities between stakeholders. In addition, the current staff and facility appear well capable of taking on this challenge.

The only way Liberia will be able to ensure sustainable, long-term capacity-building success will lie in the Liberian university system and a commitment to civil service by its graduates. Neither of these shifts will happen overnight, but there are short-term measures to get started.

Within Liberia, a community of practice focused on higher education should be encouraged, to promote the sharing of best practices and create new knowledge. Initially the emphasis could be on greater communication, information exchange, and leveraging resources between universities, community colleges, and technical/vocational institutes. This community could have components that address various elements, such as Education, Health, Democracy and Governance, and NRM. Given the vast need for rehabilitation and reform common to all higher education entities in Liberia, this community could be mobilized to focus on identifying priority needs (e.g., curriculum development, faculty training) and complementary roles of different educational entities to provide background, skills, and experience (e.g., NRM field experience from Forestry Training Institute versus classroom training from a university). Some work on these topics is being done, but a mobilized community of practice could provide additional momentum and longer-term sustainability to current projects. Over time, this higher education community of practice could engage with GOL Ministries, the private sector, NGOs, and other stakeholders to pursue opportunities for internships and employment.

In addition, external partnerships could be established between American and Liberian Universities. These partnerships could entail faculty and student exchanges. In addition, Liberian universities could be encouraged to work within regional education networks such as the African Network for Agroforestry Education (ANAFE), the African Forestry Research Network (AFORNET) and the Forestry Research Network for sub-Saharan Africa (FORNESSA). The curriculum changes proposed by UL and Cuttington University should be adopted immediately, and faculty exchanges could be arranged to provide the relevant faculty training for new courses. While Liberia has the basic capacity to provide vocational and higher-education-level training in agriculture and forest management, there is an urgent need for university-level training in conservation biology, conservation management, and land-use planning. Furthermore, currently there are no options for wildlife biology degrees in Liberia. One option would be partner with existing African universities (e.g., Tanzania College of African Wildlife Management) to assist students in acquiring doctorates in wildlife, who would then return to Liberia to establish a wildlife program in country. Alternatively, UL could host wildlife faculty from African universities. Liberian students also need to gain practical field skills and FTI appears to be the best Liberian facility to provide that technical training. Finally, Liberian students need to learn the value of civil service, and internship opportunities to work with American civil servants could help foster that.

We think a prime geographic location to help showcase some of these potential capacity interventions, in addition to some data collection needs would be the Lake Piso area. Although Grand Cape Mount is

not a USAID/Liberia focal county, it is close to the six focus counties, and there are multiple reasons to invest. Lake Piso area has a newly designated Multiple-Use Protected Area and is rich in ecosystem and biological diversity. Because of forest, ocean, and lake ecosystems in close proximity, it has considerable eco-tourism potential. There currently is a draft management plan for the area and an active site support group of community leaders and activists. Pragmatically, it is a relatively easy drive from Monrovia and is close to the Forestry Training Institute to provide practical field experience for their students.

Threats to Tropical Forests and Biodiversity

Although the majority of Liberia's ecosystems are currently functioning, there exist a variety of threats to those ecosystems that may have detrimental effects in the not too distant future. The civil conflict stalled the prior economic growth that was largely fueled by resource extraction. However, with recent civil stability, investment in growth sectors is likely to occur, and possibly at an extremely rapid rate given the wealth of relatively accessible natural resources and an accommodating political climate.

To better understand the current threats to Liberia's tropical forests and biodiversity, a review of previous assessments is helpful. Our findings concur with what was identified in both the 2008 ETOA and 2013 West Africa ETOA. We present a quick summary of those applicable findings and a re-evaluation of the most pressing threats specific to tropical forests and biodiversity.

Direct Threats

Activities that threaten tropical forests and biodiversity of the entire West Africa region, including Liberia were described in the 2013 West Africa ETOA and include:

- Conversion of forests into agriculture and tree crops (e.g., oil palm, rubber, cocoa, and small-holder encroachment) and the resulting loss and fragmentation of habitats.
- Mining extraction and exploration; both commercial and artisanal in scale.
- Infrastructure development (e.g., roads, dams, pipelines, power line rights-of-way).
- Climate change (e.g., habitat modification, alteration of rainfall patterns/events and temperatures, forest fires, outbreaks of pests).
- Wildlife poaching/trade/trafficking
- Unsustainable cutting of wood for fuel wood, charcoal, and illegal tree harvesting

Additional threats to freshwater, marine and coastal systems identified in that assessment include pollution, over-harvesting and destructive fishing, infrastructure development, oil and gas exploration, and conversion of mangrove forests. All of these are applicable to Liberia, although the effects of climate change on Liberian ecosystems are unpredictable and uncertain, as described above; in our opinion, other threats pose a greater immediate risk to Liberian forests and biodiversity.

The 2008 ETOA also provides a very thorough identification and description of the threats against all three general ecosystems--forest, coastal, and freshwater. That assessment determined that Liberia's ecosystems are threatened from a variety of fronts. Forest ecosystems were threatened by illegal and quasi-legal logging where government oversight was lacking pending true implementation of the 2006 National Forestry Reform Law. Shifting cultivation was identified as a threat but was not adequately quantified; a similar lack of data was found with our analysis. Bushmeat hunting was identified as a threat, but as with shifting agriculture, it was impossible to quantify. In 2008, agro-industrial crops were

identified as a low threat with the caveat that there may be economic pressure to expand these areas in the future; in our opinion the threat from agro-industrial expansion is highly significant and appears to be increasing. Additional threats identified were potential increases in mining concessions and invasive species. As with other identified threats, quantification of the current status of invasive species is unknown, but is anticipated to be substantial. The 2008 ETOA also identified a variety of threats to coastal and marine ecosystems that included over-exploitation of fisheries, beach sand mining, beach erosion, and mangrove loss. Similar to other ecosystems, threats identified for freshwater ecosystems included over-exploitation of the resource (i.e., over-fishing) and invasive species.

Our assessment concludes that one of the primary direct threats to tropical forests and biodiversity in Liberia is the **conversion of natural habitats to cropland, urban areas, or other human-dominated systems** (Table 9; Figure 7). The minerals, agricultural, and forestry sectors are all contributing ecosystem conversion, which also has important implications for the biodiversity of Liberia. For instance, the relative footprint of these sectors is similar in area (Figure 7), though some of these activities overlap in space and time. Robust, spatially referenced data collected at regular intervals are needed to derive a fuller understanding of land cover and land use dynamics. The conversion and degradation of natural habitats is primarily caused by:

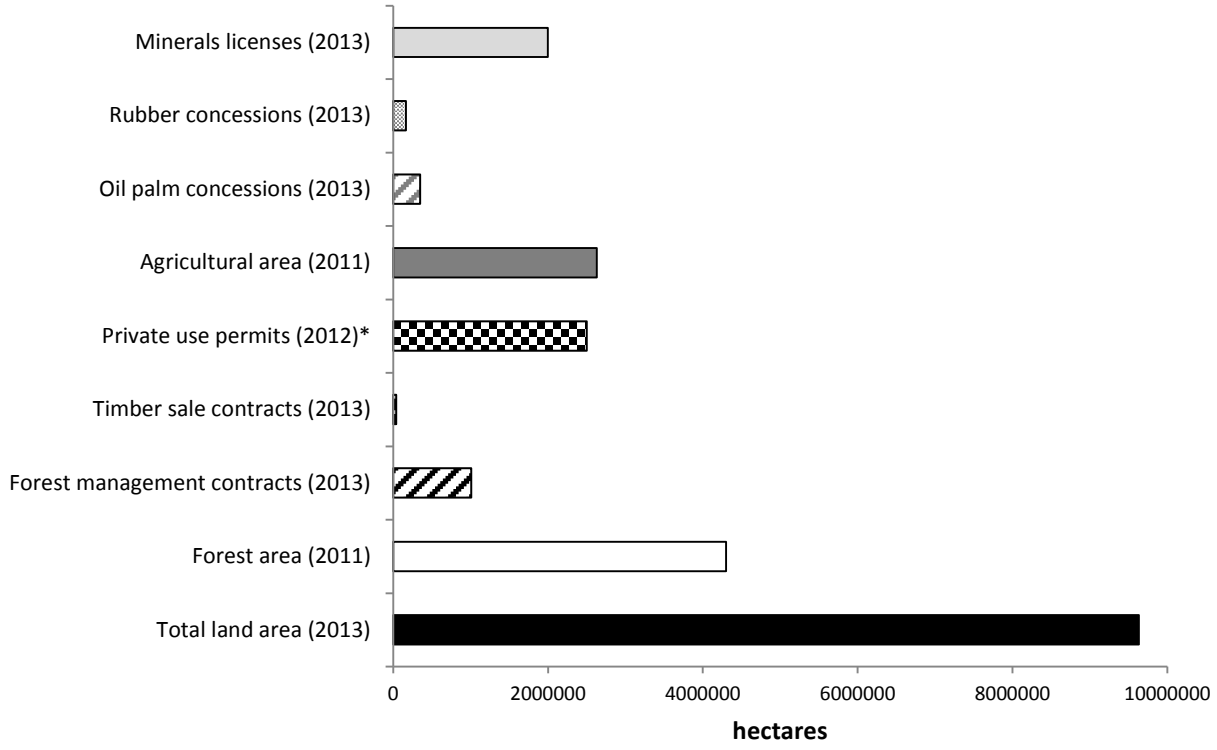
- agro-industrial plantations;
- shifting cultivation;
- extensive, excessive commercial logging;
- small scale chain saw operations for local markets and fuel wood and charcoal production (i.e.,"pit-sawing");
- mangrove loss (though we note that several sources indicated that recent mangrove conservation efforts were reducing losses);,
- swampland rice cultivation, which will likely increase as part of the GOL national rice strategy; and,
- mining (both minerals and beach sand).

Table 9. Selected patterns and trends of land cover and land use in Liberia (World Bank).

Indicator	Year			
	1990	1997	2004	2011
Forest area (ha)	4,929,000	4,719,000	4,509,000	4,299,000
Forest area (% of land area)	51.2	49.0	46.8	44.6
Agricultural land (ha)	2,493,000	2,520,000	2,595,000	2,630,000
Agricultural land (% of land area)	25.9	26.2	26.9	27.3
Arable land (ha)	350,000	370,000	380,000	450,000
Arable land (% of land area)	3.6	3.8	3.9	4.7

Indicator	Year			
Arable land (% of agricultural land)	14.0	14.7	14.6	17.1
Permanent cropland (ha)	150,000	150,000	215,000	180,000
Permanent cropland (% of land area)	1.6	1.6	2.2	1.9
Permanent cropland (% of agricultural land)	6.0	6.0	8.3	6.8
Land under cereal production (ha)	175,000	135,200	120,000	250,000
Land under cereal production (% of land area)	1.8	1.4	1.2	2.6
Land under cereal production (% of agricultural land)	7.0	5.4	4.6	9.5

Figure 7. Factors contributing to ecosystem conversion and degradation in Liberia (World Bank Databank 2011; LEITI 2013). * As described earlier, private use permits operations have been suspended after an independent body determined that these permits were being used widely in violation of the law. There are no active private use permit concessions at present.



The potential for significant increases in the size and number of agro-industrial plantations, especially oil-palm, is likely the largest contributor to ecosystem degradation and conversion on a per-hectare basis. In the absence of reliable quantitative and spatial data, however, the extent of this type of agricultural practice on deforestation rates in Liberia is not clearly understood. As detailed earlier, there are seven oil palm concessions in Liberia covering 348,196 ha (LEITI database 2013). Oil palm plantations are typically operated as a monoculture of species, with terraced landscaping and significant amounts of fertilizer. There is currently no independent monitoring of soil or water quality. The clearing of primary forests for large oil palm plantations has caused loss of biodiversity, habitat fragmentation, resource degradation, and an increase in greenhouse gas emissions, especially in Southeast Asia (e.g., Fitzherbert et al. 2008). However, there is also current research being conducted to quantify biodiversity and ecosystem function within oil palm plantations (University of Cambridge, Biodiversity and Ecosystem Function in Tropical Agriculture Project) and assist the oil palm industry to reduce the impact it has on wildlife (Zoological Society of London, Biodiversity and Oil Palm Project). During our interview, Sime Darby indicated that only secondary degraded forests were being converted to oil palm plantations, and that there is no conversion of primary or high-conservation value forest to oil palm plantations. The concept that a degraded forest has no conservation value, however, and therefore can be intensively managed without any significant biological diversity loss is a fallacy. Secondary forests provide

important habitats for both flora and fauna, and under the right conditions with appropriate management treatments (e.g., planting of native species), can develop back to primary forest over time.

Shifting cultivation is a practice that is widespread in Liberia and was commonly mentioned as one of the biggest direct threats to tropical forests and biodiversity by stakeholders that we interviewed. However, there is not much data available to quantify or support this, apart from generalized summaries that show that agricultural lands are steadily increasing, and forested areas decreasing, over the last several decades (Table 9), and there are many factors affecting both of these trends. The influence of agro-industrial plantations on shifting cultivation is unknown, though it may result in greater ecosystem conversion, because large-scale concessions eliminate access to some lands that were previously farmed by smallholders. For instance, if oil palm companies are converting secondary forests to plantations, smallholders displaced from these lands may clear other forested areas for their farming needs, including primary forests. If shifting cultivation is increasing in use, and as a result, primary, high-conservation forest is being cleared, then it certainly is a major threat to those species that depend on those habitats. However, the true spatial extent and timing of shifting cultivation practices is unclear. In addition, the effect of shifting cultivation on the provision of ecosystem goods and services in these transformed lands is unknown.

The National Rice Development Strategy of Liberia (Republic of Liberia 2012a) is aggressively attempting to double domestic rice production by 2018, which raises a number of potential environmental concerns. Historically, rice has been predominantly grown in upland habitats by smallholder farmers using slash-and-burn methods with minimal agricultural inputs, resulting in low yields harvested once per year; lowland habitats have not been farmed extensively for rice. This strategy aims to increase rice productivity in both upland and lowland ecosystems, but especially by expanding rice cultivation in the lowlands, where water resources are more abundant and climatic suitability is more favorable for higher productivity and more cropping cycles per year. In the last several decades, the land under cereal production—which includes rice—has dramatically risen, and represented 9.5 percent of all agricultural lands in 2011 (Table 9). The strategy proposes maintaining upland rice cultivation across 190,000 ha, but increasing productivity through improved methods and more cropping cycles; lowland rice cultivation is planned to increase from 22,000 ha in 2009 to 110,000 ha by 2018, and will also employ improved methods and more cropping cycles. Specific components of this strategy that raise NRM concerns include ecosystem degradation and loss due to the conversion of “virgin swamps” and manipulated hydrological cycles of lowland swamps from drainage infrastructure; and the use of chemical inputs such as fertilizers and pesticides. Overall, the rice strategy will result in a net loss of lowland swamps, which may include some wetlands. Although this initiative claims that “the proposed strategies will substantially improve the food security, environmental sustainability and livelihoods of both rural and urban communities,” there are no specific environmental safeguards identified related to ecosystem integrity or the safe use of agricultural inputs. For instance, monitoring is not mentioned, and this initiative does not appear to be using an adaptive management approach. From a public health perspective, there may be increased exposure to water-borne diseases by rice farmers in lowland swamps.

The production and distribution of charcoal is another practice commonly mentioned by stakeholders as a major threat to forests and biodiversity. Even with the limited travel our team did out of Monrovia, the charcoal production and delivery system was very evident. However, as with shifting cultivation, there is no data to support the impacts of this practice on different forest types. There is little information on whether charcoal is a primary by-product of shifting cultivation, whether it is a land-clearing activity

unto itself, or whether it may well be a sustainable, small-scale timber practice in forests that continue to maintain high biodiversity regardless of the practice.

In addition to conversion and degradation of natural forests, our assessment concluded that another primary direct threat to biodiversity is the **overexploitation of valuable species**. Unfortunately, as with most other threats identified, there are no comprehensive data to support this claim. This category of threats includes:

- Overexploitation of marine and freshwater resources, including fisheries, sea turtles, and mangroves.
- Although there have been no recent surveys to take stock of existing biomass, the BNF believes that demersal species are under threat from over exploitation from both commercial and artisanal fisheries. Since both fisheries and sea turtle population numbers and extraction levels in Liberia are largely unknown, population thresholds and dynamics are impossible to predict. The coastal zone is also heavily impacted by settlements and agriculture. Mangroves are being degraded due to over cutting for fuelwood, charcoal and construction poles and conversion to landfills, though reduction in these activities has been reported by stakeholders in Grand Cape Mount County. FAO (2005) reports that Rhizophora racemosa seems to have been eliminated in some places by extensive felling. Except for a few places in the central part of the country, primary mangrove forest has been replaced by secondary ones.
- Bushmeat hunting for subsistence and the commercial trade.
- The extent, severity, and historical trends of bushmeat hunting in Liberia are unknown, though evidence indicates that bushmeat is important to the diets and economies of rural populations in particular. There is a long cultural legacy of subsistence hunting of wildlife for nutritional needs, as well as commercial trade of bushmeat, and these activities are currently neither regulated nor monitored.
- Several recent studies have explored various aspects of the bushmeat trade in Liberia. In 2002, the Philadelphia Zoo partnered with Liberian university students to conduct a public opinion survey of more than 2,000 people, which estimated a total financial value of bushmeat at USD $78 million (Hoyt 2003). In 2003, a survey was conducted to investigate bushmeat markets in Monrovia and concluded that (1) bushmeat transport to Monrovia markets is unhindered; (2) much of this meat is exported, and Monrovia is the primary export hub; (3) bushmeat revenues are substantial, and provide livelihoods for many people, especially women; (4) Liberians consume bushmeat because of a taste preference; and, (5) more comprehensive surveys are needed to fully understand the ecological and socioeconomic impact of bushmeat hunting and trade in Liberia (CEEB 2004). Other investigations have focused on hunter demographics, hunting methods, and harvested species. For instance, survey efforts from 2011 in northern Nimba County determined that hunting was practiced exclusively by men, primarily between the ages of 30-49 years. These men hunted with guns and snare traps, primarily for protein (i.e. nutrition) but also to generate additional income from local, regional, and transboundary markets. Harvested species consisted mostly of ungulates and rodents,

with lesser quantities of primates, carnivores and pangolins (Bene et al. 2013). In the Sapo National Park area, empirical analyses indicated that domestic meat is rarely consumed compared to bushmeat and fish; there is no seasonal variation in bushmeat consumption; duikers comprise the majority of harvested biomass; income from the bushmeat trade is lucrative; offtake rates are unsustainable for some imperiled species; and, the road network is strongly associated with the bushmeat trade (Greengrass 2011). Less rigorous efforts have collected bushmeat occurrence at markets, with hunters, and in kitchens in and near Gola Forest, and found that harvests emphasized ungulates, primates and rodents (Davies 2012). While these analyses provide insights into bushmeat hunting, without more comprehensive, updated data, it is impossible to infer the effect of bushmeat hunting and trade on wildlife populations in Liberia.

- Illegal trade of live and dead wildlife and animal parts for pets, ornamental purposes (e.g., ivory carvings) and traditional uses such as medicine.
- Similar to bushmeat, the scope and ramifications of the illegal wildlife trade in Liberia on wildlife populations are unknown. Although Liberia is a signatory to CITES, banned items such as ivory, crocodile skins, and live animals for the pet trade are intercepted in Liberia. Points of origin include Liberia, Côte d'Ivoire, Nigeria, Cameroon, and Burundi, with intended destinations of Europe, Asia and the United States. There are some recent indications of progressively increasing levels of sophistication by traffickers (UNIDO, personal communication). As UNMIL and other foreign security forces withdraw from Liberia, this may pose an opportunity for increased wildlife trafficking, though baseline data is lacking.

Pollution is a threat not only to forests and biodiversity but also to basic human health. Improper waste disposal practices in much of the country threaten the access to and quality of drinking water and contribute to the spread of disease. Liberia continues to struggle with providing sufficient access to water and sanitation facilities, and this true for both urban and rural populations (Table 3). Solid waste management (e.g., disposal of hazardous materials such as pesticides) does not appear to be a major emphasis for investment by the GOL or the donor community. The need for improved solid waste management is anticipated to increase with economic growth, and with continued rural-to-urban migration. Pollution in the form of increased greenhouse gas emissions is also a threat from deforestation.

Introduction of non-native species is also a threat but the extent of their spread is currently unknown. Invasive species may outcompete native species for resources, often resulting in monocultures and loss of biodiversity, and changes in ecosystem function. For instance, there are many floral and faunal species that invaded Liberia over the last several decades (e.g., water hyacinth *Eichhornia* spp., *Leucenea leucocephalus* and *Chromoleana odorata*). The full impact of alien and invasive species on Liberian biodiversity is not well understood, because complete inventories are lacking, though the biophysical setting and climate is favorable to colonization by diverse taxa.

Indirect Threats

The underlying drivers that pose these direct threats are rooted in several categories and have been examined in the past. Almost all of the threats identified regionally for the West Africa ETOA (2013) are

applicable in Liberia. The underlying causes to direct threats are more comprehensively summarized in the 2013 West Africa ETOA, but can be generalized into a few categories: political, institutional, economics, social/cultural. The 2013 West Africa ETOA further detailed the indirect threats to biodiversity and forestry:

- Poor or weak governance, including inadequate coordination, corruption, and weak enforcement of laws, policies and NRM agreements
- Inadequate capacity at national and local levels for development planning and NRM
- Insufficient resources for NR and biodiversity conservation
- Weak or non-existent data coupled with poor monitoring practices, uncoordinated analyses and research systems needed for understanding resources, priority setting and effective policy and decision-making
- Inadequate coordination to protect high conservation value habitats
- Development plans and priorities do not adequately consider ecosystem services (e.g., forests, mangroves, watersheds, estuaries, biodiversity)
- Business practices skewed or do not adequately consider full range of social and environmental impacts
- Misguided incentives and undervaluation of goods and services provided by healthy, functional ecosystems

Similarly, the 2008 Liberia ETOA identified a suite of underlying causes of environmental degradation. These included institutional constraints where GOL Agencies and Ministries are not adequately funded, lack intellectual capacity, and are unable to enforce laws under their mandates. They also include no holistic approach to NRM and therefore an absence of any urban or rural land use planning to address the compromises needed to balance economic growth and environmental conservation needs. Insecure land and resource tenure, coupled with barriers to alternative livelihoods for rural communities, was also identified as a major threat due to the inextricable link between the environment, land, and poverty.

Currently within Liberia, the most prominent indirect threats to tropical forests and biodiversity are a synthesis of those that have been identified in the previous assessments mentioned above. For this synthesis, we group them into two general categories of indirect threats: (1) political, institutional, and macro-economic; and, (2) social, cultural, and micro-economic. Although there is overlap and interaction between categories, the potential environmental impact of these issues is significantly different by group. The threats posed by the first group can result in very large obvious consequences. The second group may only threaten to produce small-scale detrimental environmental effects, but can cumulatively pose significant threats and potential environmental impacts over large landscapes in Liberia.

The political environment includes several factors that influence NRM. One factor is the emerging influence of the private sector on natural resource management, particularly in the forestry, minerals, and agricultural sectors. The awarding of large-scale extractive concessions by the GOL, without any coordination between relevant Ministries and Agencies, is an alarming indication that short-term economic growth is overshadowing environmental sustainability and social considerations. Although recent passage of the Land Rights Policy is encouraging, the GOL has not demonstrated substantial progress with respect to natural resource governance since the last ETOA in 2008. For instance, the

recent PUP scandal has tarnished the timber industry; there is an apparent loss of political will to increase Liberia's Protected Area Networks, as outlined in the 2006 National Forestry Reform Law, despite donor support and engagement; local communities are protesting the loss of their community lands to concessionaires, including claims that required FPIC was not conducted; and, the draft Wildlife Law has been stalled in the legislative process for several years.

Economic strategies can pose threats to biodiversity and forest resources when the growth of resource-based industries is based on political mandates rather than sound sustainable environmental practices. These do not appear to be highly threatening at the moment but the specter of high economic growth in certain natural resource sectors in the near future (e.g., oil palm and mining concessions) may potentially bring this category of threats to the forefront.

The issues associated with institutional frameworks are likely the greatest in number and pose the potentially most damaging indirect threats to tropical forests and biodiversity in Liberia. These threats can also be exacerbated by political factors that have legislative and budgetary power over the institutions themselves. Institutional threats include a general lack of natural resource management capacity, base data to help make good management decisions, and contentious and ambiguous land and resource tenure.

The ability of GOL agencies and ministries to effectively carry out their mandates is hampered by a variety of issues. There is a lack of technical natural resource management understanding and skills by many (although not all) staff to actually perform the duties of their jobs. For example, we are unsure whether the EPA truly has the skilled staff to effectively evaluate ESIA documents submitted by private companies for environmental compliance. Poor educational and vocational institutes are important factors that explain the dearth of technical skills and knowledge. Another institutional threat is that land management decisions are being made with little or no data. Furthermore, there are very few people available with relevant analytical skills.

The lack of inter-agency coordination between GOL agencies and ministries is compounded by the fact that there is no integrated land use planning in Liberia. Effective land use planning would provide a large landscape perspective to balance the needs of multiple stakeholders. These plans would balance both spatial and temporal considerations of potentially competing interests of economic development, conservation/preservation efforts, and sustainable resource management. Good planning and coordination would involve collaborative processes that help to preempt conflicts and avoid issues such as the distribution of concessions in overlapping areas and across tenure boundaries as is currently happening (GeoVille GmbH and Metria AB 2011).

The confusing and contentious issue of land tenure continues to pose an indirect threat to Liberia's forests and biodiversity. Land and resource rights in Liberia have long been associated with disputes, including the recent civil war that ended in 2003. Key reforms undertaken by the GOL put it on the right track to resolving these issues: the cancellation of all existing forest concessions; the review of rubber concessions (2006); the establishment of the Land Commission (2009) to settle the question of customary land rights; and the enactment of the 2009 Community Rights Law, which returns ownership of forest resources to communities. The new Land Policy issued in 2013 is meant to help clarify these issues but confusion persists over the designation of customary lands to accommodate existing uses. Obviously, resolution of the land and resource issues will take significant time and effort. Yet the GOL faces huge challenges, including the need to jumpstart the economy. The resource sector – forest, mining and rubber – is seen as the main engine for economic development. The FDA, the MLME, and the

MOA are all poised to grant large-scale concessions amid protests from communities and civil society. The grant of concessions without a clear resolution of the issues has the potential for igniting conflict. Concerted education and outreach efforts to rural communities are critical to the successful implementation of the new Land Policy; otherwise the current patterns of resource exploitation for subsistence and livelihoods will continue unabated.

Social, cultural, micro-economic elements also indirectly threaten Liberia's forests and biodiversity. Although these could be considered results of poorly functioning political and institutional systems identified above, their influence on direct threats such as bushmeat hunting and charcoal production likely have significant impacts and pose significant threats. A common threat identified in previous national and regional ETOAs is the lack of alternative livelihoods for rural communities, especially adjacent to protected areas. A lack of education and training, along with access to markets and value chains for ecosystem goods and services, causes many rural communities to continue traditional practices that threaten biodiversity or violate laws or policies.

Threats from Proposed or Currently Implemented USAID Programs

Current or proposed USAID/Liberia programs do not pose serious direct or indirect threats to forests and biodiversity in Liberia. Economic growth is a major emphasis, however, and these projects or programs undoubtedly have some environmental impacts and effects. Although strict environmental compliance procedures are followed for individual USAID projects, a holistic and cumulative effects perspective across the entire portfolio may determine a need to emphasize additional environmental considerations into project selection and implementation.

There is a strong push to increase energy production and distribution in Liberia, which is part of the new Power Africa initiative. A recent analysis determined that sufficiently large quantities of biomass exist within Liberia to meet annual electricity consumption (Milbrandt 2009). The local production and use of biomass resources as substitute for fossil-based fuels offers many socio-economic and environmental benefits for Liberia including energy security, investment opportunities, job creation, rural development, decreased greenhouse gas emissions, waste utilization, and erosion control. However, if not managed properly, biomass resource development could have negative impacts, particularly to the environment. Some of the negative environmental impacts associated with the production and use of biomass resources include deforestation, increased GHG emissions, loss of biodiversity, and soil erosion. The implementation of alternative energy facilities may contribute to cumulative environmental degradation. Potential pollutants from biomass gasifiers may emit greenhouse gases and reduce air quality in nearby communities. Construction of hydropower plants may impact wetlands (including Ramsar sites), as noted earlier in this assessment, and should be avoided where possible.

The expansion of road and rail networks to facilitate market chains must consider the adverse effects of opening new lands to expanded resource extraction, including greater access to forest and biodiversity resources. For instance, past studies have found that the bushmeat trade is associated with road networks (Greengrass 2011). The expansion of transportation networks should consider landscape patterns and process to avoid habitat fragmentation and disruption of biological corridors.

The promotion of swampland rice cultivation—in the USAID/Liberia FED program, as well as the GOL national rice strategy—may pose significant environmental risks. There is a lack of good baseline information on hydrology, wetlands, and aquatic ecology in Liberia. The conversion of land in aquatic environments (whether wetland or forest) is likely to disrupt natural hydrologic processes. Agricultural inputs such as fertilizers will alter soil and water chemistry within these systems. The potential

cumulative impact of these activities across large watersheds is currently unknown. The specific concerns related to lowland rice cultivation—ecosystem degradation and loss, and pollution from agricultural inputs—were detailed in the Direct Threats section above.

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Annex A. Itinerary

DATE	ACTIVITY
Sept 7-8	Travel from US to Liberia (Barber, Hahn)
Sept 9 Monrovia	ETOA Team presentation to Mission on scope of work
	Meet with FAO
	Meet with UNDP
	Meet with World Bank
Sept 10 Monrovia	Meet with USAID/Liberia: Program Office, NRM/Environmental Compliance, NRM/Land Rights & Tenure
	Meet with LEITI
	Meet with UNMIL
	Meet with Land Commission
	Meet with Traditional Council
	Meet with EPA
Sept 11 Monrovia	Meet with FDA
	University of Liberia/Fendell – faculty from College of Agri and Forestry
Sept 12 Monrovia	Meet with MOA
	Meet with the BNF
	Meet with SAMFU
	Meet with SDI
Sept 13 Field	Meet with FTI
	Meet with Sime Darby Company
	Lake Piso
Sept 14	Meet with the FDA and site support groups in Lake Piso

DATE	ACTIVITY
Field	Meet with Ministry of MOA/Grand Cape Mount County
	Meet with Piso Conservation Forum
Sept 16 Monrovia	Meet with USAID/Liberia: Agriculture
	Meet with MOJ
	Meet with MLME
	Meet with MIA
	Meet with LISGIS
	Meet with MIA
	Meet with USAID/Liberia Land Tenure TDY Team
Sept 17 Monrovia	Meet with FED
	Meet with PROSPER
	Meet with SCNL and Alex Peal
	Meet with CI
	Meet with USAID/Liberia: Economic Growth
Sept 18 Field	Meet with Firestone Company and continue to Gbarnga, Bong County.
Sept 19 Field	Meet with Den-L
	Meet with CARI
	Meet with Cuttington
Sept 20 Monrovia	ETOA Team presentation to Mission: preliminary findings, scoping of Phase Two work
Sept 21-22	Travel from Liberia to US (Barber, Hahn)

DATE	ACTIVITY

Annex B. Individuals and Institutions interviewed for ETOA

Name	Affiliation	Contact Information
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Annex C. IUCN Red List Species in Liberia. IUCN Red List Status indicators are Vulnerable (VU); Endangered (EN); Critically Endangered (CR); Extinct in the Wild (EW); and, Extinct (EX).

Table 1. Plants

Phylum	Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
TRACHEOPHYTA	MAGNOLIOPSIDA	EBENALES	SAPOTACEAE	*Neolemonniera*	*clitandrifolia*		EN	
TRACHEOPHYTA	MAGNOLIOPSIDA	EBENALES	SAPOTACEAE	*Tieghemella*	*heckelii*	Cherry Mahogany	EN	
TRACHEOPHYTA	MAGNOLIOPSIDA	EUPHORBIALES	EUPHORBIACEAE	*Amanoa*	*bracteosa*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	EUPHORBIALES	EUPHORBIACEAE	*Amanoa*	*strobilacea*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	EUPHORBIALES	EUPHORBIACEAE	*Drypetes*	*afzelii*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	EUPHORBIALES	EUPHORBIACEAE	*Phyllanthus*	*profusus*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Anthonotha*	*vignei*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Berlinia*	*occidentalis*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Copaifera*	*salikounda*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Cryptosepalum*	*tetraphyllum*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Gilbertiodendron*	*bilineatum*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Haplormosia*	*monophylla*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Loesenera*	*kalantha*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Millettia*	*warneckei*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Monopetalanthus*	*compactus*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE	*Tetraberlinia*	*tubmaniana*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	LAMIALES	BORAGINACEAE	*Cordia*	*platythyrsa*	West African Cordia	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	MAGNOLIALES	ANNONACEAE	*Monocyclanthus*	*vignei*		EN	
TRACHEOPHYTA	MAGNOLIOPSIDA	MAGNOLIALES	ANNONACEAE	*Neostenanthera*	*hamata*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	MAGNOLIALES	ANNONACEAE	*Piptostigma*	*fugax*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	MAGNOLIALES	ANNONACEAE	*Uvariodendron*	*occidentale*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	MALVALES	STERCULIACEAE	*Eribroma*	*oblonga*	Yellow Sterculia	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	MALVALES	STERCULIACEAE	*Heritiera*	*utilis*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	MALVALES	STERCULIACEAE	*Nesogordonia*	*papaverifera*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	MYRTALES	COMBRETACEAE	*Terminalia*	*ivorensis*	Black Afara	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	PODOSTEMALES	PODOSTEMACEAE	*Ledermanniella*	*aloides*		VU	unknown
TRACHEOPHYTA	MAGNOLIOPSIDA	RHIZOPHORALES	RHIZOPHORACEAE	*Anopyxis*	*klaineana*		VU	

Phylum	Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
TRACHEOPHYTA	MAGNOLIOPSIDA	ROSALES	CHRYSOBALANACEAE	*Dactyladenia*	*dinklagei*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	RUBIALES	RUBIACEAE	*Hallea*	*ledermannii*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	RUBIALES	RUBIACEAE	*Nauclea*	*diderrichii*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	ANACARDIACEAE	*Trichoscypha*	*cavalliensis*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	ANACARDIACEAE	*Trichoscypha*	*mannii*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Entandrophragma*	*angolense*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Entandrophragma*	*candollei*	Cedar Kokoti	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Entandrophragma*	*utile*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Guarea*	*cedrata*	Light Bossé, Scented Guarea	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Guarea*	*thompsonii*	Black Guarea, Dark Bossé	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Khaya*	*anthotheca*	African Mahogany, White Mahogany	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Khaya*	*ivorensis*	African Mahogany, Lagos Mahogany	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	MELIACEAE	*Lovoa*	*trichilioides*	African Walnut, Congowood, Tigerwood	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	SAPINDALES	SAPINDACEAE	*Placodiscus*	*pseudostipularis*		EN	
TRACHEOPHYTA	MAGNOLIOPSIDA	SCROPHULARIALES	ACANTHACEAE	*Brachystephanus*	*nimbae*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	THEALES	GUTTIFERAE	*Garcinia*	*kola*		VU	decreasing
TRACHEOPHYTA	MAGNOLIOPSIDA	THEALES	OCHNACEAE	*Lophira*	*alata*	Azobe	VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	THEALES	OCHNACEAE	*Ouratea*	*amplectens*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	URTICALES	MORACEAE	*Milicia*	*regia*		VU	
TRACHEOPHYTA	MAGNOLIOPSIDA	VIOLALES	FLACOURTIACEAE	*Homalium*	*smythei*		VU	

Table 2. Invertebrates

Phylum	Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
ARTHROPODA	CRUSTACEA	DECAPODA	POTAMONAUTIDAE	*Globonautes*	*macropus*	Tree Hole Crab	EN	decreasing

Phylum	Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
ARTHROPODA	CRUSTACEA	DECAPODA	POTAMONAUTIDAE	*Liberonautes*	*grandbassa*	Grandbassa River Crab	CR	unknown
ARTHROPODA	CRUSTACEA	DECAPODA	POTAMONAUTIDAE	*Liberonautes*	*Lugbe*	Lugbe River Crab	CR	unknown
ARTHROPODA	CRUSTACEA	DECAPODA	POTAMONAUTIDAE	*Liberonautes*	*nanoides*	Dwarf River Crab	EN	unknown
ARTHROPODA	CRUSTACEA	DECAPODA	POTAMONAUTIDAE	*Liberonautes*	*rubigimanus*	Lobster Claw Crab	EN	unknown
ARTHROPODA	CRUSTACEA	DECAPODA	POTAMONAUTIDAE	*Liberonautes*	*Nimba*	Nimba Stream Crab	VU	unknown
ARTHROPODA	INSECTA	ODONATA	COENAGRIONIDAE	*Agriocnemis*	*angustirami*		VU	unknown
ARTHROPODA	INSECTA	ODONATA	PLATYCNEMIDIDAE	*Mesocnemis*	*Tisi*	Liberian Riverjack	EN	unknown
MOLLUSCA	GASTROPODA	ARCHITAENIOGLOSSA	VIVIPARIDAE	*Bellamya*	*liberiana*		CR	unknown

Table 3. Vertebrates

Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*Boboi*		CR	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*carcharhinoides*		CR	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*melanotaenia*		CR	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*Aliciae*		EN	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*huguenyi*		EN	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*lauzannei*		EN	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*liberiensis*	carp	EN	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Barbus*	*eburneensis*	carp	VU	unknown
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Labeo*	*Curriei*		CR	decreasing
ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	*Labeo*	*alluaudi*		EN	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Aphyosemion*	*Viride*		VU	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Archiaphyosemion*	*jeanpoli*	Jeanpol's Killi	EN	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Callopanchax*	*monroviae*		VU	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Epiplatys*	*coccinatus*		CR	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Epiplatys*	*ruhkopfi*		CR	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Epiplatys*	*Roloffi*		EN	decreasing
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Epiplatys*	*lamottei*	Redspotted panchax	VU	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Scriptaphyosemion*	*brueningi*	Bruening's killi	EN	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	NOTHOBRANCHIIDAE	*Scriptaphyosemion*	*Schmitti*		VU	unknown
ACTINOPTERYGII	CYPRINODONTIFORMES	POECILIIDAE	*Procatopus*	*nimbaensis*		VU	unknown
ACTINOPTERYGII	ELOPIFORMES	MEGALOPIDAE	*Megalops*	*atlanticus*	Tarpon	VU	decreasing
ACTINOPTERYGII	PERCIFORMES	CICHLIDAE	*Tilapia*	*Coffea*		CR	unknown
ACTINOPTERYGII	PERCIFORMES	CICHLIDAE	*Tilapia*	*Joka*		VU	unknown
ACTINOPTERYGII	PERCIFORMES	EPINEPHELIDAE	*Epinephelus*	*Itajara*	Atlantic Goliath Grouper,	CR	unknown

Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
					Goliath Grouper, Jewfish		
ACTINOPTERYGII	PERCIFORMES	EPINEPHELIDAE	*Epinephelus*	*marginatus*	Dusky Grouper	EN	decreasing
ACTINOPTERYGII	PERCIFORMES	ISTIOPHORIDAE	*Kajikia*	*Albida*	Marlin, Skilligalee, White Marlin	VU	decreasing
ACTINOPTERYGII	PERCIFORMES	SCOMBRIDAE	*Thunnus*	*Obesus*	Bigeye Tuna	VU	decreasing
ACTINOPTERYGII	SILURIFORMES	AMPHILIIDAE	*Doumea*	*chappuisi*		VU	unknown
ACTINOPTERYGII	SILURIFORMES	AMPHILIIDAE	*Paramphilius*	*firestonei*		EN	unknown
ACTINOPTERYGII	SILURIFORMES	CLAROTEIDAE	*Chrysichthys*	*Teugelsi*		EN	unknown
ACTINOPTERYGII	SYNGNATHIFORMES	SYNGNATHIDAE	*Hippocampus*	*algiricus*	West African Seahorse	VU	unknown
CHONDRICHTHYES	CARCHARHINIFORMES	CARCHARHINIDAE	*Carcharhinus*	*longimanus*	Oceanic Whitetip Shark, Whitetip Oceanic Shark, White-tipped Shark, Whitetip Shark	VU	decreasing
CHONDRICHTHYES	CARCHARHINIFORMES	CARCHARHINIDAE	*Carcharhinus*	*plumbeus*	Sandbar Shark	VU	decreasing
CHONDRICHTHYES	CARCHARHINIFORMES	CARCHARHINIDAE	*Carcharhinus*	*signatus*	Night Shark	VU	decreasing
CHONDRICHTHYES	CARCHARHINIFORMES	SPHYRNIDAE	*Sphyrna*	*Lewini*	Scalloped Hammerhead	EN	unknown
CHONDRICHTHYES	CARCHARHINIFORMES	TRIAKIDAE	*Mustelus*	*mustelus*	Common Smoothhound	VU	decreasing
CHONDRICHTHYES	LAMNIFORMES	ALOPIIDAE	*Alopias*	*vulpinus*	Common Thresher Shark	VU	decreasing
CHONDRICHTHYES	LAMNIFORMES	LAMNIDAE	*Isurus*	*oxyrinchus*	Shortfin Mako	VU	decreasing
CHONDRICHTHYES	LAMNIFORMES	LAMNIDAE	*Isurus*	*Paucus*	Longfin Mako	VU	decreasing
CHONDRICHTHYES	LAMNIFORMES	ODONTASPIDIDAE	*Carcharias*	*Taurus*	Grey Nurse Shark, Grey Nurse Shark, Sand Tiger, Sand Tiger Shark, Spotted Ragged-tooth Shark, Spotted Raggedtooth Shark	VU	unknown
CHONDRICHTHYES	RAJIFORMES	DASYATIDAE	*Dasyatis*	*margarita*		EN	decreasing
CHONDRICHTHYES	RAJIFORMES	GYMNURIDAE	*Gymnura*	*altavela*		VU	decreasing
CHONDRICHTHYES	RAJIFORMES	PRISTIDAE	*Pristis*	*pectinata*	Smalltooth Sawfish, Wide Sawfish	CR	decreasing
CHONDRICHTHYES	RAJIFORMES	PRISTIDAE	*Pristis*	*Pristis*	Largetooth Sawfish	CR	decreasing
CHONDRICHTHYES	RAJIFORMES	RAJIDAE	*Raja*	*undulata*	Undulate Ray	EN	decreasing
CHONDRICHTHYES	RAJIFORMES	RAJIDAE	*Rostroraja*	*alba*	Bottlenose Skate, Spearnose Skate, White Skate	EN	decreasing
CHONDRICHTHYES	RAJIFORMES	RHINOBATIDAE	*Glaucostegus*	*cemiculus*	Blackchin Guitarfish	EN	decreasing

Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
CHONDRICHTHYES	RAJIFORMES	RHINOBATIDAE	*Rhinobatos*	*rhinobatos*	Common Guitarfish, Violinfish	EN	decreasing
CHONDRICHTHYES	RAJIFORMES	RHINOBATIDAE	*Rhinobatos*	*albomaculatus*	White-spotted Guitarfish	VU	decreasing
CHONDRICHTHYES	RAJIFORMES	RHINOBATIDAE	*Rhinobatos*	*irvinei*	Spineback Guitarfish	VU	decreasing
CHONDRICHTHYES	RAJIFORMES	RHYNCHOBATIDAE	*Rhynchobatus*	*luebberti*	African Wedgefish, Guitarra, Lubberts Guitarfish, Spikenose Wedgefish	EN	decreasing
CHONDRICHTHYES	SQUALIFORMES	CENTROPHORIDAE	*Centrophorus*	*granulosus*	Gulper Shark	VU	decreasing
CHONDRICHTHYES	SQUALIFORMES	OXYNOTIDAE	*Oxynotus*	*centrina*	Angular Rough Shark	VU	unknown
AMPHIBIA	ANURA	BUFONIDAE	*Nimbaphrynoides*	*liberiensis*		CR	decreasing
AMPHIBIA	ANURA	CONRAUIDAE	*Conraua*	*alleni*	Allen's Slippery Frog	VU	decreasing
AMPHIBIA	ANURA	PHRYNOBATRACHIDAE	*Phrynobatrachus*	*annulatus*	Ringed River Frog	EN	decreasing
AMPHIBIA	ANURA	RANIDAE	*Hylarana*	*occidentalis*		EN	decreasing
AVES	CORACIIFORMES	BUCEROTIDAE	*Bycanistes*	*cylindricus*	Brown-cheeked Hornbill	VU	decreasing
AVES	CORACIIFORMES	BUCEROTIDAE	*Ceratogymna*	*elata*	Yellow-casqued Hornbill, Yellow-casqued Wattled Hornbill	VU	decreasing
AVES	FALCONIFORMES	ACCIPITRIDAE	*Necrosyrtes*	*monachus*	Hooded Vulture	EN	decreasing
AVES	GALLIFORMES	NUMIDIDAE	*Agelastes*	*meleagrides*	White-breasted Guineafowl	VU	decreasing
AVES	PASSERIFORMES	CAMPEPHAGIDAE	*Campephaga*	*lobata*	Ghana Cuckoo-shrike, Western Wattled Cuckooshrike, Western Wattled Cuckoo-shrike	VU	decreasing
AVES	PASSERIFORMES	CISTICOLIDAE	*Prinia*	*leontica*	Sierra Leone Prinia, White-eyed Prinia	VU	decreasing
AVES	PASSERIFORMES	MUSCICAPIDAE	*Melaenornis*	*annamarulae*	Liberian Black-flycatcher, Nimba Flycatcher, West African Black-Flycatcher	VU	decreasing
AVES	PASSERIFORMES	PICATHARTIDAE	*Picathartes*	*gymnocephalus*	Bare-headed Rockfowl, White-necked Picathartes, White-necked Rockfowl, Yellow-headed Rockfowl	VU	decreasing
AVES	PASSERIFORMES	PLOCEIDAE	*Malimbus*	*ballmanni*	Ballmann's Malimbe, Gola Malimbe	EN	decreasing

Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
AVES	PASSERIFORMES	PYCNONOTIDAE	*Criniger*	*olivaceus*	Yellow-bearded Bulbul, Yellow-bearded Greenbul	VU	decreasing
AVES	PASSERIFORMES	PYCNONOTIDAE	*Phyllastrephus*	*leucolepis*	Liberian Greenbul, Spot-winged Greenbul, White-winged Greenbul	CR	decreasing
AVES	PSITTACIFORMES	PSITTACIDAE	*Psittacus*	*timneh*	Timneh Parrot	VU	decreasing
AVES	STRIGIFORMES	STRIGIDAE	*Scotopelia*	*ussheri*	Rufous Fishing-owl, Rufous Fishing Owl, Rufous Fishing-Owl, Ussher's Fishing Owl	VU	decreasing
MAMMALIA	AFROSORICIDA	TENRECIDAE	*Micropotamogale*	*lamottei*	Nimba Otter Shrew, Pygmy Otter-shrew	EN	decreasing
MAMMALIA	CARNIVORA	HERPESTIDAE	*Liberiictis*	*kuhni*	Liberian Mongoose	VU	decreasing
MAMMALIA	CARNIVORA	VIVERRIDAE	*Genetta*	*johnstoni*	Johnston's Genet	VU	decreasing
MAMMALIA	CETARTIODACTYLA	BOVIDAE	*Cephalophus*	*jentinki*	Jentink's Duiker	EN	decreasing
MAMMALIA	CETARTIODACTYLA	BOVIDAE	*Cephalophus*	*zebra*	Banded Duiker, Zebra Antelope, Zebra Duiker	VU	decreasing
MAMMALIA	CETARTIODACTYLA	HIPPOPOTAMIDAE	*Choeropsis*	*liberiensis*	Pygmy Hippopotamus	EN	decreasing
MAMMALIA	CETARTIODACTYLA	HIPPOPOTAMIDAE	*Hippopotamus*	*amphibius*	Common Hippopotamus, Hippopotamus, Large Hippo	VU	decreasing
MAMMALIA	CETARTIODACTYLA	PHYSETERIDAE	*Physeter*	*macrocephalus*	Cachelot, Pot Whale, Spermacet Whale, Sperm Whale	VU	unknown
MAMMALIA	CHIROPTERA	HIPPOSIDERIDAE	*Hipposideros*	*marisae*	Aellen's Roundleaf Bat	VU	decreasing
MAMMALIA	CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus*	*ziama*	Ziama Horseshoe Bat	EN	decreasing
MAMMALIA	CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus*	*guineensis*	Guinean Horseshoe Bat	VU	unknown
MAMMALIA	PRIMATES	CERCOPITHECIDAE	*Cercocebus*	*atys*	Red-capped Monkey, Sooty Mangabey, Sooty/white-naped Mangabey	VU	decreasing
MAMMALIA	PRIMATES	CERCOPITHECIDAE	*Cercopithecus*	*diana*	Diana Guenon, Diana Monkey, Diana/roloway Monkey, Roloway Monkey	VU	decreasing
MAMMALIA	PRIMATES	CERCOPITHECIDAE	*Colobus*	*polykomos*	King Colobus, Ursine Black-and-white Colobus,	VU	unknown

Class	Order	Family	Genus	Species	Common name(s)	Status	Trend
					Western Black-and-white Colobus, Western Pied Colobus		
MAMMALIA	PRIMATES	CERCOPITHECIDAE	*Procolobus*	*badius*	Bay Colobus, Red Colobus, West African Red Colobus, Western Red Colobus	EN	decreasing
MAMMALIA	PRIMATES	HOMINIDAE	*Pan*	*troglodytes*	Chimpanzee, Common Chimpanzee, Robust Chimpanzee	EN	decreasing
MAMMALIA	PROBOSCIDEA	ELEPHANTIDAE	*Loxodonta*	*africana*	African Elephant	VU	increasing
MAMMALIA	SIRENIA	TRICHECHIDAE	*Trichechus*	*senegalensis*	African Manatee, Seacow, West African Manatee	VU	unknown
REPTILIA	CROCODYLIA	CROCODYLIDAE	*Osteolaemus*	*tetraspis*	African Dwarf Crocodile, West African Dwarf Crocodile	VU	
REPTILIA	SQUAMATA	GEKKONIDAE	*Cnemaspis*	*occidentalis*	Western Gecko	EN	unknown
REPTILIA	TESTUDINES	CHELONIIDAE	*Lepidochelys*	*olivacea*	Olive Ridley, Pacific Ridley	VU	decreasing
REPTILIA	TESTUDINES	DERMOCHELYIDAE	*Dermochelys*	*coriacea*	Coffin-back, Leatherback, Leathery Turtle, Luth, Trunkback Turtle, Trunk turtle	CR	decreasing