

Republic of Liberia



United Nations Development Programme  
(UNDP)



**UNDP Global Project:  
Capacity Development for Policy Makers  
to Address Climate Change**

**Executive Summary**

**Assessment of Investment and Financial Flows  
to Mitigate Climate Change in the Energy and Forestry  
Sectors and for Adaptation in the Agriculture Sector  
in Liberia**

August 2011

## **Investment and Financial Flows to Address Climate Change UNDP Global Project**

Climate Change poses significant challenges to development and policy makers are faced with complex tasks to respond to them and to ensure sustainable development. Particularly in Least Developed Countries decision makers have to balance poverty alleviation, economic development as well as social and environmental questions, while also questions of costs that occur with associated policies and measures play a vital role.

To better understand the magnitude of funds needed to tackle climate change now and in the long term, developing countries are undertaking assessments of investment and financial flows (I&FF) to address climate change for key sectors in a groundbreaking UNDP Environment & Energy Group project: Capacity Development for Policy Makers to Address Climate Change.

Liberia is one of 19 countries participating in this project, which was launched in May 2008 with the generous contributions of the Government of Norway, Government of Finland, Government of Switzerland as well as the UN Foundation and UNDP.

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# Acronyms

3C	Approach that integrates conservation, community, and commercial uses of forest
CBD	Convention of Biological Diversity
CBL	Central Bank of Liberia
CFLs	Compact Fluorescent Lamps
CSET	Center for Sustainable Energy Technology
ENDA	Environmental Development Action in the Third World
ERB	Energy Regulatory Board
FDA	Forestry Development Authority
FF	Financial Flows
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoL	Government of Liberia
I&FF	Investment and Financial Flows
IF	Investment Flows
INC	Initial National Communication
LISGIS	Liberia Institute of Statistics and Geo-information Services
LPG	Liquefied Petroleum Gas
LULUCF	Land Use, Land Use Change and Forestry
MLME	Ministry of Lands, Mines and Energy
MoA	Ministry of Agriculture
MRV	Monitoring, reporting and verification
NAPA	National Adaptation Programme of Action
NBSAP	National Biodiversity Strategy and Action Plan
NCSA	National Capacity Self Assessment
NGOs	Non-governmental organizations
NEP	National Energy Policy of Liberia
PES	Payment for ecosystem services
O&M	Operation and Maintenance Costs
PRS	Poverty Reduction Strategy
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic
REDD+	Reducing Emissions from Deforestation and Forest Degradation plus calls for activities that integrate local communities and indigenous people
REFUND	Rural Energy Fund
RREA	Rural and Renewable Energy Agency
SEA	Strategic Environmental Assessment
UN	United Nations
UNDP	United Nations Development Programme

# 1. Introduction

Liberia is slowly recovering from the civil unrest that has blocked development during the last decades. However, climate change now threatens to undermine efforts on socio-economic improvement that happen across the country. According to a national assessment of investment and financial flows (I&FF) completed in August 2011, more than \$ US 2.89 billion is needed through to 2030 to implement priority actions to:

- Reduce emissions of greenhouse gases in the forestry and energy sectors, and
- Adapt to the impacts of climate change in the agriculture sector.

Nearly 50 percent of these funds (\$ US 1.41 billion) is needed to secure the agriculture sector against the effects of climate change. Proposed measures include improving soil fertility; protecting plants; and developing livestock species that are more resistant to climate change. A further \$1.29 billion (45%) is required for the energy sector to improve efficiency of energy production and use; and to provide access to renewable energies, particularly as alternatives to firewood. Lastly, about \$0.19 billion is needed in the forestry sector for the sequestration (or storage) of carbon through enhanced forest cover; enrichment of degraded forests; and afforestation and reforestation actions.

Having completed the assessment, the government of Liberia is now well placed to discuss the costs of climate change in the international climate change negotiations, and to identify the most appropriate policy responses. This work was conducted as part of the global UNDP project, *Capacity Development for Policy Makers to Address Climate Change*, which was funded by the governments of Norway, Switzerland, and Finland, UNDP and the UN Foundation.

## 1.1 Objectives

The rationale for Liberia's investment and financial flows (I&FF) assessment is to quantify the investments and associated financial flows required to mitigate climate change in the energy and forestry sectors and adapt to the effects of climate change in the agriculture sector. The specific objectives are as follows:

- To collect, analyze and compile information on the investment and financial flows required in the three key sectors;
- To project future investment and financial flows in the baseline scenario, that is, in the absence of additional policies to address climate change;
- To identify, screen and select mitigation and adaptation measures consistent with national sustainable development priorities to address climate change;
- To project future investment and financial flows associated with the implementation of the selected mitigation and adaptation measures up to 2030;
- To assess the types and magnitudes of changes in investments in physical assets and in programs, and associated operation and maintenance costs, needed to implement the mitigation and adaptation measures;
- To determine the entities that are responsible for those investments and the sources of their investment funds;
- To evaluate policy implications to induce those entities to invest in the proposed measures.

The expected outcomes are:

- National awareness raised:
- Stakeholder views on priority activities, investments & policies coordinated;
- Inter-ministerial coordination to address climate change enhanced.

## 1.2. Choice of sectors

The **energy** sector is a major driving force for nearly all socio-economic activities in Liberia. Besides its share of about 0.8% (CBL, 2008) of the overall gross domestic product, energy also contributes to employment, trade, fiscal revenues, food security, and sub-regional development. In addition to imported petroleum, it is estimated that over 95 percent of the population relies on firewood, charcoal, and palm oil for their energy needs (Center for Sustainable Energy Technology (CSET), 2004). The Ministry of Lands, Mines & Energy formulated a National Energy Policy in 2008 that set greenhouse gas reduction targets (of 10% by 2015), as well as energy efficiency and renewable energy targets.

**Forests** are one of the most important natural resources in Liberia, yet there have been many years of mismanagement and/or no management of forest resources. Other issues include lack of adequate investments in sustainable forestry, including afforestation/reforestation, restoration of degraded forestlands, and promotion of community and conservation forestry.

**Agriculture** is a major source of employment, with nearly 70 percent of the economically active population engaged in the sector. Agriculture is the dominant contributor to export trade and earnings, and a source of livelihood for a greater number of people than any other sector (PRS, 2006). Farming in Liberia is mainly rainfed and therefore very sensitive to climate change.

## 1.3 Previous analyses utilized

For the **energy** sector assessment, various sources of data and information were consulted:

- Desk Study on the Environment in Liberia
- National Biodiversity Strategy and Action Plan
- Technical assistance to provide technical support related to production, distribution and customer supply to the tendering process of the new electricity sector in Monrovia. Reintegration Programme for Returnees and Displaced People of Liberia, European Union
- National Adaptation Program of Action (NAPA)
- Scoping study Buchanan renewable power inclusive proposed rubber tree-fired cogeneration plants
- Report on Inventory of GHG Emissions in the Energy, LULUCF, Agriculture and Waste Sectors
- Draft Initial National Communication
- National Energy Policy
- Liberia Poverty Reduction Strategy/Pillar IV: Rehabilitating Infrastructure and Delivering Basic Services

- Recommendations from the Initial National Inter-Ministerial Dialogue on climate change conducted to start the assessment process.

The forestry assessment is based on Government of Liberia (GoL) previous policies, strategies, plans and programs, which include:

- Poverty Reduction Strategy Paper (PRSP)
- National Biodiversity Strategy and Action Plan (NBSAP)
- National Adaptation Programme of Action (NAPA)
- National Capacity Self Assessment (NCSA)
- The National Forest Reform Law
- Initial National Communication (INC) draft
- CBD 4<sup>th</sup> National Report
- Recommendations from the Initial National Inter-Ministerial Dialogue on climate change conducted to start the assessment process.

For the assessment of the **agriculture** sector, the main following previous work was considered:

- Initial National Communication (INC) draft
- National Adaptation Programme of Action (NAPA)
- Poverty Reduction Strategy
- Recommendations from the Initial National Inter-Ministerial Dialogue on climate change conducted to start the assessment process.

#### **1.4 Institutional arrangements and collaborations**

Upon invitation from the Acting Executive Director of the Environmental Protection Agency of Liberia, national experts were selected from government ministries, agencies, NGOs and academia to create a multidisciplinary set of experts in finance, climate change, statistics and sector practitioners.

A Regional Centre of Excellence, ENDA Tiers Monde, based in Senegal, trained the three sectoral teams (i.e., energy, forestry and agriculture) in the approach outlined in UNDP's *User Guidebook and Methodology for Assessing I&FF to Address Climate Change*. In total, 25 national experts were trained on three occasions in Monrovia from 2009 to 2011. ENDA and UNDP also provided backstopping and technical reviews for the duration of the I&FF assessment.

#### **1.5 Basic methodology and key terms**

Basic methodology



The overall objective of the I&FF assessment is to determine the extent and sources of funds needed to address climate change at the national level, and builds directly on national government strategies, plans and programmes. In essence, the assessment seeks to answer the question: "From a development perspective, what can my country do to address climate change in selected key sectors, and what level of financial contributions will be needed to achieve these objectives?"

The I&FF assessment covered the time period 2005-2030, using a baseline scenario and a reference scenario. Values are given in constant 2005 US\$. The assessment looks at the changes in I&FF needed for three different groups: households (families, individual farmers), corporations (private and NGOs), and the government.

The basic methodology for conducting I&FF assessments comprises eight sequential steps to be undertaken for each identified sector. Once sectoral assessments are completed, the results are compiled and compared across sectors; and this synthesis report is prepared. The eight steps include:

- 1. Establish key parameters of the assessment:** Define scope of the sector; Specify the assessment period and the base year; Identify preliminary adaptation measures; Choose the analytical approach.
- 2. Compile historical I&FF data and operation and maintenance costs (O&M), and other input data for scenarios:** Compile historical annual I&FF and O&M, broken down by entity and source of investment; Compile other input data for the scenarios.
- 3. Defining the baseline scenario:** Describe the socio-economic and technological change, national and sectoral plans, and expected investments, under the current national and sectoral plans.
- 4. Derive IF, FF and O&M costs for the baseline scenario:** Derive the I&FF and O&M for each type of investment broken down by investment entity, source of funding and year.
- 5. Define the adaptation scenario:** Describe new measures to adapt to climate change, including their necessary investments, processes and activities.
- 6. Derive IF, FF and O&M costs for the adaptation scenario:** Derive the I&FF and O&M for each type of investment broken down by investment entity, source of funding and year.
- 7. Calculate changes in I&FF and O&M costs required to implement adaptation measures:** Calculate the necessary shifts in I&FF and O&M costs by subtracting values of the baseline scenario from values of the adaptation scenario.
- 8. Evaluate policy implications:** Re-assess the initial prioritization of adaptation measures undertaken in step 5; Identify policy measures to encourage induced changes in I&FF.

## Key terminology

### Investment Flow

The "Investment flows" (IF) is the capital cost of new physical assets with a lifespan of more than one year, such as the capital cost of solar PV kits or equipment for the work of conservation agricultural soil water.

### Financial Flow

A “financial flow” (FF) is an ongoing expenditure on programmatic measures; financial flows encompass expenditures other than those for expansion or installation of new physical assets. Examples of financial flows include expenditures for an agricultural extension program for farmers, a malaria prevention program to distribute mosquito nets, or the implementation of improved forest management techniques.

These investment and financial flows are NOT the same as the cost of addressing climate change; changes to the operating costs of investments are not considered nor is damage due to climate change estimated.

### **Operation and Maintenance (O&M) Costs of New Physical Assets**

The physical assets purchased with investment flows will have operation and maintenance (O&M) costs associated with them (i.e., ongoing fixed and variable costs such as salaries and raw materials). Operation and maintenance costs of new assets need to be included in I&FF assessments because these costs can vary considerably among investment flow types, and can have a significant effect on the total cost of an investment over its lifetime. For example, O&M costs are a much greater share of total costs (capital costs plus O&M costs) for gas-fired electricity generation than photovoltaic electricity generation.

### **Investment Entity**

An “investment entity” is an entity that is responsible for an investment. These are the entities that decide to invest in, for example: a photovoltaic park, a program of reforestation, national parks, a program for stabilizing sand dunes. This methodology uses three types of investment entities: households, corporations and government.

### **Households**

Households are individuals or groups of people (e.g. families) acting as one unit financially. Households invest in assets such as houses, farms, crop fields. It is assumed that all their investment funds, including capital (savings), debt (borrowing from friends, family, financial institutions) and government support in form of grants (that is to say-refundable deductions tax, tax credits on purchases) are national funds, to simplify the estimation of I&FF.

### **Corporations**

The corporations include financial firms and non-financial businesses, and organizations may be profit or non-profit. Financial firms are banks, credit unions and insurance companies. The non-financial firms produce goods (such as fossil fuels, electricity, food or wood). The non-governmental organizations are a kind of non-profit company. Firms invest in physical assets and programs. Their sources of investment funds are from domestic sources and external sources and can be in the form of shares, debt, national government support or public foreign aid.

### **Governments**

Governments are the national, provincial, county and local governments of a country. Financial and non-financial corporation owned wholly or in part by governments, such as public universities, research institutions and publicly held oil companies, utilities and management of waters and forestry authorities belong to this category. Government entities invest in physical assets and long-term programs and services that provide public benefits.

### **Sources of Investment and Financial Flow Funds**

The “sources of I&FF funds” are the origins of the funds invested by the investment entities, e.g., domestic equity, foreign debt, domestic subsidies, and foreign aid. Identification of the entities responsible for the investment decisions, and the sources of the funds that are invested, is an important component of an I&FF assessment because this information is the starting point for the evaluation of policies to change those decisions. To design policies and measures to influence decisions about I&FF, the entities responsible for those decisions and the means by which they obtain their funds must be identified.

### **Scenario**

A scenario is an internally consistent and plausible characterization of future conditions over some specified time period. Each sectoral I&FF assessment for mitigation (or adaptation) requires that both a baseline scenario and a mitigation (or adaptation) scenario be developed for that sector. In the I&FF assessment methodology, each scenario will have a stream of annual IF, FF, and O&M costs.

### **Baseline Scenario**

The baseline scenario is a reflection of business-as-usual conditions, it describes what is likely to occur in the absence of new policies to address climate change. It should describe expected socioeconomic trends, technological change, private sector and government plans, and expected business-as-usual investments in the sector. If policies to address climate change are already being implemented, they should be reflected in the baseline scenario. The description of the plans for investments should include information about the nature, scale, and timing of those investments; this information is needed to derive estimates of annual I&FF, and associated O&M costs.

### **Mitigation Scenario**

The mitigation scenario incorporates measures to mitigate GHG emissions, i.e., it should describe expected socioeconomic trends, technological change, new measures to mitigate GHG emissions, and the expected investments in the sector given implementation of the mitigation measures.

### **Adaptation Scenario**

Similarly, the adaptation scenario incorporates new measures to respond to the impacts of climate change. It should describe expected socioeconomic trends, technological change, new measures to respond to the potential impacts of climate change, and the expected investments in the sector given implementation of the measures to respond to potential impacts. Both the mitigation and adaptation scenarios should include information about the nature, scale, and timing of the investments.

### **Assessment Period**

The **assessment period** is the time horizon for the assessment; i.e., the number of years spanned by the baseline and climate change scenarios and the associated stream of annual IF, FF, and O&M costs. The assessment period for I&FF assessment should be at 2005-2030.

### **Base Year**

The **base year** is the first year of the assessment period, i.e., it is the first year of the baseline, mitigation, and adaptation scenarios. The base year should be set at a recent year for which I&FF and O&M information is available so that the IF, FF, and O&M costs for the first year of all the scenarios are historical data.

## 2. Summary of sectoral assessments

### 2.1 Energy sector

#### Sector scope

The energy sector I&FF assessment covers the following supply and demand side areas in both the baseline and mitigation scenarios for all three investment entities - households, corporations and government:

- Lighting
- Cooking, Heating, Cooling and Motive Power
- Charcoal Production
- Renewable Energy.

Within these areas domestic, commercial and industrial energy production and consumption are considered. Electric and non-electric equipment and appliances are included.

The energy market in Liberia is dominated by refined imported petroleum products, fuel wood and charcoal. The market for petroleum products is formal in nature while that of woody biomass is informal. The production of fuel wood and charcoal is also an important source of employment and sale of these goods is a source of supplemental income for many low income and poor families. In some cases, it supplements as much as 40 per cent of their total income (SOE, 2006). The unsustainable production and use of woody biomass energy also contributes to environmental degradation.

#### Base year and assessment period

The base year for this assessment is 2005 and the assessment covers the period 2005-2030.

#### Mitigation measures for which I&FF were assessed & results

Liberia has in place a National Energy Policy (2008) that includes targets to:

- Reduce greenhouse gas emissions by 10% by 2015;
- Improve energy efficiency by 20% by 2015;
- Increase renewable energy from current level of 10% to 30% of electricity production by 2015; and
- Increase the level of biofuels in transport fuel to 5% by 2015.

The ultimate goal is to implement a long-term strategy to make Liberia carbon-neutral country.

Increasing **energy efficiency** is one of two major mitigation options analyzed in this assessment. Lighting, cooking/heating/cooling/motive power, and charcoal production were prioritized as efficiency measures for this assessment. Investment in these efficiency measures amounts to US\$1.347 billion, of which efficient lighting is largest, accounting for 70% (US\$946.51 million). This is followed by efficient cooking/heating/cooling/ motive power at 29% (US\$385.93 million), and just 1% for improved charcoal production at US\$14.61 million.

The other major option, **renewable energy**, accounts for the highest level of investments required to mitigate climate change in the energy sector. Investments in renewable energy, mainly hydro, followed by biomass plants and solar energy technologies, account for 50%

(US\$1.369 billion) of all investments, the largest of which will occur in 2011 and 2012 at US\$ 124.61 million and US\$113.70 million.

It was determined that US\$ 1.29 billion is needed to improve efficiency of energy production and use (US\$ 0.73 billion) and promote renewable energy (US\$ 0.57 billion). With respect to improving energy production and use efficiency, three fields were analysed:

- ✓ Lighting (US\$ 0.49 billion);
- ✓ Cooking (US\$ 0.18 billion); and
- ✓ Charcoal production (US\$ 57 million).

The cost of measures to promote renewable energy, namely solar PV systems, biomass-fired power plants, and hydro power plants, amounted to US\$ 0.57 billion.

The largest investments are expected to occur in 2011 at US\$204.35 million and 2012 at US\$189.44 million.

### Policy implications

The Cabinet-approved National Energy Policy of Liberia (NEP) should be passed into law as the legal platform to achieve the necessary changes. Besides the issue of energy access, quality, standard and cost mentioned in the NEP, the establishment of the legal and regulatory framework as outlined in the policy is crucial. The policy mentions the restructuring of the Ministry of Land, Mines and Energy (MLME) by upgrading the energy section to a Deputy Ministerial level. The NEP also recommends the establishment of an Energy Regulatory Board (ERB), the Rural and Renewable Energy Agency (RREA), and the Rural Energy Fund (REFUND). The RREA is already established and being currently run with GOL and donor assistance.

The policy objectives are to promote energy efficiency measures and to increase the renewable energy portfolio in the national energy mix. Investment in energy efficient products and services will require massive nation-wide awareness and sensitization targeting different categories of end-users, financial advisory services to banks and financial institutions for loans to enterprises investing in efficient energy products and services. This should be complemented by enforcing the use of energy efficient equipment and tax incentives to importers of such products. Key energy efficient products include compact fluorescent lamps (CFLs) for lighting; liquefied petroleum gas (LPG), improved charcoal cook-stoves, solar cookers, and efficient charcoal kilns for charcoal production.

In order to realize the potential of end-use energy efficiency improvements, appropriate targets for every five years should be set up to 2030. Setting such targets will be consistent with the NEP and the Poverty Reduction Strategy (PRS). End-use energy efficiency norms, legislative and regulatory considerations should be integrated into national energy policy and planning. On the basis of national circumstances and needs, agreed standards and labeling criteria should be established. Private investment should be attracted in the energy sector through technology transfer, fiscal and tax incentives.

Building capacity is critical to the formulation of energy efficiency policy and regulation, the establishment of standards and norms, the promotion and implementation of plans and programs at national and local levels. Also needed is building local capacity through training

in clean and efficient energy technology applications as well as developing and expanding the country's emerging fledgling energy market through public and private partnership.

Generally, there should be annual national budgetary allocation to climate change activities for both adaptation and mitigation. The Government of Liberia (GOL), through the EPA, should put in place monitoring mechanism for climate change activities. In addition, effective enforcement mechanisms for environmental laws should be developed at national, county and local levels in a coordinated manner (e.g. County inspectors). Furthermore, training and research on climate change issues should be prioritized.

There should also be an improved and effective inter-ministerial, agency and local government coordination regarding climate change mitigation issues and challenges. The Government should raise community awareness (conduct regional workshops), ensure development and implementation of regulations on charcoal production and keep promoting sustainable alternatives.

Public awareness about GHG emissions in simple English and local languages should be implemented in the print, broadcast and folk media channels. These could be in the forms of radio/TV messages, jingles, drama as well as other information education communication/behavioral change communication (IEC/BCC) materials and messages for posters, flyers, billboards, wall writing, etc.

#### Uncertainties and methodological limitations

No mechanism (database system) is yet available to record, monitor and measure progress or development in Liberia's energy sector. Therefore, data paucity which was and still is a major constraint, led to projections made over the assessment period after obtaining data for only a few years. Annual projections made for the assessment period were based on population growth rates.

Due to lack of adequate data, the assessment did not include the calculations and estimates of projections in respect of annual carbon emissions, energy produced and consumed over the assessment period for the various scenarios. The setting up of a standard energy sector development database system may help reduce significantly these uncertainties and limitations, leading to a more improved future assessment of investment and financial flows.

## 2.2 Forestry sector

### Sector scope

In spite of massive deforestation, to date the country has the greatest percentage of the remaining blog of the Upper Guinea Forest, accounting for approximately 43% of this vast spread of tropical rainforest (Bayol and Chevalier, 2004).

To implement the “3C” approach that integrates conservation, community, and commercial uses while emphasizing job creation and community incentives (National Forest Reform Law, 2006), I&FF is in the following sub-sectors:

- Sequestration of carbon by enhancing forest cover through afforestation/reforestation;
- Enrichment of degraded forest;
- Restoration of existing plantation;
- Sustainable forest management through the 3 “C” approaches;
- Substitution with alternative energy sources to reduce the consumption of wood and charcoal (e.g. through eco-stoves and through solar energy for lighting).

However, investment needed to provide alternative energy sources to address climate change have not been calculated in this report, as it is consider in the Energy Sector report.

### Base year and assessment period

Based on the methodology of the UNDP on the forestry sector, the base year of the assessment is 2005 and the assessment period extends to 2030, which makes for a period of 25 years.

All monetary values in the report are expressed in constant 2005 United States dollars. The United States Dollar serves as a legal medium of exchange in Liberia. National budgets are usually in United States Dollar and bank payments are in US\$ in this country.

### Mitigation measures for which I&FF were assessed & results

Taking into consideration climate change, the calculation of the mitigation scenarios is made on the following basis (Forestry Development Authority (FDA):

- The mitigation period is for 25 years, commencing in 2005;
- The cost per hectare for sequestration of carbon by enhancing forest cover through afforestation and reforestation is USD\$150.00 / hectare
- The cost per hectare for enrichment of degraded forest is USD\$100.00 / hectare
- The cost per hectare for restoration of an existing plantation is USD\$250.00 / hectare
- The cost per hectare for sustainable forest management (3C) is USD\$2.50 / hectare

In deriving the cost for Operation and maintenance (O&M) a rate of 25% of the amount for the I&FF was applied; this is the standard rate applied across projects in the country.

Based on this, a total of US\$ 0.19 billion is needed to reduce emissions of greenhouse gases in the forestry sector. Four measures were analysed:

- Sustainable forest management (US\$ 0.14 billion);
- Enrichment of degraded forest (US\$ 13.22 million);
- Restoration of existing plantations (US\$ 5.9 million); and
- Afforestation and reforestation actions (US\$ 27.7 million).

With the government accounting for 45% of the new investment across sectors, the private sector with 35% of new investment will play an equally crucial role in this process. Households, with 20% of new investment will contribute the least in this process. However, with the increasing recognition of the rights of local communities and the prominence given to community rights in the Reform Law it is expected that the proportion of investment that will be attributed to household will rise very significantly. Households are involved in forest activities, but these are often not fully captured in statistical data by The Liberia Institute of Statistics and Geo-information Services (LISGIS), Central Bank of Liberia (CBL) or the Finance Ministry, this could account for the low figures being projected.

### Policy implications

The Forest Law (2006) calls for the establishment of refugia within commercial forest plantations to conserve plant and animal species as well as habitat of high conservation value. The nation-wide Strategic Environmental Assessment (SEA) identified capacity constraints in the forest sector. Capacity building, the SEA predicts will ensure national ownership of sustainable forest management processes in Liberia and will make the implementation of effective forest policies an achievable target.

The Government together with private companies and local communities can invest in programs that add value to the production of non-timber forest products to diversify the income of forest dependent communities and relieve pressure on the forest as their sole income source. Together with logging companies and local communities, government can initiate a process whereby companies undertaking meaningful social development projects can get a tax break because of their work in the communities.

The Government can also invite international rights and environmental groups at regular intervals to review the progress on the maintenance of high environmental and social standards and the distribution of the social funds from commercial forestry, and to also verify actions to promote fair play, transparency and accountability in the sector. In line with the independent findings of these bodies, punitive actions can be taken on companies and individuals that violate the Law.

Important activities for the implementation of the findings from this assessment are:

- Involve effectively policy makers from the highest government level. Strengthen inter-sectoral relationships between government agencies and relevant NGOs to avoid duplication of functions and wastage of resources;
- Create multi-stakeholder fora involving traditional rulers with the full participation of local communities they represent for consultation to ensure that policies are culturally sensitive and respect values and traditions of local communities;
- Enhance carbon sinks through good governance and constructive cultural practices, involve local communities in the crafting of forest management plan, and placing management and the management of monitoring, reporting and verification (MRV) in the hands of the forest communities. Train forest dwellers so that they become custodians of the forest, with full knowledge of sustainable harvesting of forest resources and alternative livelihood activities;
- Revamp educational institutions to meet challenges in the forestry sector and update forest curricula to meet national needs, implement international best practice in the sector;



- Conduct market assessments to determine non-timber values of the forest. Publicize the procedures for forest certification;
- Intensify reforestation programs, ensuring that logging companies reforest areas in which they operate and help communities establish community forests according to the “3C” principles. Increase the rotational period for logging operations from 25 to 50 years to allow logged forests to regenerate.

During the 2-day National Inter-Ministerial & Stakeholder Dialogue held in August 2011 to present the findings of the assessment of I&FF required to address climate change and to solicit inputs, participants made the following recommendations:

- Policies and law: Prevent the destruction of habitat through the effective implementation and enforcement of forest laws, rules and regulations. Define clear penalties for conservation laws violators. Promote payment for ecosystem services (PES) schemes in the forest sector. Provide incentives to attract private investments;
- Capacity and training: Train and maintain adequate man power for forest monitoring, provide logistical support for forest management at the local level. Intensify public awareness on forest policy, harmonize Land Use Policy;
- Diversification of livelihoods: Create an alternative livelihood opportunity for forest dwellers, develop and introduce appropriate technology.

#### Uncertainties and methodological limitations

While the methodological guidelines for I&FF assessment were very useful, the limited amount of data in the forestry sector meant that a lot of the data were extrapolated based on professional insights. Though the team did its best to gather whatever data was available, the years of civil conflict, coupled with the UN ban on the forestry sector meant that data were at best limited, scanty and sometimes totally absent for some years.

Without certainty of the outcome of negotiations on the post 2012 climate regime, it is virtually impossible to determine the future of REDD+, which is fast becoming Liberia’s options for forestry mitigation. Additionally, there is an urgent need for a software system that is exclusively created for the I&FF process to simplify the projections in the assessment.

## 2.3 Agriculture sector

### Sector scope

Liberia's agriculture sector is dominated by traditional subsistence farming systems, characterized by labor intensive practices like shifting cultivation and using low technologies. These have resulted in low productivity. Commercial agricultural activities are almost exclusively plantation estates of rubber, oil palm, coffee and cocoa. Land and water resources are abundant and offer potential for significant expansion of agriculture production. Agriculture contributed 54.9% of the GDP in 2005 (National Human Development Report of Liberia, 2006).

There are five major sub-sectors under the agriculture sector of Liberia, playing a vital role in the socio-economic development of the country namely:

- Crop production: The main food crops grown in Liberia include rice, root and tubers, sugar cane, legumes, maize, plantain, bananas, etc. while the main tree crops include rubber, coffee, cocoa and oil palm.
- Livestock production: Local breeds include cattle, goat, sheep, pig, rabbit, guinea pig, chicken, duck, and guinea fowl, which are well adapted to local conditions plus high productivity imported breeds.
- Fishery: Liberia has a coastalline of 520 km and a continental shelf which extends 200 nautical miles offshore. There are also six major rivers and several streams that run inland and use for multiple purposes including fishing.
- Plant protection: With increases in temperature, pests and diseases would have the tendency to proliferate, causing havoc to plants and animals.
- Soil & water management: 86% of Liberia's land area is dry land, so it is important to conserve soil and water quality.

### Base year and assessment period

Historical data collected cover the period 2000 to 2005. The year 2005 was selected as the base year, the assessment period is 2005-2030.

### Adaptation measures for which I&FF were assessed & results

US\$ 1.41 billion is needed to adapt to the effects of climate change in the agriculture sector through the implementation of:

- Intercropping, irrigation and the improvement of farming practices: Intercropping is a common traditional farming practice among subsistence farmers in Liberia where the main crop – often rice – is intercropped with cassava, which functions as a security crop: US\$ 0.50 billion;
- Development of livestock species most resistant to climatic conditions: It is important to plan activities to select animal species that best adapt to changing climate. The development of adequate prophylactic programs and program of animal breeding will serve as an effective coping mechanism in this regard: US\$ 0.21 billion;
- Development of fish farming (aquaculture and fishing): In a number of counties, the development of fishponds will be a solution for the diversification of activities and efficient use of rainwater. This has the advantage to channel and store rainwater and to reuse it to avoid flooding, but also to diversify the products produced: US\$ 0.43 billion;
- Measures to fight new diseases and prevent proliferation of old diseases: This includes measures to promote the fight against the emergence of new diseases or the

proliferation of old diseases due to climate change. It also includes diagnosing the diseases and provide effective coping mechanisms, plus surveillance of pests: US\$ 0.21 billion; and

- Improvement of soil fertility by maintaining fast growing nitrogen fixing tree species and using multi-purpose tree species: The activities under this option which will enhance resilience of the soil to climate change include action to defend and restore soil, soil water and soil fertility: US\$ 0.07 billion.

### Policy implications

Agriculture is the single most important source of livelihood for most rural Liberians. Over 75% of the country's population of 3.475 million are engaged either directly or indirectly in smallholder subsistence agriculture or fisheries. However, the MoA needs to redefine its roles and functions and to restructure to support climate change adaptation and mitigation programmes.

It would be prudent for the Ministry of Agriculture to revise its policy on food security and agriculture by capturing the selected adaptation activities and interventions stated in this assessment. Key components of these agriculture policies and strategies include:

- Pro-poor agriculture and agric business development: Provide micro-finance & low-cost extension services to needy farmers; Supply of timely farm inputs.
- Food and nutrition security: Promote production and consumption of local food items.
- Intensification and diversification of farming system: Proper land use plan; optimal water usage; crop rotation; low-external inputs; resistant crops and animals.
- Farm mechanization: Introduction of appropriate technology; irrigation.
- Increased market access: Improved transport system; quality control & fair price for local agricultural produces; formation of cooperatives.
- Reduce post-harvest losses: Processing of agricultural produce to add value chain; improved storage; pest control.
- Human and institutional capacity building: Develop a national policy on climate change; provision of funding to build human capacity on climate change and food security.

Policy development emanating from this assessment is the sure way of mainstreaming climate change adaptation efforts at the national, local and community levels. The results of this assessment will influence national budgetary planning and give GOL the resolve of addressing climate change by paying keen attention to adaptation in the agricultural sector. Basically, it is important that these vital statistical data provided by the study be integrated into rural development planning, National Communications, National Actions Plans and National Development Plans. This assessment raises the awareness of fundraising initiatives for climate change adaptation and helps political leaders such as cabinet ministers, lawmakers and County and district leaders understand the reasons for which adaptation should be integrated into national budgetary allocation. This assessment also gives rise to the development concept notes and ideas will be sharpened through seminars, policy dialogues and regular technical briefing papers for specific target groups. Through effective communication strategy and information dissemination on lessons learnt from the assessment, policy recommendations will be made for the consideration of policy makers.

During the 2-day National Inter-Ministerial & Stakeholder Dialogue held in August 2011 to present the findings of the assessment of I&FF required to address climate change and to solicit inputs, the working group on agriculture recommended the following:

- Incorporate the I&FF findings for agriculture in next Poverty Reduction Strategy (PRS-II);
- Policies: Mainstream climate change in the Agricultural Policy documents; Reduce taxes on farming inputs; Subsidize farming implements/machines; Put in place a price policy for all agriculture commodities;
- Plans: Integrate climate change into national long-term planning with a wide participation of stakeholders; Address climate change using a broader programmatic approach as opposed to fragmented activities; Prepare an agricultural land use plan for the country; Accelerate land zoning, conduct land suitability study; Improve the marketing system; Promote aquaculture; Secure access to land.
- Practices: Improve agro-forestry; Strengthen extension service; Promote adaptable varieties of agricultural crops.

#### Uncertainties and methodological limitations

It was difficult to collect data on investment and financial flows for the period 1995 to 2000 to form part of the historical period because of the problem of missing data during the civil crisis in Liberia. Due to insufficient data collected on the contribution of households, estimates were based on assumptions of CBL as well as the common agricultural practices of small-scaled farmers.

To calculate the cost of adaptation activities, the percentage was allotted based on expert judgement which might have led to over or understatement of the values in each sector. In the analysis carried out, the level of disaggregation of data does not indicate all sources of I&FF funds.

### 3. Summary tables of incremental investment costs

Table 1: Incremental Cumulative Discounted I&FF for All Investments in Each Sector, by Investment Entity and Funding Source (in million 2005 US\$)

Category of Investment Entity	Source of I&FF Funds		Incremental Cumulative (2005-2030) Discounted Sectoral Investments (million 2005US\$)							
			Mitigation				Adaptation			
			Energy		Forestry		Agriculture			
			ΔIF	ΔFF	ΔO&M	ΔI&FF	ΔO&M	ΔIF	ΔFF	ΔO&M
Households	Domestic	Equity and debt								
	Total Household Funds (all domestic)		802.35	80.24	200.59	29.67	7.45	407.45	98.85	127.05
Corporations	Domestic	Domestic equity (including internal cash flow)								
		Domestic borrowing (bonds and loans)								
		Total Domestic Sources	-6.06	-0.61	-1.51					
	Foreign	Foreign direct investment (FDI)								
		Foreign borrowing (loans)								
		Foreign aid (ODA)								
		Total Foreign Sources	36.86	3.69	9.21					
Total Corporation Funds		30.80	3.08	7.70	51.94	13.06	316.91	76.89	98.82	
Government	Domestic	Domestic funds (budgetary)	-6.37	-0.64	-1.59					
	Foreign	Foreign borrowing (loans)								
		Bilateral foreign aid (bilateral ODA)								
		Multilateral foreign aid (multilateral ODA)								
		Total Foreign Sources	127.05	12.70	31.76					
Total Government Funds		120.68	12.07	30.17	66.78	16.80	181.11	43.93	56.47	
Total (all investment entities and all sources)			953.83	95.38	238.46	148.44	37.32	905.46	219.66	282.33

Negative values mean net savings

IF = Investment Flows, FF = Financial Flows

ΔI&FF = incremental changes of Investment and Financial Flows

Source: National I&FF assessment

**Table 2: Incremental Annual I&FF for All Investments in Each Sector (in million 2005 US\$)**

Year	Incremental Annual Sectoral Investments (million 2005US\$)							
	Mitigation					Adaptation		
	Energy			Forestry		Agriculture		
	$\Delta$ IF	$\Delta$ FF	$\Delta$ O&M	$\Delta$ I&FF	$\Delta$ O&M	$\Delta$ IF	$\Delta$ FF	$\Delta$ O&M
2005	128.65	12.86	32.16	-	-	1.66	0.41	0.53
2006	116.47	11.65	29.12	0.44	0.09	1.98	0.52	0.63
2007	96.79	9.68	24.20	0.89	0.23	3.47	0.86	1.08
2008	95.58	9.56	23.90	1.37	0.34	4.16	1.06	1.32
2009	89.29	8.93	22.32	1.80	0.45	8.00	2.00	2.52
2010	84.55	8.46	21.14	2.25	0.57	2.06	0.75	0.64
2011	150.26	15.03	37.56	2.69	0.67	2.58	0.63	0.82
2012	140.50	14.05	35.12	3.15	0.78	3.23	0.78	1.02
2013	129.58	12.96	32.39	3.62	0.90	4.02	0.98	1.25
2014	118.38	11.84	29.60	4.05	0.99	5.03	1.22	1.58
2015	107.53	10.75	26.88	4.52	1.14	6.29	1.53	1.36
2016	96.75	9.68	24.19	4.94	1.23	7.86	1.92	2.46
2017	87.40	8.74	21.85	5.45	1.37	9.84	2.39	3.08
2018	78.82	7.88	19.70	5.91	1.48	12.29	2.98	4.54
2019	70.96	7.10	17.74	6.35	1.60	15.38	3.73	4.80
2020	63.78	6.38	15.95	6.82	1.72	19.20	4.66	5.98
2021	57.21	5.72	14.30	7.29	1.82	24.02	5.82	7.49
2022	45.24	4.52	11.31	7.76	1.95	30.01	7.27	9.35
2023	45.69	4.57	11.42	8.22	2.06	37.51	9.10	11.72
2024	40.63	4.06	10.16	8.70	2.17	46.90	11.36	14.64
2025	35.99	3.60	9.00	9.18	2.30	58.61	14.22	18.29
2026	31.73	3.17	7.93	9.65	2.43	73.27	17.76	22.86
2027	27.80	2.78	6.95	10.12	2.54	91.60	22.22	28.58
2028	24.18	2.42	6.05	10.60	2.66	114.49	27.75	35.72
2029	20.84	2.08	5.21	11.07	2.77	143.11	34.7	44.68
2030	17.76	1.78	4.44	11.57	3.79	178.90	43.36	55.84

IF = Investment Flows, FF = Financial Flows

$\Delta$ I&FF = incremental changes of Investment and Financial Flows

Source: National I&FF assessment

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