

Platform
for Agricultural
Risk Management

Managing risks
to improve farmers'
livelihoods

Risk Assessment



Liberia

Study conducted by



In collaboration with



**Agricultural Risk
Assessment Study**

Full Report
August 2018





PARM
PLATFORM FOR
AGRICULTURAL RISK
MANAGEMENT

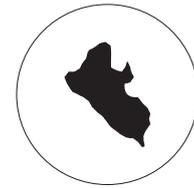
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Foreword

The **Platform for Agricultural Risk Management (PARM)**, a G7-G20 initiative hosted by the International Fund for Agricultural Development (IFAD), is a multi-donor partnership co-financed by the European Commission (EC), Agence française de Développement (Afd), Italian Government and IFAD, to support Governments and stakeholders on Agricultural Risk Management (ARM). The Platform works in strategic partnership with NEPAD / CAADP in African countries to mainstream agricultural risk management into the national agricultural policy and investment plans (www.p4arm.org). Current work supports ARM assessment and policy process in Cabo Verde, Cameroon, Ethiopia, Liberia, Niger, Senegal, Zambia and Uganda.

This Risk Assessment Study is part of the ARM process in Liberia. The report was conducted by the Research Centre for the Management of Agricultural and Environmental Risks (CEIGRAM) a joint Research Centre of the Universidad Politécnica de Madrid (UPM).

The Government of Liberia and, in particular, the Ministry of Agriculture, has largely contributed to this report with inputs and suggestions. PARM thanks the engagement of the Ministry of Agriculture of Liberia, for mobilizing relevant stakeholders during the Risk Assessment Workshop held in Monrovia in June 2017 in order to provide their inputs to the report through their expertise and active participation.

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List of acronyms

ACGF	Africa Catalytic Growth Fund
ADAL	Agro-inputs Dealers Association of Liberia
ADF	African Development Fund
AEAS	Agricultural Enterprise Areas
AESCs	Agro-Enterprise Service Centers
AFAP	African Fertilizer and Agribusiness Partnership
AfDB	African Development Bank
AfRGM	African Rice Gall Midge
AfricaRice	Africa Rice Center
AfT	Agenda for Transformation
AGI	Association for Geographic Information
AHA	African Humanitarian Action
AHS	Department of Animal Health Services
AI	Avian Influenza
AIDP	Agriculture Infrastructure Development Program
AML/CFT	Anti-Money Laundering/Combating the Financing of Terrorism
ANRPC	Association of Natural Rubber Producing Countries
APHLIS	African Postharvest Losses Information System
ARM	Agriculture Risk Management
ASF	African Swine Fever
ASRP	Agricultural Sector Rehabilitation Project
AVHRR	Advanced Very High Resolution Radiometer
BCL	Bank Central Liberia
BNF	Bureau of National Fisheries
BQ	Blackquarter
BRAC	Building Resources Across Communities
CAADP	Comprehensive African Agriculture Development Programme
CAAS	Comprehensive Assessment of the Agriculture Sector
CABI	Centre for Agriculture and Biosciences International
CAC	County Agriculture Coordinator
CARI	Central Agricultural Research Institute
CBB	Cassava Bacterial Blight
CBL	Central Bank of Liberia
CBPP	Contagious Bovine Pleuroneumonia
CCAAP	Climate Change Adaptation Agriculture Project
CCBS	FAO/GIEWS Country Cereal Balance System
CCPP	Contagious caprine pleuro-pneumonia
CDA	Cooperative Development Agency
CEIGRAM	Research Center for the Management of Agricultural and Environmental Risks
CGIAR	Consultative Group on International Agricultural Research
CGR	Community Grain Reserve
CIMS	Concession monitoring and evaluation software
CIRDev/EWS	Climate Information for Resilient Development/Early Warning System
CMVD	Cassava mosaic virus disease
CPO	Crude Palm Oil
CSSV	Cacao Swollen Shoot Virus



CSSVD	Cocoa Swollen Shoot Virus Disease
CV	Coefficient of Variation
DFID	UK's Department for International Development
DHS	Demographic and Health Survey
DMER	Department of Mineral Exploration and Environmental Research
DRDRE	Department of Regional Development, Research and Extension
DSSAT	Sun Storage Tek Availability Statistics
ECOWAS	Economic Community of West African States
EM-DAT	Emergency Events Database
EPA	Environmental Protection Agency
EPML	Environmental Protection and Management Law
EPO	Equatorial Palm Oil
EU	European Union
EVD	Ebola virus disease
F2F	Farmer to Farmer Program
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO's Corporate Statistical Database
FAPS	Food Agricultural Policy and Strategy
FBO	Farmer Based Organizations
FDA	Forestry Development Authority
FED	Food and Enterprise Development Program
FEWS NET	Famine Early Warning Systems Network
FFP	Food for Peace Program
FMD	Foot and Mouth Disease
FOs	Farmer Organizations
FTF-ITT	USAID-Programme Management Unit
FUN	Farmer Union Network
GAFSP	Global Agricultural and Food Security Program
GCI	Global Competiveness Index
GCMs	General Circulation Models
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIEWS	Global Information and Early Warning System
GoL	Government of Liberia
HANDS	Health, Agriculture and Food Security Program
HMIS	Health Management Information System
HSCC	Health Sector Coordination Committee
ICBT	Informal Cross-Border Trade
ICCO	International Cocoa Organization
ICT	Information and Communications Technology
IDA	International Development Association
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFDC	International Fertilizer Development Center
IITA	International Institute of Tropical Agriculture
IMF	International Monetary Fund
IMPACT	International Model for Policy Analysis of Agricultural Commodities and Trade
IPMP	Integrated Pest Management Plan
IPPC	International Plant Protection Convention



IRC	International Rescue Committee
IRR	Internal Rate of Return
ITC	Infrastructure for Communication
ITCZ	Intertropical Convergence Zone
ITTO	International Tropical Timber Organization
IUU fishing	Illicit, Unregulated and Undeclared fishing
KEPHIS	Kenya Plant Health Inspectorate Service
LAC	Liberian Agriculture Company
LACRA	Liberia Agricultural Commodity Regulation Agency
LADA	Liberia Agri-business Development Activity
LAFA	Liberia Artisanal Fisherman Association
LASIP	Liberian Agriculture Sector Investment Program
LATA	Liberian Agricultural Transformation Agenda
LAUNCH	Liberian Agricultural Upgrading, Nutrition and Child Health Program
LBA	License Buying Agents
LBPM	Liberian Produce Marketing Corporation
LGB	Larger Grain Borer (<i>Prostephanus truncatus</i>)
LHS	Liberian Hydrological Service
LIBINCO	Liberia Operation Oil Palm Inc.
LIMSS	Livestock Information Management Systems and information delivery Services
LISGIS	Liberia Institute of Statistics and Geo-Information Services
LLP	Liberia Livestock Policy
LMA	Liberia Maritime Authority
LNIC	Liberia National Investment Commission
LPC	Liberia Peace Council
LPMC	Liberia Produce and Marketing Corporation
LRD	Liberian Dollar rates
LSD	Lumpy Skin Disease
MCC	Millennium Challenge Corporation
MCCLP	Millennium Challenge Corporation Liberia Program
MEAS	Modernizing Extension and Advisory Services Project
MERLIN	Medical Emergency Relief International
MetOp	Meteorological Operational satellite Programme
MFPD	Ministry of Finance & Development Planning
MGCSP	Ministry of Gender, Children & Social Protection
MIA	Ministry of Internal Affairs
MLME	Ministry of Lands, Mines and Energy
mm	Milimetre
MoA	Ministry of Agriculture
MoCI	Ministry of Commerce and Industry
MoH	Ministry of Health and Social Welfare
MoT	Ministry of Transport
MT	Metric Tons
MTDF	Multi Donor Trust Fund
NAPA	National Adaptation Programme of Action
NBC	National Bureau of Concessions
NCCS	National Climate Change Secretariat
NCCSC	National Climate Change Steering Committee
ND	Newcastle Disease



NDRC	National Disaster Relief Commission
NDVI	Normalized Difference Vegetation Index
NEP	National Energy Policy
NFSN	National Food Security
NGO	Non-governmental organization
NIPL	National Infrastructures Plan for Liberia
NLB	National Livestock Bureau
NMCDP	National Millennium Compact Development Project
NOAA	US National Oceanic and Atmospheric Administration
NPPO	National Plant Protection Organization
NSL	National Standards Laboratory
NSP	National Seed Policy
OICI	Opportunities Industrialization Centers International
OIE	World Organisation for Animal Health
PARM	Platform for Agricultural Risk Management
PCU	Programme Coordination Unit
PDF	Probability Density Functions
PHL	Postharvest Losses
PPR	Pressure to Produce Revenue
PPR	Pest des Petits Ruminants
PROSPER	People, Rules and Organizations Supporting the Protection of Ecosystems and Resources
PVS	Performance of Veterinary Services
RAS-WS	Risk Assessment System
RCFI	Rural Community Finance Institution
REDISSE	Regional Disease Surveillance Systems Enhancement project
RESMP	Rural Energy Strategy and Master Plan
RYMV	Rice Yellow Mottle Virus
SAPEC	Smallholder Agriculture Productivity Enhancement and Commercialization
SFNS	Sustainable Food and Nutrition Security
SPI	Seed Programs International
SPS	Sanitary and Phytosanitary Standards
STCRSP	Smallholder Tree Crop Revitalization Support Project
TADs	Trans-boundary Animal Diseases
UL	University of Liberia
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Fund for Population Activities
UNICEF	United Nations Children Fund
USA	United States of America
USAID	United States Agency for International Development
USAID WAFP	USAID West Africa Fertilizer Program
USAID-EAT	USAID-Enabling Agricultural Trade project
USAID-GEMS	USAID-Global Environmental Management Support Project
USDA	United States Department of Agriculture
USFFP	USDA Food for Progress
WAAPP	West Africa Agriculture Productivity Program
WAD	West African Dwarf
WASH	Water, sanitation, and hygiene
WASRP	West Africa Agriculture Productivity Program



WB	World Bank
WCMC	World Conservation Monitoring Centre
WFP	World Food Programme
WFP-VAM	World Food Programme Vulnerability Assessment and Mapping
WGI	Worldwide Governance Indicators
WHO	World Health Organization



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Executive summary

In this report, the Liberia country profile is presented based on the general and agricultural information on risks emanating from weather and climate change, food security, biological and environmental, inputs and infrastructure, market and prices as well as the policy and institutional context.

Because of the difficulties to calculate the average economic losses for every agricultural risk due to the lack of reliable data, statistics and information, we followed a methodology for risk prioritization which combines quantitative and qualitative risk assessments depending on the availability and reliability of data. The methodology is based on four elements:

1. quantitative or qualitative assessments of frequency, severity and worst scenario for the different agriculture risks;
2. main constraints that increase the impact of some agricultural risks and the vulnerability of farmers facing that agricultural risks;
3. academic literature review and the search for reports, studies and analysis from NGOs, consulting, think tanks, cooperation agencies and national and international institutions; and
4. interviews with experts from NGOs, cooperation agencies, international institutions and officers of Liberian ministries and national institutions collected in the field work and by e-mail or teleconference.

Based on these four elements and using the scoring methodology (chapter 6), the following table was generated to present the prioritization of the agricultural risks in Liberia.

Table A: Risk scoring for Liberia

Risk	Severity	Frequency	Worst scenario	Score
High precipitation (Floods)	● VERY HIGH	● HIGH	● VERY HIGH	4.60
Post-harvest losses	● HIGH	● VERY HIGH	● HIGH	4.35
Crop pest and diseases	● HIGH	● MEDIUM	● VERY HIGH	3.85
Livestock pest and diseases	● MEDIUM	● VERY HIGH	● MEDIUM	3.65
Price risk	● HIGH	● LOW	● VERY HIGH	3.37
Political risk	● MEDIUM	● MEDIUM	● MEDIUM	3.00
Inputs counterfeit	● MEDIUM	● LOW	● MEDIUM	2.59
Windstorm	● LOW	● MEDIUM	● LOW	2.34

Source: Authors Construct based on qualitative assessments of risk and scoring methodology

The most important risks to tackle for the agricultural development in Liberia according the scoring are: 1) high precipitation (floods); 2) post-harvest losses; 3) crop pest and diseases; 4) livestock pest and diseases; 5) price risk; and 6) political risk.

Further, the study prioritizes risks according to the main crops and livestock production sectors. We observe that the high precipitation is a high risk for cassava and livestock, but it has a medium risks core for rice and some cash crops which are widely grown in the North and Central part of the country where excess rain-fall and floods are uncommon. The second risk according to relevance is post-harvest losses as it is very high in cassava and rice the two main staple foods in Liberia and therefore with a high potential negative impact on food security. The crop pest and diseases risk are very high for rice provoking important reduction of rice harvest which implies increasing import and food aid to face food security problems. The lack of pesticides for fighting against the pest and diseases of rice is a constraint that increases the impact and harvest losses from rice pest and diseases.



The livestock pest and diseases risk are very high for livestock farmers but the impact on national economy is not very relevant as the livestock subsector represents only 14% of agricultural GDP. The three main diseases of livestock are Pest des Petit Ruminants (PPR) in goat and sheep, swine fever in pigs and Newcastle Disease in back-yard poultry production. These three are the most devastating diseases for livestock in Liberia, followed by the all sort of non-well-defined diarrheal diseases. They occur regularly and damage a great proportion of rural and peri-urban households.

About 95% households reared chickens or ducks, 52% reared goats and at least 35% reared pigs according to data issued in 2013. An important increase in the number of households with chickens, goats and pigs is taking place during the last five years and therefore the risk and impacts of animal and human health (zoonosis) is increasing. The lack of veterinary services, vaccination and medication products together with the very limited access to adequate raw materials are important constraints that increase the impact of pest and diseases on Liberian livestock.

Concerning the price risk, we assessed a great difference between the price risks in food crops compared to cash crops. The price risk is high in cash crops which are exported as the farmers growing cocoa and rubber are subject to the volatility of the international markets and the lack of transparency of domestic market prices as the transition from LPMC to LACRA is still pending. In the case of cassava, rice and palm oil the price risk is medium based on information published by WFP on retailer prices

The study also prioritizes agricultural risk according to the different regional context of the country. For this analysis we consider five regions in Liberia: Montserrado that includes Monrovia, North Western, North Central, South Central and South Eastern. The main risk in Liberia is deemed as flood which is very high in the South regions provoking huge impacts in these regions due to the combination of very high risk of huge precipitations and very bad road infrastructure. In addition, the risk of wind storm is very low or low in across Liberia except in the North Central Region where the topography is very hilly. The risk of post-harvest losses is very different across regions, is low in Montserrado, medium in North Western, high in North Central and South Central and very high in South Western. Farther from Monrovia more post-harvest losses risk increases as the road and storage facilities are much worse in the south and excess of raining and floods has dramatic impact on post-harvest losses.

Concerning biological risks, the crop pest and diseases risk is just high in North Central and South-Central regions where the upland rice cultivation is concentrated. In Montserrado the risk is low and medium in North Western and South Eastern. In the case of livestock pests and diseases risk are relatively high throughout all the rural areas, except North Western Liberia and medium in Monrovia because of the establishment of animal farms in the peripheral areas. The risk of communicable diseases related to water is a major threat in Liberia due to the high prevalence of diarrheal related disease like malaria. Malaria is endemic across the entire country and it is the nation's number one direct cause of morbidity and mortality. Adequate WASH access should be a top priority to reduce the health risks

The price risk is different in the North compared to the South. The Southern regions have a high price risk since they are far regions from Monrovia and the frequent floods collapse the roads and prevent the transport to and from outside provoking impacts on food markets and prices. Lastly the input risk and political risk is very similar in all regions and ranking from low to medium risk.

After the assessment and prioritization of agricultural risks in Liberia and the analysis of the main constraints that Liberian agriculture face, the main recommendations on policies to be implemented and tools to be used for agricultural risk management in Liberia are summarized in the following table.

**Table B:** Risk management tools for Liberia

Ranking	Risk	Risk management option
1	Rain (Floods)	Watershed management (improvement of roads and drainage) Information system and early warning;\
2	Post-harvest losses	Improvement of infrastructure (roads, storage, warehouse) Extension services (Adequate information and training farmers)
3	Crop pest and diseases	Extension services (training in plant health management) Diagnostic laboratories for analysis of plants Increasing input availability and use (pesticides) Information system and early warning
4	Livestock pest and diseases/human health	Improvement of Veterinary services, implementation of an epidemiology unit and diagnostic laboratories for animal health Information system to improve preparedness and early warning Reinforce the implementation of WASH
5	Price risk	Market information and early warning systems Strategic food reserves Market Liberalization and standards regulation (LACRA)
6	Politic risk	Strengthening the institutional framework Security of land rights
7	Inputs counterfeit	Strengthening the agro-input market and distribution chain Extension services (Adequate information and training farmers)
8	Windstorm	Information system and early warning

In chapter 3, the study outlines the existing policy and institutional environment as well as the initiatives for risk management in Liberia. It goes on to conclude that the capacity to implement national policies is limited mainly due to institutional weaknesses, lack of technical capacity and budgetary constraints. Programs and projects in Liberia funded by international agencies and NGOs in many cases do not focus on the strengthening of the technical capacity of national institutions. Deficiencies in human resources and technical capacities and limited financial resources make it difficult for the government to implement national policies, programs and projects.

More capacity for data collection and technical analysis is needed in the public sector. In several risks the role of extension services is a key component of ARM policies. The lack of coordination and collaboration among different institutions is another institutional weakness that should be overcome to improve the agricultural risk management effectiveness.





Liberia



Part one: Country profile

1. Country Context

1.1. The national profile - general information on Liberia

Liberia is located on the West Coast of Africa with a long (579 km) coastline of the North Atlantic Ocean on its south-western side, bordered on the north west by Sierra Leone, the north by Guinea (Conakry), and the east by Cote d'Ivoire. The country consists of 96,320 km² of land and 15,049 km² of sea.

Liberia has only moderate variation in ecology, rainfall patterns and hazards. In fact, we may distinguish only two big agro-ecological zones in Liberia: the coastal plain in which cassava is dominant crop and the elevation of the interior up to the borders with Guinea and Ivory Coast where rice (mostly rain-fed or in swampland rather than irrigated) dominates the higher hinterland. The lean season occurs in most zones in Liberia from July through September, in advance of the mid-October rice harvest; the exception is in the southeast of the country, from April through July, in advance of the August rice harvest. Periods of peak rainfall, from June through October, are of concern because of the risk of flooding.

Liberia's population is estimated at about 4.13 million for 2011 (43 persons/km²), comprising 48 per cent urban and 52 per cent rural (Table 1).

Table 1: Demographic Profile

Year	1990	1995	2000	2005	2010	2011	2013	2020
Total Population(x10 ³)	2,127	2,095	2,847	3,183	3,994	4,129	4,558	5,166
% Urban	41	43	44	46	48	48	52	54
% Rural	59	57	56	54	52	52	48	46

Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects. The 2011 Revision, <http://esa.un.org/undp>.

Liberia has experienced a relatively high rate of urban population growth promoted by better transport and communication systems, fertile agricultural lands, local alluvial mining activities, and the presence of international mining and agricultural companies, as well as opportunities for employment and trade with contiguous West African countries. In addition, many farmers deserted rural areas during the civil war. This migratory trend is expected to continue to reach a 54% urban and 46% rural population by 2020 (Table 1).

The capital Monrovia is the most densely populated city due to its relatively superior socioeconomic conditions. Major challenges associated with population growth include destroyed infrastructure, power cut, weak health system, malnutrition, lack of clean drinking water, bad road conditions, and high levels of unemployment. As the population increases, there will be a high demand not only for the limited basic social services but also for the untapped natural resources. Transportation is very important for agricultural development. In Liberia, the poor road conditions make it very difficult to transport agricultural products from the southeastern counties to Monrovia (Jalloh et al., 2013).

Liberia's GDP per capita increased from about US\$700 (US dollars) in 1960 to just above US\$800 in 1970 and then dropped throughout the 1980s to its lowest level, less than US\$100, during the civil war of the mid-1990s. The decrease from 1970 to 1990 reflected the downward shift in the global economy. From 1995 onward, Liberia's GDP started improving and has been steadily increasing at high rates of 11 to 14 percent since 2007. This steady growth has been largely attributed to the growth in the mining and rubber industries which have been rehabilitated after the end of the second Liberian civil war (1999-2003).



However, the GDP per capita in 2013, adjusted for the Purchasing Power Parity was low at USD 878 as compared to about USD 2000 average for the Sub-Saharan Africa, making Liberia one of the poorest countries in the world. In 2013, the country was ranked nearly at the bottom (175th) out of 187 countries on the United Nations Development Programme's (UNDP) Human Development Index. The proportion of poor people is huge as 90–95 percent of the population of Liberia lives on less than US\$2 per day.

1.2. The importance of agriculture in the Liberian economy

Historically, the Liberian economy has depended heavily on foreign direct investments including foreign aid and exports of cash crops, natural resources and mining. However, like most sub-Saharan economies, its exports are dominated by raw materials rather than value added or processed commodities. The principle exports include iron ore, rubber, gold, as well as timber. The current account balance of payments is constraint by a huge negative trade balance. Against an average (2005-2015) of more than US\$ 240 million of imports, exports earned just US\$ 15 million. The high deficit in the balance is mainly due to the very narrow export base coupled with lower receipts from some of existing export e.g. rubber.

The share of its GDP from agriculture increased slowly, from about 30 to 40 percent between the mid-1960s and 1990 (Jalloh et al., 2013). During the civil war, the share of its agricultural GDP increased sharply because other sectors of the economy were disrupted and most became nonfunctional. Agricultural companies such as Firestone were still in operation, with intermittent interruptions during the civil war. Later, during the civil crisis (1999–2003), agricultural production started to drop as people fled their farms and the supporting infrastructure collapsed. After the 2005 general election and presidential election, other sectors of the economy revived, including forestry, mining, and international trade, leading to a gradual rise in GDP (Jalloh et al., 2013). Rubber, a major export crop, contributes 26 percent of the country's GDP (GOL, 2008).

Majority of the population is reliant on subsistence agriculture and while the country is richly endowed with water, mineral resources, forests, and a climate favourable to agriculture, it lags in productivity compared to other neighbour countries due to poor human capital, lack of infrastructure, and instability.

Liberia has a very high dependency on agricultural imports, mainly cereals. The main exports are rubber and cocoa but the revenue from agricultural exports are low. Therefore, agricultural trade balance is negative (See Table 2).

Table 2: Agricultural Trade Balance (million US\$)

Year	2000-2008	2004-2008	2008	2009	2010
Exports	91.54	104.75	100.16	81.88	197.77
Imports	131.94	172.17	216.51	236.40	270.89
Net imports	40.40	67.42	116.35	154.58	73.12
% GDP	6.37	10.39	13.68	13.38	5.66

Source: Food Balance Sheet (World Bank, 2014)

1.3. Climate and meteorology

The climate of Liberia is tropical and humid with relatively small variations between day and night and between seasons. There are three types of climate in the country: Monsoon climate, Tropical Savanna and equatorial climate (Bateman et al., 2000). These types affect different Counties (Table 3).

Temperatures never exceed 37°C nor does it fall below 12°C. Mean annual temperatures range between 18° C in the northern highlands to 27° C along the coast. The average humidity in the coastal belt is between 82% during the wet season and around 76% during the dry season. However, it is liable to drop to 30% during the harmattans (dry, heavily dust-laden winds blow from the Sahara) that occurs from December to March.



There are two seasons, the wet season from May to October and the dry season from November to April, although this can be changed depending on the County. In general, the annual rainfall averages from 3,810 mm to 4,320 mm along the coast and decreases to about 1,778mm in areas farthest inland. The greatest amount of rainfall (5,200 mm) occurs at Cape Mount and diminishes inland to about 1,800 mm on the central plateau.

Based on the data available from US National Oceanic and Atmospheric Administration (NOAA) / Famine Early Warning Systems Network (FEWS NET), there are sensitive differences in precipitation among Counties in the crop lands (Table 3). The highest precipitation is found in the Equatorial climate, in a range from 1,300 to 1,600 mm, and the lowest in Bomi (871 mm) that present a Monsoon climate.

Table 3: Estimate of annual average precipitation by County, on crop land from 1996-2012

County	Precipitation (mm)	Climate
Bomi	871	Monsoon Climate
Montserrado	907	
Grand Cape Mount	929	
Margibi	943	
Bong	964	
Gbarpolu	959	
Grand Bassa	1001	
Lofa	1086	
River Cess	1120	
Nimba	1009	Tropical Savanna / Monsoon Climate
Grand Gedeh	1247	Tropical Savanna / Monsoon Climate / Equatorial Climate
Sinoe	1361	Equatorial Climate
Grand Kru	1437	
Maryland	1504	
River Ghee	1616	

Source: NOAA/FEWSNET, climate classification based on World Maps of Köppen-Geiger

1.4. Farming systems

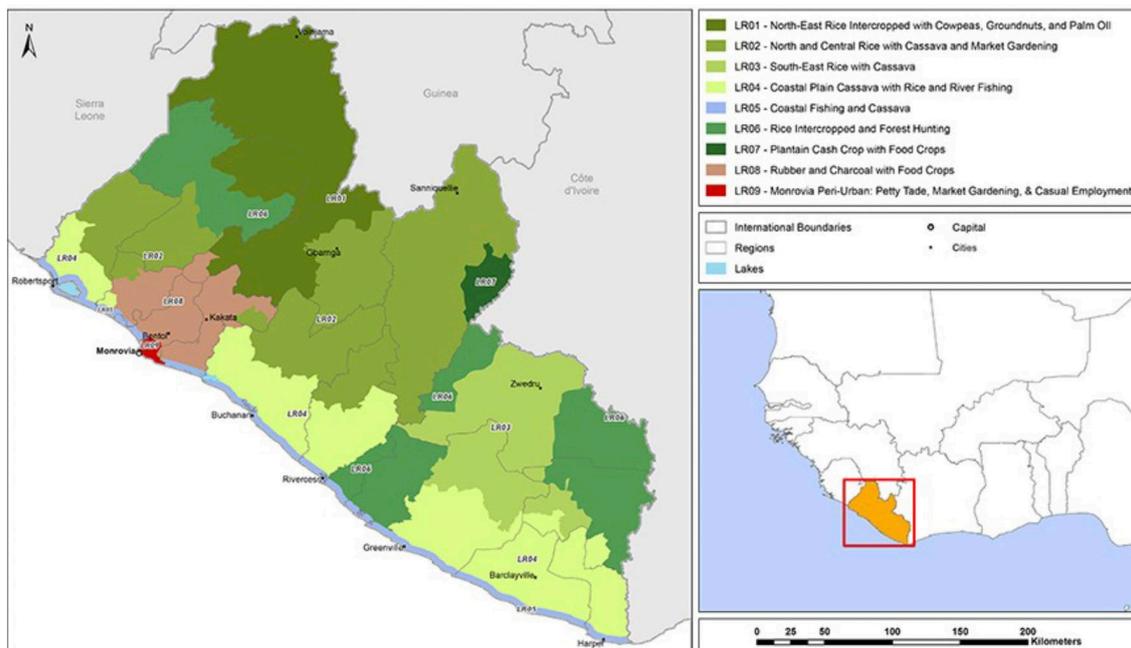
Four production systems characterized the Liberian agriculture:

- Foreign commercial plantations producing perennial export crops (rubber, palm oil);
- State owned plantations run by the Liberian Palm Products Corporation and the Liberian Cocoa and Coffee Corporation;
- Domestically owned, medium-sized commercial farms producing industrial crops for export and livestock for the local market; and
- Small traditional household farms using primitive production techniques with extremely limited use of modern inputs.

The farming system is characterized by shifting cultivation, which has led to the conversion of extensive areas of forest into farmland and grassland in many parts of the country (Jalloh et al., 2013)

Rice is the staple food of Liberians, while cassava is the second major food-crop. Overall, Liberian farmers are resource poor and invariably produce at subsistence level. Against the background of limited resources, the typical Liberian farmer is faced with numerous biophysical constraints, including low-yielding crop varieties, pests, and diseases, as well as poor soil conditions. Heavy reliance on rainfall exposes farmers to the vagaries of the weather (Jalloh et al., 2013).

Figure 1. Livelihoods zoning “plus” activity in Liberia



Source: FEWS NET (2011)

1.5. Land use

1.5.1. Acreage distribution

The land area of approximately 111370 km² of which 96160 km² (86 percent) is dry land. The rest, 15210 km² and constituting 14 percent of the surface area, is covered by water. The topography comprises mainly flat to rolling coastal plains running into some interior plateaus and then mountains in the north eastern part of the country. The country is made up of four physiographical units: coastal plains (0-100 m), interior hills (100-300 m), interior plateaus (300-600m) and the mountainous areas (> 600m).

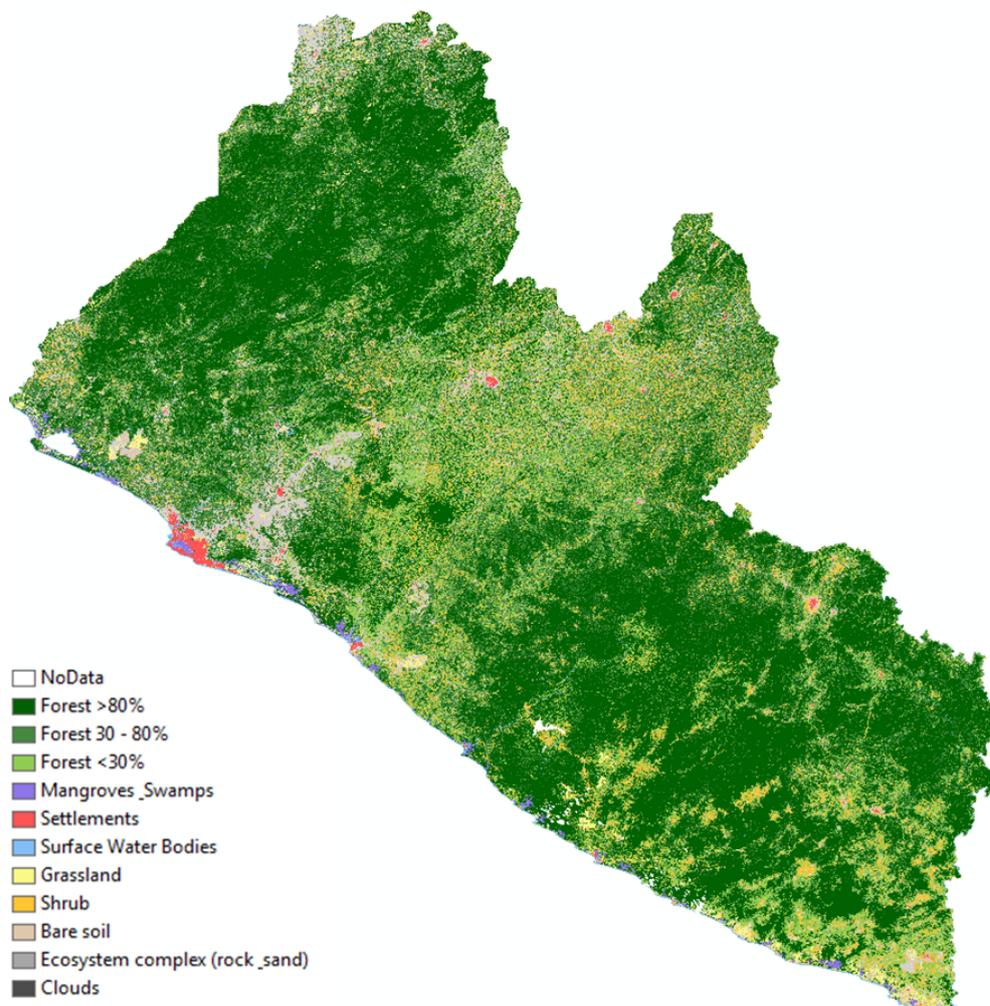
These locations provide important protection for fragile environmental areas, which may also be important for the tourism industry. In Liberia there are two gazette protected areas: Sapo National Park is located in the south-eastern part of the country, bordering the Sinoe River in the south and the Putu Range in the north; the Mount Nimba Nature Reserve is located in the north, sharing a massif with Côte d'Ivoire and Guinea. Sapo National Park has an area of 180,363 hectares of lowland rainforest, including swampy areas, dry lands, and riparian forests; it represents one of the most intact forest ecosystems in Liberia, located in the only remaining evergreen block of forest in the Upper Guinea Forest Ecosystem. Mount Nimba Nature Reserve covers an area of 11,723 hectares. In addition, there are five proposed protected areas: Lake Piso Nature Reserve (estimated area 30,766 hectares), Cestos Senkwen National Park (estimated area 91,698 hectares), Wologezi National Park (estimated area 80,001 hectares), Wenegizi National Park (estimated area 71,422 hectares), and Grebo National Park (estimated area 260,326 hectares) (UNDP Liberia, 2006; UNEP-WCMC, 2006; Jalloh et al., 2013).

1.5.2. Forest

Liberia is situated within the Upper Guinean Forest that extends from Guinea at the north western extreme to the eastern limit in Cameroon. The Upper Guinean Forest is fragmented and Liberia accounts for more than half of West Africa's remaining tropical forest. The total Liberian land area is 9.6 million ha, of which forests cover about 45% or 4.39 million ha. About half of the forest area is classified as closed dense forest (2.42 million ha); 1.02 million ha are classified as open dense forest almost 1million ha are degraded or have been converted to agriculture (USAID, 2013; EPA, 2013).

There are three general types of forest, the evergreen or mixed evergreen/semi deciduous moist forests of western Liberia where there is a distinct dry season (under 100 mm rain/month), and the wet evergreen forests of eastern Liberia where the dry season is very short or absent. The highest hills in Liberia support the third forest type, sub-montane (or montane) forest above about 800-1000 m, although this zone is poorly-differentiated from the contiguous lowland 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 coastal zone is heavily impacted by settlements and agriculture, with a mosaic of sandy and rocky shores, mangroves and fresh-water swamps, grass/shrub savannas on sand, and coastal forests. (USAID, 2013).

Figure 2. Liberia Land Cover and Forest Mapping



Source: Forestry Development Authority (FDA) (2015)



1.5.3. Land tenure system

The land tenure system reflects the division of the country between an urban-elite descendant from freed slaves from US and Caribbean (5% per cent of the population) and rural native population (95% of the population). The urban elites use a system based on statutory law with individual fee simple titles while the native population use a customary system based on collective ownership. While the statutory law recognizes absolute ownership, the customary law usually limits the tenure to usufruct rights. There is a long history of disputes between the two systems and a discrimination against traditional customary tenure benefiting government. The property law establishes numerous categories of land, creating confusion. These categories include (USAID-EAT, 2015):

- **Customary, tribal or communal lands:** Include the land in indigenous communities that is held by families or smallholders living in the interior of the country. Individual access remains regulated by elders and chiefs and resemble as usufruct.
- **Privately held land:** ruled under the statutory law with individual private property rights.
- **Government land:** Used for government functions.
- **Public lands:** land at the government disposal although historically may have been under customary systems. This category has been frequently used for taking land from communities for concession agreements. If there was not a deed to the land, as usual in communal lands, then the land was public land. Generally, public land has been interpreted as state owned land. This interpretation grants the state the right to natural resources without the obligation to compensate the communities that occupy the land. This has created resentment towards foreign investors granted long term leases. It is estimated that 21% of land area is dedicated to concessions including agriculture (rubber and palm oil), timber and mining (AfDB Group, 2013).

This dual system has contributed to the existence of numerous conflicts where traditional smallholders, with customary access to land and associated with subsistence agriculture, and commercial cash crop farmers compete with international concession companies over access to land (Mulbah, 2015).

1.5.4. Soil and water resources

Liberia lies within the humid agro-ecological zone, with 70 percent of the soils comprising Ferrasols (Deckers, 1993). These generally have good physical properties for plant growth but poor chemical fertility and low capacity to retain nutrients.

As a consequence of the intense weather over prolonged time periods, they have lost nearly all of the minerals they had inherited from their parent rock and are now dominated by stable products such as aluminium oxides, iron oxides and kaolinite. Ferrasols are acidic and have low nutrient availability. Their ability to hold nutrients (e.g., from fertilizer or released from decomposing organic materials) is low and mostly tied to their organic matter. On the positive side, these soils are deep and have a favourable structure that poses few obstacles to water infiltration and root development (van Wambeke, 1992).

Part of Bong County and small areas of Nimba County are also covered by Leptosols, shallow soils without agricultural potential and unsuitable for cocoa and coffee. Nimba County presents small areas of Cambisols, younger and more fertile soils, but the dominant one is Ferrasols. More fertile soils with higher agricultural potential, such as Nitisols, can be found across the border in Guinea and on very small areas in Lofa County.

Liberia is endowed with abundant water resources. Approximately 14% of the country is covered by freshwater bodies including rivers, lakes, wetlands, lagoons, streams, and creeks that drain to the Atlantic in a northeast to southwest direction. These provide critical ecosystem services such as drinking water, irrigation, and power generation as well as habitats for plant and wildlife species.

The first hydrological division of Liberia was proposed by Strupczewski and Meijers (1982) and the first coding system for Liberian basins by Strupczewski and Sua (1983). The 2016 Liberia River Basins report provides condensed information on Liberian drainage network and river basins (Liberian Hydrological Service, 2016). The Liberian principal basins are drained by rain-fed rivers discharging into the Atlantic Ocean. All largest rivers, apart from the middle reaches of the Cavalla River flow from their headwaters in the south-west direction towards Atlantic Ocean.

Six largest principal basins in Liberia are trans-boundary river basins, which can be defined as basins shared by two or more riparian states. The Mano River, the Lofa, the St. Paul, the St. John, the Cestos and the Cavalla River have headwaters in Guinea or in Sierra Leone and the rivers cross all the Liberia territory from north-west to south-east. This situation could put upstream countries in a position of advantage over their downstream neighbour Liberia. The complexity of relations and potential conflicts of interest within trans-boundary river basins can make equitable management of their water resources especially challenging.

Figure 3: Liberian principal Basins.



Source: Liberian Hydrological Service, 2016

1.6. Structure of the agricultural sector

Liberia's agricultural sector was largely developed as dual system consisting of a commercially oriented plantation sector and subsistence producers. The majority of the rural Liberians have worked as laborers on commercial plantations or on small subsistence farms with a relatively small percentage of farms involved in cash crop production.



There are an estimated 938,383 households in Liberia, with an average household size of 4.26 persons per household; households are larger in urban areas (4.37) than rural areas (4.16). Household farms are based on family labor with an estimated average size of 1.5 ha according to 2001 Baseline Survey. (LISGIS, 2016). Output is largely consumed by household members and consists of food crops (rice, roots, tubers, legumes), small livestock (chickens, goats) and small plots of cash crops (coffee, cocoa). The predominant character of the traditional small farm is one of low productivity of land and labor. Shifting cultivation on the uplands is still the main technique; the secondary forest is cleared and burned, followed by one to two years of cultivation after which the land is returned to bush fallow for eight to ten years.

Number of households in which at least a member is actively growing crop(s) or raising livestock or poultry is given in Table 4. The overall total agricultural household in 2008 excluding peri-urban was estimated at 274,070. Of this number, the household reported producing rice was estimated at 231,370, producing cassava was estimated at 117,730 and rearing livestock and poultry were 65,470 and 117,120 respectively. Almost 70% of Liberian agricultural households have livestock or poultry. In addition, the Table 4 shows percent change between 2008 and 2001 as well as pre-war (1988). There was significant increase in the number of agricultural households, rice producing households and households reported growing cassava as compared to 2001 by 80.4 percent, 82.4 percent and 31.3 percent, respectively. This significant difference is expected, because during the 2008/2009 crop season Government in collaboration with FAO provided over 100 metric tons of rice seed to small-scale farmers, which served as encouragement. (MOA, 2009; LISGIS, 2010-2011).

Table 4: Food Crops, cash crops and animal farming household.

Particulars Household	Year			Percent Change	
	1988	2001	2008	1988	2001
Agricultural	180,290	151,940	274,070	52.0	80.4
Rice producing	155,180	126,840	231,370	49.1	82.4
Cassava producing	103,050	89,680	117,730	14.2	31.3
Rubber producing	N/A	N/A	48,290	N/A	N/A
Oil palm producing	N/A	N/A	29,080	N/A	N/A
Cocoa producing	N/A	N/A	35,960	N/A	N/A
Coffee producing	N/A	N/A	24,240	N/A	N/A
Livestock Rearing	46,350	N/A	65,470	41.2	N/A
Poultry Raising	96,330	N/A	117,120	21.6	N/A

Source: (MOA 2009; LISGIS, 2010-2011)

Table 5 shows the estimated percentage of households that have grown or sold each of the crops. Cassava is the most often grown and sold crop, with 38.9% of households growing cassava nationally, and 19.4% selling. Out of the main grown crops, only rice shows a distinct pattern: it is primarily grown for own consumption, approximately a 30% of households record growing rice, but less than 6% record selling any rice. In the case of the cash crops, it could be expected that nearly all the households that grew the crop also sold them. However, the percentage of households selling cash crops is often lower than expected. This could be due to further processing of a raw crop, for example palm nuts into palm butter, or own consumption. In the case of rubber, there is a noticeable discrepancy between those growing rubber trees (10.3%) and those selling tapped rubber (4.7%). It should be noted that households are asked whether they sold tapped rubber in the 12 months prior to interview, but not whether they harvested rubber. Low and continuously declining rubber prices have reduced the profitability of harvesting rubber, whose primary cost is that of hiring labor to tap the rubber. Thus, households who are growing rubber trees, but are not tapping currently, would not be recorded as selling (LISGIS, 2016).

**Table 5:** Percentage of Households that have either grown or sold specific crops

Crops	Percentage of Household that have...	
	grown	sold
Cassava	38.9 %	19.4 %
Rice	32.0 %	5.6 %
Pepper	32.1 %	18.5 %
Bitterballs	26.3 %	14.6 %
Corn	27.0 %	14.3 %
Plantain	26.5 %	16.5 %
Palm Oil	21.2 %	15.7 %
Cocoa	7.4 %	5.1 %
Rubber	10.3 %	4.7 %

Source: (LISGIS, 2016)

1.7. Commodities

1.7.1 Cash crops

Rubber

Rubber has become synonymous with Liberia since the first concession agreement was signed by the Government with the Firestone Company in 1926. Production began in 1935.

- Prior to the civil conflict there were seven large-scale rubber plantations in Liberia:
- Firestone Plantations Company in Harbel, Margibi County
- Liberian Agriculture Company (LAC) in Grand Bassa County
- Cavalla Rubber Corporation in Maryland County
- Cocopa Rubber Plantation in Nimba County
- Sinoe Rubber Corporation in Sinoe County
- B.F. Goodrich (now Guthrie Rubber Plantation) in Bomi County
- Salala Rubber Corporation (Bong County)

Currently only the Firestone and LAC plantations are functional. In addition, SOCFIN, the parent company for LAC, operates the Weala Rubber Company, which has a rubber mill in Bong County and buys rubber from smallholders operating on 14,000 hectares, much of which may have been part of the previous Salala Rubber plantation (USAID, 2008).

The Firestone rubber plantation has a concession of approximately 416,670 hectares. It is the largest rubber plantation in Liberia, and the world's largest contiguous industrial rubber plantation. LAC has a concession for 125,000 hectares. But the area of the concession in both cases does not represent the area planted to rubber; indeed, the planted area is much smaller than the concession area. For instance, LAC has rubber on only 14,060 hectares of its concession area. It estimates that it needs to have 16,000 hectares of rubber to optimally supply its rubber mill but has had trouble expanding the area planted to rubber due to tenure concerns within the larger concession area (USAID, 2008).

According to annual report of Bank Central Liberia (BCL), the estimated production for the year 2016 was 49,965 metric tons. Table 6.



Palm oil

In the 1970s and 1980s, GoL made a strategic decision to establish oil palm as an alternate tree crop for export. Plantations were established in the northern, north-eastern and north-western parts of the country. The decision to locate farms predominantly along the northern ridge was because the bulk of agricultural (especially at the commercial level) activities are already concentrated (as it indeed continues to be) in the counties within the north – namely Nimba, Bong, Lofa and to a lesser extent Grand Gedeh. The civil war resulted in large-scale abandonment and destruction of plantations and processing facilities. There has been limited maintenance or replanting in the last 20 years and the trees are largely at the end of their productive life. (International Trade Centre, 2013).

Over the years there is considerable interest from both smallholders and large investors in expanding export production. Stakeholders in the oil palm sector are smallholder farmer cooperatives, individual farmers, large multinational corporations and concessionaires, as well as individuals playing various intermediation roles and support services. One of the main obstacles in the sector is that smallholder farmers and cooperatives lack both capital and professional expertise to independently increase the productivity of their farms. In the short-term larger plantations, which provide employment and livelihood opportunities for rural communities, provide smallholders with access to inputs, services and markets. Uncertainty of land tenure is among the most critical challenges for potential oil palm farmers and investors to overcome; this is true with other land-intensive industries such as rubber and cocoa.

Cocoa

According to the Comprehensive Assessment of the Agriculture Sector (CAAS) (2007), about 40,000 households in Liberia are engaged in the production of cocoa, the country's second most important export crop after rubber. Based on the 2012 agriculture survey, the Government statistics agency LISGIS (2012) reported a slightly lower number with 38,350 households involved in cocoa growing, of which 13,470 were in Nimba County, 12,120 in Lofa County and 3,930 in Bong County. This means that 76.9% of all cocoa producing households are residents in the three counties of the "cocoa and coffee belt," while most other counties host a small number of cocoa producers. Cocoa accounts for as much as 12.6% of total employment in the agriculture sector (Republic of Liberia, 2010).

Although cocoa is an important crop for many households in Liberia, the country is only a minor player in the global cocoa market, accounting for <1% of global sales (ranked 21st globally among cocoa exporters in 2012). The Netherlands, Spain and Germany were the top three markets for Liberian cocoa in 2012 (Republic of Liberia 2012; Schroth et al., 2015).

Total cocoa production of Liberia is estimated at about 10,000 tons from about 30,000 ha. Until recently, only the smaller part of this production was officially exported through Liberian ports, with the remainder being informally exported via neighboring countries Guinea, Côte d'Ivoire and Sierra Leone. Average cocoa farm size is 1–3 ha, in the same range as many cocoa farms in Ghana, where small farm size is often seen as an obstacle to the adoption of more intensive and profitable practices. Already modest average yields of 400 kg/ha experienced in the 1980s have further declined, often to values as low as 100–200 kg/ha (Republic of Liberia 2010), or even less (Schroth et al., 2015).

According to annual report of BCL, the estimated production for the year 2016 was 9,603 metric tons. Table 6.

Coffee

Liberian coffee production is also concentrated in Bong, Nimba and Lofa Counties, and often coffee is grown on the same farms as cocoa. Compared to cocoa, coffee is less significant as a smallholder crop in Liberia. According to the 2012 agriculture survey, a total of 24,390 households were engaged in coffee production, of which 13,710 were in Lofa County, 6,300 in Nimba County and 1,120 in Bong County (LISGIS, 2012). The three counties of the cocoa and coffee belt thus contributed 86.6% of the households involved in coffee growing in the country.



According to Schroth et al. (2015), most coffee in the country is Robusta with very little Arabica coffee (mostly in Lofa County) and very little Liberia coffee. The reduced importance of coffee compared to cocoa as a smallholder crop in Liberia is because coffee was the first tree crop introduced as an export crop (together with sugarcane) in the mid-19th century. However, after experiencing a large expansion in area and production between the 1960s and the 1980s, reaching 21,310 ha and 8,250 tons, respectively, by the mid-to-late 1980s coffee export earnings fell sharply, and cocoa was replacing coffee as the dominant smallholder tree crop (CAAS, 2007). This is in line with developments observed in neighboring Côte d'Ivoire, where coffee farmers have shown a tendency to switching from coffee to other, more profitable crops, such as cocoa and rubber over recent decades (Ruf and Schroth, 2015a).

According to annual report of BCL, the estimated production for the year 2016 was 162 metric tons (Table 6).

Table 6: Key Agricultural Production (2014-2016).

Commodity	Unit	2014	2015+	2016*
Rubber	Mt	59,892	45,657	49,965
Cocoa Beans	Mt	6,602	14,968	9,603
Coffee	Mt	-	58	162
Crude Palm Oil (CPO)	Mt	N/A	N/A	3,021

Source: BCL; Ministry of Commerce and Industry (MOCI); Liberia Produce and Marketing Corporation (LPMC). (+Revised; *Projection)

Table 7: Commodity Composition of Exports in Millions of US\$ (2014-2016).

Commodity	2014+			2015+			2016*		
	Export volume	Export value	% share of total	Export volume	Export value	% share of total	Export volume	Export value	% share of total
Rubber(000/Mt)	44.9	85.1	19.1	40.4	61.1	23	42.5	58.8	34.6
Cocoa beans(000/Mt)	168.3	5.0	1.1	227.6	12.3	4.7	119.5	11.9	7.0
Coffee beans(000/Mt)	0.3	0.0	0.0	161.2	0.3	0.1	20.7	0.1	0.1

Source: BCL; Ministry of Lands, Mines and Energy; and Firestone Liberia Ltd. (+Revised; *Projection).

1.7.2. Food crops

Rice and cassava are the key food crops, with rice produced at a level about 40% of self-sufficiency for domestic consumption in contrast to cassava where production far exceeds domestic requirements. As revealed in Table 8, some 280,000 metric tons of paddy rice was produced in the 2008/2009 crop season (MOA 2009). Approximately 63 percent of subsistence households produce rice, mainly on the uplands (Jalloh et al., 2013).

Table 8: Rice and Cassava production.

CROPS/AREA	Year			
	2008	2001	1988	
Production (Metric tons)				
Paddy Rice	279,000	219,040	298,630	
Fresh Cassava	496,290	373,390	409,840	
Total	775,290	592,430	708,470	(...)



(...)	Year		
Area Harvested (Hectares)			
Rice	222,670	170,480	235,760
Cassava	57,360	47,930	52,160
Total	280,030	218,410	287,920
Yields per hectare (kg/ha)			
Rice	1,253	1,285	1,270
Cassava	8,652	7,790	7,860

Source: MOA 2009.

Rice and cassava are widely cultivated in the middle part of Liberia (Nimba, Bong, Bassa, and Margibi Counties) and some parts of Maryland and River Gee. Yields range from 1 to 2 tons per hectare for rice and from 4 to 7 metric tons per hectare for cassava. Sugarcane and plantains and bananas are mainly cultivated in counties bordering the coast, as well as River Gee and Grand Gedeh Counties. Sugarcane yields an average of 10 metric tons per hectare, whereas plantains yield 2–4 metric tons per hectare (Jalloh et al., 2013).

1.7.3. Livestock

The impacts of the civil war on the livestock sector can still be observed. The vandalization of infrastructure and destruction or stealing of animals kept at institutional herds and flocks have left lasting scars on livestock research, extension and development. As reported by Agyemang in 2013 there was no Government/public livestock research, breeding or multiplication on-going in the country. There are NGOs-led restocking in goats and pigs in most counties, and for sheep to a lesser extent. Donor-funded Projects are also doing restocking in selected counties. With respect to livestock extension, as is the case of the veterinary services and laboratories, the technology transfer centers were also dilapidated and are mostly not functioning. Several NGOs involved in livestock projects are performing extension duties.

The cattle population in Liberia was estimated at 7,000 head in 2011. Almost all the cattle population is believed to belong to the taurine breeds of N'Dama (longhorn) and the Muturu (shorthorn). Non-taurine breeds found in the country are mostly imported from neighbor countries and are often destined for slaughter. Few farmers have recently introduced a handful of Zebus from Mali for trial purpose. The small ruminant population was estimated at 47,200 sheep and 100,000 goats. The sheep are mostly of the West African Dwarf (WAD) or Djallonke breed. Some Sahelian type sheep have been introduced in some parts of the country through the national restocking programme. The goats are of the West Africa Dwarf breed. The chicken population in 2011 was estimated at 951,000 whereas ducks amounted to 53,350. The pig population was estimated at 65,600 (Agyemang, 2013).

As of 2012, nearly a quarter of agricultural households (21.7%) had livestock, including cattle, sheep, goats, pigs, and chicken. A majority of the livestock are held in Nimba County, with 41.8% and 63.7% of the nation's total stock of cattle and pigs, respectively (LISGIS, 2012). There is also a significant discrepancy in livestock holdings between male- and female-headed households, with male-headed households holding 81.5% of total livestock and female-headed households holding only 18.5% of livestock (LISGIS, 2012). Farmers receive practically no assistance from government extension officers to address animal disease, animal husbandry, forage, and productivity challenges.

The livestock populations of ruminant and monogastric animals recorded during the pre-war period, 1988, and from 2008 to 2012 are shown in Table 9. Figures do not represent census data but rather information obtained during agricultural surveys. A steady increase has been observed between 2008 and 2012 for all animals except for pigs. Goats have the greatest increase (50%), followed by chicken (20%), but the number of animals is still lower than before the civil war.

Table 9. Trends in the number of heads of Livestock and Poultry Production in Liberia

Livestock	Year					
	1988	2008	2009	2010	2011	2012
Goat	128,670	63,460	75,330	96,750	100,000	96,400
Sheep	60,560	43,270	43,470	48,450	47,200	46,680
Cattle	14,830	8,370	8,370	10,660	7,000	10,400
Pigs	52,400	77,720	68,000	64,990	65,600	61,210
Chicken	723,390	785,010	774,960	800,780	951,260	927,700
Ducks	39,190	43,670	39,210	48,580	53,350	--

Source: Agyemang, 2013 and Agricultural crop survey 2012, LIGSIS.

Liberian agriculture comprises food and tree crops, fisheries, and livestock, and the sector accounted for 42.2% of real GDP in 2008 (CBL, 2009). The livestock sub-sector accounts for 14% of agricultural GDP (Rhissa, 2007; SFNS, 2010 and Koikoi, 2011). Most of the animals are of local breeds and are owned by traditional farmers who have very little access to inputs and almost no government support technical services, thus having very low productivity. Domestic supply of livestock and livestock products is far from demand of food from livestock, which derives into a large dependency on imports from neighbor countries. In 2011, some 6,000 meat cattle, and 3,300 small ruminants (goat and sheep) were imported from Guinea, Sierra Leone and Ivory Coast (Koikoi, 2011, Agyemeng, 2013).

About 80-90% of the ruminants are kept under traditional - extensive production systems with pastoral, ranching and peri-urban systems to a limited extent (Larbi, 2012). There is no dairy production in Liberia (Koikoi, 2011) and milk extraction for human consumption is not common. Cattle production is not well implanted and small ruminant livestock in most cases are used only for meat production. Indications from field projects dealing with small ruminants show that goat kid mortality is close to 50%. Lamb mortality is similarly high. Although there is a substantial increase in the number of people keeping pigs, inadequate feeds, management and absence of veterinary services produce high mortality and low animal performance.

A pastoral area development plan, aimed at reducing degradation of pastoral resources by ensuring their rational management to increase animal production and to satisfy the needs of the people, was proposed for implementation during 2007-2009 (CAAS, 2007; Rhissa, 2007). Priority activities of the plan included: taking inventory of rangeland and pastoral resources; rehabilitating existing ranches; developing pastoral areas; and building human capacity in pastoral management.

Liberia's civil conflict greatly reduced livestock herds and poultry flocks in rural areas. Today, the main source of animal protein in Liberian diets is from fish and wild animal "bush meat." Most of the eggs, chicken, pork, and other meats sold in Liberian markets are imported. To resurrect production in Liberia, two main hurdles must be overcome—specifically, obtaining sufficient and adequate feed, and resolving persistent health issues that jeopardize herds and flocks. If (1) feed requirements can be addressed by utilizing mostly local, affordable raw materials and (2) animal and poultry health issues can be resolved to reduce mortality and increase productivity, then production of goats and poultry (both broilers and for eggs) can be viable enterprises for smallholder farmers (USAID, 2015).

1.7.4. Fisheries

Liberia has a coastline of 570 km and a continental shelf averaging about 34 km in width extending 200 nautical miles off-shore from the geographical baseline providing an area of about 20, 000 km² of fishing grounds. More than 50% of the Liberian population lives along the coastal area, where the predominant occupation is fishing. The coastal (marine) fishery comprises both artisanal and industrial fisheries.



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 yellow fin 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 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.

Liberia fisheries are made up of marine fisheries, involving industrial and artisanal activities; inland fisheries which are mainly artisanal; and aquaculture through subsistence fish farming. An important problem is the lack of data and information, including on the status of fish stocks and the level of fishing effort including illicit, unregulated and undeclared (IUU) fishing, which limits Liberia's ability to adopt appropriate management measures.

Around 11,000 fishers practice artisanal fishing, which is governed as a section of the Marine Division of the Bureau of National Fisheries (BNF). There are fisherman associations that work as a space of management collaboration between fishers, government, other stakeholders as boat owners or fish traders, and external agents, like NGOs, academic and research institutions, etc. There also exist a Liberia Artisanal Fisherman Association (LAFA), that represents the interest all fishing associations in several areas, as fishing, fish processing, fish preservation, fish trading and marketing.

Mrag (2005) estimated illegal fishing to be 59.4% of total catches. Braimah (2012) reported the total number of illegal vessels at 200–300. Mcconnell (2008) reported that some 250 boats were fishing illegally in Liberian waters, including trawlers from China, South Korea, Spain, Portugal and Greece, as well as large motorized pirogues from Senegal and Ghana. The presence of fisheries instruments and institutions, during and after the Civil War, was mainly symbolic, and the fisheries data that any realistic management plan would rely on were scarce, unreliable or completely lacking. Moreover, there has been no government fisheries policy for over a decade and the institutions and staffs were not able to guarantee resource conservation (Kebe et al., 2009).

Belhabib et al (2013a and 2016), reconstructed total an alternative time series of marine catch data from 1950 to 2010. Liberian small-scale artisanal and subsistence fisheries catches represented around 20% of total removals from Liberia. The small-scale sectors represent the truly Liberian domestic fisheries catch made available to the local population. This sector alone is 66% higher than the data supplied by Liberia to FAO (337,900 tons) covering only the marine component, and twice as high when also accounting for lagoon catches. The legal industrial sector accounted for around 1.8 million tons from 1950 to 2010, while the unregulated/illegal foreign catch was responsible for over 1.3 million tons in the same period, along with 249,000 tons of illegal discards. Taxonomically, although over 140 taxonomic groups were identified and caught by the different sectors operating in Liberia, catfishes and small pelagic fishes, mainly clupeoids, dominated catches.

Moreover, this study also shows a shift from legal to illegal operations in Liberia. The legal industrial sector decreased, and the unregulated sector increased during the civil war, while one would suspect that the same vessels would stay in the same fishing grounds in the absence of monitoring and control. This is illustrated by Chinese pair trawlers being banned from Liberian waters, but still operating there, if illegally, from bases in Guinea or Sierra Leone (Belhabib et al., 2013b).

Liberia remains, however, one of the very few African countries that demonstrate a clear improvement in both conflict reduction between artisanal and industrial fisheries and tackling illegal fishing practices. When artisanal and industrial fisheries are in conflict because of the competition in the same area, the fishing resources may be exhausted and the main impact on the artisanal fisheries is a great reduction of catching of fish. This risk can affect the development and growth of artisanal fisheries due to significant reduction of income and loss of livelihoods of the fisherman families in coastal rural areas. The main mechanisms to address that conflict are enforcement of licensing, control of illegal fisheries and increasing of areas reserved to artisanal fisheries. Indeed, the Liberian government answered to the increasing conflicts between artisanal and industrial fleets by increasing the size of the areas reserved for artisanal fishing. (Belhabib et al., 2016).

Fish, mostly from the sea and inland rivers and lakes, plays an important role in the Liberian diet as a source of much-needed protein. Tilapia, an omnivorous fish, is especially adapted to smallholders because it can be farmed, and a wide array of feedstuffs can be used to raise them. Catfish are another option, for the same reasons. Therefore, fish farming, especially of Tilapia species 11 and catfish, represents an opportunity to produce low-cost, high-value protein at the smallholder level (USAID-EAT, 2015).

1.7.5. Forest

The natural forest of Liberia covers 4.8 million ha, with disturbed productive (unprotected productive forest) forest constituting 45% of the total ha available. All people in Liberia, including urban dwellers, depend on forests in some ways. Urban demand for forest products and the need for rural households to generate income are key drivers for the exploitation of these products. Generally, people in urban communities (e.g., Monrovia, Kakata, Buchanan, and Zwedru) depend on forests products such as construction timber, charcoal and firewood.

Estimates of volume from 2010 suggest that between 86,000 m³ and 201,000m³ of forest products are sold in Liberian markets every year (EPA, 2016).

Liberia had recommenced log exports in 2011 after a long period of political conflict. However, in 2014 the Ebola virus was expected to disrupt trade through border closures with neighboring countries, in addition to delays and disruptions by shipping companies (ITTO MIS, 2014).

Table 10: Estimated production and exports of tropical Timber by ITTO (x10³m³)

Products	2010	2011	2012	2013	2014
Production					
Logs	480	484	518	518	518
Sawnwood	80	80	80	80	80
Exports					
Logs	9	74	190	136	143
Sawnwood	0	2	3	2	3

Source: International Tropical Timber Organization MIS 16-31 October 2014

1.8. Infrastructures and logistics

Apart from climate or ecological differences, a major element is the access to the Monrovia market which inter alia encourages local rice sales in the northern half of the country. That market represents the demand of as much as near two-third of the national population and therefore the Monrovia's market has a huge influence over all the northern half of the country up to Nimba county in the north-west border with Guinea. At the other end of the country, the South-East Rice zone is largely defined by its isolation from Monrovia and the resulting lack of market opportunities. There is no paved road towards the capital along which goods can easily be transported, and indeed local villages are cut off even from local centers during the rainy season.

Much of the country's infrastructure was destroyed during the war. Despite improvements to roads and the electricity grid since 2003, infrastructure remains extremely poor and will continue to hinder economic growth and direct foreign investment. In addition to being among the least developed in West Africa, the road system only covers 10,600 kilometers (Liberia's total area is 111,370 km²). Of these, only 657 kilometers are paved. Heavy annual rains, lack of maintenance, and overloaded trucks contribute to major deterioration on all highways. The long rainy season, which lasts eight months, rendering most of the roads inaccessible, particularly in Nimba, Lofa, Sinoe, Gbarpolu, and Maryland counties where forests are the dominant land use. Specifically, out of the 10,600 km roads in Liberia, less than a quarter are classified as all-weather roads (EPA, 2016).



The 700 kilometers of paved roads are extending from Monrovia to Bo Waterside (on the Sierra Leone border), Ganta, and Buchanan Counties, making these areas easily accessible; they are very different from the 1,600 kilometers of unpaved roads, mostly in need of repair, that make it difficult to transport agricultural products from the southeast counties to Monrovia (Jalloh et al., 2013).

The electricity grid in Liberia was destroyed during the conflict years. Today, only 9.8 percent of the population has access to electricity and this is only available in a few urban areas. In addition, electricity is used predominantly for commercial economic production. As a result, domestic energy is derived almost entirely (80%) from woody biomass, and statistics from 2004 suggested that 95 percent of the population depends on firewood or charcoal for cooking and heating, with most of the charcoal consumption taking place in urban areas (EPA, 2016). Prior to the war the State Liberian Produce Marketing Corporation (LBPM), had at least informal authority over all storage facilities in the country. During the war, storage facilities were destroyed and have not been rebuilt.

1.9. Plant, animal and human health

1.9.1. Plant health

Rice is the staple of the Liberian diet. Therefore, pests and diseases that affect rice, either in production or storage, are critical. Nevertheless, there is very little information and no data on pests and diseases, and their incidence on production. In other crops, the situation is the same.

Vanderwal (2010) describes that the MOA quarantine service has officers stationed at the seaport (part of ship boarding party), airport, some land border posts, and the post office to inspect for any plant pests and for phytosanitary certificates. However, the unit is understaffed and lacks adequate logistical support to effectively carry out inspection of planting materials and other incoming plant products. Moreover, Liberia is a member of the International Plant Protection Convention (IPPC) since 1986 and therefore could benefit from some of the training and other capacity building in plant protection available through IPPC. The Quarantine unit in MOA serves as the National Plant Protection Organization (NPPO) and carries out most plant protection functions in Liberia. Their capacity also needs further strengthening, but possibly not as urgently as in animal health. Plant protection is, however, very important to Liberia as it is aiming to increase the production (and reduce post-harvest losses) of staple crops such as rice and export tree crops and other plant products.

In the recent 2016 International Phytosanitary Conference that was held at the KEPHIS headquarters in Kenya, Mr. Jeremiah Matthew Swinteh (Senior Inspector Plant and Animal Quarantine Service, Ministry of Agriculture, Republic of Liberia), presented the five key concerns or Plant Health issues in Liberia:

1. Even though there is National Plant and Animal Quarantine Law since 1972, this is obsolete. In addition, the enforcement of laws and regulations in most countries in West Africa are partially executed.
2. There are inadequate information and knowledge sharing for farmers.
3. Many countries in the West African Region lack or have inadequate capacities for disease surveillance, diagnosis, appropriate inspection and reporting system of plant health issues. They do not have the facilities, equipment and logistics to scientifically prove issues concerning plant health.
4. Many of the agro-chemical applicators in the region, especially Liberia, do not have adequate training in chemical management. They not use recommended dosages and increasing the highly toxic nature of the chemicals to most plants and plant products they produced. Several compounds of agro-chemicals have been proven to accumulate toxins in food products. These products are found in the markets, released in the wrong hands.
5. Frequent new outbreak of pests in the West African Region. Liberia had experienced major pest infestation (Caterpillar) identify as forest dwelling moth called "Achaea Catocaloides Guence".

1.9.2. Animal health

Due to many reasons, including structural adjustment policies of the 1980s and 1990s, civil wars and general declines in economies, the effectiveness of animal health services in most of sub-Saharan Africa has seriously declined over the years. Services such as disease surveillance, epidemic disease control measures, and curative services have become woefully inadequate or non-existent. It is also argued that veterinary service needs vary from country to country. The Liberia Veterinary Service faces several challenges including personnel, facilities and operational funds to carry out its mandate within the National Livestock Bureau. This is because, few of the enabling Legislative Acts that empower it to perform its roles with legal backing are still not in place.

A report by Agyemang in 2013 suggest Liberia has only one veterinarian in government service and a couple of veterinarians in private service. Moreover, animal health service delivery in Liberia is constrained by limited qualified human resources, inadequate facilities, high costs of drugs and equipment, poor infrastructure, poor technical support services and weak private sector participation. Furthermore, the borders of Liberia with neighboring countries being so "porous" and virtually all cattle slaughtered in Liberia having to be imported across these borders with, almost non-existent quarantine service at the borders, the chances of introduction of animal diseases from neighboring countries into Liberia remain very high.

Local breeds are reasonably well adapted to local conditions, but the productivity of local breeds is poor due to a lack of nutritious animal feed (GOL, 2007). Additionally, there are several endemic infectious diseases that are Africa-wide risk such as: Rinderpest, Contagious bovine pleuroneumonia (CBPP) and the Pest des Petit Ruminants (PPR) are an Africa-wide risk and cause high mortalities and severe economic loss in the Sub-Saharan Region as well as throughout the whole African continent. These diseases are classified under Group 1 diseases. However, the most important animal diseases of livestock in sub-Saharan Africa are the parasitic and viral diseases, mainly vector transmitted, and whose severity is influenced by the environment. These diseases are classified under Group 2. Other common infectious and non-infectious diseases are not generally associated with significant mortality, but causes serious economic losses are classified under Group 3.

There are several Trans-boundary Animal Diseases (TADs) that are highly infectious, endemic to this region and of high economic importance. To control and reduce the impact of these diseases a continuous, intensive and urgent action at national, regional and international level is required. These can only be achieved through an enhanced system of early warning, early detection, coordination and harmonization of control strategies. Amongst the important TADs reported in Liberia includes:

In bovines

- CBPP. This is the most prevalent disease in cattle causing up to 20-50% mortality (Koikoi, 2011)
- Foot and Mouth Disease (FMD)
- Blackquarter (BQ)
- Lumpy Skin Disease (LSD)

In small ruminants

- Contagious caprine pleuro-pneumonia (CCPP)
- Pest des petits ruminants (PPR)



In poultry

- Newcastle Disease (ND): The domestic poultry sub-sector in Liberia is dominated by backyard indigenous chicken production in terms of number of producers. The commercial sector deals with improved breeds. ND is known to affect both improved breeds and indigenous local chicken. In both systems the disease can take a big toll in terms of mortality. So far vaccination campaigns have been limited to few districts within some selected counties where specific NGOs operate.
- Avian Influenza: Avian Influenza is one of the emerging and re-emerging diseases that can be transmitted from domestic and wild birds to humans. Outbreaks have been recorded in many countries including some in the Sub-Saharan Region. International organizations such as WHO, OIE and FAO have jointly assisted countries in developing preparedness plans against outbreaks of the disease. Liberia has been a recipient of one such assistance and has completed at least one externally funded Project. Lack of budgetary support has affected follow-up activities.

Other important animal diseases of significance for the Liberian livestock

- African Swine Fever (ASF): There is a rapid development of the swine sector in the urban and peri-urban settings of Liberia. ASF is known to have devastating impact in swine-herds. Information on this disease is however not available to producers and the public. There is therefore the need to sensitise the public on the prevention and control of ASF and the enforcement of quarantine and regulatory measures during ASF outbreaks.
- Rabies: Rabies is a zoonotic disease, which can be transmitted from animal to human. The disease is therefore a threat to the public health. Encounters with both domestic and wild animals susceptible to the disease, are the main predisposing factors.
- Tuberculosis: Tuberculosis is a zoonotic disease, which can be transmitted between animal and human and thus it is a threat to public health. Living in proximity to animals, and consumption of raw animal products are the main predisposing factors. Other zoonotic diseases: Swine flu, Brucellosis, Anthrax and Salmonellosis
- Fluke (water and fish parasite), Tick (external parasites) and Mange (skin parasite) are very frequently found. They produce negative impact on livestock performance and eventually may even transfer contagious diseases to humans.
- Trypanosomiasis, pastoralosis hemorrhagic septicemia, piroplasmosis, anaplasmosis, babesiosis, and theileriosis (GOL, 2007).

It is quite difficult to secure animal vaccines in rural areas, and para-vets are in short supply, apart from initiatives led by NGOs. Monrovia lacks a sanitary abattoir; butchering of meat in rural areas is rudimentary, and the cold chain for storage is inadequate. Due to the shortage of meat, Liberia imports this commodity from neighboring countries, with some estimates reporting up to 137 trucks of live animals crossing the border each week (GOL, 2007). This trade is largely informal, and though fees are paid at various checkpoints, traders do not fully pay associated import taxes.

1.9.3. Human health

pests and disease vectors constitute serious hazards to public health, food security and safety in Liberia. Communicable diseases are a major threat, with risk from the high prevalence of diarrheal disease, malaria, acute respiratory illness, and other diseases such as measles, schistosomiasis, tuberculosis, cholera, Onchocerciasis (River Blindness), lassa fever and Yellow fever transmitted by *M. natalensis* (rats) and *Aedes* mosquitoes respectively.

**Table 11:** Record of human health related disasters in Liberia from 1977 till 2016

Year	Type	Subtype	Occurrence	Total deaths	Affected
1980	Epidemic	Bacterial disease	1	466	1,887
1995	Epidemic	Viral disease	1	9	359
1996	Epidemic	Bacterial disease	1	56	
1998	Epidemic	--	1	12	560
1999	Epidemic	Bacterial disease	1	39	
2000	Epidemic	Bacterial disease	1	3	112
2000	Epidemic	Viral disease	1	10	
2002	Epidemic	Bacterial disease	1	--	661
2003	Epidemic	--	1	--	1,857
2003	Epidemic	Bacterial disease	1	--	17,561
2005	Epidemic	Bacterial disease	1	29	674
2009	Insect infestation	--	1	--	500,000
2014	Epidemic	Viral disease	1	4810	10,682

The Ebola epidemic in 2014–2015 became an acute and dangerous threat that imposed a devastating burden on the overall health system as the government redirected the limited available funds, human resources, and scarce supplies to contain the virus. During 2014, vaccination campaigns were halted due to Ebola, resulting in 850 measles cases. The Ebola outbreak escalated the fastest in Liberia and led to a sharp disruption of economic activities mainly based on changes of behavior due to fear. In 2014, the foreign direct investments slowed down due to the Ebola outbreak and the GDP is expected to suffer. The World Bank has estimated the growth rate to drop from 5.9 percent to 2.2 percent. All sectors have been affected especially the agriculture and the services which are the two largest contributors to the economy.

There are direct and indirect as well as behavioral effects of Ebola epidemic on the farm families and farm labor. Quantitatively, the direct impact in terms of the number people infected in relation to the size of the population of the area is very small. Much of the impact observed has been of the behavioral type due to quarantines, border closures, restrictions/ban on people movement, people fleeing the area, reluctance to work in usual labour groups, breakdown of the traditional kuu system (group/team work), etc.

Endemic across the entire country, malaria is the nation's number one direct cause of morbidity and mortality, reportedly responsible for 40% of outpatient health consultations and 41% of inpatient deaths of children under 5 (GOL, 2011).

Diarrheal disease is also a primary contributor to illness, malnutrition, and under-5 mortality, with 22% of these children, experiencing diarrhea in the 2 weeks before the 2013 (Demographic and Health Survey - DHS). The Liberian Dialogue 2015/03 estimated that improvements to the water supply could reduce diarrhea morbidity by 21%, while improved sanitation facilities could reduce diarrhea morbidity by 38% (Nyepon, 2015).

Water and sanitation infrastructure, and personal hygiene practices can prevent diarrheal disease, along with other communicable diseases, such as Ebola.

Women's nutritional status is an important predictor of child malnutrition, as shown by higher stunting and wasting among the children of malnourished women.

Due to the historic lack of refrigeration in Liberian homes, prepared food is often left at room temperature for extended periods of time. There is a strong tradition of bush meat consumption, leading to an increase in its capture and consumption. The animals may be poisoned, trapped or shot, and are often slaughtered under unhygienic conditions in the forest (Vanderwal, 2010).



1.9.4. Food Security and Food Safety

Liberia's national food security policy priorities are principally to (1) keep the cost of food affordable and (2) avoid civil strike. These priorities surround the most important basic foodstuff in the country: rice, which accounts for 85% of the calories consumed in Liberia. With respect to the first priority, the government of Liberia keeps rice affordable by allowing it to be imported duty-free. This means that it is not feasible for smallholder rice producers to compete with zero-duty imported rice. There might be some niche market opportunities for locally produced "country rice" at higher than import parity prices, but the volume of market demand is limited. For the time being, rice production for smallholders can contribute to a family's food security but will remain on a household subsistence level (USAID, 2015).

Likewise, cassava is, and will remain, an important food security/subsistence crop for smallholders, playing an important role in caloric intake for large number of Liberian households. Cassava is well-adapted to growing conditions in Liberia, quite resilient to pests, and easy to store in the ground until needed. However, only fragmented landholdings are dedicated to cassava—on average 0.5 hectares (ha) 8 per farm—and yields are low (on average 4 metric tons [MT] per hectare). These factors have resulted in relatively high raw cassava prices and little investment in cassava processing (USAID, 2015).

Although there is hardly any stand-alone licensing regime for food safety, several institutions have some regulatory authority over the sale of food, including the Ministries of Health, Agriculture, and Commerce and Industry. Also, the Monrovia City Corporation, which, in theory, is mandated to regulate food sales only in the capital, nevertheless impacts food sales for the majority of the country's population. To date, efforts to streamline overlapping regulatory functions, particularly for food inspection, have not been perceived as effective. Like other regulatory regimes, the regulations themselves are difficult to access. Since 1971, Liberia has been a member of the Codex Alimentarius Commission, the international body overseeing a harmonized system of food standards, but Liberia's National Codex Committee has remained essentially inactive since the country's war years. The Monrovia City Corporation's Ordinance No. 1, Section 2 (a), states that "no selling of foodstuff on the street, sidewalk or through Government offices within the City shall be permitted. Items affected by this Ordinance include such edible[s] as oranges, bananas, corn, cassava, peanuts, sugarcane, avocados (butter pear), coconuts, candy, cigarettes, chick lets, fish and other seafood, etc. Anyone found guilty of violating this provision shall be subject to a fine of not less than \$200.00 for each offence." This section is widely ignored among traders but has been used in the past less as a means for providing for food safety, and more as grounds for thinning out the informal markets and enterprises that crowd the streets (USAID-EAT, 2015).

2. Identification of agricultural risk – country risk profile

2.1. Agricultural risks

2.1.1. Weather risks

A series of several natural disasters was obtained from Emergency Events Database (EM-DAT, 2017). In this section the disasters related to weather are showed in Table 12 with the year of occurrence. In this list is evident that the epidemic disasters have been one of the principal enemies of this country. We have summarized this information by type and subtype of disaster to have a wider view of it (Table 13).

The most frequent weather disasters are floods (40% of the events) and wind storms or harmattans (13%) according to EM-DAT 2017. Flooding is the main problem in the lowland areas of the country. In these areas, rivers are threatening the dwellings and livelihood of the population during the rainy season. In addition, sea erosion by the coastline is a risk and it also destroys houses and buildings. Both floods and sea erosion are causing periodical displacement of people in the disaster-prone areas, and the consequences are often worse than it should be due to the fragility of infrastructure. This could explain the number of events in transport accidents (20% of the events).

Respect to temperatures there is one event related to cold wave affecting 500,000 people. On the other hand, there is a drought event registered, even we believe that this is a hydrological drought that could have its consequences on agricultural yield (Table 13).

A major problem in Monrovia is overpopulation; the city was built for 500.000 inhabitants, but now hosts more than twice as many. The overpopulation makes the city very vulnerable; people are building houses and settle down in areas vulnerable to floods. The trees are natural wind breakers protecting the villages, but due to deforestation in highland areas this protection is gone. According to one informant, “the poverty is the worst enemy of environment” (Holmgren and Moe, 2012).

Table 12: Record of weather related disasters in Liberia from 1977 till 2016

Year	Type	Subtype	Occurrence	Total deaths	Affected
1977	Miscellaneous accident	Fire	1	--	950
1982	Mass movement	Landslide	1	46	200
1983	Drought	Drought	1	--	
1990	Extreme temperature	Cold wave	1	--	1,000,000
1995	Storm	--	1	--	2,000
1998	Flood	Riverine flood	1	10	5,000
2002	Transport accident	Water	1	60	
2007	Flood	Riverine flood	1	1	17,000
2007	Storm	Convective storm	1	--	3,500
2008	Flood	Riverine flood	1	--	340
2009	Flood	Riverine flood	1	2	584
2010	Flood	Riverine flood	1	1	15,486
2010	Transport accident	Water	1	11	16
2013	Transport accident	Air	1	10	
2016	Flood	--	1	--	15,431

Source: EM-DAT International Disaster Database, 2012 <http://www.emdat.be/result-country-profile>.

Table 13: Number of occurrence, deaths of affected people by disasters from 1977 till 2016

Type	Occurrence	Total deaths	Total Affected	Subtype	Occurrence	Deaths	Affected
Drought	1	--	--	Drought	1	--	--
Extreme temperature	1		1,000,000	Cold wave	1	--	1,000,000
Flood	6	14	53,841	Riverine flood	6	14	53,841
Mass movement (dry)	1	46	200	Landslide	1-	46	200
Miscellaneous accident	1		950	Fire	1	--	950
Storm	2		5,500	Convective storm	2	--	5,500
Transport accident	3	81	16	Air	1	10	--
				Water	2	71	16

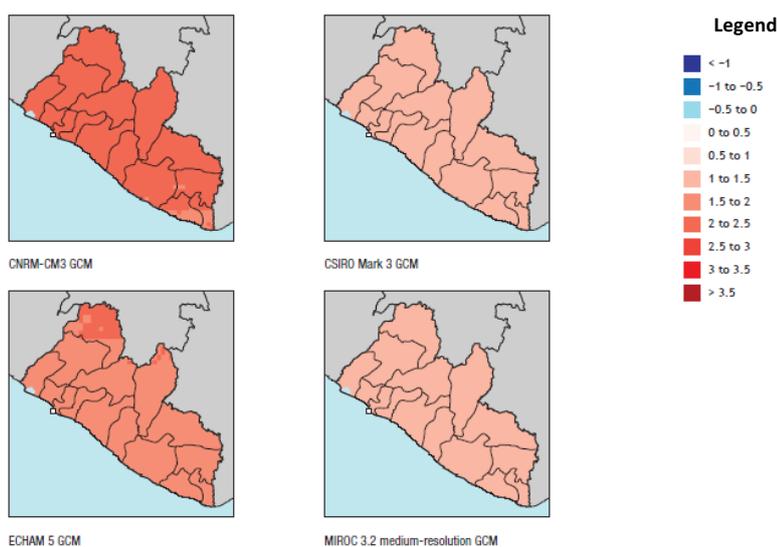
Source: EM-DAT International Disaster Database, 2012. <http://www.emdat.be/result-country-profile>.

2.1.2. Climate change

Liberia is vulnerable to the impacts of climate change. While Liberia has a low carbon footprint, the impact and effects of climate change may have severe consequences in multiple sectors and areas. According to Stanturf et al. (2013), expected changes in temperature and precipitation by 2050 and 2080 for most of the country, including Monrovia, are of warmer and wetter climate.

The most conservative estimates have Monrovia warming by an estimated average of 1.3°C by 2050 and 1.90°C by 2080. All GCMs (General Circulation Models) models show relatively uniform increase in temperature across the country, with variation among the models in the level of increase in temperature. The CNRM-CM3 GCM predicts an increase of 2.0°–2.5°C; both CSIRO Mark 3 and the MIROC 3.2 medium-resolution GCM predict an increase of 1.0°–1.5°C. The ECHAM 5 GCM predicts an increase of 1.5°–2.0°C (Jalloh et al., 2013) (See Figure 4).

Figure 4: Change in normal daily maximum temperature in Liberia for the warmest month, 2000–2050, A1B scenario (°C).

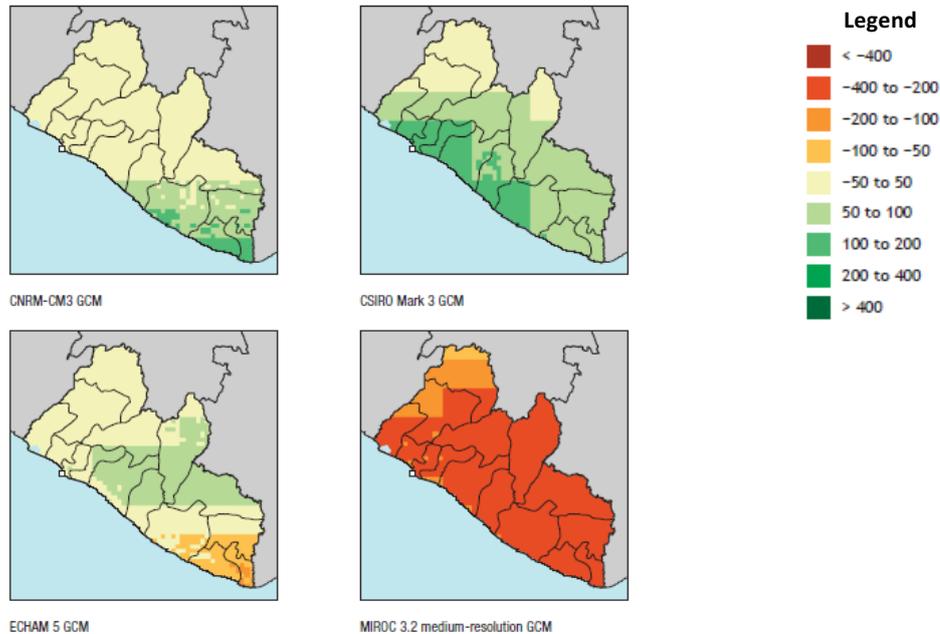


Notes: A1B = greenhouse gas emissions scenario that assumes fast economic growth, a population that peaks midcentury, and the development of new and efficient technologies, along with a balanced use of energy sources; CNRM-CM3 = National Meteorological Research Center–Climate Model 3; CSIRO = climate model developed at the Australia Commonwealth Scientific and Industrial Research Organisation; ECHAM 5 = fifth-generation climate model developed at the Max Planck Institute for Meteorology (Hamburg); GCM = general circulation model; MIROC = Model for Interdisciplinary Research on Climate, developed at the University of Tokyo Center for Climate System Research.

Source: Jalloh et al. (2013) estimation based on Thomson et al. (2009).

A recent study of climate change impacts in Liberia (Stanturf et al., 2013) indicates trends for wetter conditions in most of the country by 2060, with increased rainfall being concentrated along the coast. Changes in the timing and intensity of rainfall events are also predicted. In the Figure 5 the changes in mean annual precipitation are showed following different models under A1B scenario.

Figure 5: Change in mean annual precipitation in Liberia, in mm, 2000-2050, A1B scenario



Notes: A1B = greenhouse gas emissions scenario that assumes fast economic growth, a population that peaks midcentury, and the development of new and efficient technologies, along with a balanced use of energy sources; CNRM-CM3 = National Meteorological Research Center–Climate Model 3; CSIRO = climate model developed at the Australia Commonwealth Scientific and Industrial Research Organisation; ECHAM 5 = fifth-generation climate model developed at the Max Planck Institute for Meteorology (Hamburg); GCM = general circulation model; MIROC = Model for Interdisciplinary Research on Climate, developed at the University of Tokyo Center for Climate System Research.

Source: Jalloh et al. (2013) estimation based on Thomton et al. (2009).

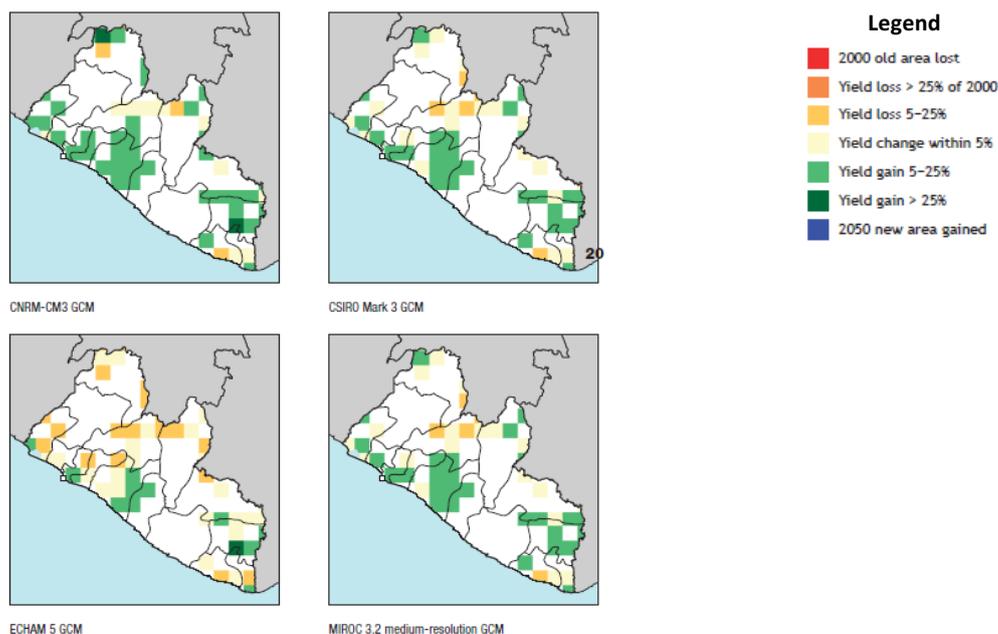
In Liberia, as much as 70% of the population depends on agriculture for their livelihoods; rural areas, which are as much as 80% vulnerable to food insecurity (EPA, 2013) depend mainly on production of rice and cassava, with bush meat and fish being the main sources of protein. As we can observe in Figure 4 and Figure 5 there are considerable variation in the predictions for temperature and precipitation changes due to climate change. The consequence is that different projected outcomes, regarding the agricultural production, have been obtained. This remarks the need of flexibility and responsiveness in the agricultural sector to adapt to climate change. (Jalloh et al., 2013).

Cassava, a more resilient crop than rice, is adapted to high temperatures, drought and erratic rainfall. The impact of climate changed is expected to be lower than that for rice. Different studies on rice project different outcomes. Stanturf et al. (2013) suggests that projections of higher temperatures, even with adequate precipitation, will negatively impact rice. Upland rice, the predominant cropping system, will be impacted by changes in seasonality of precipitation.

Jalloh et al. (2013) mapped the output for rainfed rice (Figure 6), which compares the potential crop yields in Liberia for 2050 assuming climate change with the potential yields assuming an unchanged (2000) climate. All the GCMs predict more areas of yield increase than yield decrease, and for the most part the changes are less than 25% of the baseline yields for 2000. Although the GCMs have very similar results, it seems that the CNRM-CM3 GCM has a slightly higher ratio of gains to losses, and it even has two areas for which yield increases are

predicted to exceed 25%. The MIROC 3.2 GCM has probably the lowest ratio of gains to losses ratio, with most of the losses concentrated in the northern portion of the country. These results are encouraging because they suggest that climate change will bring more benefits than costs, at least for rainfed rice. It is not entirely clear why the projected drop in annual rainfall in MIROC did not result in more yield reduction, but it could be that the rainfall was not too adversely affected during the growing season, where all the crop models in the DSSAT (Sun Storage Tek Availability Statistics) software focus on (Jalloh et al., 2013).

Figure 6: Yield change under climate change of rainfed rice in Liberia, 2000-2050, A1B scenario.



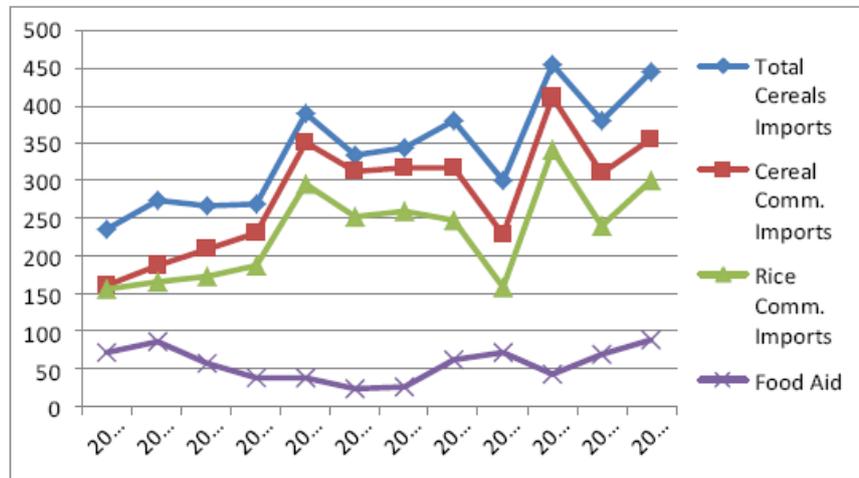
Notes: A1B = greenhouse gas emissions scenario that assumes fast economic growth, a population that peaks midcentury, and the development of new and efficient technologies, along with a balanced use of energy sources; CNRM-CM3 = National Meteorological Research Center–Climate Model 3; CSIRO = climate model developed at the Australia Commonwealth Scientific and Industrial Research Organisation; ECHAM 5 = fifth-generation climate model developed at the Max Planck Institute for Meteorology (Hamburg); GCM = general circulation model; MIROC = Model for Interdisciplinary Research on Climate, developed at the University of Tokyo Center for Climate System Research.

Source: Jalloh et al. (2013) estimation based on Thomson et al. (2009).

2.1.3. Food security (nutrition and vulnerability)

Liberia is not self-sufficient in rice which is the most important food staple. Historically, the total cereal import requirement to ensure availability of cereal in Liberia and reducing food insecurity is met through commercial imports and some food aid (Figure 7). The assumed level of commercial import leaves about 90,000 tons of uncovered gap in 2015 to be filled with international food assistance and/or additional budgetary allocation by the Government. This level of food assistance is about 20,000 tons higher than in 2014 and almost at the level of a historical high food aid in 2005. This would be, especially aimed at providing food assistance to the most vulnerable people affected by Ebola crisis and outline the importance of the food aid for Liberia food security status.

Figure 7: Liberia - Cereal imports (x 103tonnes)



Source: 2004 to 2014 FAO/GIEWS CCBS, (Country Cereal Balance System) 2015 CFSA.

According to a report from USAID, the main food security risks in Liberia, taking into account not only the food availability but also the food access (livelihoods) are the following (USAID, 2011):

- The South-Eastern area of the country is at slightly higher risk of food insecurity due to several factors including: rainfall in this area can be erratic, households are highly dependent on their own production for food, and markets are not well-integrated into the national marketing system as access to the Southeast is very difficult during the rainy season
- Shocks that typically impact food security include staple food price spikes, erratic rainfall, excessive rainfall and crop pest such as grasshoppers and groundhogs
- Periods of peak rainfall, from June through October, are of concern because of the risk of flooding. This period of higher risk coincides with the lean season and its corresponding risk of staple food price rises as well as the peak malaria period

It is interesting to know the future perspective for food availability as a main component of food insecurity risk. This analysis will allow us to assess the future vulnerability of Liberian population concerning food insecurity.

Agricultural Vulnerability Scenarios:

The next three figures show simulation results from the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) for key agricultural crops in Liberia. The Figure 8 for each featured crop has five graphs showing production, yield, area, net exports, and world price. Rice production is shown to increase, reflecting productivity increases. All scenarios show very little change in the area planted with rice (Figure 8). Any projected increase in rice production will be the result of improved management, because there are already rice varieties with a yield potential of up to 4 tons. Liberia is not self-sufficient in rice, and the scenarios show an increasing deficit based on an increase in population without a sufficiently large corresponding increase in rice production. An increasing world price for rice would therefore increase the burden on the country's economy (Jalloh et al., 2013).



Unlike rice production, cassava production is predicted to increase only until 2030 and then to be relatively flat (with some small increases and some small decreases) thereafter. Like the case of rice, improved management practices rather than improved varieties will be responsible for any increase in production (Figure 11). The area planted with cassava will decrease more than the area planted with rice. The decrease in the area planted and the possible increase in population will cause the country to become an increasingly larger importer of cassava. After 2025, the world price for cassava will tend to be higher in the pessimistic scenario than in the optimistic scenario (Jalloh et al., 2013).

Unlike the production of rice and cassava, the production of sugarcane will be significantly influenced by the area under cultivation. Shows the area planted with sugarcane increasing in line with production increases, while productivity appears to be unchanged. However, like the cases of both rice and cassava, the net export of sugarcane would decrease despite the increase in world price. The increase in imports is a consequence of increased consumption in the country because of the population increase (Jalloh et al., 2013).

Nutritional Vulnerability Scenarios

In addition to agricultural outcomes, IMPACT also predicts the number of malnourished children under the age of five and the number of available kilocalories per capita. Figure 9 shows the impact of future GDP and population scenarios on under-five malnutrition rates. The box-and-whisker plots in the figure indicate the range of climate scenario effects. Low GDP per capita and a larger population will result in an increase in the number of children under age five who suffer from malnutrition until 2030 in the baseline scenario and until 2035 in the pessimistic scenario, though the malnutrition rates might fall slightly during those years because the population is projected to grow at a faster rate than the number of malnourished children (Jalloh et al., 2013).

We also note that the kilocalories available to each person will eventually increase with the increase in GDP per capita (Figure 10), though they will be fairly constant between 2010 and 2025. There is a correlation between the availability of kilocalories and the reduction of under-five malnutrition (Jalloh et al., 2013).

Although our analysis shows an increase in the importation of staple commodities, it does not appear that this will adversely affect the nation's food security, because the IMPACT model predicts that in the latter half of the period under study, the malnutrition rates of children will decline, and the number of calories consumed per capita will increase. (Jalloh et al., 2013).



Figure 8: Impact of changes in GDP and population on rice in Liberia, 2010-2050

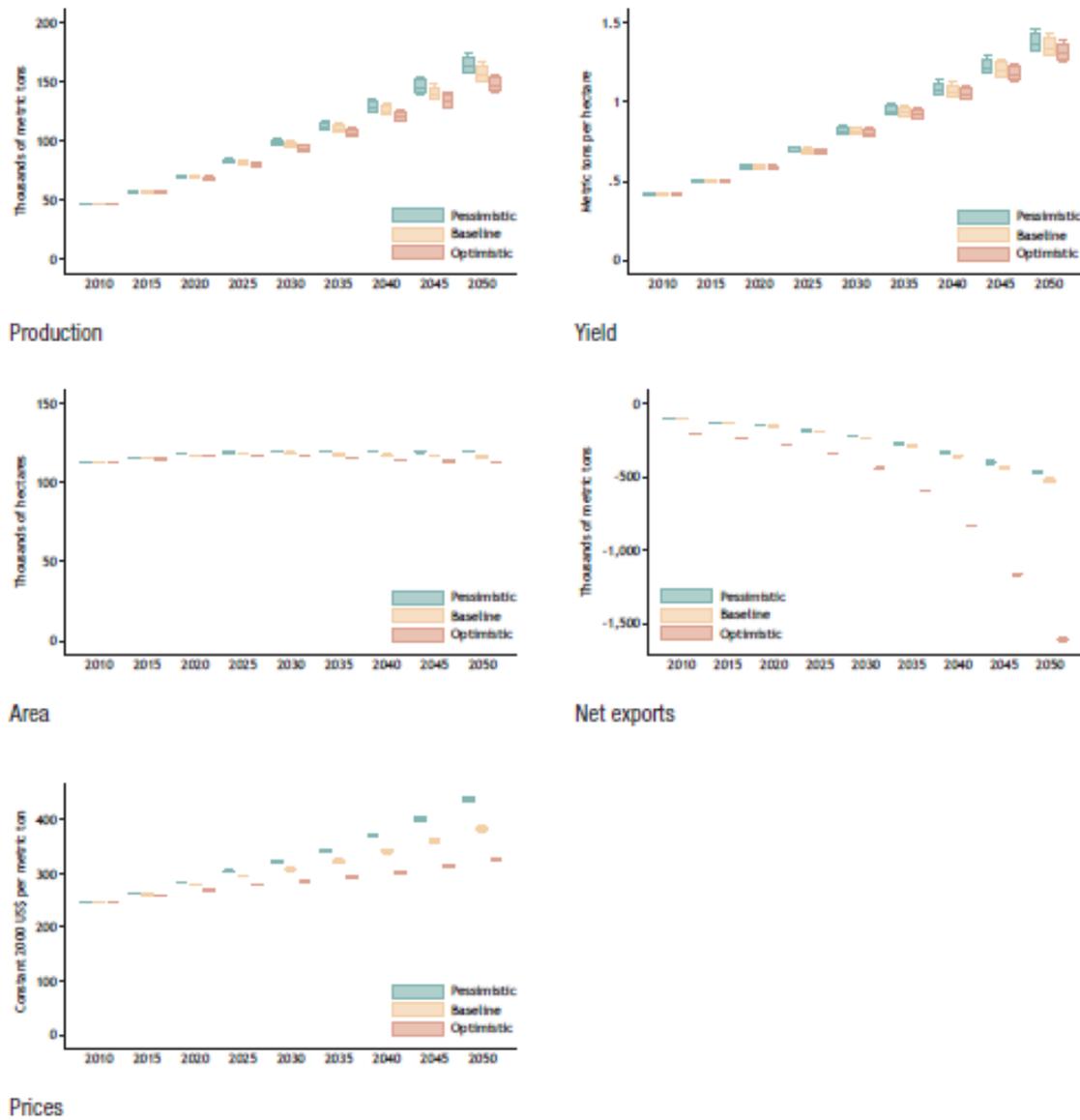
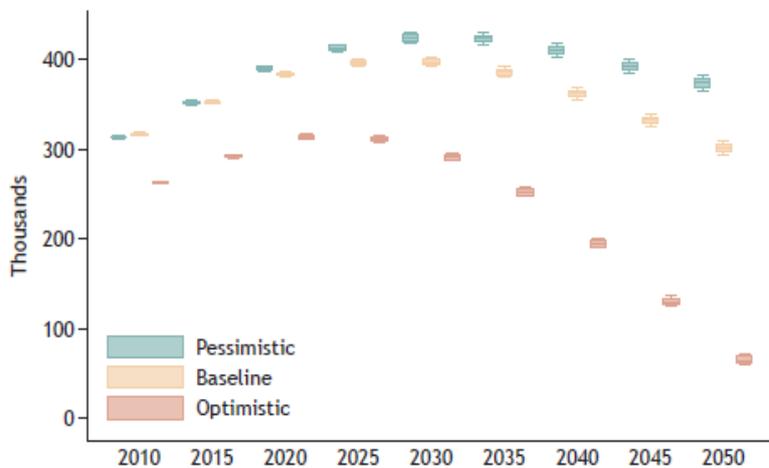


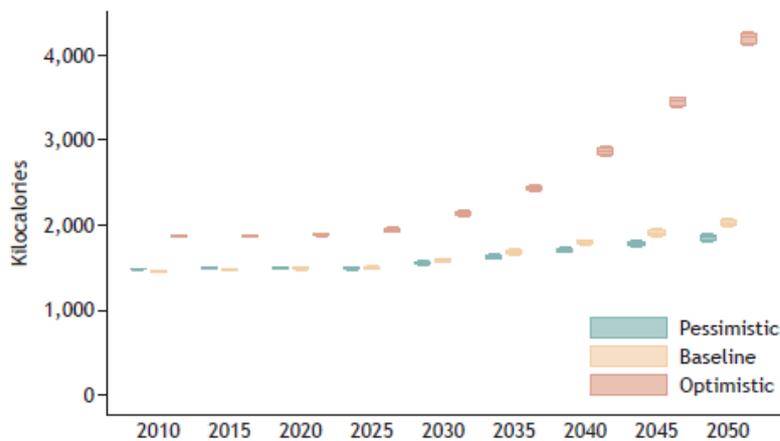


Figure 9: Number of malnourished children under five years of age in Liberia in multiple income and climate scenarios, 2010-50

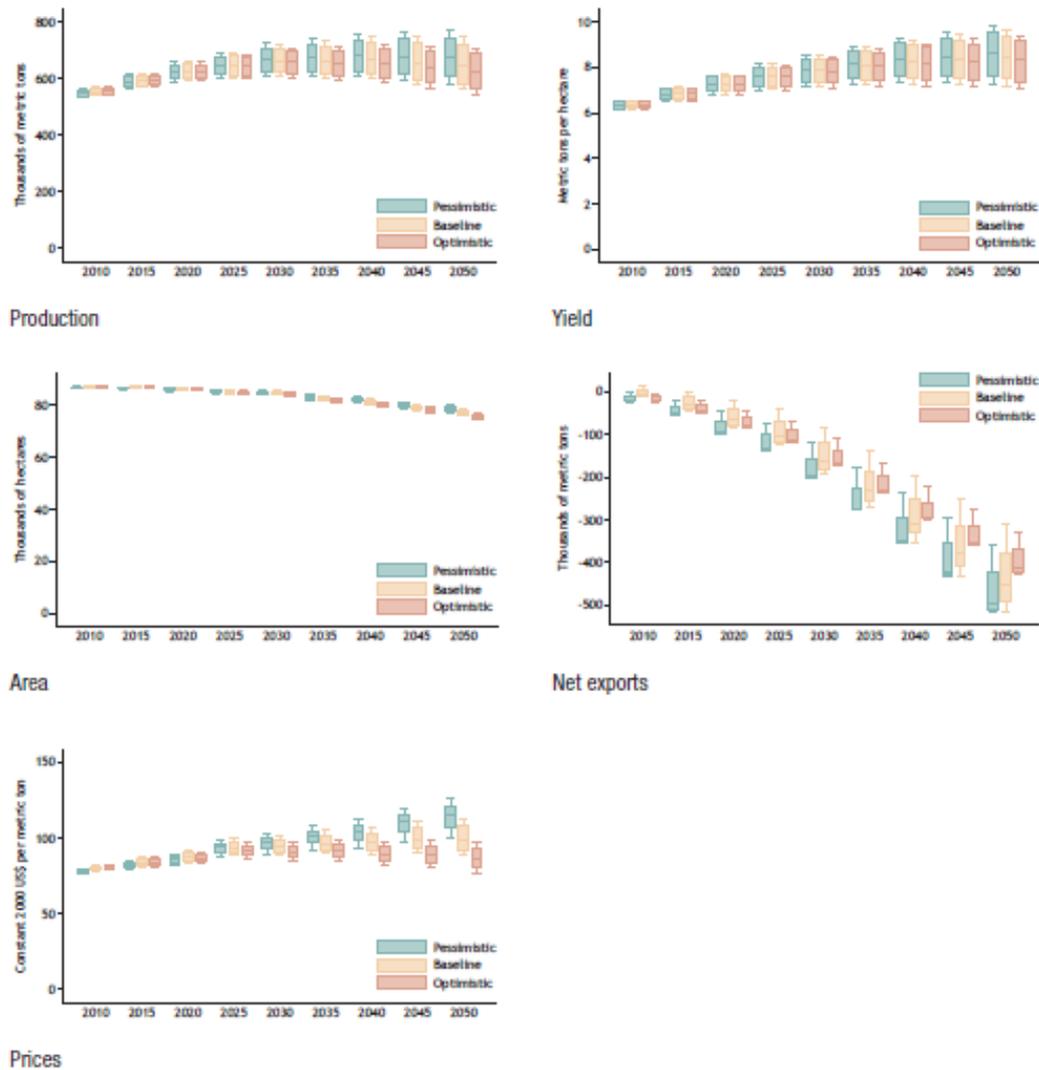


Source: (Jalloh et al., 2013)

Figure 10: Kilocalories per capita in Liberia in multiple income and climate scenarios, 2010-50



Source: (Jalloh et al., 2013)

Figure 11: Impact of changes in GDP and population on cassava in Liberia, 2010-50


2.1.4. Biological and environmental risks

Crop pests and diseases

As already mentioned, the pests and diseases that affect rice (either in production or storage) are critical. The major problem resulting in significant decrease of rice yields is the high incidence of pests mainly, grass cutters (ground-hogs) and birds throughout the country. These pests' attacks have intensified following the end of war and resumption of farming activities in rural areas. Some of the initial explanations include the suspension of farming activities during the years of war, which usually involve pest control measures, combined with reduced hunting activities which also reduces the population of these pests. This resulted in the multiplication of these pests with high rates which continued to attack relatively less area of cultivated land in comparison to pre-war cultivated areas. The impact of pests is much higher on scattered small farms areas, which are dominant, than on large farm areas. The traditional methods of control used by the farmers proved to be inefficient in face of recent heavy attacks. Other pests reported include bush cow, porcupines, and grasshoppers. The cassava crop throughout the country is infected with cassava mosaic virus which, in turn, is responsible of the low yields of this food crop (FAO, 2006).



Therefore, in Liberia, two problems coexist, the crop pest and diseases and the lack of resources to handle them. According Mr. Jeremiah Matthew Swinteh (Senior Inspector, Plant and Animal Quarantine Service, Ministry of Agriculture, Republic of Liberia), Liberia has insufficient capacities for disease surveillance, diagnosis, appropriate inspection and reporting system of plant health issues. There are not the facilities, equipment and logistics to scientifically prove issues concerning plant health. Therefore, the situation is critical.

The following are described the pests or diseases main in West-Africa according from international sources, such as Centre for Agriculture and Biosciences International (CABI), Africa Rice Center (AfricaRice) and Consultative Group on International Agricultural Research (CGIAR). The selection has been made by taking into account the environmental conditions of Liberia.

- **Rice Yellow Mottle Virus (RYMV)** is endemic and largely restricted to the African continent, where it has been found in most of the rice-growing countries. RYMV is an important constraint to rice production in irrigated areas in Sub-Saharan Africa.
- **African rice gall midge (AfRGM)** is a serious insect pest of rainfed and irrigated lowland rice in Africa. It is a bud/stalk borer and larval feeding causes severe damage to rice during the vegetative stages (seedling to panicle initiation). Rainfed lowland and hydromorphic ecologies seem to be at higher risk than upland and mangrove ecologies. It has become a major pest in Burkina Faso, Nigeria, Mali and Sierra Leone. It has been recorded in a further 16 sub-Saharan African countries.
- **Cassava mosaic disease (CMD)** is commonly known as leprosy. Sick plants have pale green and yellowish patches on the leaves. The sick plants are often small. They do not grow to their normal height. Sick plants have small leaves and small tubers, so the harvest is poor.
- **Cassava Bacterial Blight disease (CBB)** is caused by a bacteria called *Xanthomonas axonopodis* pv. *manihotis*. It is a major constraint on cassava cultivation and losses can be extremely severe after introduction of the pathogen, or possibly of more aggressive strains, in a region where highly susceptible cultivars are grown.
- **Phytophthora palmivora** is a serious pathogen in West Africa where over 60% of global cocoa is produced. The whole plant of cocoa is attacked leading to various symptom. This fungus grows on cocoa trees in the shade when it is cool and damp. When the area is warmer and drier, the disease will not grow. This fungus can attack also to the rubber trees. Symptoms of infected rubber trees are mature leaf fall, green stem die-back, pod rot and bark rot (black stripe).
- The **Cocoa Swollen Shoot Virus Disease (CSSVD)** caused by the Cacao swollen shoot virus (CSSV) has for many years been a major constraint to cocoa (*Theobroma cacao*) production in West Africa. The virus (CSSV) is a member of the Badnavirus (bacilliform DNA virus) genus and is semi-persistently transmitted through the feeding action of several mealybug species (Pseudococcidae, Homoptera). This virus has haunted the cocoa industry of Ghana from the 1930s to the present and been the cause of extensive eradication campaigns involving the destruction of many tens of millions of cocoa trees. The virus currently occurs mainly in West Africa: Benin, Côte d'Ivoire, Ghana, Liberia, Nigeria, Sierra Leone and Togo.
- **Green spider** (*Mononychellus tanajoa*) (cassava green mite) is of Neotropical origin but was accidentally introduced to Africa in 1971. Currently the pest is reported in over 60 countries. *M. tanajoa* is mainly dispersed by human activity, whereby infested plant materials and contaminated media are transported over long distances. Damage caused by *M. tanajoa* varies according to the cassava cultivar and the length of the dry season.
- **Whitefly** (*Aleurodicus disperses*). It is not a fly but a true bug, a member of the order Hemiptera who all feed on liquid food via stylets, modified tubular mouthparts. The common name spiralling whitefly arises from the adult females laying eggs in spirals of waxy material. All whiteflies are plant feeders and the spiralling whitefly is highly polyphagous, feeding on many plant species, in many plant families. The wide host range of the spiralling whitefly is the major reason it is able to spread so quickly from one crop to another across the tropics.

In addition, it is very important to note that Liberia has experienced major pest infestation (Caterpillar) identify as forest dwelling moth called "Achaea Catocaloides Guence, since 2009, 2010, 2012, 2014 and 2016. The insect major feed and host is Dahoma (A forest tree) found near river banks. It also feeds on agricultural crops such as (cocoa, coffee, rubber trees, oil palm, plantain and banana leaves, rice strews, cowpeas, assorted vegetable, etc.). Its green leaf-eating habit and fast spreading nature prompted the National Government to declare National Emergency in 2009.

Animal pests and diseases

Currently, the MoA has two departments involved in implementation of international Sanitary and Phytosanitary Standards (SPS) and regulation of international trade of agricultural products: The National Quarantine and Environmental Services Division, which does not include the inspection and testing of food and plants (Quarantine) and the Department of Animal Health Services (AHS). However, several challenges including personnel, facilities and operational funds limit these Departments to carry out their mandate within the National Livestock Bureau.

Additionally, few of the enabling Legislative Acts that empower the MoA to perform its roles with legal backing are in place yet. Services such as disease surveillance, epidemic disease control measures, and curative services have become woefully inadequate or non-existent. There is now a general recognition that government animal health services cannot deliver all the services previously expected of them (Agyemang, 2013).

Main constraints and threats for Liberian livestock development, which will put at risk the success of the different agricultural policies, are summarized and examples given, below:

1. Institutional risks: The country has a very limited number of veterinarians and trained livestock technicians. There is no clear policy on livestock, little coordination and overlapping of responsibilities between ministries. There is inadequate financial support to the livestock division at the Ministry of Agriculture (MoA) a particularly of the Department of Animal Health Services (AHS). All institutional risks are critical because they affect the Governmental regulation on Pressure to Produce Revenue (PPR). These institutional risks bring also risk for the health of animals, people and plants. Moreover, directly increase the risk of food insecurity. About 100.000 hoof animals and 150.000 poultry are imported yearly in Liberia.
 - Poor coordination, cooperation and dialog among border agencies together with complex import/export procedures, which result in long time to clear goods and deterioration of imported food (Trading Across Borders, 2015). Moreover, great risk of introduction of pests and diseases in the Liberian Agricultural sector occurs.
 - The existing policy of open markets, within regional neighbours of Mano River Union, constituted by Sierra Leone, Guinea and Liberia together with the Economic Community of West African States (ECOWAS). However, the agreed free trade without duty is not always real since the local agencies charge for crossing borders (Trading Across Borders, 2015).
 - Overlapping of functions between the Ministry of Commerce and Industry (MoCI) and MoA hindering the efficacy of the Food Safety Program and application of the agreed International Sanitary and Phytosanitary Standards (SPS). (Trading Across Borders, 2015). This results in an increased risk on the health of the Liberian people.
 - The inspection and testing of agricultural exports following guidelines of the SPS program is poorly done by the MoA, which limits the acceptability of Liberian goods and imposes a health risk on the international community. (Trading Across Borders, 2015).
 - Low efficacy and lack of coordination between the Bureau Veritas and the MoCI for the sanitary certification of food and feed imports, which compromises the health of Liberian people. (Trading Across Borders, 2015).
 - Complex process to obtain import/export certificates from the MoA, which limits export of staple foods crops to lucrative markets reducing economical competitiveness, and the import of staple food, increasing risk of food security in Liberia. (Trading Across Borders, 2015).
2. Infrastructure and equipment: The slaughterhouse in Monrovia is in a deplorable state and the slaughter slabs do not meet the basis hygienic requirements for the general public. Also, slaughterhouses outside Monrovia are almost non-existent imposing a great risk on the food safety for the health of Liberian people.
 - The lack of laboratories in Liberia to perform plant, livestock and food analyses results in increased risk of food security and food safety.



- The lack of adequate quarantine facilities at the Monrovia port makes impossible to keep live animals for more than 24h, whereas the international industry standard stipulates a minimum of three days under veterinary control. It is even worse at the Ganta border with Guinea, where more than 3,000 animals go across the border every month for food use in Liberia with just a fast-visual inspection, since quarantine facilities do not exist. The risk of transmission of diseases is totally dependent on the Guinea services for veterinary controls and vaccination programs. (Trading Across Borders, 2015).
3. Animal diseases: Mortality rate is high because of the lack of disease surveillance in the field and veterinary controls of animal health. Availability of trained livestock officers is very limited, and they are not well equipped to diagnose diseases. Moreover, the lack of research on the state of prevalent diseases in the country makes almost impossible to have a good diagnose on time. As reviewed by Agyemang (2013), the most frequent livestock diseases encountered in the field are: PPR (pest des petits ruminants), mite mange, flukes, CCPP, foot-rot, contagious agalactia, sheep pox, goat pox, CBPP, white scourges of calves, flukes, ticks and mite mange, hog cholera, leptospirosis, swine pox, and Newcastle Disease (Agyemang, 2013).
 4. Breeding stock: There is insufficient breeding stock in the country.
 5. Feed and pasture: feed supply is one of the major technical constraints to livestock production. Access to complete balanced feeds, minerals vitamins and other essential inputs for production is very limited and unaffordable for Liberian farmers. Pasture management is mostly traditional with insufficient inputs and inadequate efforts to make any improvement (Larbi, 2012; Agyemang, 2013).

Even though Liberia has pasture resources with high potential for cattle, sheep and goat production, many are yet to be rehabilitated. Except for the cattle ranch of the Central Agricultural Research Institute. Several risk factors that constrain improvement of the pasture resources in Liberia (FAPS, 2008; Koikoi, 2011; SFNS, 2010) have been identified:

- Lack of commercial outlook: earing of cattle, sheep and goats is not considered as a business by most farmers. There is need to assist farmers to adopt market-oriented ruminant production.
- Great abandonment of existing grazing areas: Ranches established before the war for multiplication of trypanotolerant livestock have been neglected.
- Lack of enabling policies: there is no comprehensive policy on grassland, and pasture and fodder crops.
- Land ownership or land tenure: Most cattle farmers do not have title to land. Hence, there is no incentive for development of the pasture resources.

Human health

For Liberia, the experience of the Ebola outbreak is still very fresh. This event uncovered the deficiencies of Liberia's health system and the need for improvement. On the other hand, many diseases, such as malaria and dengue, are linked to climatic variations. According to Liberia's Initial National Communication (2013), changes in rainfall will lead to increased vulnerability to malaria, cholera and diarrheal diseases, as well as increased incidences of Lassa fever, schistosomiasis, lymphatic filariasis, yellow fever, hepatitis A, and intestinal worms. The incidence geographic area of dengue fever could affect Liberia, as it may expand from neighboring Côte d'Ivoire.

Water related pests

Water, sanitation, and hygiene (WASH) access and behaviors remain exceedingly problematic across Liberia, confounding efforts to address acute and chronic malnutrition. The health and nutrition implications of WASH deficits are exacerbated by the country's lengthy rainy season (May–October) and endemic waterborne diseases (e.g., cholera).



Safe WASH access and behaviors are essential to prevent fecal-oral disease transmission and the long-term consequences of repeated diarrheal infections on children's physical and cognitive development (e.g., environmental enteropathy and stunting) (Humphrey, 2009). An estimated 3,000 Liberians, including 1,800 children, die from diarrheal diseases each year, and roughly US\$17.5 million (2% of GDP) is lost to health care costs and productivity losses from inadequate WASH access (World Bank, 2012).

Access to improved water and sanitation is markedly lower in rural areas, with approximately half (57%) of rural Liberians accessing improved drinking water sources and virtually none (5%) accessing improved sanitation.

Among rural Liberians who have access to improved drinking water, virtually all (96%) rely on hand-dug wells with hand pumps, indicating that the vast majority of drinking water must be carried and stored in the household. Despite this, few Liberians (15%) report appropriately treating their water (e.g. boiling, chlorination), making it likely that water is contaminated before consumption (LISGIS et al. 2014). Due to the lack of basic infrastructure in Liberia, the time burden of collecting and transporting water is significant, particularly for women and children, and makes it more difficult to engage in other productive activities for the household.

As shown earlier in this document (Table 13), under the weather risks section, floods are the most frequent weather disaster in Liberia (21% of the events) and at the same time it brings dramatic biological disasters associated with bacterial and viral epidemic diseases. Although bacterial diseases occur most frequently, mortality is mainly due to viral diseases.

Contributing to and exacerbating poor health is Liberia's dire situation with sanitation infrastructure and limited access to water. Regarding improved sanitation, few rural households (4%) and only 22% of urban households have unshared access to an improved latrine or toilet, making open defecation a common reality (LISGIS, 2014). Roughly half of rural households have access to an improved water source, while 86% of urban households have access (Ibid). A weak water and sanitation environment added to the hazardous situation during the Ebola crisis and continues to increase the risks of disease transmission.

The risk of communicable diseases related to water is a major threat in Liberia, with particular risk from the high prevalence of diarrheal disease, malaria, acute respiratory illness, and other diseases such as measles, schistosomiasis, tuberculosis, and cholera.

Endemic across the entire country, malaria is the nation's number one direct cause of morbidity and mortality, reportedly responsible for 40% of outpatient health consultations and 41% of inpatient deaths of children under 5 (GOL, 2011)

Diarrheal disease is also a primary contributor to illness, malnutrition, and under-5 mortality, with 22% of these children experiencing diarrhea in the 2 weeks before the 2013 survey. The Liberian Dialogue 2015/03 estimated that improvements to the water supply could reduce diarrhea morbidity by 21%, while improved sanitation facilities could reduce diarrhea morbidity by 38% (Nyepon, 2015).

Policies related to community health, infant and young child feeding, and water and sanitation target a multisectoral response through integrating health and nutrition services with water and sanitation support, agriculture promotion, and social services. Main urgent objectives are:

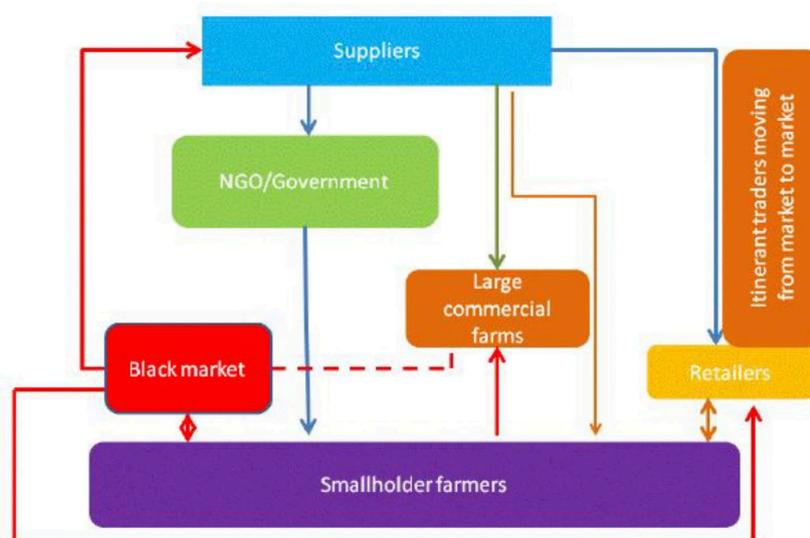
- Achieve universal Access to water and sanitation
- Eliminate open defecation nationwide
- Provide a minimum standard WASH package to 100% of the population by 2030
- Prioritize the delivery of basic services to the poorest rural districts with highest malnutrition rates, as well to informal settings of urban dwellings

2.1.5. Inputs risks

Agro-input dealers play a key role in agriculture and thus their absence affects farmer's access to quality seeds, fertilizers and crop protection products, which invariably affects productivity. Data on Liberia's fertilizer imports and consumption is difficult to access since records are either unavailable or poorly kept and incomplete. However, available information indicates that the fertilizer market is small with limited formulations and most common fertilizer being triple superphosphate (15-15-15) and urea, (IFDF-AFAP, 2014). This is because commercial fertilizer, in particular, is prohibitively expensive and unlike other countries (such as Ghana and South Africa), the Government of Liberia does not subsidize fertilizer—in fact, Government of Liberia taxes it. In contrast, the palm oil and rubber concessionaires are allowed, under their concession agreements, to import commercial fertilizer duty-free (USAID-EAT, 2015)

The agro-input dealer sector is characterized by more than 80% importers and a few itinerant traders/retailers in the rural counties. More than 90% of agro-input dealers are found in Monrovia and generally supply agro-inputs to donor agencies/projects and government. There are also few stockists and itinerant traders moving from market to market. Fertilizers and agro-chemicals are repackaged into smaller units. Repackaging into smaller units allow farmers to afford them due to the high cost of agro-inputs. However, the smallholder farmers hardly use fertilizers and agro-chemicals as a result of high cost on one hand and lack of access to these inputs on the other hand. The access to extension services by smallholder farmers contributes to low use of agro-inputs. Due to low educational levels by farmers, they unable to access information on improved farming techniques (IFDC, 2013).

Figure 12: Current agro-input distribution chain



Source: 2013, IFDC

The Liberian households do not possess many assets, and their depletion put the whole family at serious risk. As an example, only 17 percent of the interviewed households had seeds at the time of the survey. The agriculture tools such as the shovel, sickle, hoe and axe were only held in 27 percent of the cases, despite Liberians being mostly employed in the agricultural sector.

Table 14: Possession of Seeds at County Level

County	Possession of Seeds (%)
Bomi	7%
Bong	29%
Gbarpolu	23%
Grand Bassa	31%
Grand Cape Mount	16%
Grand Gedeh	18%
Grand Kru	22%
Lofa	32%
Margibi	5%
Maryland	18%
Rural Montserrado	4%
Nimba	34%
Rivercess	12%
River Gee	41%
Sinoe	13%
Greater Monrovia	1%
Liberia-average	17%

Source: Liberia Food Security Assessment, 2015

According to the draft seed policy, there are currently just two “registered and functioning seed companies in Liberia:” Green Star and Arjay Farms. Notably, under the draft policy, these companies are not subject to Liberia’s seed certification protocol. They are exempted because they “source their foundation seeds directly from international research institutes— Africa Rice and IITA for rice and maize, respectively.” In addition to special treatment for these two private producers, the draft policy notes a number of domestic institutions engaged in producing distributing certified seed: the Central Agricultural Research Institute (CARI) and various NGOs, including BRAC (Building Resources Across Communities). Unfortunately, the vagueness of the process for licensing purveyors of certified seed, both within the draft policy and in practice, creates an apparent bottleneck that delays or deprives farmers’ access to the seed they need. It is not clear how these few entities became licensed seed dealers, how much a license costs, why there are so few licensees, or why CARI plays such a large market role. (USAID-EAT, 2015).

2.1.6. Marketing logistic and infrastructure risks

Rice farmers face important constraints to access to markets. Urban markets are difficult to access due to the fact that import rice is cheaper and cleaner, making domestic production less competitive compared imported rice. Cassava and vegetable production face similar problems even these products do not compete with imports.

The penetration in higher value markets is hindered by poor roads, limited availability of trucks to transport and storage conditions (USAID, 2016). The low capacity of storage force to sell at harvest time. Lack of equipments, technical know-how and financing prevent farmers to profit from value-added products. High cost of energy and the limited grid are also problematic for rice milling and are constraints identified in many value chain analyses (USAID, 2016).

Currently LBPM operates a storage facility in at the port of Monrovia and collect commissions based on the value of exports. But its role is in the inspection, grading and quality control of Liberian cocoa is just nominal and non-effective.

The Southeast markets have higher prices particularly in the rainy season as the roads to the Northern regions remain unusable and the Southeast region becomes isolated leading to the lack of external food supply and pushing the food prices upwards, creating serious problems of food insecurity especially in years of poor harvest in the Southeast region.

2.1.7. Market risks

The Ministry of Agriculture's (MOA's) Food Security and Nutrition Program, along with county-level offices of the Liberia Institute of Statistics and Geo-information Services (LISGIS), collect prices around the country on imported rice, palm oil, rubber, cocoa, labor, charcoal, and gasoline that are then summarized and reported—but only several months later and there is not full and reliable information on prices from national information systems). The WFP provides monthly prices in several markets for the main staple foods, with longer and more complete time series than the prices provided by GIEWS-FAO and FIEWS-NET (USAID) and thus the analysis of variations of domestic palm oil, rice and cassava prices in the main markets will be based on time series of food prices from WFP.

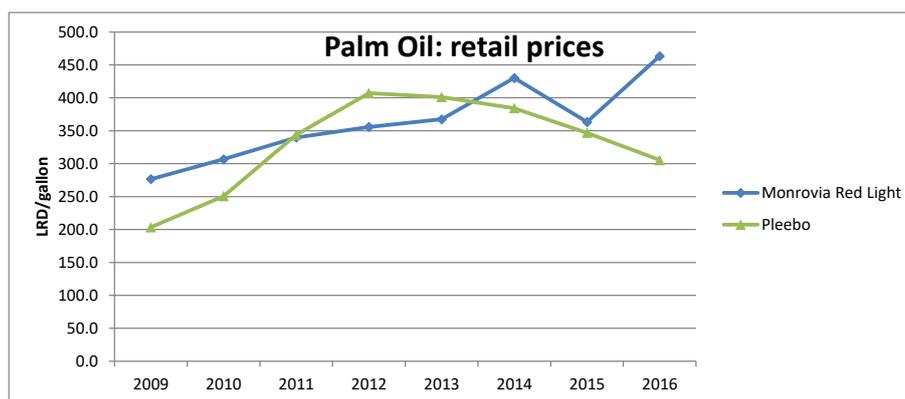
Food crops

We consider three food crops: palm oil, rice and cassava because they are the most important food staple in Liberia. Observing the following figures we appreciate that inter annual variations for some food crop prices are very different according to the different markets (e.g. palm oil and cassava) while is very similar in the case of imported rice. This can be explained because in the case of palm oil and cassava are local production and markets while for imported rice the prices in Liberia follow the international market.

Palm oil

The inter-annual variation of the palm oil prices strongly differs in the Monrovia market compared to the Pleebo market and prices (Figure 13), and on the contrary of the cassava, the prices of palm oil are higher in Monrovia, due to the great demand of national palm oil in the capital.

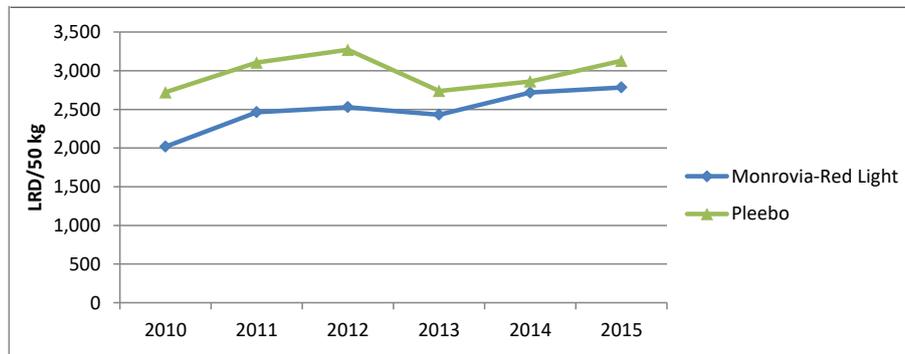
Figure 13: Palm oil: retail prices



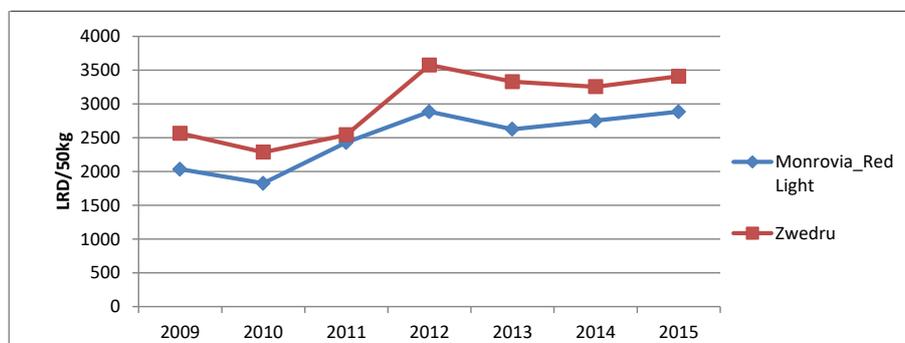
Source: WFP

Rice

For imported white rice (Figure 14) we observe a great stability of prices in the period 2010-2015, moving from 2,500 to 3,000 LRD/50 kg. For imported rice during the period 2009-2015 we appreciate a slight up-trend from 2,000 to 3,000 LRD/50 kg. The imported rice prices (Figure 15) are slightly lower in the Monrovia market than off-Monrovia markets due to the fact that the imported rice arrives to the Monrovia port and it has to be transported to the off-Monrovia markets adding some transportation costs.

Figure 14: Rice White imported: retail prices.


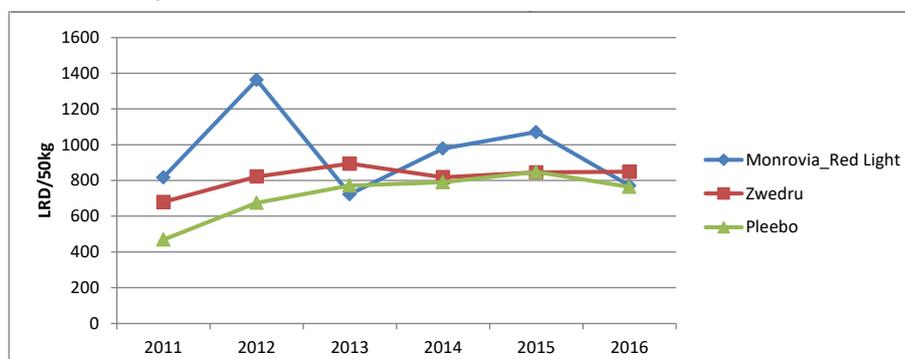
Source: WFP

Figure 15: Rice imported: retail prices.


Source: WFP

Cassava

For cassava prices in the period 2011-2016 (Figure 16) we must distinguish between the Monrovia market and the Zwedru and Pleebo markets. For the last two we observe a great stability moving around 800 LRD/50 kg, while the cassava prices in the Monrovia market shows great inter annual variations from 800 LRD/50 kg in 2011 to 1,400 LRD/50 kg in 2012. This represents some risk for farmers who sell cassava but also for consumers (food security).

Figure 16: Cassava: retail prices.


Source: WFP



Cash crops

We consider cocoa, rubber and palm oil. The palm oil is a food crop and a cash crop, but in the case of Liberia is mainly a food crop as at the present the country does not almost export palm oil and instead is a great importer of Palm oil. The cocoa and rubber are the main exported agricultural commodities and therefore we will analyze the variations of international prices which are the relevant prices to export to the world market. Since 1961, the Liberia Produce Marketing Corporation (LPMC) has reportedly held the authority to market specific Liberian product including cocoa, coffee and palm products and to serve as the sole buyer and/or licensor of buyers of cocoa and coffee. During the LPMC's boom years (1962-1990) the LPMC not only served as the mandatory buyer of cocoa and coffee products, it also operated estates engaged in the first level refining of these products as well as rice milling. Over years of conflict however the LPMC lost control over its properties and its ability to participate in agricultural markets.

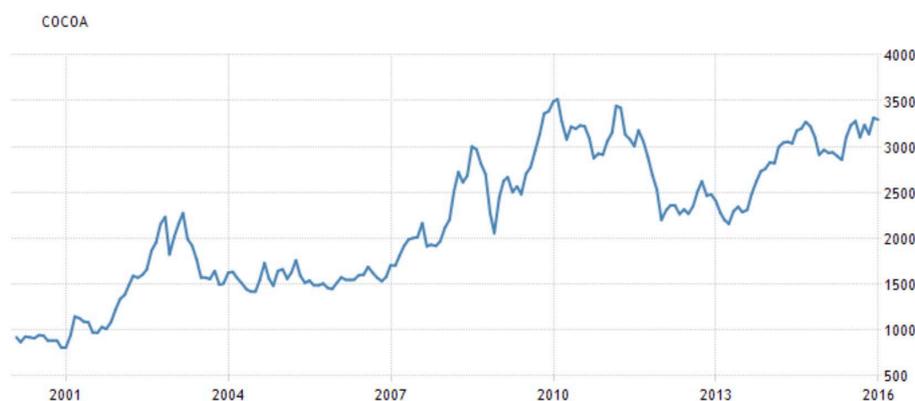
Cocoa

According to the National Cocoa Policy issues by the Ministry of Agriculture (MOA), the LPMC continues to issue "district specific" licenses to companies that purchase cocoa from farmers, called License Buying Agents (LBAs), who are reportedly financed by downstream buy and obtain their license for a \$ 3.000 fee (MOA, 2009). LBA often solicit the assistance of middlemen to secure cocoa supplies. Local independent agents are typically non-licensed and prevalent in the more remote areas of the Liberian cocoa belt and serve otherwise missing markets. In addition to paying the LPMC for permission to purchase cocoa and coffee from farmers, traders of Liberian cocoa and coffee must also pay the LPMC \$ 10.000 for the right to export cocoa (Accessing Marketing Infrastructure, 2015).

The LPC has the legal mandate to set prices for export crops, but practically speaking only does so for cocoa. Prices for cocoa are set quarterly by taking into account world market prices, cost of production, and the LPMC determination of the margins buyers and sellers should each make. MOA also takes some responsibility for disseminating price information to farmers, which is done primarily through the Cooperative Development Agency (CDA). But it does not work and in practice the farmers are often unaware of official prices when they are set and rely on informal networks or conversations with buyers. There are no mobile phone dissemination systems (Accessing Marketing Infrastructure, 2015). In any case it is possible to access to the cocoa world prices published by World Cocoa Foundation (2014) and can be used as a proxy of the exported cocoa prices.

As we can see in the Figure 17, the evolution of the cocoa world price the inter annual volatility of cocoa price in the period 2001-2016 is very high. There are prices spikes in 2002, 2008 and 2010 and strong drops in 2004, 2009 and 2012 and this implies important market risks for exporters and for farmers. Nevertheless, we can appreciate a clear upward trend in the cocoa prices in that period moving from 1000 in 2001 to 3.500 in 2016.

Figure 17: Inter annual volatility of cocoa price in the period 2001-2016



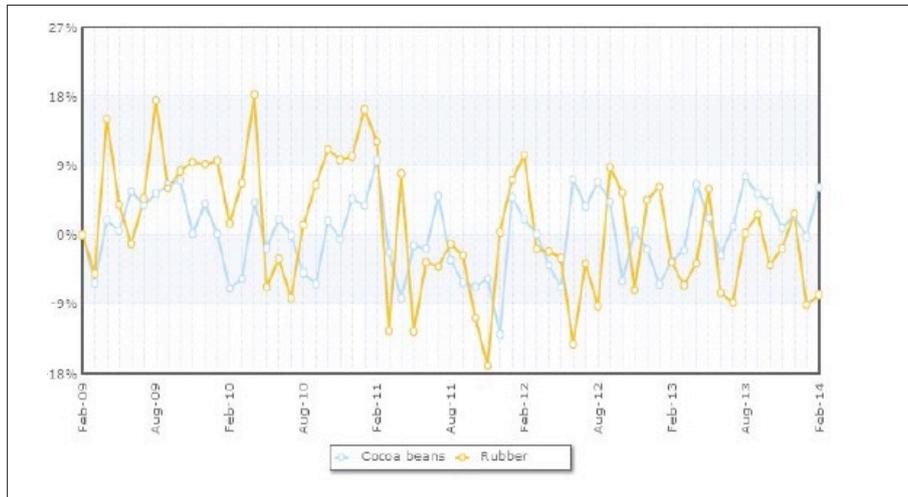
Source: WCF



Rubber

The Figure 18 shows a high inter annual volatility in the rubber prices (2009-2014). Comparing rubber and cocoa we observe that the volatility is lower in the case of cocoa.

Figure 18: Inter-annual volatility prices comparison between Cocoa beans and Rubber.

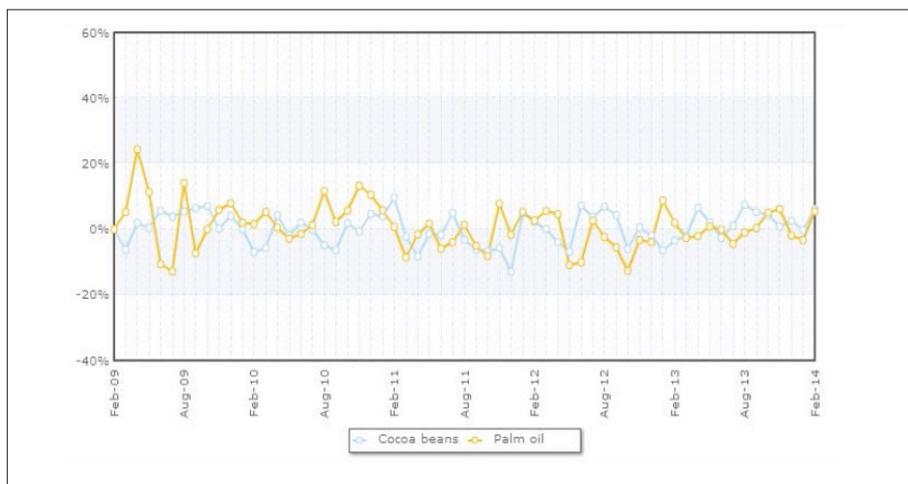


Source: WCF

Palm oil

In the case of palm oil prices, the inter-annual volatility is relatively low though is higher than the volatility of cocoa world prices in the period 2009-2014.

Figure 19: Price volatility of Cocoa beans and Palm oil.



Source: WCF



2.1.8. Public policy and institutional risk

Land tenure

Land issues continue to be a source of conflicts in rural areas where the customary system is prevalent. The complexity of the land tenure systems results in several kinds of smallholding arrangements with different levels of security. Insecurity of tenure is one of the main impediments to the modernization of the smallholder sectors as the incentives to investments are low. The arrangements range from deed holders with comparatively high security of tenure to squatters with no security (The African Development Bank Group, 2013).

Five primary types of land holding can be distinguished with different characteristics and levels of risks (African Development Bank Group, 2013; USAID, 2016):

- **Deed holders** (or holders of other documents): High degree of tenure security but lack of registry creates confusion and insecurity of claims.
- **Customary tenure without a deed:** Relative security within the customary domain. Lack of confidence among smallholders regarding customary courts and their ability to fairly adjudicate land issues.
- **Tenants:** Farmers who lease land but have lower security. Tree crops or other perennial type crops are prohibited. Tenants are thus limited to annual crops only and they often rent land for only one cropping season. Acute fear not to appear too successful as a farmer to avoid land and standing crop to be taken back by owner prior to the agreed upon time.
- **Strangers or borrowers of land:** Farmers that are not from the area but are allowed temporary. They must supply a portion of crop produced to the owner of land. Crops are limited to annual varieties. It is a highly insecure form of tenancy.
- **Squatters:** Individuals who can be evicted at any time if discovered by the owner. They may claim land by planting trees or through the doctrine of "adverse possession" (squatting without eviction for 20 years).

Other risk related with land issues is the absence of a national land registry and, therefore, no records to determine the land ownership, transfers or, boundaries puts the deed holder in a vulnerable position. In many cases it is impossible to know with certainty who is the legitimate owner of a piece of land.

The increased of land concessions is an important source of conflicts and threats to peace. It's estimated that agricultural concessions amounted 10% of the total land area, primarily for the palm oil industry and the government has committed to increase this amount in at least 520,000 has (USAID, 2016). The risk has been exacerbated by some controversial land concessions during the Ebola crisis.

Political and security risk

The Agenda for transformation (AfT) established by the GOL as a long-term vision to achieve structural economic transformation, prosperity, and inclusive growth by 2030, details some of the main risks Liberia is exposed to and that can constrain the development (GOL, 2013), including the security risk. The civil war ended years ago but the risks of tension are still present. The threat of internal instability persists and there are risks also of being affected by regional conflicts and violence in neighbor countries. The trafficking of goods and persons across borders increases, and also the risk to security as the government tries to control their illegal activity (GOL, 2013). The insecurity environment decreases the likelihood of investments and threatens the possibilities of development. The next general elections in October 2017 could bring new unrest to the country as different candidates search their ways to the government. With even the former president, now convicted - Charles Taylor - is trying to get some influence from his prison in Britain (Africa Confidential, 2017).

Macroeconomic risks

Liberia budget is highly dependent on exports, mainly iron, rubber, ore, timber and palm oil to obtain enough resources to import most of its food needs. It is an economy undiversified and based on concessions to foreign companies. This situation presents various risks. In the first place makes its economy very dependent on the world prices fluctuations. Besides, the high current account deficit makes Liberia dependent on the availability of donor's funds. Finally, it exacerbates the potential conflicts on land use and land rights and poses also an increasing concern on the competence over natural resources as these activities relies on the use of land and natural resource extractions (GOL, 2013). The risks are especially important in the forest sector, where the increase of timber exports can lead to deforestation threatening climate change. Liberia has nearly half of the remaining Upper Guinean forest (USAID, 2016).

Trade policy

Liberia has a liberal trade policy open to regional neighbors and with low tariffs with the rest to attract investments and ease imports of farm inputs. Additionally, there are numerous exemptions, waivers and tariff reductions but in many cases its obtaining depends of the negotiation skills and the influence of importer making the issue sensible to corruption. Rice imports are exempted of tariffs (USAID-EAT, 2015). This policy is consistent with the food security and growth national goals for which rice is a sensitive product. However, the upcoming adoption of ECOWAS Common External Tariff (CET) represents a risk of increasing price of imported rice. The current applied tariff rate of 0% can increase to 10.0% (NMCDP and GOL, 2103).

Otherwise trade imports require permits and controls, and, in many cases, there are too many agencies with too many controls hindering border trade. Long process affects specially to exports as they are one of the main revenue sources for the government (USAID-EATTA, 2015).

Price controls

The Liberian government has a fixed-price scheme for imported rice that is adjusted based on prevailing world market prices. Customs assesses a fee of US\$0.25 per bag of imported rice deposited to a rice price stabilization fund overseen by the Ministry of Finance. The Ministry of Commerce and Trade maintains a 2-month strategic reserve of about 700,000 bags of rice, which is held by the largest private sector rice importer, Sinkor Trade Company (USAID, 2016).

Besides the Central Agriculture Research Institute (CARI), former dependent from the Ministry of Agriculture (MoA) and since January 2016 an autonomous research institution, controls the rice sector as they are the sole importer of foundation seed rice into Liberia. Only CARI and other few entities are allowed to sell rice seed obtained from this rice foundation. It is unknown why this research institute plays this market role (USAID-EAT, 2015).

Financial inclusion

The low presence of commercial banks in rural areas constraints the financial inclusion of farmers by preventing the access and use of financial services. Some factors explain this low presence. Poor infrastructure, limited access to electricity and weak communication network increase the cost of maintenance in rural areas. The land issues including the registration process and the uncertainties about clear owners of the land hinder also the openness of rural branches (IMF, 2016). Insecurity on land rights constraints also its use as collateral and hinder the loan contracts.



Some factors limit also further expansion of mobile money penetration in rural areas (IMF, 2016):

1. The difficulties to adjust to the dual currency system use in Liberia—the US dollar as hard currency and the Liberian dollar as the local currency –has created financial hardship for many local agribusinesses and considerable troubles in rural communities. The problem arises from the fact that the revenues are often reflected in Liberian dollars but their liabilities in US dollars. This is exacerbated by the government charging in US dollars for many of its services, including licensing functions, public education and electricity. As a result, when the Liberian dollar weakens against the US dollar, these businesses are in trouble (USAID, 2015). Easy conversion between both currencies would be essential (IMF, 2016).
2. The mitigation of AML/CFT (Anti-Money Laundering/Combating the Financing of Terrorism) risks, deepened by mobile money, should require the development of quick customer identification (IMF, 2016).

Institutional risks

Deficiencies in human resources and capacities and limited financial resources impede the implementation of many policies and projects. More capacity for data collection and technical analysis is needed in the public sector (GOL, 2013). The absence of coordination and collaboration among different institutions should remove many obstacles to development. For example, the absence of coordination among the Ministry of Health, Ministry of Commerce and Industry and the Ministry of Agriculture with overlapping competencies in the trade of live plants and animals has hindered the elaboration of a food safety program preventing to apply international sanitary and phytosanitary standards to trade goods (USAID-EAT, 2015).

Various ministries, departments, and other bodies in Liberia all have diverse roles and responsibilities related to different issues of livestock, including marketing, food safety and biosecurity. Whereas the Ministry of Agriculture is responsible for most aspects of animal production and consumption issues, a number of Ministries have responsibilities and activities in the area of livestock-based food safety, livestock-mediated pollution and environmental degradation and capacity building (Agyemang, 2013). Implementation of Liberia Livestock Policy will therefore involve a wide range of partner institutions (public and private) operating at different levels (Agyemang, 2013) which represents an institutional risk due to the overlapping functions and lack of coordination. The key institutions identified to support implementation of livestock policy are:

- Ministry of Agriculture (MoA)
- Ministry of Commerce and Industry (MoCI)
- Ministry of Health and Social Welfare
- Ministry of Finance
- Ministry of Planning and Economic Affairs
- Ministry of Education
- Ministry of Information, Culture and Tourism
- Land Commission
- Water and Sewerage Corporation
- Forestry Development Authority (FDA)
- Environmental Protection Agency
- Private Sector (including Civil Society Organizations)
- Regional and International Communities

3. Mapping of existing agricultural risk management policies and tools

3.1. Policy environment for risk management in Liberia

3.1.1. The National Agricultural Policy

The Government of Liberia (GOL) has prepared three important agricultural policy documents since 2006: the Statement of Policy Intent for the Agricultural Sector of 2006, the 2008 National Food Security (NFSN) and the 2009 Food Agricultural Policy and Strategy (FAPS).

The Statement of 2006 was an interim measure including a short-term recovery plan which objective is the development of agriculture into a modernized and competitive sector. It recognized the importance of an effective land use planning and sustainable practices.

The NFSNS prioritizes the needs of the food insecure and nutritionally vulnerable and lays out actions Liberia must take to achieve that end. It calls for enabling factors as sufficient human capacity, improved knowledge on household food security and the need for community level actions.

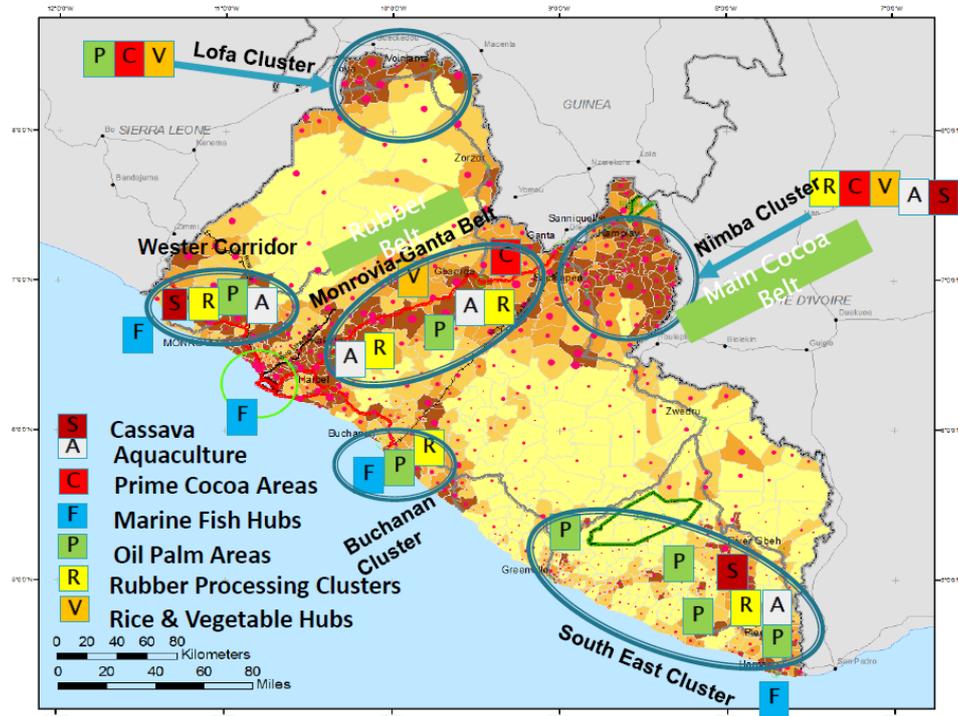
Finally, the FAPS is related to food insecurity, while identifies specific sector and subsector policies and strategies to revitalize agriculture, placing the accent on policies and strategies that will engage large number of smallholders in the sector (AfDB, 2013). The specific objectives are to improve food security enhancing competitiveness and market linkages.

In 2009 the GOL committed to the Africa-wide Comprehensive African Agriculture Development Programme (CAADP) aimed to promote economic growth in the region through agricultural development. In 2011, the GOL finalized the Liberia Agriculture Sector Investment Program (LASIP) to align national objectives with the CAADP. LASIP is a framework for the coordination of investments in the agricultural sectors, identifying priority areas consistent with the poverty reduction strategy. The investment plan includes four sub-components:

- Programme 1: Food and nutrition
- Programme 2: Competitive value chains and market linkages
- Programme 3: Institutional development
- Programme 4: Land and water management

Finally, in 2013 the GOL prepared the AFT, a long-term vision to achieve structural economic transformation, prosperity, and inclusive growth by 2030 and in 2016 the Liberian Agricultural Transformation Agenda (LATA) was launched. LATA is a new policy framework for developing agriculture and agribusiness. The strategy intends to concentrate investments across strategic value chains: rubber, palm oil, cocoa, fisheries, cassava and rice. The goal is to create more stable markets for farmers and for value addition investors.

Figure 20: Agro-clusters identified in Liberia.



Source: Liberia Agricultural Transformation Agenda. Presentation at the Liberia-UK Investment Forum by Dr. Moses M. Zinnah, Minister of Agriculture, November 22, 2016

The execution strategy includes several stages (Zinnah, 2016):

1. Know the customer: It considers the creation of e-registration platform of all farmers to create a data base. Currently there are 321,661 farmers enrolled distributed on 15 counties (<http://www.moa.gov.lr>).
2. Make access to finance easy: The goal is to connect farmers to input and service providers via mobile wallets. It has been initiated a cost-sharing mechanism for agro-inputs and credit guarantee, technical support, bank incentive mechanism and co-financing and grants to SMEs are included. The implementation of warehouse receipt mechanism is also considered.
3. Reform the policy environment. The objective is the creation of Liberia Agricultural Commodity Regulation Agency, the approval of Seeds, Fertilizers and Pesticides Act and the Land Rights Act, currently being debated at Legislature, and set up specific regulations and taxation regime per value chain.
4. Promote private sector investment. For that the purpose is to set up a special scheme for incentives and business development support for signature Investors at critical stages of value chain. Moreover, to allow duty free access for essential equipment, seeds and goods for agricultural development and promote targeted investments and development of export markets.
5. Doing business differently as a Government. It considers the redefinition of the Ministry of Agriculture as business enabler and not an implementer, providing clear strategic directions and targets. The strengthening of coordination and collaboration among institutions and of partnerships with relevant stakeholders is also considered besides the increase of information and transparency.

LATA is a three-year program focus on the diversification and the increase of investments on agriculture, agro-processing and manufacturing along the value chain. The goal is to attract investors to value added activities as bio-energy projects, post-harvest processing, cold storage facilities or aquaculture.

3.1.2. Other relevant agricultural policies

Besides national framework for agricultural policy a number of other policies are relevant for agricultural risk management, even though limited funding and capacities limit their implementation. Among them:

Land Rights Act: The problems related with land issues were the reason of the creation the Land Commission in 2009. The Land Rights Policy of the Land Commission was officially adopted by President in 2013, and sets out the principles upon the new Land Law have to be based. In July 2014, the Commission submitted the Liberian Land Right Act to the National Legislature for passage, but it is still stalled. In the meanwhile, disputes continue and unclear land tenure policies contribute to insecurity.

National Seed Policy and Regulatory Framework: The draft, completed in April 2012, integrates a proposed scheme for certifying seed. Seed certification involves assuring varietal identity and purity through generation control—that is, control of origin and class in the multiplication from breeder seed to basic seed—as well as inspection and labelling. In addition to seed certification, the draft policy addresses licensing and registration of individuals or organizations engaged in the production and sale of certified seed, albeit with insufficient detail. The draft seed policy contains two sections: (1) a statement of overall seed policy, including general policy recommendations; and (2) a summary of the overall regulatory framework, including general provisions; a summary of administrative bodies; delineation of seed production, quality, and control; the certification process; issues of marketing; disposal; and other various requirements. Currently, under LATA program there is a project to reform this policy and elaborate a Seeds, Fertilizers and Pesticides Act.

Liberia Livestock Policy (LLP): Within the LLP it is envisioned a Liberia that is self-sufficient in safe, locally produced livestock and livestock products, made possible through improved and hygienic production and processing methods. The mission of LLP is to achieve a public-private partnered sustainable livestock development sub-sector that creates incomes and employment opportunities for actors in the livestock value chains, and nutritional wellbeing of Liberians, while guaranteeing the safety of the general public from consumption and utilization of livestock products. The overall general policy objective is “to increase the availability of quality livestock and livestock products by promoting profitable and safe local production through enhancement of service delivery.

The Specific Objectives of LLP are: (1) To safeguard the safety and health of livestock products for the consumers. (2) To enhance the profitability of livestock farming and product processing for producers and processors. (3) To promote integrated production of livestock with other farming activities in order to increase farm level resource and labor use efficiency and improve production base, and (4) to enhance quality of public and private service delivery to producers, processors, marketers and other actors in the livestock value chains.

The main areas of action and their particular objectives within the LLP are: (1) To increase investments to develop ruminant, non-ruminant and non-conventional livestock sectors to meet demand for diverse livestock products by consumers. (2) To improve technical Services and Commodities. (3) To establish a credible public livestock research program and promote private sector research for the generation of appropriate technologies for production, processing and marketing of livestock and livestock products. (4) To recruit and maintain a caliber of extension agents with deep knowledge on livestock production, animal health and livestock production systems by delivering quality livestock extension services to producers. (5) To develop a livestock Information Management Systems and information delivery services (LIMSS). (6) To adequate marketing infrastructure and value addition facilities by improving and strengthening marketing of livestock and livestock products and to regulate import and export of animals, animal products and animal production inputs in accordance with the WTO Sanitary and Phyto-sanitary Agreements. (7) To improve animal safety and protection by promoting proper animal care (8) To improve livestock security and reduction of stock theft.

The LLP states that all objectives should be achieved having in consideration the main Cross-Sectorial Issues: (1) Environmental degradation prevention by promoting the use of environmentally friendly livestock technologies. (2) Accessibility and affordability of land and water resources for livestock producers by promoting sustainable livestock production. (3) Market-oriented smallholder livestock businesses and medium to large scale commercial livestock enterprises must have access to credit, and (4) Equal opportunity in accessing services and credit by both genders.



National Policy for Agricultural Extension and Advisory Services

The agricultural extension service was created in 1960 but during the Civil War the system completely collapsed. The objective of the policy approved in 2012, is to provide the legal and enabling framework for the transformation of the existing extension system into a pluralistic, decentralized, demand-driven, and market-oriented Agricultural Enterprise Areas (AEAS) system that is responsive to cross-cutting issues such as gender, nutrition, HIV/AIDS, natural resource management, and climate change, and to provide guidance to AEAS stakeholders. There are five primary areas of policy intervention: (1) system characteristics, (2) client stakeholders and geographic coverage, (3) content, approach, and methods, (4) actor roles and responsibilities and (5) coordination.

Policy for Climate Change Adaptation

As with other countries in the region, climate change policy is fairly recent, with the establishment of the governing structures around the last decade. The Environmental Protection Agency (EPA), the National Energy Policy (NEP) and the Environmental Protection and Management Law (EPML) Act were established in 2002. The first action directly related to climate change was the National Adaptation Programme of Action (NAPA), which was launched in 2008 (EPA, 2008). Later, in 2010, the President of Liberia launched the National Climate Change Steering Committee (NCCSC) and the National Climate Change Secretariat (NCCS). In 2012, Liberia presented its first National Communication and in 2014, Liberia began the development of its climate change policy.

Liberia National Plant Protection Policy (pending ratification, USAID, 2015)

Finalized and presented **National fisheries and Aquaculture Policy** to the Government of Liberia as the preparation of Fisheries Act and revised Fisheries Regulations is ongoing (MOA, 2015).

3.1.3. Social Protection Policy

Food security remains high and was severely eroded by Ebola Virus Disease (EVD). In rural communities is often linked to low productivity and production levels. The social protection is a key aspect of the Liberia government Development Agenda included in the Human Development pillar of the Agenda for Transformation (Aft). In accordance with this, in 2013, the National Social Protection Policy and Strategy (2012-2017) was approved. The objective of the policy is to build a social protection system which improves food security, capable of responding income shocks. The social safety net programs implemented in Liberia provides experience and foundations to the realization of this policy. The first social cash transfer program (SCT) was developed in Liberia in 2009 with the support of UNICEF, European Union and Japan. Its objective was to reduce vulnerability among extremely poor providing cash transfer. It was firstly implemented in Bomi County and expanded to Maryland County in 2012. The last payments were made at the end of 2014 and evaluation of the project showed significant improvements in food security (UNICEF, 2015) but the Ebola Virus Disease (EVD) outbreak hit harshly both counties.

As a consequence, the World Bank provided additional funds for the Social Cash Transfer in Response to EVD (SCT-REPLI) scheduled to close at the end of 2016. In addition to this program several donors introduced short-term cash transfer programs to cope with the crisis. Currently some social safety net programs have been launched. Among them, the Social Safety Net Cash Transfer and Resilience Strengthening Programme implemented by the United Nations Development Programme (UNDP) and the Government of Liberia through the Ministry of Gender, Children and Social Protection launched in 2015 in two initial counties, Bong and Lofa. Significant also is the Liberia Social Safety Net Project (LSSNP) approved in 2016 by World Bank with the objective of providing income support to extremely poor households in the four most insecure counties: Bomi, Maryland, Grand Cru and River Gee.



3.2. The institutional framework

3.2.1. The Ministry of Agriculture (MOA)

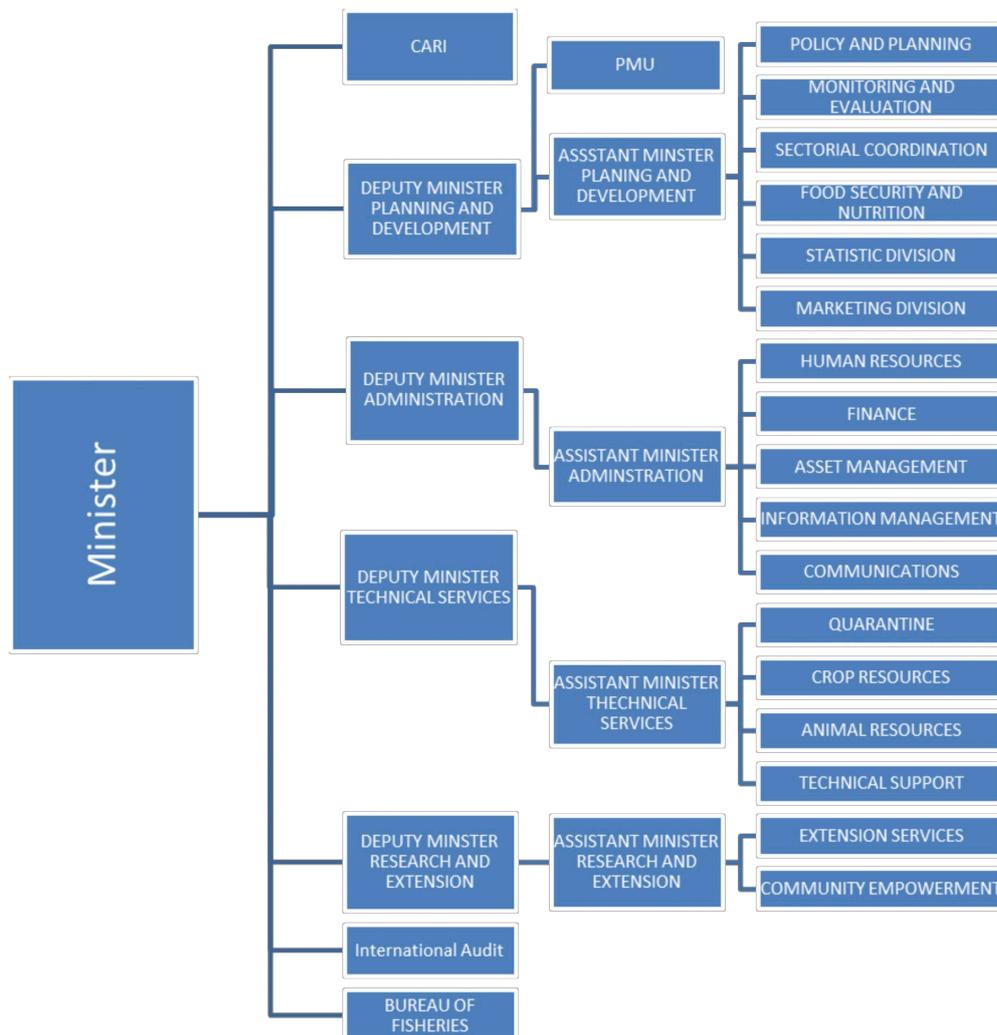
The Ministry of Agriculture (MoA) of the Republic of Liberia is mandated to formulate policies and strategies to guide the growth and development of the Agriculture Sector.

The main functions of MoA are:

- Provides oversight for policy formulation implementation and monitoring.
- Coordinates planning, delivery of services and support to agents and beneficiaries, and monitor sector activities.
- Advises Government on laws and guidelines to regulate the activities of the sector.
- Liaises with the EPA, FDA and others to ensure appropriateness of agricultural activities and practices for environmental protection.
- Regularly assesses consistency of the policies and strategies of other sectors with the FAPS and analyze the impact of such policies on the agriculture sector.
- Promotes and facilitates public-private and private-private sectors dialogue and partnerships.
- Facilitates the development, dissemination and promotion of research, technology and information.
- Promotes the establishment of formal planning linkages between the agriculture sector and other sectors (especially, health, tourism, commerce, communication, education) in order to ensure a more integrated and coordinated approach to policy and program development aimed at reducing poverty.
- Provides phyto-sanitary and zoo-sanitary inspection services for exports and imports of agricultural commodities including crops, fisheries and livestock.



Figure 21: Organization Chart of MOA.



3.2.2. Agricultural Extension System

As shown in Table 15 the extension system in Liberia includes extension services and programs delivered by public and private sectors. The public sector is delivered by the ministry of agriculture, Central Agricultural Research Institute and the University of Liberia. While the private sector is delivered by the NGOs, Cooperatives and private agricultural Universities. (2016.USAID-Programme Management Unit (FTF-ITT)).

Government extension services are housed in the Department of Regional Development, Research, and Extension (DRDRE) at the Ministry of Agriculture which has the core function of providing farmers agricultural extension services to promote improved productivity and income. The DRDRE has a decentralized structure, with agricultural offices in all 15 counties and is currently establishing sub-offices at district levels. (Peterson, 2016).

**Table 15:** List of Extension Providers for Liberia.

Name of extension organization	Type of organization
Ministry of Agriculture	Public
Ministry of Agriculture - Regional Development and Extension Divisions	Public
University of Liberia College of Agricultural and Extension	University
National Women's Commission of Liberia	NGO
Center for Environmental Education and Protection of Liberia	NGO
Acres of Hope Liberia	NGO
Africare Liberia	NGO
Focus Liberia	NGO
AAH - Action Against Hunger	NGO
ACDI / VOCA - Agricultural Cooperative Development International	NGO
AVSF - Agronomes et V	NGO
WPCDC - West Point Community Development Cooperative	NGO

Source: (USAID, 2016)

3.2.3. Ministry of Commerce and Industry (MoCI)

The Functions of the Ministry includes the promotion, development, regulation; control, operation and expansion of commercial, industrial enterprises and activities in the Republic. The Ministry of Commerce and Industry exercises broad powers with respect to protection of the public interest and the achievement of national goals through the establishment and enforcement of standards for commodities and for trade.

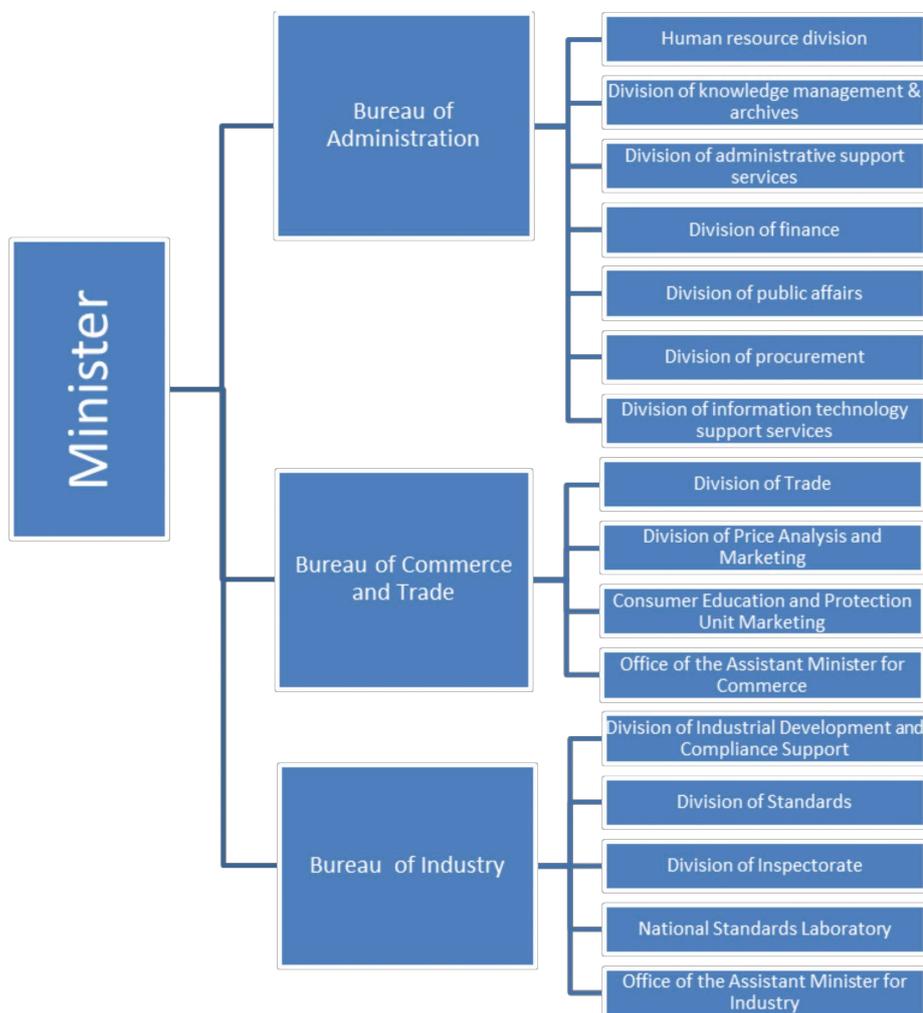
The Ministry is organized into three Bureaus (Administration, Commerce and Trade, and Industry) and in many subdivisions. See Figure 22.

Primarily the functions of this Ministry can be summarized as:

- Establish and regulate commodity and trade standards;
- Collect, evaluate, and publish data pertaining to commerce, and industry;
- Establish and enforce standards of business practice;
- Promote sound and development of foreign and domestic commerce;
- Develop plans for the movements of goods and people within and without the Republic.



Figure 22: Organization Chart of MoCI. Bureau of Industry.



The National Standards Laboratory (NSL) is a major component of Liberia's national quality infrastructure. The NSL mission is to provide quality services in the areas of product testing and calibration for the purpose of improving the sanitary and phytosanitary (SPS) system of Liberia, meeting food and basic commodities quality and control and facilitating trade. The purpose of this is to curtail, if not prevent the importation of sub-standard products that may threaten consumer, plant and animal health while at the same time assuring food and agricultural exports from Liberia meet international standards.

The NSL is comprised of three labs:

- Microbiology Lab conducts testing to detect spoilage and disease causing microorganisms in food, water and non-food materials including drugs.
- Chemical Lab conducts testing for quality and safety of food, water and non-food material.
- Metrology Lab provides testing and calibration of devices used for weights, volume, dimension, temperature according to international standards.

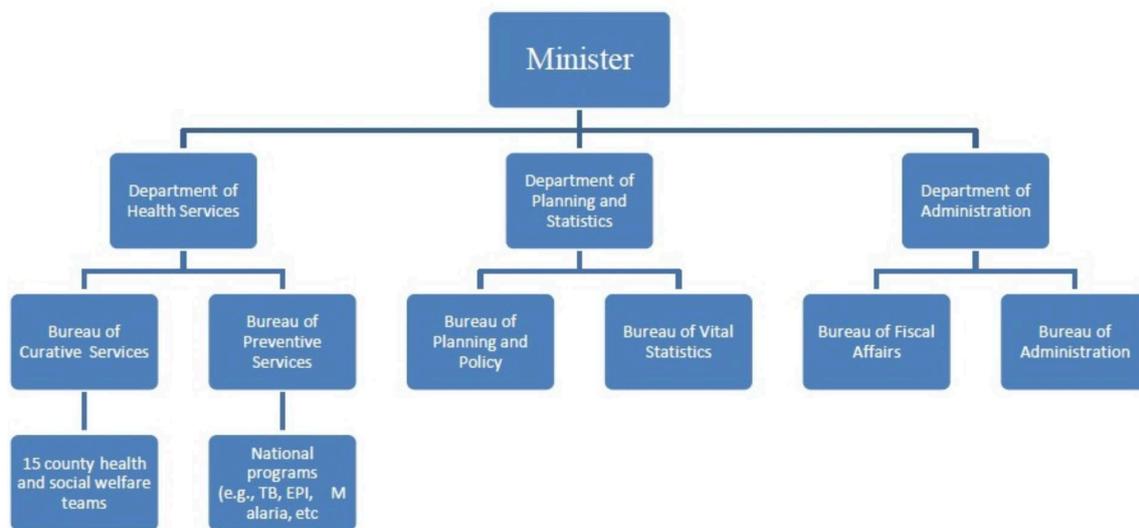
Since its inception in 2011, the National Standards Lab has made significant progress towards establishing a reliable standards framework to facilitate trade and enforce the criteria of the International Organization for Standardization for the quality control of food and basic commodities in Liberia.

3.2.4. Ministry of Health and Social Welfare (MOH)

The Minister of Health, who chairs the Health Sector Coordination Committee (HSCC), governs the health sector. The HSCC is comprised of the major actors and stakeholders in the sector. Its membership consists of UN agencies (WHO, UNFPA, UNICEF, etc), donors (EU, USAID, Irish Aid, DFID, etc), NGOs (MERLIN, Africare, African Humanitarian Action (AHA), EQUIP, Save the Children, IRC, MDM, etc), Civil Society Organizations and relevant line ministries (Ministries of Finance and Development Planning, Public Work, etc).

The Ministry is decentralized at the district and county levels where policies and plans are implemented, while the national level is responsible for policy and strategic plans formulation and resource mobilization. Below is the structure of the MoH.

Figure 23: Organization Chart of MoH.



The Ministry developed a 10-year National Health Policy and Plan (2011-2021) with a mission to reform and manage the sector, to effectively and efficiently deliver comprehensive, quality health services that are equitable, accessible and sustainable for all people in Liberia. The ten-year plan adapts the WHO health systems framework and includes seven health system building blocks: governance and leadership, health financing, human resources, information systems, management and organization, medical products and technology, and infrastructure network.

3.2.5. Environmental Protection Agency (EPA)

The EPA is the regulatory Institution of the Government of Liberia for the sustainable management of the environment and its natural resources.

The National Environment Policy Council referred to as 'Policy Council' is the ultimate and highest decision - making body including policy formulation and direction of the Agency on issue of the environment. The Field Agents of the Agency are the Environmental Inspectors.

There are many Technical committees such as A technical Committee on Lands and Mines; A Technical Committee on Pollution; A Technical Committee on Health and Sanitation; A Technical Committee on Environmental Impact Assessment; A Technical Committee on Biotechnology; A Technical Committee on Forestry/Agriculture/Wildlife; and A Technical Committee on Marine and Coastal Ecosystem.



3.2.6. The National Climate Change Secretariat (NCCS)

The National Climate Change Secretariat (NCCS) is the operational arm of the National Climate Change Steering Committee (NCCSC). For the past several years, the NCCS and NCCSC were not operative due to lack of funding to support staff and operations. This situation changed in 2014 through the National Adaptation Plan for Action framework under the UNFCCC platform. Under that, the need to re-activate the NCCS and NCCSC was stressed and catalytic funding from the GEF/LDCF/UNDP projects was allotted to jumpstart the NCCS. The NCCS was re-activated in September 2014 and operational since October 2014; and is currently housed at the EPA.

Under a new proposed structure, the Office of the President or Office of the Vice President would be the Chairman, with the MFDP and the EPA as Co-Chairmen. Members of the NCCS would include MoA, MGCSP, FDA, MLME, National Investment Commission, LMA, MIA, World Bank, UNDP, Association of Liberian Universities, Ministry of Foreign Affairs, and Civil Society Organization.

3.2.7. National Bureau of Concessions

The National Bureau of Concessions was established by an Act of the National Legislature effective September 23, 2011 to implement this strategic economic policy and to provide the governance framework necessary for coordinating the post concession award process including monitoring, evaluating and reporting as a basis for enforcing (in cooperation with relevant Ministries) concessionaires' and Government of Liberia's compliance with the obligations contained in the Agreements.

3.2.8. The Liberian Hydrological Service (LHS)

The Liberian Hydrological Service (LHS) is a Liberian public institution established by Executive Law in 1972. It was mandated to assess, evaluate, monitor and protect the Nation's water resources. It is a functional bureau under the Department of Mineral Exploration and Environmental Research (DMER) of Ministry of Lands, Mines and Energy. LHS supports the Water, Sanitation and Hygiene Sector in Liberia to ensure the monitoring of the quality.

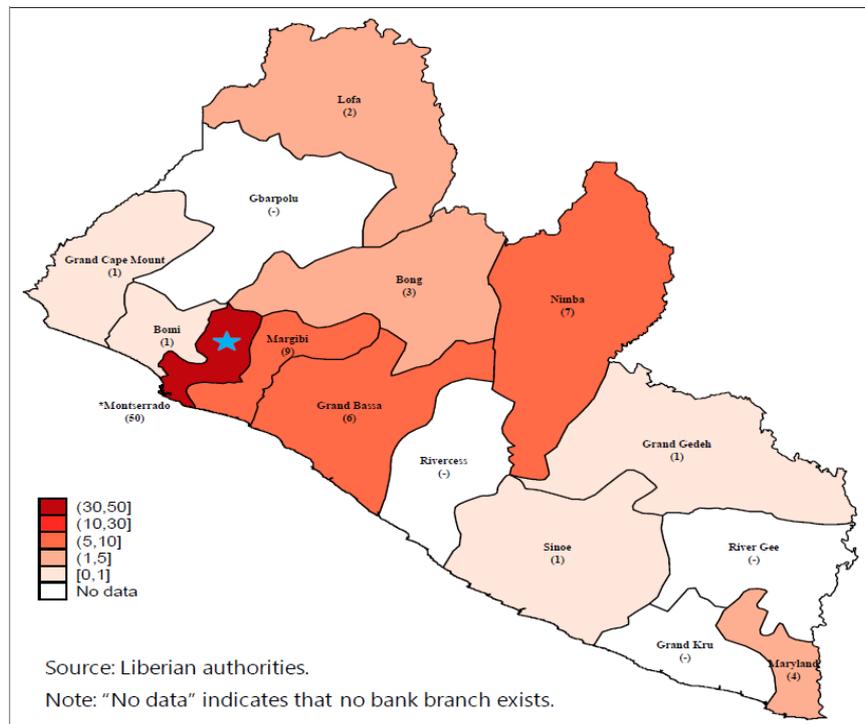
The bureau serves as the national consulting agency on groundwater for potable water supply to the populace. The conduct of hydrogeological investigations, river flow measurements, water resources quality monitoring and hydro meteorological (rainfall) recording are the cardinal functions of LHS.

There are five operational sections in the Bureau: Surface Water, Groundwater, Water Quality, Hydrometeorology and Maintenance.

3.2.9. Financial institutions

The financial sector in Liberia (see Figure 24) includes nine commercial banks, one development finance company, one microfinance deposit-taking institution, 20 insurance companies, 20 microfinance institutions, nine licensed rural community financial institutions, 400 credit unions and 1450 village saving and loan associations (IMF, 2016). Commercial banks serve mainly in Monrovia where 60% of the commercial branches are located. The presence of the commercial banks in rural areas is very limited and, in some counties, inexistent. In rural areas non-bank financial institutions as credit union and village saving and loan associations, (composed of 20/30 member usually women that provide short term loans), have grown significantly (IMF, 2016). In the last years the use of mobile money services has also increased in parallel with the growth of mobile phones, covering all counties. The access to mobile money eases that people living in remote rural areas can access to basic financial services. Liberia the mobile money penetration is advanced compared with neighbor countries but lower than the South Sahara countries average (IMF, 2016).

Figure 24: Distribution of commercial bank branches in Liberia.



Source: IMF, 2016

3.2.10. Other institutions

Ministry of Finance: in collaboration of the Ministry of Agriculture and the support of the Central Bank of Liberia, coordinates the mobilization of external resources in support of the agriculture sector.

Ministry of Public Works: fosters improvement in roads infrastructure, particularly feeder roads linking producers to markets.

Forestry Development Authority (FDA): supports efforts to ensure sustainable land management and forest resources development.

Ministry of Internal Affairs (MIA): ensures that local governance structures and processes including decentralization are effective, supportive, and enabling of rural transformation and agricultural sector growth and development. The MIA through the National Disaster Relief Commission (NDRC) has formally reactivated County Disaster Management Committees in each County.

Ministry of Lands, Mines and Energy (MLME): This Ministry has the statutory responsibility for the development of mineral, water and energy resources of the country and the administration of its lands; is in charge of land surveys in all parts of the country; coordinates the activities of miners of gold and diamonds, including granting of operation licenses; regulates beach sand mining and works along with the Ministry of Agriculture and the University of Liberia to conduct training research on land rehabilitation.

Central Agricultural Research Institute (CARI): There is a Master Plan 2015-2025 for CARI it was developed, validated and adopted. The new mission is to contribute to increased productivity, commercialization and competitiveness of the agricultural sector through adaptive research and promotion of knowledge, information and technologies.



The Bureau of National Fisheries (BNF): It was created by Legislation in 1957 under the National Resources Law within the Ministry of Agriculture (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 in running its day to day affairs. In 2010 the BNF through the MOA finalized the new Fisheries Regulations to ensure that the sector is well managed and regulated.

Central Bank of Liberia: facilitates availability of financial services in support of agriculture sector programs.

Liberia National Investment Commission (LNIC): promotes, attracts, facilitates, and retains quality investments.

Land Commission: The Commission is to propose, advocate and coordinate reforms of land policy, laws and programs in Liberia. It does not have adjudicatory or implementation role.

Table 16: Summary roles-services vs Institutions-Agencies.

Roles and mandates	Responsible institutions and agencies
Formulation of policies and legislation. Implementation and enforcement	
Public health	MOH
Food safety	MOH, MOA, MOCI, MCC
Animal health	MOA- Animal Resources and Quarantine
Plant health	MOA-Quarantine
Environment and Forestry	EPA, FDA
Invasive alien species	EPA, MOA-Quarantine, FDA
Fisheries	BNF
Trade	MOCI
Land tenure	Land Commission
Services (Regulatory, research, diagnostic and certification)	
Quarantine	MOA-Quarantine
Risk Analysis	MOH, MOA-Quarantine and Animal Resources, EPA
Diagnostic services	MOCI Standards lab, MOH (water quality), MOA-Animal resources, other labs in planning stages
Research and scientific advise	CARI, University of Liberia
Early warning on food-borne disease outbreaks	MOH
Monitoring and surveillance	MOH, MOA- Animal Resources and Quarantine, FDA, MOCI
Advocacy and trade	MOCI, MIA, Customs
Inspections and Certification	MOH, MOCI, MOA- Animal Resources and Quarantine, MCC, BNF, FDA
Land tenure	National Bureau of Concessions

3.3. Risk management initiatives

3.3.1. Information systems

Table 17: Information and early warning systems.

Information System	Data/Information provided	Timeliness and Accessibility
FAO-Stat	Production data	Annual. Data on line
FEWSNET	Early Warning on food Security and livelihoods	Timely monthly updates, food security outlook with six-month lead period
World Food Programme (WFP-VAM)	Prices of Cassava, Rice, Cocoa, Palm oil and Cowpeas for various local markets in Liberia	Monthly. Data online
Global information and Early Warning System (GIEWS-FAO)	Prices of Cassava, Rice, Cocoa and Palm oil for three local markets in Liberia (Buchanan, Monrovia and Saclepea)	Monthly Data online
Earth Observation GIEWS-FAO	Precipitation, Vegetation index	Precipitation data Monthly Decadal Index veg Data online
Plantwise by CABI	Plant health information, including diagnostic resources and best-practice pest management advice	Data online. 10,000 factsheets
The African Postharvest Losses Information System (APHLIS),	Postharvest loss estimates (PHLs) for the cereal crops of Sub-Saharan Africa, for individual countries.	Annual. Data on line
Health Management Information System (HMIS)	Early Warning on Health Management	Weekly reports on internet
Liberia Institute of Statistics and Geo-Information Services (LISGIS)	Agricultural survey, Labour Force Survey, Maps.	Reports not updated
Ministry of Agriculture (MOA)	Policies and programs documents	Website incomplete (no statistics data)
Ministry of Commerce and Industry (MOCI)	Annual reports, Trade reports. Policies and Strategies documents	Annual since 2008 to 2013.

The information is key to risk analysis and decision making. In the case of Liberia, the national information systems are very poorly developed. There is a huge deficit of historical data. This situation makes international systems the main source of information but not always are reliable as themselves recognize.

In an effort to improve baseline data collection, the MOA in partnership with the Global Agriculture and Food Security Program (GAFSP), Cellulant Mobile, and the African Development Bank (AfDB) have launched a farmer e-registration program as part of the Liberia Agriculture Transformation Agenda (LATA) (MOA, 2016). Launched in January of 2016, the program has registered 184,722 as of mid-September 2016 (LATA, 2016). The baseline data collected will help the MOA and other extension organizations prioritize highly vulnerable agricultural communities and serve as a platform for new eWallet based input distribution reforms (MoA, 2016).

FlexiCadastre

The National Bureau of Concessions (NBC) in collaboration with the USAID- GEMS has launched a New Concession Monitoring and Reporting tools. For the first time in the country's concessions management has been developed an automated concession monitoring and evaluation software (CIMS) tool that includes maps of concession areas by category, list and contact information of Concessionaires. FlexiCadastre is a workflow-centric database that uses Esri mapping technology to properly manage land titles. CIMS have a map to show the exact boundaries of concessions, to detect and avoid "overlaps". The full map is available on the Liberia National Concessions Portal (<http://portals.flexicadastre.com/liberia/>).



3.3.2. Overview of initiatives in the Liberian agriculture

Table 18: Programs and Projects, Initiatives for Liberia.

Programs and Projects	Funding and Period	Objectives	Components	Results
Enabling Agricultural Trade (EAT) Project	USAID 2014-2019	Creating enabling environment for agribusiness that encourages private sector investment and promote food security	<ol style="list-style-type: none"> 1. Analysis of constraint. 2. Technical assistance. 3. Thought leadership. 	Help donors and policymakers to identify the regulatory burdens faced by agribusiness and act on them through recommendations that improve the efficiency of the agricultural sector.
Food and Enterprise Development Program (FED)	USAID 2013-2017	Increase production, marketing and nutritional use of rice, cassava and vegetables in Bong, Lofa, Nimba, Gran Bassa, Margibi and Montserrat	<ol style="list-style-type: none"> 1. Increase agricultural productivity. 2. Launch a Market Development Fund. 3. Develop skills of the agriculture workforce. 	Training 14.000 farmers in more than 2.600 has 1200 young people and 165 women engaged in the project 425.000 \$ generated in private investments (rice seed, goat and vegetables seedling).
Food for Peace (FFP) Program	USAID 2014-2017	Provide food assistance to the Ebola affected region since the beginning of outbreak in 2014	<ol style="list-style-type: none"> 1. Provide in-kind food to improve nutrition. 2. Cash transfers. 3. Identification of food insecure locations. 	Providing much needed food assistance to individuals households and communities directly affected by the Ebola. The assistance provided will be boosting food access, purchasing power and market recovery.
Health, Agriculture and Food Security Program (HANDS)	OICI 2016-2020	Eliminate current food gap and nutritional deficit in two most food insecure places: Grand Gedeh and River Ghee	<ol style="list-style-type: none"> 1. Developing fortified cassava blended cereals. 2. Build and rehabilitate community infrastruct. 3. Promote feeding and health care education. 4. School feeding. 	Increase food availability and food access, improve food utilization and expand opportunities for education. Ensuring good health, productive agriculture and good nutritional habits for Liberian population.
Millennium Challenge Corporation Liberia Program (MCCLP)	MCC \$ 15 million 2010-2015	Improving land rights and access, increasing girls primary education and improving trade policy and practices	<ol style="list-style-type: none"> 1. Strengthening land rights and access. 2. Improve girls access to primary education. 3. Improve trade freedom and policies. 	Develop a reform for land policy and low to increase clarity of land property rights. Provide scholarship to 2.350 girls year in Bong, Grand Bassa, Lofa Implement tariff harmonization and best custom practices.
Modernizing Extension and Advisory Services Project (MEAS)	USAID 2011-2015	Introducing changes in extension services to effectively serve the food security and economic development needs of resource-poor farmers.	<ol style="list-style-type: none"> 1. Disseminating best modern approaches to extension. 2. Learning through success stories. 3. Analysis, design and reform of extension and advisory services. 	Identifying the key issues within the pluralistic extension system in Liberia that will need to be addressed in order to develop a sustainable farmer-led and market driven system of rural extension and advisory services.
USDA Food for Progress (USFFP)	USDA	USFFP has two main objectives: to improve agricultural productivity and to expand trade of agricultural products	<ol style="list-style-type: none"> 1. Modernize the agricultural sector. 2. Improve food access and availability and reduce hunger. 	Trained farmers in plant and animal health, improved farming practices, developed roads and utility systems, established cooperatives, provided micro credit and developed value chain.
Farmer to Farmer Program (F2F)	USAID	Increase the use of innovative farming methods, develop capacity of farmers organizations and improve the nutritional status of Liberians	<ol style="list-style-type: none"> 1 Support equitable growth of horticulture. 2. Increase incomes for livestock small farmers. 3. Innovative farming practices and build market opportunities by and youth. 	2850 individuals will directly benefit from technical assistance from 57 USA volunteers in Liberia.
Liberian Agricultural Upgrading, Nutrition and Child Health Program (LAUNCH)	USAID (40 million) 2011-2016	Reduce food insecurity among vulnerable rural population	<ol style="list-style-type: none"> 1. Increase availability and access to food. 2. Reducing chronic child malnutrition. 3. Increasing access to education. 	To date 30.015 MT of food commodities has been shipped to Liberia to support program objective through both direct distribution and Monetization.

(...)



(...) Programs and Projects	Funding and Period	Objectives	Components	Results
People, Rules and Organizations Supporting the Protection of Ecosystems and Resources (PROSPER)	USDAID (2.5 million) 2012-2017	Enhancing livelihoods through improved agriculture and sustainable harvest of non-timber forest products	<ol style="list-style-type: none"> 1. Improve capacity for natural resources management. 2. Improve community-based forest management. 3. Enhance livelihood from sustainable forest and agriculture systems. 	Household income of 330 farms improved through sustainable management of natural resources. Eight Enterprises for cassava and palm oil processing supported.
Agricultural Sector Rehabilitation Project (ASRP-AfDB)	AfDB 24 \$ million 2010-2016	Reduce poverty of the pro-poor by increasing farmers income and rural entrepreneurs and contribute food security	<ol style="list-style-type: none"> 1. Agriculture Infrastructure Rehabilitation and development 2. Agriculture production/ productivity Improvement 3. Project management 	Rehabilitation of water management infrastructures (barrages, canals) on 314 hectares for lowland in Grand Gedeh, River Gee, GarndKruand Maryland Counties, rehabilitation of feeder roads and development of Community Infrastructures.
ASRP II-IFAD	IFAD 13 \$ million 2016-2018	Piloting an Extension Service delivery model involving both farmer organizations and the MOA at field level	<ol style="list-style-type: none"> 1. Capacity building of Farmers Union Network. 2. Enhance delivery of Extension Services farmers in, Bomi, Grand Bassa, Montserrado and Grand Cape Mount. 	280 Lead farmers benefited from training in rice, cassava and vegetable production techniques. 100 Lead farmers trained in pre-cooperative formation.
Smallholder Tree Crop Revitalization Support Project (STCRSP-IFAD)	IFAD, GOL and Private Sector 24.9 \$ million (2012-2017)	Increasing the quantity sold and price received by smallholder farmers for cocoa and coffee	<ol style="list-style-type: none"> 1. Revitalization cocoa and coffee plantations. 2. Rehabilitation of farm to market roads. 3. Institutional capacity building. 	Seven cooperatives sold 265,891 MT of cocoa beans. Cocoa seedling from 189 village nurseries in 7 districts of Lofa. 83 km of farm to market roads in 7 districts of Lofa County. 2 community warehouses in Lofa.
Italia Supplementary Funding (IT/IFAD)	IT-67/IFAD 13.5 million	Fosters farmers and farmers organization for effective and good management of project and finances	<ol style="list-style-type: none"> 1. Enhance pro-poor smallholder farmers to access to finance. 2. Farmers consultation advocacy through the Farmers Union Network (FUN). 	13 Rural Community Finance Institutions supported.
Smallholder Tree Crop Revitalization Support Project (STCRSP World Bank)	World Bank-GOL and beneficiaries 23.1 \$ million 2012-2017	Increase access to finance, inputs, technologies and markets for smallholder tree crop farmers in Liberia	<ol style="list-style-type: none"> 1. Revitalization of tree crops smallholders. 2. Small-scale oil palm revitalization. 3. Rubber revitalization. 4. Institutional building. 	Provided technical to supporting rehabilitation on 1,800 ha cocoa and 184 coffee in Bong, Nimba and Grand Gedeh. Better management of 600 ha of palm oil in Konobo communities. 300 has rubber (150 farmers) for long term credit.
Agriculture Infrastructure Development Program (AIDP)	World Bank	Improve infrastructure for agricultural production and productivity	<ol style="list-style-type: none"> 1. Seed multiplication. 2. Development of productive agriculture infrastructure. 3. Strengthening the Agriculture value chain. 	10 MT of breeder seeds in Lofa. 71 ha of lowland fully developed in Gbarpolu, Bomi and Grand Kru. 8 Community Grain Reserve. 12 clusters with 80 farmer-based organization and 2,000 farmers.
West Africa Agriculture Productivity Program (WAAPP)	World Bank-Japan and GOL 2012-2016	Achieve self-sufficiency and export capacity for rice and cassava production	<ol style="list-style-type: none"> 1. Enabling conditions to regional cooperation and market integration. 2. Support of Research National Centers. 3. Funding for demand driven technology. 	ECOWAS regulation on Seeds, Fertilizers and Pesticides have been validated and implemented. Upgrading of CARI core facilities. Three Cassava nurseries. Multiplication of 500 MT of rice seeds (CARI) distributed to 35,000 farmer.
Climate Change Adaptation Agriculture Project (CCAAP)	GEF-UNDP 2012-2017	Implementing priority interventions for the agricultural sector identified in Liberia's National Adaptation Program for Action	<ol style="list-style-type: none"> 1. Reduce vulnerability 2. Increase resilience by enhancing the capacity for climate change adaptation. 3. Addressing the additional risks posed by climate change in the agriculture sector. 	The pilot phase is in Bong and Grand Gedeh Counties targeted to benefit 60 technical staff of the sector, 30 sector field staff, 100 university students. 200 farmers, NGO and policy makers

(...)



(...) Programs and Projects	Funding and Period	Objectives	Components	Results
Smallholder Agriculture Productivity Enhancement and Commercialization (SAPEC)	GAFSP-AfDB-GOL 2012-2017 GAFSP is a Multi-Donor Trust Fund hosted at the World Bank	To reduce rural poverty and household food insecurity in 12 of the 15 Counties	<ol style="list-style-type: none"> 1. Sustainable Crop Production Intensification. 2. Value addition and marketing of smallholders. 3. Capacity building and institutional strengthening. 4. Project management. 	915 ha of lowland for rice production rehabilitation. Registered 5,000 farming households in 12 Counties. Distributed 70 Kg of assorted vegetable seeds and 100 bags of potatoes vines to 500 farms. Rehabilitation of 12 markets, 3 technology centers and sites for 9 agribusiness centers.
Wienco Liberia	GAFSP-IFC 5 million 2014-2018 Component of IFC's Recovery Program Response to Ebola crisis	Provide financing to local private companies to reach smallholder farmers and increase agriculture productivity	<ol style="list-style-type: none"> 1. Access to input through import and distribution of quality fertilizers and agrochemical for cocoa. 2. Storage facilities and construction warehouses. 	Expected reach of up to 7,500 farmers and can expect a significant total increase of 200 % in their cocoa yields from 750 kg per hectare without the use of inputs to 2,250 kg per hectare.
Rubber renovation	GAFSP-IFC 25 \$ million 2014-2018 Component of IFC's Recovery Program Response to Ebola crisis	Finance rubber farmers as they emerge from the Ebola crisis Firestone Company is a sponsor in this program	<ol style="list-style-type: none"> 1. Provide support to independent out grower farmers with technical support, guidance and new planting material as well as secure off-take agreement. 	Finance up to 600 farms enabling farmers to renovate up to 8,000 hectares of aging trees and to secure their livelihoods for the future.
The Rural Energy Strategy and Master Plan (RESMP)	AfDB, World Bank and EU USD 185M 2016-2030	funding and implementation, with appropriate institutional framework and capacity to increase energy access and renewable energies to the country's rural areas and population	<ol style="list-style-type: none"> 1. Growing the Grid Program. 2. Decentralized Grids Program. 3. Beyond the Grid Program. 4. Building capacity. 	Electrification rate for the population outside of Monrovia of 35% in 2030. More than 75% of all electricity generated from renewable by 2030 with 19% coming from other than large hydro: Mini-hydro, Solar and Biomass.
West Africa Regional Fisheries Program in Liberia - ACGF PROJECT	Africa Catalytic Growth Fund (ACGF) 2011-2017	Rehabilitation and reclamation in Mesurado Pier for fish landing	<ol style="list-style-type: none"> 1. Construction of a jetty for industrial fishing vessels. 2. Product storage and transport facilities. 	Complete key construction works at Mesurado Pier and Roberts port landing sites.
Regional Disease Surveillance Systems Enhancement project (REDISSE, 2016).	US \$ 230M from IDA and US \$ 12, 32M from a multi donor trust fund (MTDF)	To improve the preparedness of the West African region to handle future epidemics and minimize the impact of disease outbreaks	<ol style="list-style-type: none"> 1. Surveillance of information systems. 2. Strengthening laboratory capacity. 3. Preparedness and emergency response. 4. Human resource management for effective disease surveillance and epidemic preparedness. 5. Institutional capacity building. 	
Integrated Pest Management Plan (IPMP) for the Liberian REDISSE project	REDISSE US \$ 30M (2016-2017)	To support of relevant safeguard consultants to apply the IPMP and build capacity in the PCU and key health care implementation institutions	<ol style="list-style-type: none"> 1. Pest and diseases control using sound ecological principles, according to international legislation. 2. To control the effect of hazards and residues that affect to public health, food security and safety. 	No information available.

Source: Authors elaboration

3.3.3. Initiatives related to input risk

The limited use of modern inputs as fertilizers and low quality of seeds constrains agricultural development. Many initiatives can address these issues:

Smallholder Agricultural Productivity Enhancement and Commercialization Project (SAPEC): It is a project that was established as a pillar of LASIP, funded by the GAFSP, the African Development Fund (ADF) and the Government of Liberia (GoL). The objective is to improve the productivity, income and nutritional outcomes of farmers located in 12 counties, with a special focus on youth and women. To enhance the sustainable crop intensification the program distributes subsidized materials, including 50 kg of improved rice or cassava seeds and harvesting tools. The program uses also the created e-platform to recruit participants under 35 years old.

Agricultural sector Rehabilitation Project (ASRP): The goal of the project, funded by African development Bank (AfDB) and IFAD is to restore capital lost by rural households during the Civil War by rehabilitating agriculture infrastructure and rebuilding farmers' productive capacity. The program has three components and the second is the improvement the productivity and agricultural practices. In 2015, 1,629 lowland rice farmers were trained and provided with improved seeds, allowing a significant increase of yields.

West Africa Agriculture Productivity Program (WAAPP): The Programme was officially launched in 2012. The Project is funded by World Bank, Japan and Government of Liberia. The goal and objective of the project are to: (1) achieve self-sufficiency and export capacity for rice and cassava production whilst improving productivity in rice and cassava along their respective value chains and (2) Improving the productivity of rice and cassava along their value chain in order to enhance Liberia's food self-sufficiency and regional competitiveness. The project is implemented in eight (8) counties (Bong, Margibi, Bomi, Gbarpolu, Grand Gedeh, River Gee, Maryland and Sinoe). It has an implementation period of five years, July 2012- June 2016.

With respect to regional collaboration and technology adoption, 451.6 metric tons of certified rice seed were brought into the country from Guinea and Burkina Faso; 40 metric tons of foundation rice seed from Togo; 79 Metric tons of Maize seed from Mali and 100 metric tons of Cowpea seed from Niger as a sign of implementation of the ECOWAS regulations on Seeds, Fertilizer and Pesticides. (MOA, 2015).

Seed Programs International (SPI). Seed for Liberia: SPI is an NGO aimed to provide quality seed and critical seed experience. In Liberia they work with youth-led Agro-Enterprise Service Centers (AESCs) in Lofa, Bong and Margibi counties. They provide packets of vegetable seeds, non-GMO and most are open-pollinated seeds. In addition, they have distributed seeds and provided technical assistance and training on improved agricultural practices and farming as a business to more than 6,000 farmers.

USAID West Africa Fertilizer Program (USAID WAFP): It is a five-year program implemented by the International Fertilizer Development Center (IFDC) across the Economic Community of West African States (ECOWAS) region. Country-specific interventions will target focus countries of Ghana, Liberia, Mali and Senegal. In these countries, specific value chain interventions are implemented including: improvement of site- and crop-specific fertilizer recommendations; soil testing and mapping; fertilizer trial demonstrations; and capacity strengthening of agro-dealers. The Program tries to move smallholder farmers from subsistence to commercial agriculture – farming as a business. This will require adequate supplies of affordable fertilizers and seeds for farmers, as well as access to credit, storage facilities and technical advice.

Rural Community Finance Project: funded by IFAD with the aim to create sustainable access to rural financial services. The project is based on the support of the Rural Community Finance Institution (RCFI), a simplified version of the rural/community banks and financial service associations. The purpose of the RCFI is to establish a locally accessible, locally owned and operated financial institution. The RCFIs capitalize on informal local rules, customs, relationships, trust and local knowledge, while also introducing solid banking concepts and methods. People buy shares and save with the RCFI because it is owned and operated by local residents and their elected representatives within the community, and because they trust them. They reinforce the sense of ownership by belonging to the local community where they have their roots. Loans are financed mainly from equity and savings mobilized from shareholders.



3.3.4. Initiatives related to weather risk

According to the MOA annual 2015, the development of a Climate Risk Management Strategy for stakeholders in the agriculture sector with specific focus on women is 60% completed.

The **National Adaptation Programme of Action (NAPA)** (EPA, 2008) represents the first climate change initiative and the first set of systematic adaptation actions taken in Liberia with a focus on three areas: 1) Coastal defense, led by the MLME; 2) Integrated cropping/livestock farming (with a focus on a small number of counties) led by the MoA; and 3) Climate Information for Resilient Development/Early Warning System (CIRDev/EWS) Project, executed by the MoT.

The **CIRDev/EWS Project** has the objective to generate hydrometeorological data and improved networking for the measurement of climatic parameters. The project started in 2013 for 2 years at a cost of USD 3 million. The expected results are to increase the availability of hydrometeorological data, strengthened the national capability to forecast climatic events thereby reducing level of vulnerability to climate hazards and to strengthen the coordination among climate related institutions. (EPA, 2015).

There is a **Global Environmental Facility (GEF) project** "Strengthening Liberia's Capability to Provide Climate Information and Services to Enhance Climate Resilient Development and Adaptation to Climate Change" which will provide the equipment and coverage to generate the necessary climate data that can be used to support the NAP process. However, this will not be fully implemented until 2017. The project has been CEO Endorsed, with EPA and MoT as executing agencies and UNDP as GEF Agency (EPA, 2015).

LHS - NVE Cooperation Program

The Norwegian Government has since 2010 granted an institutional cooperation program between Ministry of Lands, Mines and Energy and the Norwegian Water and Energy Directorate. One of the most successful cooperation areas has been National Hydrometric Network & Database where LHS has been the Liberian responsible partner.

As the project started, the Liberian hydrometric network was non-operational and LHS for nearly 30 past years and did not collect any hydrological data. The program activities have changed this situation radically.

The Project re-established a minimum Liberian hydrometeorological network consisting of 10 hydrometric stations, several rain gauges and one automatic weather station. A provisional hydrometeorological database and data collection system is operational where users will have access to information and data through the LHS webpage.

The next phase from July 2016 to July 2020 will focus on:

- Improving the system for collecting data and data management
- Maintain the existing 10 hydrometric stations and provide all of them with automatic water level loggers
- Maintain the automatic weather station and the rain fall stations
- Expand the hydrometric network with 4 stations

3.3.5. Initiatives related to biological risk

Regional Disease Surveillance Systems Enhancement project (REDISSE, 2016).

It is well documented that the majority of the infectious diseases in humans have originated in animals (Zoonotic diseases), with more than 70% emerging from wildlife. Among these, the most catastrophic health and economic effects that the world has witnessed recently have been due to Ebola virus disease (EVD), Avian influenza (H7N9), Middle-East respiratory syndrome, Margburg virus, Nipah virus, bovine spongiform encephalopathy and HIV/AIDS.

The REDISSE project, dotted with US \$ 230M from IDA and US \$ 12, 32M from a multi donor trust fund (MTDF), has been planned to strengthen weak human health, animal health and disaster response systems to improve the preparedness of the West African region to handle future epidemics and minimize the impact of disease outbreaks.

REDISSE has 5 project components:

- **Component 1:** Surveillance of information systems (US \$ 50 from IDA and US \$ 12,32M from MDTF) to support national and regional surveillance of priority diseases and the timely reporting (early warning) of human public health and animal health emergencies and trends
- **Component 2:** Strengthening laboratory capacity (US \$ 58M from IDA) to establish a network of highly efficient public and private laboratories for diagnosis of infectious human and animal diseases including a Regional Reference laboratory in accordance to international quality assurance standards.
- **Component 3:** Preparedness and emergency response (US \$ 34M from IDA) to enhance national and regional infectious disease outbreak preparedness and response capacity
- **Component 4:** Human resource management for effective disease surveillance and epidemic preparedness (US \$ 47M from IDA) with special emphasis on involvement and training at the community level
- **Component 5:** Institutional capacity building (US \$ 41M) for project coordination, fiduciary management, monitoring and evaluation, data generation, and knowledge management, together with institutional support, capacity building, advocacy, and communication always under the “One Health” approach.

Integrated Pest Management Plan (IPMP) for the Liberian REDISSE project

The budget assigned for Liberia, within the REDISSE project is US \$ 30M, but there it is still not clear how this budget is assigned for financing the different activities defined in the project at national level. Particularly, it would be important to know the budget assignation to improving the surveillance systems involved in the monitoring of pests and diseases of animals.

The IPMP is defined as the practical manipulation of pests using sound ecological principles to keep them pest populations below a level causing economic injury. Special consideration is given to the anticipated increase in the use of chemicals and pesticides with potential negative impacts on the environment and human health. Therefore, within the scope of IPMP it is covered the national and international legislation on the use of chemicals for pest management and the institutional responsibility.

There is no information uploaded and available about animal health at the World Health Organization and the information given in this report has been obtained from the Draft Final Report published by the Ministry of Agriculture of the Government of Liberia (IPMP, 2016).

The pests and disease vectors for infectious diseases that constitute serious hazards to public health, food security and safety in Liberia are: Ebola virus disease, Malaria, River blindness, Lassa fever and Yellow fever. Additionally, ectoparasitic diseases caused by Ticks, Lice, Mites and Mange produce important economic losses and are a serious threat to both animals and humans.

However, it is recognized that, the lack of preparedness, insufficient resources, and the lack of cross-sector collaboration, to address promptly and efficiently, disease outbreak disaster scenarios such as Ebola and the resurgence of highly pathogenic avian influenza, characterize the Liberia context.

Therefore, the IPMP initiatives are focused on the assistance to the Government of Liberia with the support of relevant safeguard consultants to apply the IPMP and build capacity in the PCU and key health care implementation institutions within the first two years of the project (2016 – 2017).

Liberian Agriculture Sector Investment Program (LASIP, 2011 - 2015): An initiative for Livestock development and promotion has been identified within the Subprogram number 5 of the National Food Security and Nutrition Program of LASIP. However, no mention is given to biological risks and diseases for animals or humans, which could be associated with animal production.



3.3.6. Initiatives related to infrastructure

3.3.6.1. Rehabilitation of feeder roads

Three projects have some component to rehabilitate the farm-to-market roads: the Agriculture Sector Rehabilitation Project (ASRP), the Smallholder Tree Crop Revitalization Support Project (STCRSP), the Smallholder Agriculture Productivity Enhancement and Commercialization (SAPEC).

ASRP

The component 1 of ASRP is Agriculture Infrastructures Rehabilitation and Development focuses on the rehabilitation of water management infrastructures (barrages, canals) on an estimated 314 hectares for lowland in Grand Gedeh, River Gee, GarndKruand Maryland Counties, rehabilitation of feeder roads and development of Community Infrastructures (MOA local offices, processing facilities) across the project counties. The main challenges of this project were delay by contractors to execute work activities in line with plan and time; the Bank protocol in grating "No Objection" to project request causes undue delay to implement of project activities; and the preferences of upland rice farming by most farmers is a limitation of their participation in rehabilitation and development of lowland rice. Up to 2016, 136 ha of lowland were rehabilitated in Grand Gedeh, Grand Kru, River Gee and Maryland counties and 27 km of farm to market road were rehabilitated from Ziah town to Zwedru. Smallholder Tree Crops Revitalization Support Project (STCRSP).

The STCRSP specific objectives are increasing the quantity sold and price received by smallholder farmers for cocoa and coffee, improving access to markets through rural roads rehabilitation and maintenance systems development, and strengthening the MOA and/or private extension services as well s Farmer Based Organizations (FBO) in Lofa County. The component 2 of STCRSP is Rehabilitation of Farm-to-Market Roads. Up to 2016, 83 km of farm to market road in all 7 Districts of Lofa County were rehabilitated.

Smallholder Agriculture Productivity Enhancement and Commercialization Project (SAPEC)

The component 3 (Value Addition and Marketing) of SAPEC a project (\$ 46.5 million) over period of 5 years (2012-2017) funded by GAFSP, a multi donor Trust Fund of the World Bank, the ADF the Government of Liberia focuses on access to market by increasing feeder roads and storage facilities, modern marketplaces and processing equipment.

GAFSP financing in Liberia will support the implementation of sustainable medium and long-term investments in agriculture guided by the Liberia Agriculture Sector Investment Program (LASIP). By supporting LASIP, GAFSP funds enables Liberia to rebuild and maximize the agricultural sector's contribution to economic growth, employment and income generation, food and nutrition security and overall poverty reduction. The program increases the income of smallholder, particularly women and youth, through irrigation expansion, land husbandry improvements and market access.

270 km of farm to market roads were identified to be rehabilitated or constructed in Grand Gedeh, River Gee, Grand Kru, Maryland, Sinoe and River Cess counties.

3.3.6.2. Improving storage facilities and practices

Post-harvest losses due to the lack or deficient storage facilities and the use of non-appropriate practices to store farms production is another important risk. There is an initiative to set a complete information system on post-harvest losses in Africa that is the project APHLIS (Agricultural Post Harvest Losses Information System). APHLIS is a source of information on the postharvest losses (PHLs) of cereals in Sub-Saharan Africa in 2003-2015. It has special relevance to the current situation where agriculture is being challenged to produce ever more food for a rapidly growing world population in the face of limited physical resources and the negative impacts of



climate change. This is because reducing the losses that occur in the postharvest chain for cereals offers a resource efficient means of increasing food availability without further use of land, water and other agricultural inputs. Reliable PHL figures are essential for better targeting of loss reduction programs, monitoring the success of these programs and estimating food availability in countries threatened by food insecurity.

APHLIS integrates a network of local experts who supply data, a shared database and a Losses Calculator. Working together these generate estimates of the weight losses of cereal grains in Sub-Saharan Africa by country and by province. The estimates can be viewed as maps or as tables of loss values.

How does APHLIS estimate PHL?

The PHL profile - The figures, one for each link in the postharvest chain, derived from the scientific literature. PHL profiles are specific to crop type, climate type and to the type of farm (smallholder or larger scale farming). One problem faced in seeking to provide PHL profiles is, that for many provinces there are no specific PHL data. It is therefore inevitable that many different provinces have to share the same data. This was achieved by clustering together the provinces of many countries that are basically similar with respect to the factors that influence PHLs; the most convenient method of doing this is regrouping of provinces according to climate classification, namely by tropical savannah, hot semi-arid, humid subtropical and subtropical highlands. For each crop there is a PHL profile for each climate and farm type.

Seasonal data - Several 'seasonal' factors are taken into account in the loss calculation and these have a very significant bearing on the actual loss estimate. They are contributed by the APHLIS network members and include 1) whether or not there is damp weather at time of any of the harvests which would make drying difficult, 2) the proportion of grain that is marketed within the first three months, so will not enter farm storage for any significant time, 3) the length of the farm storage period, and 4) in the case of maize, whether or not LGB (*Prostephanustruncatus*) is expected to be a significant pest.

APHLIS is currently being updated and expanded under the APHLIS+ project with a grant from the Bill and Melinda Gates Foundation. The APHLIS+ project will run from 2015 - 2020 and will add the following functionality to APHLIS:

- Increase the crop varieties it covers
- Improve the accuracy of its estimation models
- Add estimates of value and nutritional losses
- Provide interactive tools to access the data and underlying models

There are some initiatives to improve storage facilities and training farmers to use more appropriate practices to storage farms production trying to reduce the risk of postharvest losses and food insecurity. These initiatives come from components of the AIDP, The ASRP II, SAPEC (GAFSP) project and Wienco (GAFSP-IFC) project.

Agriculture Infrastructure Development Program

The component 2 of this program is focused on development of productive agricultural infrastructure (lowland irrigation and storage facilities) in collaboration with WFP. Up to 2016 the main achievements in grain reserves facilities and equipments were the following:

- 8 Community Grain Reserve (CGR) equipped with rice mills and post-harvests parboiling tanks in Bomi, Gbarpolu and Grand Gedeh
- 1,424 women efficiently operate the mills and parboiling equipment
- 154.7 TM of paddy rice available in the 8 CGR



ASRP II

ASRP-II is an extension of ASRP I and its emphasis is on piloting an extension service delivery model involving both farmer organizations and the MOA at field level. GOL, through MFDP and MOA, finalized negotiation with IFAD for USD13m loan and USD4.5m grant for replication of the success stories of Lofa County in Nimba County. The project approved for 18 months (January 2016 – June 2017) ASRP adopted a three-pronged approach for the implementation of project activities in Bomi, Grand Cape Mount, Grand Bassa, and Montserrado Counties: (a) Capacity Building of farmer Union Network (FUN) to enhance delivery of Extension Services to farmers, (b) Capacity Building of County Agriculture Coordinator (CAC) to improve their effectiveness in outreach activities, and (c) Supervision, monitoring and evaluation of FUN activities

SAPEC (GAFSP)

In the project areas of SAPEC, at least 40% of crops are lost during postharvest activities. The component 2 “Improving access to market” of GAFSP is funding efforts to address this issue through increasing and rehabilitation of feeder roads and storage facilities.

Wienco (GAFSP-IFC)

The components of this project funded by IFC and private initiative is access to input through import and distribution of quality fertilizers and agrochemical for cocoa and storage facilities and warehouses.

3.3.6.3. Increasing energy access and renewable energies in rural areas

The Rural Energy Strategy and Master Plan for Liberia (RESMP) for the period 2016 until 2030 aims to set clear targets, to identify least-cost projects and technologies, to propose concrete investments for funding and implementation, with appropriate institutional framework and capacity to increase energy access and renewable energies to the country's rural areas and population – meaning all areas and population outside of greater Monrovia.

Five Programs for rural electrification of Liberia. The Master Plan identifies 92 projects and investments to electrify 265 000 homes and 1.34M people outside Monrovia until 2030. The action plan and rural energy projects are structured under 5 main programs. USD 746M still to be funded mostly for the period between 2020 and 2030. From the required USD 935M, around USD 140.8M are already committed and an additional USD 45M secured, representing a total of USD 185M – mostly from African Development Bank, World Bank and European Union. Most of the secured funding will be deployed in the first phase (2016-2020) representing a significant part of the estimated investment of USD 262M during that period. A gap of USD 749M remains to implement the Rural Energy Master Plan with additional USD 102M being required in the next years, USD 303M between 2020 and 2025 and the remaining until 2030.

3.3.7. Initiatives related to price and market risks

3.3.7.1. Warehouses

The component 3 (Institutional Capacity Building) of the STCRSP project, has rehabilitated or constructed up to 2016 two community warehouses in Lofa County.

The Wienco Liberia project (GAFSP-IFC) is a blended finance solution from IFC and GAFSP to provide long-term affordable financing to cocoa small farmers through Wienco Liberia Limited. The project will enable Wienco to support its capital expenditure program including the construction of warehouses in up-country Liberia

The Liberia Agricultural Transformation Agenda (LATA) is the new policy framework and vision for developing agriculture and agribusiness, directly supported by the President. It represents a decisive holistic move towards transforming Liberian agriculture into a strong economic pillar over the period 2016-2020.

The LATA will implement a warehouse receipt system but the proposal is still under review in December 2016.

3.3.7.2. Price setting mechanisms

An Act transforming the Liberia Produce Marketing Corporation (LPMC) to the Liberia Agriculture Commodity Regulatory Authority (LACRA) has been passed into law in September 2015 by the House of Representatives. This change represents a moving from a public purchases system and public fixed prices to free market prices for the main cash crops to export (cocoa, coffee and palm oil). LACRA was approved following the submission of a report by the House's Joint Committee on Agriculture, Forestry and Fishery. The Joint Committee in the report indicated that it was prudent for the Government of Liberia to liberalize the produce sector of the economy to promote free marketing of produce in response to global changing trends in the international commodity market.

A well-regulated market will attract huge investments in the agro sector as well as create employment for Liberians. Buyers are avoiding Liberia agriculture products because they are not sure if Liberian products meet international standards. The new agency would thoroughly monitor the production of cocoa, coffee and palm oil to meet the demands of consumers around the world. The new agency will protect farmers from exploitation and increase the desire of outsiders to invest in Liberian produce.

The transformation of LPMC to LACRA will surely generates benefit for cocoa, coffee and palm oil farmers who are in need of cash. With LPMC marketing system prior conflict the producer prices were low and price information system did not exist, making the market not transparent. The creation of LACRA should be complemented by a quality standard monitoring and a complete, reliable and farmers accessible price information system to support farmer's market knowledge and decisions making.

Cash crops (cocoa, coffee, rubber and palm oil)

The market liberalization will approach producer prices for Liberian farmers to the world prices movements for the main cash crops to be exported and particularly cocoa, coffee and palm oil. Therefore, the risk for cash crop prices (cocoa, coffee and palm oil) will be closely related to the volatility of international prices for these commodities.



Cocoa

In the case of cocoa, historically, the Liberian trade in cocoa was controlled by the Liberian Produce Marketing Corporation (LPMC), a state-owned company (parastatal enterprise) with extensive regulatory powers over internal and external trade. The picture of recent post-war changes in the structure of the Liberian cocoa market that emerges from the analysis after the collapse of LPMC is one of a growing number of market actors selling and buying cocoa. This has contributed to increased competition for cocoa at national and local levels among and between small and large buyers, including new investors providing integrated services and led to higher producer prices.

The market power of buyers at all levels has thus been reduced compared to the past, although certain market power remains. By implication, the market position of smallholder farmers producing, cocoa has been correspondingly strengthened. Simultaneously, the re-emergence of farmers' organizations as sellers of cocoa on behalf of smallholders has given them some market power on the supply side of the market and helped to countervail some of the buyers' market power, which has further strengthened farmers' bargaining power. A central conclusion is that the structural changes in the Liberian cocoa market have contributed to strengthening the market position and bargaining power of smallholder farmers, from both the supply side, through the cooperatives, and the demand side, through increased competition and improving the cocoa prices perceived by the smallholder farmers.

The STCRSP-IFAD (2012-2017) has a component 1 for revitalization (rehabilitation, replanting and extension) of Cocoa and Coffee farms (15,000 ha) in Lofa County. The STCRSP-WB-GOL has a component on smallholder Tree Crop Revitalization that will be implemented in partnerships with concessionaires/large firms, NGOs, Farmer Organizations (FOs) and financial institutions in the six counties of Montserrado, Margibi, Bong, Nimba, Grand Gedeh, and Grand Bassa. The Project was approved on June 5, 2012 and became effective on May 13, 2015 for stakeholders implementation. This project has a component for Smallholder Tree Crop Revitalization which focuses on Cocoa/Coffee Revitalization: replanting and extension of cocoa/coffee farms (7,500 ha) in Bong, Nimba, and Grand Gedeh Counties; technical and management advice to smallholders and their farmer organizations (FOs); quality promotion and market linkages; enhancing access of cocoa and coffee farmers and FOs to adapted financial services; and development of small scale processing.

Palm oil

The STCRSP-WB-GOL has a component on Small-scale Oil Palm Revitalization: relates to the revitalization of the Dube Oil Palm Plantation in Konobo District in Grand Gedeh run by smallholders; including support to rehabilitation/replanting (600 ha), capacity building of the existing cooperative, and development of intermediate processing technologies; and promotion of an out growers scheme (600 ha) around a concessionaire, EPO-LIBINCO in Grand Bassa County.

Liberia maintains a very small share of the total world exports of palm oil. Nevertheless, it has been presenting important increases of exported growth in value between 2008 and 2012 (90 %). The top three markets for Liberia's palm oil are Portugal, the United States and Cameroon; although the country's exports are highly concentrated in the Portuguese market (8.9%). There is clear evidence that ICBT (Informal Cross Trade) is currently the most important market for the Liberian smallholder value chain. Red oil also goes out of Liberia via Foya into Sierra Leone and into Côte d'Ivoire out of border markets in Nimba County. Between 2012 and 2013 the price per gallon of palm oil presented significant increases due to the ICBT and high transportation cost. There is a large unmet domestic demand for palm oil in Liberia. In 2012, nearly US \$ 30 million of palm oil was imported, primarily from Indonesia which constituted the bulk of these imports and Malaysia. The trade balance heavily skewed towards imports as imports are growing at a much higher rate than exports. The deficit constitutes an important opportunity for Liberian in the form of imports substitution in the short term.

Rubber

The STCRSP-WB-GOL project has a component on Rubber Revitalization that focuses on their planting and extension of rubber farms (2,600 ha) in Margibi and Montserrado Counties in partnership with two concessionaires and one large Liberian estate; and, rehabilitation of critical markets access roads in project areas.

The Rubber Renovation project (GAFSP-IFC) provides support to 600 independent out-grower farmers with technical support, guidance and new planting material. This will enhance the farmer's ability to access long-term affordable financing to replant and rehabilitate 8,000 hectares of rubber farms.

Staple foods (rice and cassava)

The West Africa Agricultural Productivity Program (WAAPP) was officially launched in 2012. The Project is funded by World Bank, Japan and Government of Liberia. The goal and objective of the project are to: (1) achieve self-sufficiency and export capacity for rice and cassava production whilst improving productivity in rice and cassava along their respective value chains and (2) Improving the productivity of rice and cassava along their value chain in order to enhance Liberia's food self-sufficiency and regional competitiveness.

The project is implemented in eight (8) counties (Bong, Margibi, Bomi, Gbarpolu, Grand Gedeh, River Gee, Maryland and Sinoe). It has an implementation period of five (5) years, July 2012- June 2016 under four components namely. The component 1 is related to market integration and aims at establishing, rehabilitating and strengthening key national mechanisms, regulations and institutions, so to allow Liberia to benefit fully from the regional cooperation and market integration, as partner in the regional WAAPP.

The component targets the following four key areas: (i) adoption and mainstreaming of ECOWAS regulations on genetic materials and agrochemicals; (ii) support to the formulation and implementation of national seed policy (NSP), an agricultural research policy, and a policy and development strategy for agricultural advisory services; (iii) support to regional rice market integration and trade; and (iv) knowledge management, communication and information systems.

Most of the programs and project to improve food security (see next section) includes components to increasing productivity and food availability of rice, cassava and vegetables.

3.3.8. Initiatives related to food security

In addition to the Food Aid Program for Liberia from World Food Program (WFP), several projects funded by USA, mostly by USAID, come to mitigate the high food security risk in Liberia. We may highlight the following projects and programs: Farmer to farmer Program (F2F), Food and Enterprise Development Program (FED), Food for Peace (FFP), Health, Agriculture and Food Security Program (HANDS), Liberian Agriculture Upgrading, Nutrition and Child Health (LAUNCH) and USDA Food for Progress (Table 18). Most of them are implemented in the more food insecure Counties: Bong, Lofa, Nimba, Grand Bassa, Montserrado and Margibi (FED), Bong and Nimba (FFP in partnership with WFP) and Grand Gedch and River Ghee (HANDS).

Some of them aim to increasing the local production of rice, cassava and vegetables (staple foods) to improve food availability and others are based on donation of external food (USA) and/or fortification foods. Some projects combine traditional food aid with cash transfers, vouchers or work for food to increase not just food availability but also food access (FFP). Most of that programs and projects include some educational component (school feeding; improvement of the enrollment at the school; improve education access, nutritional education...). Several programs focused on child and women as the target most vulnerable population.



3.3.9. Initiatives related to financial inclusion

The project Rural Community Finance Project has the aim of improving the financial inclusion of rural communities with the establishment of Rural Community Finance Institutions (RCFI). They are owned and managed by the communities in which they are located, reinforcing the sense of ownership. Based on informal local rules, relationships, trust and local knowledge, introduce at the same time banking concepts. Current regulation permit these institutions to provide products and services not only to the shareholder but also the community and public (IFAD, 2015). By 2016, the Central bank of Liberia in partnership with Afriland First bank has supported the establishment of 11 RCFIs, operating in 8 counties some of them where no bank branches existed (CBL, 2016).

3.4. Risk management tools

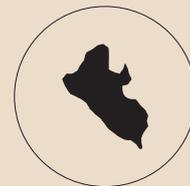
The national policies are very limited due to the institutional weaknesses and budgetary constraints. The main tools used in the Liberian national policies related to ARM are: 1) reform of regulatory framework (land rights reform, LACRA, National Seed Policy and Regulatory Framework and others); 2) planning and budgeting (the Liberia National Plant Protection policy, the Rural Energy Strategy and Master Plan for Liberia and others). There are several good national plans and strategies to increase the productivity and competitiveness of key sectors like rice, cassava, cocoa, rubber and palm oil. We read these plans and have right diagnosis, deep and exhaustive sector analysis and well designing with an adequate combination of tools (public investments, incentives to private investment, subsidies to farmers, technical assistance and capacity building. But we verified that these plans are often just a theoretical exercise and they are really not implemented due to the lack of budget, technical capacity and institutional weaknesses; 3) Co-financing projects and programs funded by loan and grants from international agencies and cooperation national agencies (donor).

Most of the projects and programs funded by international agencies and national cooperation agencies (donors) aim to overcome or at least alleviate the main constraints that increase the impact and losses provoked by agricultural risks e.g. input availability, feeder roads, storage facilities, irrigation network rehabilitation). Others intend to reduce agricultural risks e.g. strengthening plant and animal health services or improving the productivity and competitiveness of main crops and animal production. All these programs and projects act mainly through public investments (public goods and services provision) funded by a combination of tools mainly loans, grants and technical assistance as we presented in section 3.3.2. There also are a lot of programs to assist people food insecure funded from financial international agencies (World Bank, AfDB) and agencies and programs of United Nations, mainly WFP, and USDA, USAID and NGO as we presented in section 3.3.8. These programs use diverse tools as traditional food aid with cash transfers, vouchers or work for food to increase not just food availability but also food access (FFP) and fortification of food (nutrition) thus benefiting all components of food security. Some of that programs and projects include some educational component (school feeding; improvement of the enrollment at the school; improve education access, nutritional education...). Several programs focused on child and women as the target most vulnerable population.





Liberia



Part two: Agricultural risk analysis and implications

4. Risk analysis: a systematic assessment of impacts and likelihood

The agricultural risk analysis in Liberia is a difficult task because the assessment of the frequency and severity of the main agricultural hazards and the estimation of the annual and average losses of production and income caused by the main agricultural risks, requires time series of data related to the correspondent agricultural risk and that time series of data are not available or are not reliable, except for some meteorological and climate variables like rain or wind storm, thanks to the satellite images. In most cases we found only international or regional data and information (FAO, WFP, WB, AfDB, USAID) and there are not national sources or information systems. For time series of yields, production or prices for the main Liberian food crops (rice, cassava and palm oil) the only data we found comes from WFP and FAO but not always are reliable data. For the cash crops we did not find complete time series for domestic production and prices from national sources but we got time series of international prices from international producer organizations (cocoa and rubber).

We made an exhaustive literature review of information systems, reports, studies and papers from NGOs, academic, consulting, think tanks and cooperation agencies, national and international institutions and sources to collect data and information on agricultural risks in Liberia. But for several risks, the data and information we found were insufficient and/or unreliable to quantify the frequency and severity of that risks. Of course the data and information available is very different according to the different agricultural risks, ranking from complete information and data on weather, thanks to the satellite images, to absolute lack of information and data on plant pest. Therefore, we cannot use the same methodology to quantify the frequency and severity of the different agricultural risks. In the case of weather risks (flood and wind storm) we were able to do statistical analysis and quantify the frequency and severity of that risks. In the agricultural risks with lack of data (plant and animal pests and diseases, post-harvest losses and others) we assessed the frequency and severity of risks in a qualitative way based on literature review and interviews to experts, NGO, cooperation agencies and public officers made in our field work. In agricultural risks with some data e.g. prices risk we used a mix methodology i.e quantitative and qualitative to assess the frequency and severity of risks.

4.1. Severity and frequency of risks in Liberia

4.1.1. Inputs

One of the main obstacles to increase productivity is the low use of inputs by smallholder farmers, mainly good varieties of seeds and fertilizers. There are several reasons explaining this low use: (1) the absence of extension services and technical advice (2) the high prices of fertilizers (3) the state of roads and transport of infrastructures that constrain its availability in rural areas and (4) the free distribution made by donors, NGO and government that contribute to the discouragement of its acquisition by farmers and to the underdevelopment of the private sector and to the scarce of distribution points in the rural areas (FED, 2013).

The supply chain is underdeveloped and there are few importers located in Monrovia. More than 90% of agro-input dealers are found Monrovia and generally supply agro-inputs to donor agencies/projects and government. Recently (March 9, 2017) the Agro-inputs Dealers Association (ADAL) of Liberia has been launched by the Liberia Agri-business Development Activity (LADA) in collaboration with the Ministry of Agriculture, with the aim to ensure that smallholder farmers across Liberia access quality and assessable agro-inputs. The objective is to reach 20,000 farmers by the end of next year through the activity of agro-dealers.

The low use of inputs is especially marked in the food crops and by smallholder farmers. Usually they use their own seed from previous harvest and most of the imported fertilizers are used by large commercial producers including multinational companies and medium-sized cash crop producers.

This situation contributes to low risk associated to the use of inputs, usually related to quality deterioration and adulteration. However, some identified practices can be source of risk. In some cases, distributors repackage inputs into smaller packs merging with fertilizers that cross borders from neighboring countries without control, or with fertilizers from the black market where some farmers sell the products given by donors and NGO (IFDC, 2014). The unavailability of data in the literature regarding the use of inputs made impossible the assessment of the risk associated to frauds in their sale, even though due to the current low use is not expected to be significant but potentially high.

4.1.2. Weather

Nature unpredictability is one of the major sources of risk in agriculture activity. In the case of Liberia there is one predominant risk: flood. This was already mentioned earlier when a series of several natural and biological disasters was obtained from EM-DAT (2017) and it was showed in Table 12 and Table 13. In this analysis, it was observed that the most frequent weather disasters were floods (40% of the events), that has a direct consequence on land slides, soil erosion, crop production, deforestation and an indirectly in the water quality, pest and diseases, transportation among others. The second one that has some relevance is the wind storms or harmattans (13%) with an impact of drought in the crop land.

Floods

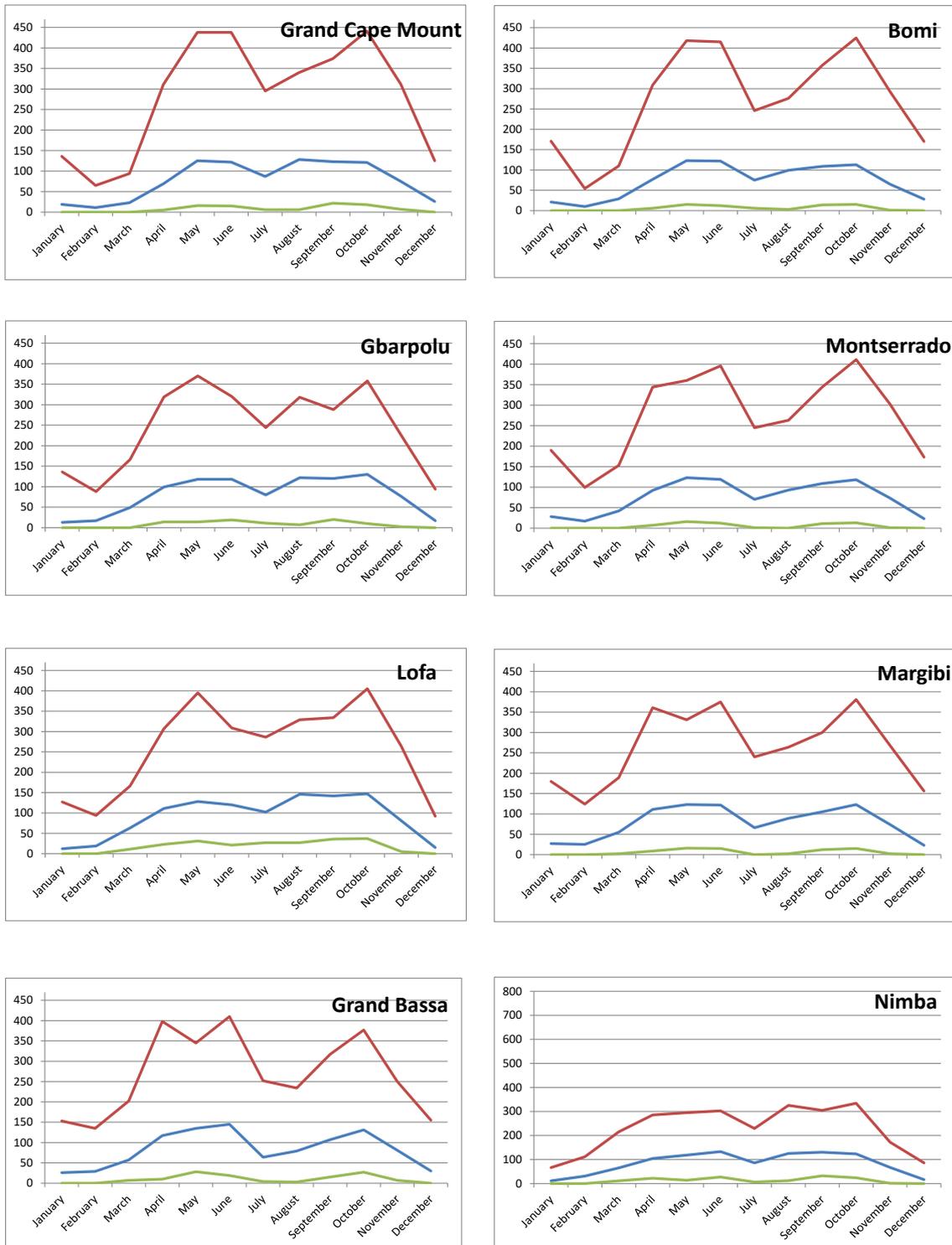
At Liberia, we could find different situations that drive to floods events. Slow-rising floods most commonly occur in large rivers with large catchment areas. The increase in flow may be the result of sustained rainfall, monsoons, or tropical cyclones. Also rapid flooding events, including flash floods, more often occur on smaller rivers, rivers with steep valleys, rivers that flow for much of their length over impermeable terrain, or normally-dry channels. The cause may be localized convective precipitation (intense thunderstorms) or sudden release from an upstream impoundment created behind a dam or landslide. Both type of flooding events has a direct relation with rain or precipitation pattern.

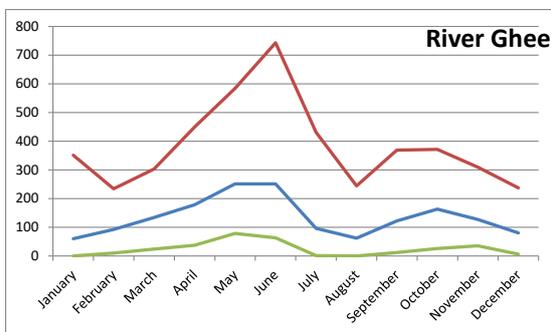
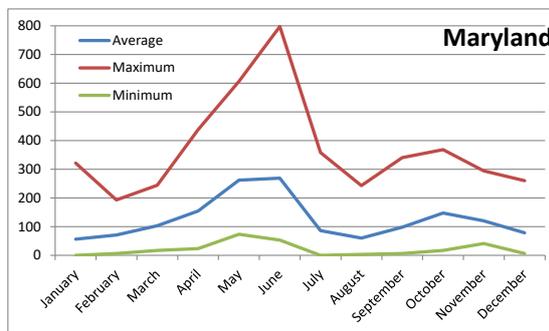
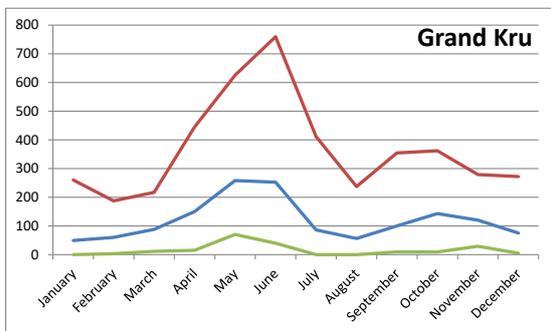
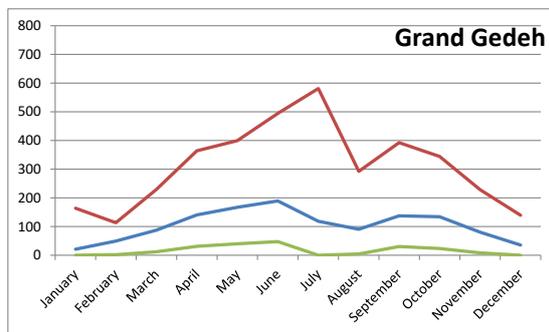
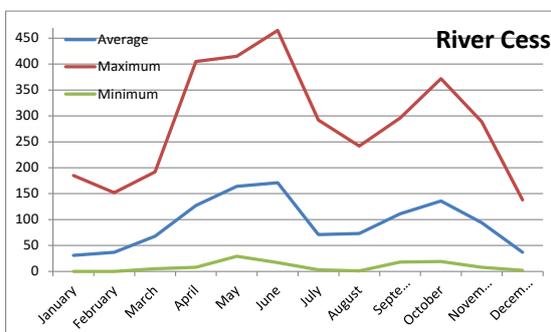
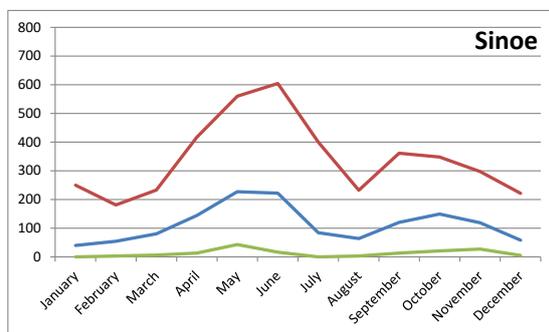
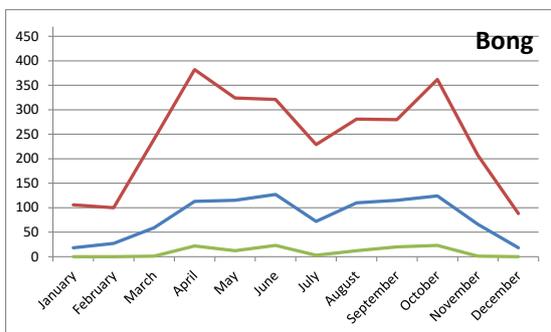
A carefully analysis of precipitation pattern was done based on data available from NOAA/FEWS NET by county of monthly precipitation on crop land from 1996-2012. We point out that the amounts of precipitation differ from other sources as the estimation is for water used by the crop. However, the pattern and the percentage of frequency in the precipitation are kept and, therefore, their probability density functions (pdf) present the same shape. As a summary, we present in Figure 25 the minimum, maximum and average monthly precipitation on crop land for each county.

The first nine counties presented in Figure 25 show that these counties do not exceed a maximum precipitation of 450 mm and two marked peaks in rain. All of them have been classified as with Monsoon Climate. In the second part of the Figure 25, the first county (Nimba) follow this pattern, included in the Monsoon Climate and part as Tropical Sabana. However, the rest of them the range changes to a maximum of 800 mm and different patterns are revealed. They have a common Equatorial Climate classification. Observing these differences among counties, we will study the probability of surpass a certain amount of precipitation on the crop land based on the pdf of each county.



Figure 25: Monthly precipitation on crop land in mm.

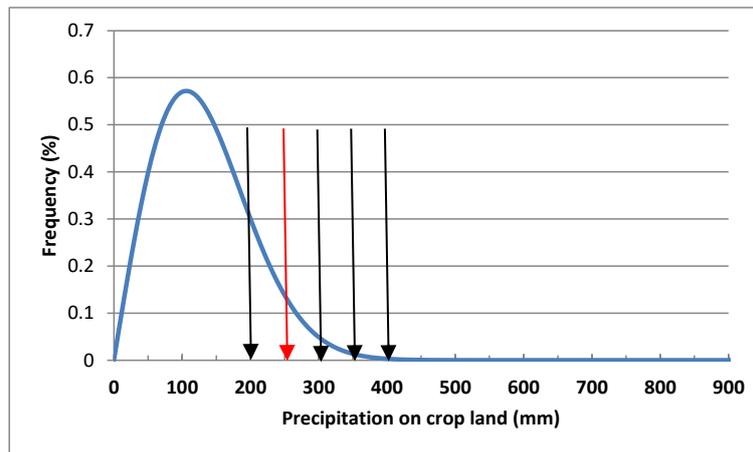




Average (blue line), minimum (green line) and maximum (red line). Available from NOAA/FEWS NET from 1996-2012.

Each monthly precipitation where adjusted to a Weibull function as the frequency of the events is not symmetric. We have represented, as an example, a Weibull function distribution in Figure 26. Based on this type of pdf, we will calculate the probability that rain will exceed a certain value in each month (threshold), and then we will add all monthly probabilities obtaining annual probability estimation.

Figure 26: Adjusted Weibull function to precipitation on crop land in May in Maryland county



The arrows represent the threshold values to calculate the frequency that monthly rain exceeds it. Red arrow represents the value used for the severity index. Source: Authors elaboration

The results for each county at each threshold of monthly precipitation showed in Table 19. Again, the counties with an Equatorial Climate present distinctive values that include the last five counties. However, River Cess, Lofa, Grand Bassa and Grand Cape Mount are counties with an intermediate behaviour between Moonsoon Climate and Equatorial Climate. This table will be used in section 4.2.2 to see the impact of flood in several crops.

We could compare the severity of this risk among counties based on the probability to exceed a monthly rain of 300 mm, as it is the value where the probability density function (pdf) tail for extreme events begins (Leadbetter, 1991). The impact of these events depends on diverse factors and it will be included in crop lost. However, the threshold applied (300 mm) assures that the impact cannot be neglected. Based on the methodology by the work Liberia: Risks (Annex 1) we elaborated a severity risk on function of the likelihood to this event to occur. The severity index is range from 1 (the maximum) to 5 (the minimum). The maximum severity index "1" is given when the probability is $\geq 50\%$. Severity index of "2" when this event present a probability higher than 25%, "3" higher than 10%, "4" higher than 2% and the lowest ("5") $< 2\%$. The severity index point out that Sinoe, Grand Kru, Maryland and RiverGhee have the highest severity in this risk.

Another hazard indirectly related to weather is deforestation. Land use has a direct impact on it. However, the advances of area crops diminish the area and density of forest being more susceptible of erosion that increases deforestation. Based on database of Hansen et al. (2013), we calculate the areas cover by trees over 30%, to assure that we are counting forest and not plantations. This calculation was done in 2000 and in 2015 by county. Doing a comparison by county of both years the percentage of area reduced was estimated and is show in Table 20. The counties Bomi, Montserrado and Margibi present the higher reductions in forest tree area and therefore a highest probability to deforestation.

Table 19: Probabilities of exceed a given monthly precipitation value (from 250 till 450 mm) during a year in each county. Severity index based on the probability to exceed 300 mm of monthly rainfall in a year.

County	Probability to exceed a monthly rain value					Severity index
	250 mm	300 mm	350 mm	400 mm	450 mm	
Bomi	14.3%	4.2%	1.0%	0.1%	0.0%	3
Montserrado	14.4%	4.0%	0.6%	0.0%	0.0%	3
Grand Cape Mount	22.3%	6.9%	1.5%	0.3%	0.0%	3
Margibi	16.0%	4.0%	0.5%	0.0%	0.0%	3
Bong	16.4%	3.1%	0.3%	0.0%	0.0%	3
Gbarpolu	18.0%	3.6%	0.3%	0.0%	0.0%	3
Grand Bassa	25.0%	8.3%	1.7%	0.1%	0.0%	3
Lofa	33.4%	9.2%	1.6%	0.1%	0.0%	2
RiverCess	41.9%	17.8%	6.7%	1.7%	0.2%	2
Nimba	18.7%	1.8%	0.0%	0.0%	0.0%	3
Grand Gedeh	56.5%	25.0%	9.3%	2.8%	0.9%	1
Sinoe	81.8%	45.8%	25.3%	14.1%	7.4%	1
Grand Kru	95.1%	60.1%	38.2%	24.2%	14.8%	1
Maryland	100.0%	65.0%	42.1%	27.1%	17.0%	1
RiverGhee	100.0%	65.7%	39.2%	23.2%	13.3%	1

Source: Authors elaboration

Table 20: Reduction in forest tree area, with a cover higher than 30%, in each county comparing 2000 and 2015.

County	ReducedArea %
Bomi	-0.16
Montserrado	-0.17
Grand Cape Mount	-0.07
Margibi	-0.17
Bong	-0.13
Gbarpolu	-0.04 (...)
Grand Bassa	-0.12
Lofa	-0.08
RiverCess	-0.07
Nimba	-0.09
Grand Gedeh	-0.02
Sinoe	-0.03
Grand Kru	-0.07
Maryland	-0.09
RiverGhee	-0.02

Source: Authors elaboration

Wind Storm (Harmattan)

From November to the middle of March is when the harmattan could happen in the West African subcontinent. It is characterized by dry and dusty northeaster trade wind which blows from the Sahara Desert over West Africa into the Gulf of Guinea (Enciclopedia Britannica). It achieves Liberia around November to March. Average temperatures that have been observed in Liberia ranged at the 21°C to about as high but never exceeding 37°C, while the relative humidity drops under 10%.

The harmattan blows during the dry season when the subtropical ridge of high pressure stays over the central Sahara Desert and when the low-pressure Intertropical Convergence Zone (ITCZ) stays over the Gulf of Guinea. On its passage over the Sahara, it picks up fine dust and sand particles.

The counties that could present this type of event are mainly the ones in the north: Bomi, Montserrado, Grand Cape Mount, Margibi, Bong, Gbarpolu and Lofa. One way to estimate the dry effect of the harmattan on these counties is to study de anomalies of the vegetation indexes during these months. One of the most common used is the Normalized Difference Vegetation Index (NDVI). This index has a range from 0 to 1, closer to the unit the vigour of the vegetation is better.

Based on the available data from FAO (<http://www.fao.org/giews/earthobservation/country/index.jsp?lang=en&code=LBR>) the statistics of the NDVI per county has been recollected. All the vegetation indicators are based on 10-day (dekadal) vegetation data from the Advanced Very High Resolution Radiometer of the Meteorological Operational satellite Programme (MetOp-AVHRR) sensor at 1 km resolution from 2007 onwards. Data at 1 km resolution for the period 1989-2006 was derived from the NOAA-AVHRR dataset at 16 km resolution. Figure 27 shows the monthly NDVI average through the year of the selected counties.

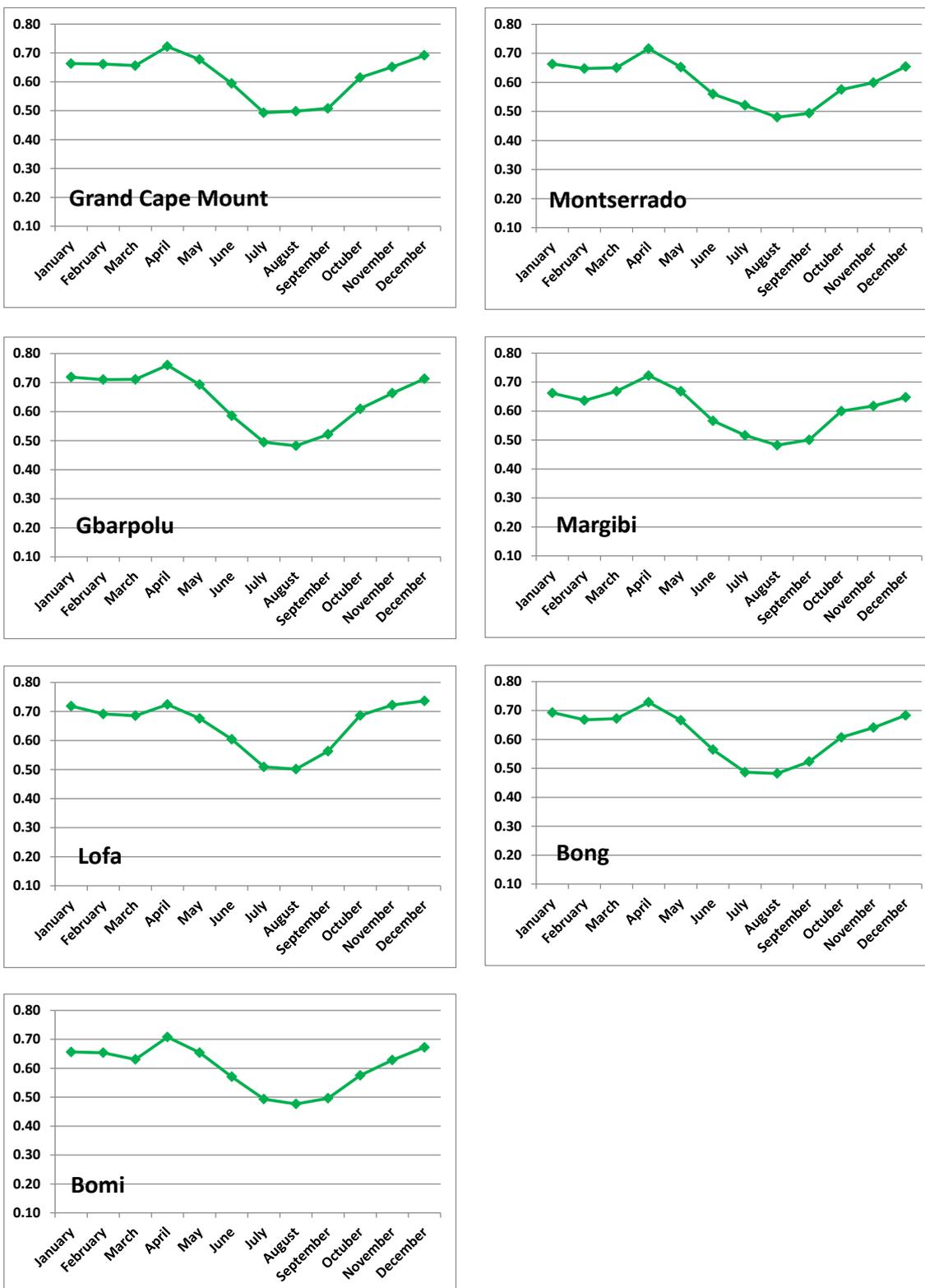
Each monthly NDVI where adjusted to a Gaussian function. We have represented, as an example, a Gaussian function distribution in Figure 28 as we have found is the most common used in the literature for NDVI. Based on this type of probability distribution function (pdf), we will calculate the probability that NDVI will be lower to a certain threshold in each month in which the harmattan can occur, as a low value in NDVI reflects a damage in the vegetation that can be related to a harmattan event. This threshold is calculated, in each month and county, based on the pdf mean and standard deviation following the methodology commonly establish in the vegetation index-based insurance (Benedetti and Rossini, 1993; Chantarat et al., 2013). Then we will add all monthly probabilities from November till March obtaining a seasonal estimation.

The results, for each selected county, at each threshold of NDVI are showed in Table 21. A first glance at the table reveals that Gbarpolu and Grand Capemont are the ones most likely to show a harmattan effect. This table will be used in section 4.2.2 to see the impact of harmattan in several crops.

We could compare the severity of this risk among counties based on the probability to have a lower NDVI monthly value of 0.40, as it is the average NDVI value of the drought season (from July to September) for the studied counties with the same criteria than for flood. The severity index point out that Grand Cape Mount and Bong have the highest severity in this risk and Margibi the lowest.

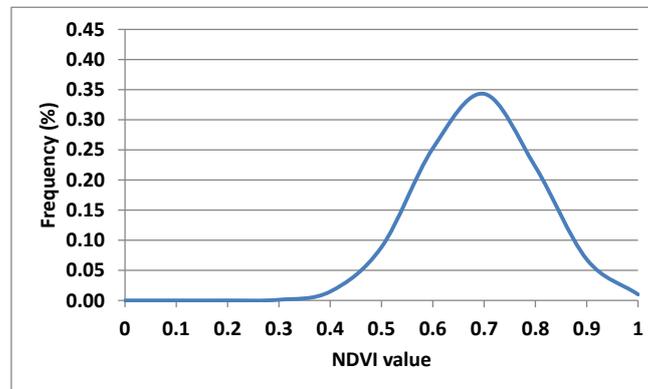


Figure 27. Monthly NDVI average.



Available from FAO, Earth Observation.

Figure 28: Adjusted Gaussian function to monthly NDVI in February in Lofa county.



Source: Authors elaboration

Table 21: Probabilities to underneath a certain monthly NDVI (from 0.40 till 0.20) during a harmattan season (from November till March) in each selected county. Severity index based on the probability to underneath 0.40 NDVI monthly value in a harmattan season.

County	Probability to underneath a threshold					Severity index
	0.40	0.35	0.30	0.25	0.20	
Bomi	26.8%	4.5%	0.6%	0.1%	0.0%	3
Montserrado	23.0%	3.5%	0.4%	0.0%	0.0%	3
Grand Cape Mount	42.8%	10.4%	2.1%	0.4%	0.1%	2
Margibi	9.3%	0.8%	0.1%	0.0%	0.0%	4
Bong	26.3%	5.1%	0.8%	0.1%	0.0%	2
Gbarpolu	62.5%	21.1%	6.3%	1.6%	0.4%	1
Lofa	33.2%	8.5%	1.8%	0.3%	0.1%	2

Source: Authors elaboration

4.1.3. Pests and disease

4.1.3.1. Crops

The pests and diseases crops are a mayor global agricultural risk. Crop losses to weeds, animal pests, pathogens and viruses continue to reduce available production of food and cash crops worldwide. Absolute losses and loss rates vary among crops due to differences in their reaction to the competition of weeds and the susceptibility to attack of other pest groups.

As already described above, the information is very limited in Liberia. According to Mr Garmonyou (Entomologist, Crop Resource Officer, Ministry of Agriculture, Republic of Liberia), National institutions do not have sufficient resources, and there is no historical data on diseases and pests. This situation makes it difficult to quantify these risks.

The only pest in which there is a little information is Caterpillar. Since 2009, Liberia had experienced major pest infestation identify as forest dwelling moth called "Achaea Catocaloides Guence" (Table 22). It is observed that the North Central region is the one that has a greater frequency of Caterpillar. Therefore, this is potentially the most sensitive area, because it is also the area with the highest food crops production (rice and cassava).



Also, it also feeds on agricultural crops such as (cocoa, coffee, rubber trees, oil palm, plantain and banana leaves, cowpeas, assorted vegetable, etc.). In addition to damaging crops, drinking water sources may become contaminated by the faeces of this pest. Swarms of *A. catocaloides* can affect crops, water and buildings.

Table 22: Counties affected by Caterpillar (2009-2016).

Region	County	Years
Monsarredo	Monsarredo	2014
North Western	Gbarpolu	2009;2014;2016
	Gran Cape Mount	2012
	Bomi	2012
North Central	Bong	2009;2010;2014;2016
	Nimba	2009;2014;2016
	Lofa	2009;2014;2016
South Central	Gran Bassa	2012
	Margibi	-
South Eastern	River Cess	2010;2012
	Sinoe	2012
	Gran Gedeh	-
	Maryland	2012;2014
	River Gee	2012
	Grand Kru	2014

Source: Technical Service, MOA 2016

Moreover, it has been made a table (Table 23) of the potential losses of major crops in Liberia. The pests or diseases related are the main in West-Africa according from international sources, such as CABI, Africa Rice Center (AfricaRice) and Consultative Group on International Agricultural Research (CGIAR). The selection has been made taking into account the environmental conditions of Liberia and were already mentioned in section 2.1.4.

Table 23: Loss levels of major crop groups due to pest and diseases.

Crop	Pest/Disease	Potential Loss Level
Rice	Rice Yellow Mottle Virus (RYMV)	10-100%
	African rice gall midge (AfRGM)	25-80%
Cassava	Cassava mosaic virus disease (CMVD)	20-95%
	Cassava Bacterial Blight (CBB)	18-100%
	Grasshoppers	<50%
	Green spider (<i>Mononychellustana</i>)	10-80%
Cocoa	Cocoa Swollen Shoot Virus Disease (CSSVD)	<70%
Rubber, Cocoa, and Palm Oil	Phytophthorasp	60-70%
Various crops	Achaea Catocaloides	70-100%
	Whitefly (<i>Aleurodicus</i> disperses)	<90%
	Weeds	50%
	Birds	50%

Source: Authors elaboration

Rice Yellow Mottle Virus (RYMV). Yield losses vary widely, from 10 to 100% depending on the type of variety and period of infection. Early infection normally leads to higher losses.

African rice gall midge (AfrGM). Heavy yield losses of 25–80% in farmers' rice crops have been recorded in some fields (for example, in the late 1970s, severe outbreaks occurred in Burkina Faso, and in 1988, some 50,000 ha of lowland rice were severely damaged in southeast Nigeria). Rainfed lowland and hydromorphic ecologies seem to be at higher risk than upland and mangrove ecologies. It has become a major pest in Burkina Faso, Nigeria, Mali and Sierra Leone. It has been recorded in a further 16 sub-Saharan African countries.

Cassava mosaic disease (CMD). Yield losses with individual cultivars have been reported from different countries to range from 20 to 95%. Losses depend on variety and stage of infection, but are usually substantial.

Cassava Bacterial Blight disease (CBB). Yield losses have been reported from different countries to range from 18 to 100 %.

Phytophthora palmivora. Pod rot and stem canker caused cocoa pod losses of up to 63% and the death of up to 10% of trees annually on average in West Africa. The whole plant of cocoa is attacked leading to various symptoms. This fungus grows on cocoa trees in the shade when it is cool and damp. When the area is warmer and drier, the disease will not grow. This fungus can attack also to the rubber trees. Symptoms of infected rubber trees are mature leaf fall, green stem die-back, pod rot and bark rot (black stripe).

The Cocoa Swollen Shoot Virus Disease (CSSVD). The virus (CSSV) is a member of the Badnavirus (bacilliform DNA virus) genus and is semi-persistently transmitted through the feeding action of several mealybug species (Pseudococcidae, Homoptera). Its severest types could substantially reduce yield by about 70% and even cause death of cocoa trees within 2-3 years of infection at all stages of cocoa growth.

Green spider (Mononychellus tanajoa) (cassava green mite). Damage caused by *M. tanajoa* varies according to the cassava cultivar and the length of the dry season. Prolonged drought encourages the buildup of mites and increases yield losses. Chlorosis and stunted growth reduce the harvest of leaves as a vegetable. In some east and central African countries, tuber yield losses of 10-80% have been recorded.

Whitefly (Aleurodicus disperses). The economic impact of *A. dispersus* infestations is due to a combination of three factors. Direct feeding damage results from the extraction of sap from leaves, mainly by larval stages but with adults also contributing. Direct feeding can cause premature leaf drop, reduces plant vigor and yields, but rarely kills plants outright. Indirect damage is due to excreted honeydew that encourages the development of sooty moulds, which hinder photosynthesis and reduce yields. Finally, cosmetic damage is due both to sooty moulds and to the white flocculence secreted by immature stages, which reduces the market-value of crops.

4.1.3.2. Animal and human health

The main identified animal health risks, with most dramatic consequences for Liberian livestock correspond to outbreaks of animal diseases. Direct losses are mostly a consequence of animal mortality and significant production loss. To quantitatively evaluate this loss, the farmers' average annual economic damage derived from diseases of livestock should be estimated on the basis of the frequency of occurrence and the severity of the damage caused by each shock to each animal species. However, very little quantitative data has been found to assess each risk, because there is no epidemiology unit at central office of Ministry of Agriculture, is not currently working.

Therefore, a qualitative evaluation has been applied following a methodology proposed by the World Bank (2016) when no quantitative data are available. The prioritization presented below should be fine-tuned after additional interviews with local farmers and livestock officers at national and county levels. The estimated risk for farmers based on occurrence and severity for the main livestock diseases in Liberia has been analysed with the feedback from a questionnaire sent to the Ministry of Agriculture. The complete questionnaire is shown in Annex 2. A summary of the main prioritized animal diseases is shown in Table 24.

**Table 24:** Risk of diseases of domestic animal species in Liberia.

Disease	Animal Specie	Frequency Occurrence	Severity	Risk
Newcastle disease (ND)	Poultry	Very high	Very high	Very high
Avian Influenza (AI)	Poultry	Low	High	High
Pest Petit Ruminants (PPR)	Goat, Sheep	Very high	Very high	Very high
African Swine Fever (ASF)	Swine	High	Very high	Very high
Diarrhealdiseases, salmonella, E. coli, enteritis	All	Very high	Very high	Very high
Respiratory diseases	All	Moderate	High	High
Anthrax	Bovine	Low	Low	Low
Brucellosis (Sheep & Goat)	Bovine	Moderate	Moderate	High
Contagious Bovine Pleuroneumonia (CBPP)	Bovine	Low	Moderate	High
Tick infestation	Sheep, Goat	Very high	High	High
Mange infestation	Sheep, goat	Very high	High	High
Bovine TB	Cattle	Moderate	Moderate	High

Source: MoA: Dr. Etagegnehu D. Belayneh, DVM, Veterinary and Public Health Consultant (2017) and CARI: Dr. Arthur Bob Karnuah, Director for Livestock Research & Services and Dr. Kwaku Agyemang (2013) and Dr. Asamoah Larbi (2011) consultants for the Ministry of Agriculture of Liberia.

Risk for all the mentioned diseases is high or very high, except for Anthrax. Even for Avian Influenza, which has a low frequency of occurrence because no poultry industry is developed in Liberia, the risk is high due to the potential transmission and impact on human health. Similarly happens with CBPP and Bovine Tuberculosis with low frequency and moderate severity but high risk due to potential transmission to humans with fatal effects.

The three main diseases of livestock are PPR in goat and sheep, swine fever in pigs and ND in back-yard poultry production. These three are the most devastating diseases for livestock in Liberia, followed by the all sort of non-well-defined diarrheal diseases. These diseases occur regularly and damage a great proportion of rural and peri-urban households. About 95% households reared chickens or ducks, 52% reared goats and at least 35% reared pigs in 2013 (Agyemang, 2012). An important increase in the number of households with chickens, goats and pigs is taking place during the last five years.

The economic value of biological risks should be estimated by quantifying the mortality, morbidity, veterinary costs and % productivity losses for each type of livestock and quantified, as USD million per year. Per cent estimated losses due to mortality, morbidity derived from biological risks are shown. These per cent values could be expressed in monetary terms as soon we have more reliable information on the livestock census and current productivity.

Table 25: Estimated losses due to pests and diseases in Liberian livestock.

Animal Specie	Mortality, %	Morbidity, %	Productivity loss, %
Poultry	30	40	30
Goat, Sheep	20	40	10
Swine	20	40	30
Bovine	20	30	10
Total (Average)	25	40	20

Source: Authors elaboration

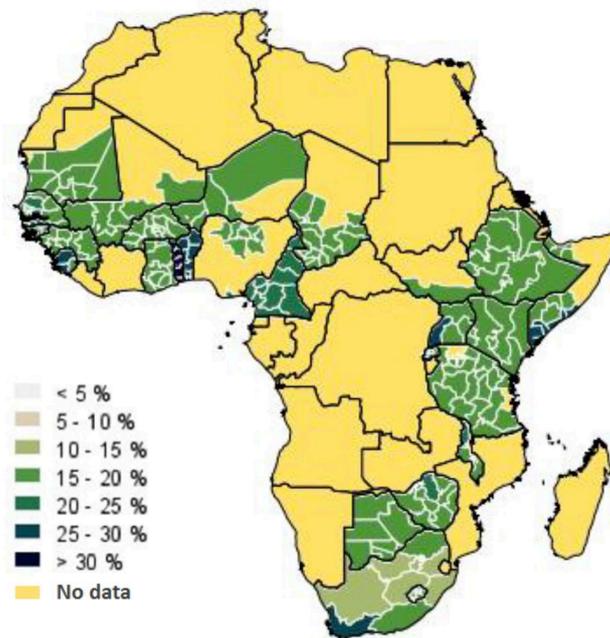
There are animal diseases that affect human health (zoonosis). Therefore, in addition to the animal production losses, the risk and impact on human health from zoonosis should be evaluated.

In summary, livestock pests and animal diseases occur annually, with relatively high frequency, and their impact increases due to the lack of effective veterinary services (PVS). Furthermore, damages augmented due to regular occurrence of flooding events. Zoonosis and communicable diseases in rural areas are very high in rural areas due to with informal border trade of live animals.

4.1.4. Infrastructure

The infrastructure deficits are a constraint for agriculture rather than an agricultural risk. Two main infrastructure deficits were identified in Liberia: feeder roads and storage facilities. The first increase the vulnerability of farmers in raining season: 1) for food supplying from outside of flooding areas, provoking the increasing of local food prices and food insecurity in years with short harvest of rice or cassava; and 2) prevent the local farmers to access to the outside markets therefore provoking the decreasing of local market prices or the inability to sell the surplus production and thus causing farm income losses. The second implies postharvest losses that may reduce the self-sufficiency of food or reducing the agricultural production to be sold and thus farm income losses. The deficit of storage facilities and roads provoke important postharvest losses and make difficult the access to market and prevent to the farmers to take advantage of selling the production some months after the harvest at higher prices. The Figure 29 and Table 26 shows the postharvest losses estimated for Sub-Saharan Africa.

Figure 29: Postharvest losses estimated for Sub-Saharan Africa.



Source: APHLIS

**Table 26:** Weight loss ranges for links in the postharvest chain for cereal grains in Sub-Saharan Africa.

Links in the postharvest chain	Loss (%)
Harvesting/field drying	4-8
Transport to homestead	2-4
Drying	1-2
Threshing/shelling	1-3
Winnowing	1-3
Farm storage	2-5
Transport to market	1-2
Market storage	2-4
Cumulative loss from production	10-23

Source: APHLIS

In the case of Liberia, the postharvest losses estimate only exist for rice that anyway is the most important staple food in that country. The figures quoted are estimates of cumulative weight loss from production incurred during harvesting, drying, handling operations, farm storage, transport and market storage. In the period 2008-2011 the estimated average annual postharvest losses for rice in Liberia reach 11.3% (APHLIS, 2015), which seems low due probably to underestimation as many studies say that the average post-harvest losses in Africa are over 25-30%.

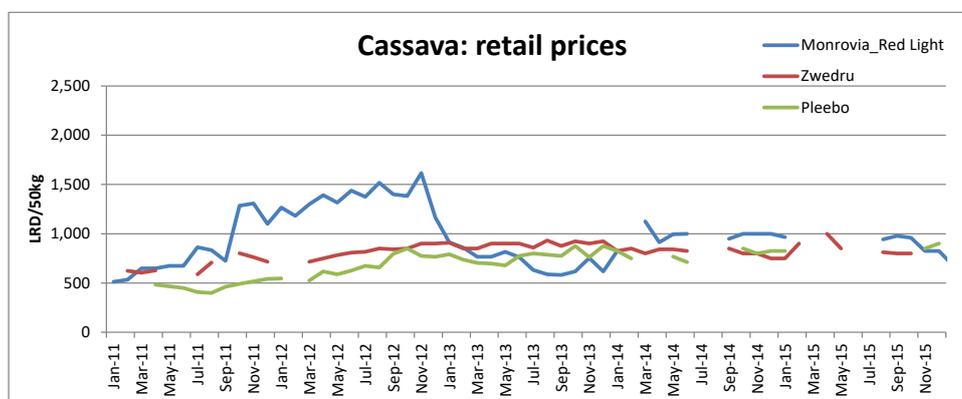
To estimate the income losses suffered by farmers due to the inadequate storage practices and infrastructure we need to know the seasonality (intra-annual prices) of the main agricultural products. The intra-annual price variations will allow us to know if some seasonality there exists. This is important to learn about the incentive for farmers to storage the harvest and selling it later at higher prices and thus to assume the risk of postharvest losses due to the inadequate storage infrastructure or practices. If seasonality there is not exist the farmer will sell immediately the production after harvesting to avoid postharvest losses. This analysis is pertinent just in the case of crops produced for domestic consumption, in particular cassava, rice and palm oil, and not for products to be exported like cocoa and rubber.

Cassava

As we can see in Figure 30, the cassava intra-annual prices (source World Food Program) are rather stable in the period 2011-2015 and therefore seasonality does not exist. This is confirmed by the calculation of coefficient of variation (CV) into each year (Table 27) as the CV are very low in the three markets except in Red Light (Monrovia) where the CV is high in some years (2011 and 2015) but this is explained for some inter-annual price variation more than for intra-annual price variations. The low intra-annual price variation for cassava is confirmed in Table 28 as the monthly price deviation from annual average is always less than 6% except in Pleebo which is 10%. The conclusion is that farmers growing cassava will not be interested to store their production and will sell it immediately after harvesting avoiding the risk of postharvest losses. Nevertheless, a great part of cassava farmers are producing for self-consumption and they must process the cassava to consume it along the year and to avoid or at least reduce post-harvest losses.



Figure 30: Cassava intra-annual prices.



Source: WFP

Table 27: Cassava intra-annual price variability (2011-2015).

Intra-annual (LRD/50 kg)	Average	Σ	CV (%)
Pleebo			
2011	469	46.4	9.9
2012	675	108.0	16.0
2013	772	62.3	8.1
2014	790	48.7	6.2
2015	848	33.4	3.9
Red Light			
2011	817	273.3	33.4
2012	1363	128.9	9.5
2013	723	112.0	15.5
2014	979	80.9	8.3
2015	1071	414.8	38.7
Zwedru			
2011	679	79.6	11.7
2012	822	59.7	7.3
2013	894	29.1	3.3
2014	818	31.4	3.8
2015	845	82.8	9.8

Source: Calculations of authors based on WFP

Table 28: Cassava monthly price deviation from annual average. (2011-2013).

Cassava	average JUL (2011-2013)	Δ	%	average MAY (2011-2013)	Δ	%
Pleebo	628	-10.7	-1.7	578	-60.5	-9.6
Red Light	957	-11.0	-1.1	936	-31.8	-3.3
Zwedru	754	-44.1	-5.5	842	43.3	5.7

Source: Calculations of authors based on WFP

Rice

In the case of rice and according to the prices provided by WFP in the period 2009-2015 the intra-annual variability of prices is even lesser than in the cassava market. The Figure 31 does not show any signal of rice price seasonality. The intra-annual coefficients of variation (Table 29) and the monthly price deviation from annual average (Table 30) show again the relative stability of intra-annual rice prices and therefore the rice farmers in general. Thus, farmers cropping and selling rice do not store the rice production after harvest and will sell immediately after harvest to avoid post-harvest losses. But a great part of rice farmers, mainly upland farmers, are producing for self-consumption and they must process the rice (pre-boiled) to consume it along the year.

Figure 31: Rice intra-annual variability of prices



Source: WFP

Table 29: Rice intra-annual price variability (2009-2015)

Intra-annual (LRD/50 kg)	Average	Σ	CV (%)
Red Light			
2009	2035	135	6.6
2010	1827	138	7.6
2011	2431	247	10.2
2012	2886	123	4.3
2013	2627	128	4.9
2014	2753	322	11.7
2015	2886	79	2.7 (...)
Zwedru			
2009	2566	128	5.0
2010	2286	101	4.4
2011	2544	149	5.9
2012	3577	207	5.8
2013	3330	272	8.2
2014	3256	384	11.8
2015	3411	88	2.6

Source: Calculations of authors based on WFP

**Table 30:** Rice monthly price deviation from annual average (2009-2015)

Rice Month	average (2009-2015) (LRD/50 kg)		Δ		%	
	Red Light	Zwedru	Red Light	Zwedru	Red Light	Zwedru
Jan	2361	2915	-131	-81	-5.3	-2.7
Feb	2362	2750	-131	-246	-5.2	-8.2
Mar	2347	2896	-145	-100	-5.8	-3.3
Apr	2320	2907	-172	-89	-6.9	-3.0
May	2402	2881	-91	-115	-3.6	-3.8
Jun	2431	2945	-61	-51	-2.5	-1.7
Jul	2457	2881	-35	-115	-1.4	-3.8
Aug	2514	2998	22	2	0.9	0.1
Sep	2562	3014	70	18	2.8	0.6
Oct	2633	3042	141	47	5.6	1.6
Nov	2547	3023	55	27	2.2	0.9
Dec	2506	2892	14	-104	0.6	-3.5

Source: Calculations of authors based on WFP

Palm oil

In the case of Palm oil there is a strong intra-annual price variability especially in Pleebo market but any pattern of seasonality can be identified as it can be seen in the Table 31.

Table 31: Palm oil intra-annual price variability (2009-2016)

Intra-annual (LRD/gallon)	Average	Σ	CV (%)
Pleebo			
2009	203.5	54.7	26.9
2010	250.6	74.8	29.9
2011	343.8	68.2	19.8
2012	407.2	55.1	13.5
2013	401.2	37.1	9.2
2014	384.3	89.4	23.3
2015	346.8	44.5	12.8
2016	305.4	9.9	3.3
Red Light			
2009	276.5	34.7	12.6
2010	306.7	28.2	9.2
2011	339.9	30.7	9.0
2012	355.8	8.9	2.5
2013	367.5	34.9	9.5
2014	430.1	66.5	15.5
2015	363.2	24.0	6.6
2016	463.3	71.1	15.3

Source: Calculations of authors based on WFP

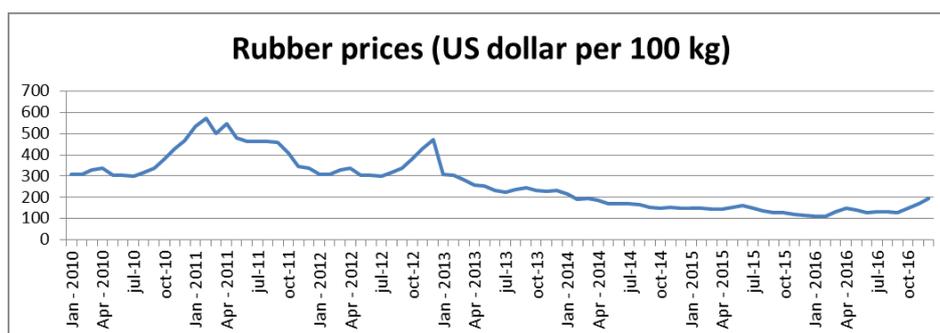
4.1.5. Prices

To assess the price risk for farmers we must analyze the inter-annual price variation. In the case of export products like cocoa and rubber we got the price of international markets for a long period based on the information collected and disseminated by international producer organizations of cocoa and rubber (The International Cocoa Organization ICCO) and The Association of Natural Rubber Producing Countries (ANRPC). For food crops produced for domestic consumption we will take the price information from WFP which covers periods just from 5 to 7 years but unfortunately are retail prices i.e. much closer to the consumer than to the producer and the assumption that the producer price and consumer price are correlated is not always true.

Rubber

In the rubber international market, the inter-annual variation of prices is very high for the period 2010-2016. But the Figure 32 shows two different period. The first 2010-2013 with strong volatility i.e. up and down movements of prices and the second 2013-2016 with a down trend from 500 dollar per 100 Kg to 100 dollar per 100 Kg. In that sense the farmers or companies cropping rubber are exposed to a high risk of prices. The Table 32 shows a high CV (47%) that is coherent with that huge variation of rubber prices in the period 2010-2016 although the intra-annual variation of prices are much lesser.

Figure 32: Rubber prices



Source: The ANRPC

Table 32: Rubber inter-annual and Intra-annual price variability (2010-2016)

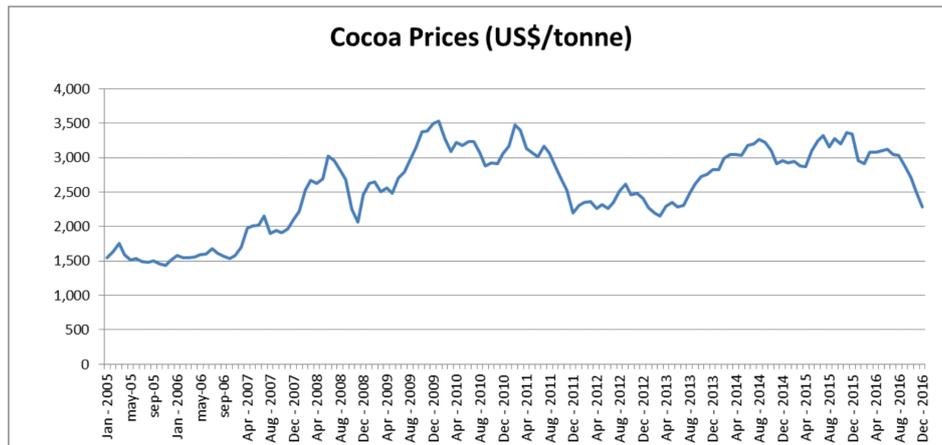
US dollar per 100 kg	Average	Σ	CV (%)
Inter-annual			
	265	123	46.6
Intra-annual			
2010	343	55	16.2
2011	464	72	15.6
2012	343	55	16.2
2013	252	28	11.2
2014	173	21	12.0
2015	141	14	10.1
2016	140	25	17.6
Average Intra annual			14.1

Source: Calculations of authors based on the ANRPC

Cocoa

According to the Figure 33 and the Table 33 we can assume a medium-high volatility of international cocoa prices with up and down price movements (CV=22%). There are strong price falls in 2008, 2011 and 2016, i.e. each three years approximately the farmers face a great reduction of prices thus assuming a severe risk. Instead the intra-annual variation of prices is low with CV values between 3% and 12% (normally less than 10%).

Figure 33: Cocoa price



Source: The ICCO

Table 33: Cocoa inter-annual and intra-annual price variability (2005-2016)

US\$/tonne	Average	σ	CV (%)
Inter-annual			
	2553	576	22.6
Intra-annual			
2005	1538	88	5.7
2006	1591	53	3.3
2007	1998	86	4.3
2008	2581	292	11.3
2009	2889	371	12.8
2010	3133	184	5.9
2011	2980	362	12.1
2012	2392	108	4.5
2013	2439	234	9.6
2014	3064	135	4.4
2015	3135	187	6.0
2016	2892	264	9.1
Ave. Intra annual			7.4

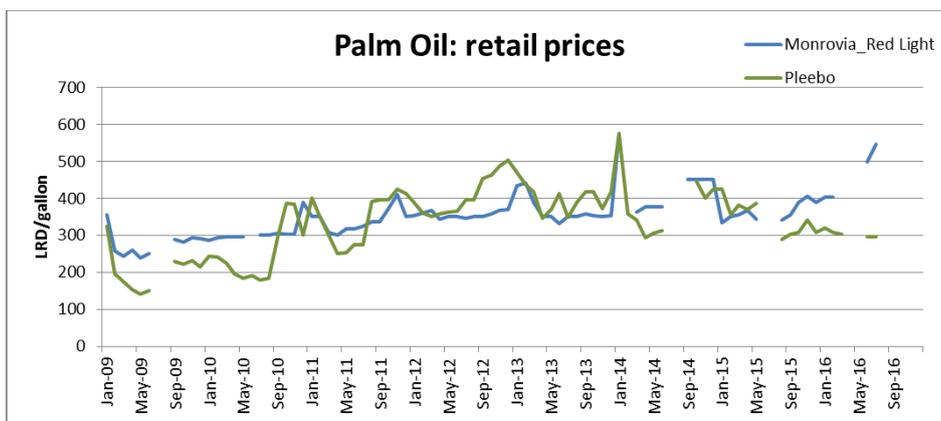
Source: Calculations of authors based on the ICCO



Palm oil

The volatility of palm oil prices is high observing the Figure 34 that shows the monthly palm oil prices in the period 2009-2016. The volatility is much higher in the Pleebo market than in Red Right market (Monrovia). The palm oil prices in Red Light market is rather stable between 300 and 400 LRD/gallon while the price in Pleebo market varies between 200 LRD/gallon in 2009-2010 and 500 LRD/gallon or even 600 LRD/gallon in the peak in January 2014. The higher CV for Pleebo market (see Table 34) confirm the higher volatility of palm oil prices in that market. The prices collected from WFP are retail prices thus closer to the consumer than to the producer but we can assume that the price for the producer is related with the retail prices, but this is not sure.

Figure 34: Palm oil prices



Source: WFP

Table 34: Palm oil Inter-annual price variability (2009-2016).

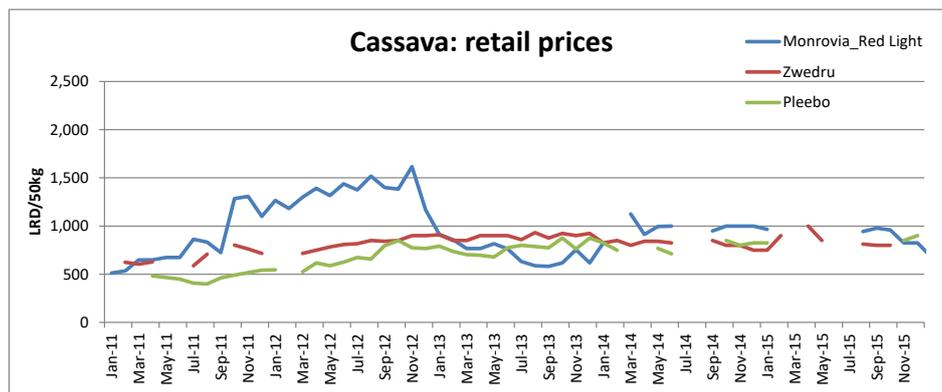
Inter-annual(LRD/gallon)	average (2009-2016)	σ	CV (%)
Pleebo	330	73.1	22.1
Red Light	363	60.7	16.7

Source: Calculations of authors based on WFP

Cassava

The Figure 35 shows the monthly variation of domestic cassava prices in the period 2011-2015 collected from WFP. The conclusion is a period of high prices in 2011-2012 for Monrovia Red Light market but for the rest of years and markets the domestic cassava prices are rather stable and thus the price risk faced by farmers is low. But the Table 35 shows a medium CV of inter-annual price variability in Pleebo and Red Light markets and low CV for Zwedru market that can be explained by the fact that in Zwedru the cassava is largely produced for self-sufficiency and not for selling in the market.

Figure 35: Cassava prices



Source: WFP

Table 35: Inter-annual price variability. Cassava (2011-2015)

Inter-annual (LRD/50 kg)	average (2011-2015)	Σ	CV (%)
Pleebo	711	148.7	20.9
Red Light	991	248.5	25.1
Zwedru	812	79.8	9.8

Source: Calculations of authors based on WFP

Rice

The Figure 36 shows the monthly variation of domestic rice prices in the period 2009-2015 collected from WFP. The conclusion is that the domestic rice prices at retailer level are rather stable and thus the price risk faced by farmers is low if effectively the consumer prices follow the producer prices. The Table 36 confirms a low-medium CV of inter-annual rice price variability in Red Light and Zwedru markets. But In the case of rice almost 60-70% of the rice consumption in Liberia is imported rice and thus the price of imported rice is influencing the domestic prices although the price of domestic price is much lower than the price of imported rice due to the very low quality of domestic rice.

Figure 36: Rice prices



Source: WFP

Table 36: Inter-annual price variability. Rice (2009-2015)

Inter-annual (LRD/50 kg)	average (2009-2015)	Σ	CV (%)
Red Light	2492	418.7	16.8
Zwedru	2996	513.4	17.1

Source: Calculations of authors based on WFP

The conclusion is that for cash crop produced to export (rubber and cocoa) the volatility is high. The frequency of drop in prices is high in cocoa (each three/four years) and the severity is high (drops higher than 30%). For rubber we observed a downward trend in the last three years from 500 dollar per 100 Kg to 100 dollar per 100 Kg thus the frequency of rubber price drops is very high (each one or two years) and the severity is very high (drops higher than 50%). For food crops produced to domestic market the volatility and price risk is lower. The rice, cassava and palm oil prices in domestic markets are usually low with few up and down inter annual price movements. In the case of cassava because much of cassava production is produced for self-consumption is small holding farmers. In the case of palm oil and even more in rice because the imports is the most important source of provision for the national consumption and the import prices act as a domestic prices regulator. We observe less volatility in Red Light market (Monrovia) than in far markets due to the proximity of the port of Monrovia through which the imports arrive. Anyways, the conclusions on food crops are less reliable due to the short period of data price and the fact that the best source of data (WFP) collect and disseminate retailer prices and not producer prices.

4.1.6. Conflict

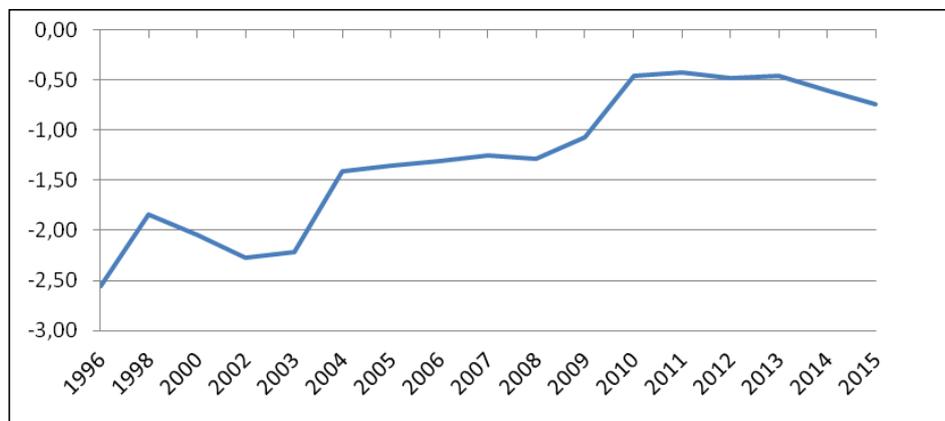
4.1.6.1. Conflicts, Instability and Violence

Since the end of Civil War in 2003 Liberia has experience a peace period and perceptions of political stability have improved significantly since the end of the conflict (GoL, 2013). However, challenges remain and some factors can be a source of concern contributing to generate a difficult climate to invest in the agricultural and a precarious business environment. The forthcoming 2017 presidential elections, the corruption scandals related with members of the ruling party and the United Nations troop's withdrawal in December 2016 constitute a severe risk threatening the stability. In addition, there are also risks of spillover of regional conflicts due to the difficult economic situation of border regions (GoL, 2012).

This situation made that all world indicators assessing the risk profile of Liberia reflect a situation of high risk:

1. The Worldwide Governance Indicators (WGI) are a research dataset summarizing the views on the quality of governance provided by a large number of enterprise, citizen and expert survey respondents in industrial and developing countries. These data are gathered from a number of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms. One of the indexes is the *Political Stability and Absence of Violence/Terrorism index that measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism*. Its values from 1996 show an improvement of the situation until 2013 when the values start to decline.

Figure 37: Political Stability and Absence of Violence/terrorism in Liberia



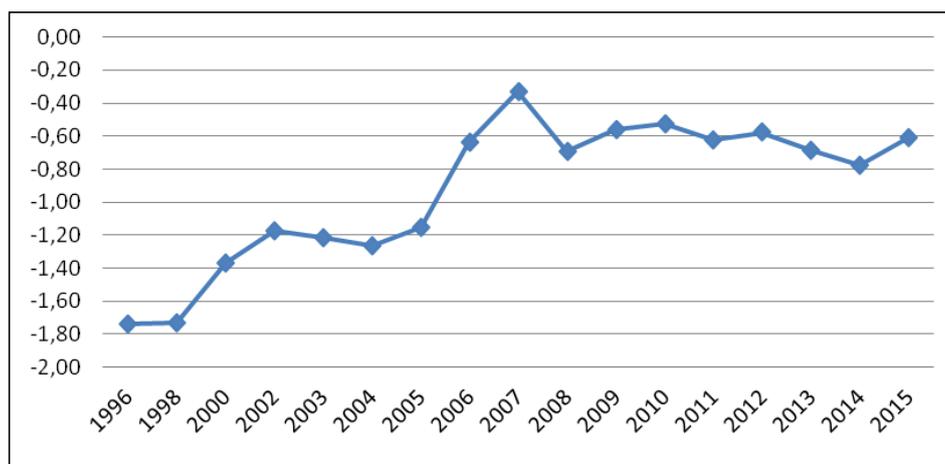
Source: WGI. The index ranges from -2.5 (weak) to 2.5 (strong) governance performance

2. Coface (www.coface.com/Group), a world leader in credit insurance, publishes a political risk assessment ranking calculated from various types of risk in relation to their impact on business activity including conflict index and political and social fragility index. For Liberia, the value of the index for 2016 is 34.8%, being 100% the highest score. This value reflects a modest political risk.

4.1.6.2. Corruption

The dependency of the economy on the natural resources and the importance of the concessions to the exploitations of these resources generate significant rents and is a source of corruption risk. The WB reports governance indicators, including control of corruption for over 200 countries including Liberia, which show low values in all period. (<http://info.worldbank.org/governance/wgi/#home>).

Figure 38: Control of corruption in Liberia



Source: WB, WGI. The indicator ranges from -2.5 (weak) to 2.5 (strong) governance performance

4.2. Impacts of risks

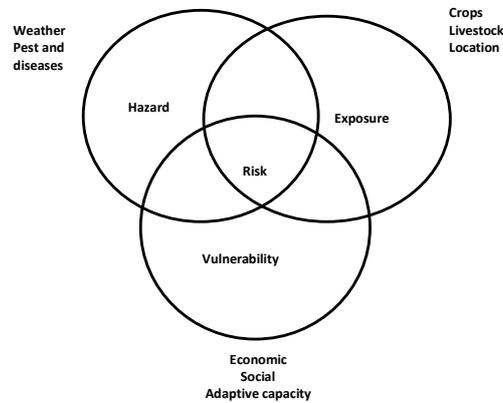
4.2.1. Constrains and risk

Agricultural risk assessment implies to analyze, identify and prioritize risk, which serves as the basis for the design of risk management strategies. In this process, it is important to distinguish several concepts implied. Risk is defined as an uncertain event that has the probability to cause losses and it is composed by three variables:

- Hazard: Categorization of the event considered and assessed through three components: frequency, severity and spatial extent.
- Vulnerability: Reflects the capacity of households or individuals to prevent, mitigate or cope with shocks and stresses, and it is increasingly being recognized that this capacity relates to assets and constraint i.e. more severe constraints imply more vulnerability.
- Exposure: Identification of the location of crops, livestock and farm holdings that can be directly impacted by the uncertain event.

It is important also to distinguish between risk and constraint. Whereas the risk implies the presence of uncertainty and the probability of losses, a constraint is a condition that lead to suboptimal performance in agriculture and where the element of certainty is present. Examples of constraints are limited access to finance, poor infrastructure or limited supply of inputs. Often constraints and risk are related and it is important to realize the difference. For example, limited access to finance conditions the capacity of farmers to manage risks affecting their vulnerability but also the access to finance could be improved if the risk of repayment diminishes with the adoption of other risk management tool. The consideration of constraints is important as they influence the vulnerability and the capacity of farmers to manage risks. For instance the impact of risk of flood is very high due to the bad road infrastructure, but the bad road infrastructure is not a risk is a constraint that produces a high impact and high vulnerability of farmers facing floods risk.

Figure 39: Component of risks



4.2.1.1. Constraints

Roads

Roads emerge as one of the main constraints agriculture faces in its possibilities of growth. The physical inaccessibility of rural areas, especially in rainy season, impede farmers the access to markets, discouraging production, investments and value-added activities and preventing of increasing their incomes.

Even without physical inaccessibility, the bad state of roads increases the costs and the periods of transport. It is estimated that in many rural areas, transport costs account for up to 70% of marketing costs (NMCDP and GoL, 2013). That aggravates the competitiveness of smallholders' production and increases the risk of post-harvest losses and spoilage of products with a direct effect on perceived prices.

Bad roads also difficult the provision of inputs as seeds, fertilizers and tools, and services as financing with direct effects on productivity. The bad situation of roads acts against the establishment of selling points of inputs, accessing of retailers to production sites or new bank branches and that explains why some counties do not have any.

Liberia has about 10.600 km of primary, secondary and feeder road networks and it is estimated that about 25.8% is in good condition and 24.8 % in fair condition (NMCDP and GoL, 2013). More recent index maintains the low level of roads. The score component of quality of roads included in the Global Competitiveness Index (GCI) of WB for 2016/2017 is 3.1 in a scale of 1 to 7, ranking Liberia the 104 over 138 countries.

The impact of roads on risks faced by agriculture is significant. It increases the post-harvest losses, the prices of selling the products and the risks of pest and diseases avoiding the access to treatments. In the case of human health the inaccessibility of rural areas increase the needed time to get to health care facilities. The poor conditions of roads increase also the risk of flood due to heavy rains.

Electricity

During the Civil War the power sector suffered a devastating blow with the destruction of dams, power plants and facilities, causing a strong impact on generation capacity. Nowadays, the sector has not recovered the levels of the pre-war and Liberian has one of the worst performance and highest power tariffs of Africa (NMCDP and GoL, 2103). Most energy is obtained by generators and to ensure regular power is considered critical to the development of economic activities.

All indexes reflect the problems in the electricity supply. The score component of quality of electricity supply included in the GCI of WB for 2016/2017 is 2.8 in a scale of 1 to 7, ranking Liberia the 117 over 138 countries.



The deficiencies in the production and distribution of electricity are also a major constraint to agriculture in many ways. The lack of affordable and reliable electricity affects to agriculture and hinders the development of value added activities as paddy rice mills or cold storage facilities increasing the risk of post-harvest losses and preventing farmers to market their products along the year.

Financing

The access to credit is a significant constraint to growth in agriculture, hindering getting of inputs and discouraging investments in farming and in the agro-processing. The inaccessibility to credits and finance is conditioned by reluctance of commercial banks to lend smallholders, the limited physical access to commercial banks, the inexistence of secure land titles and formal deeds to use for collateral and the complicated requirements for accessing loans. The access to credit is also constrained by the high risk of crop failure and loan repayments associated with natural risk as weather conditions.

The establishment of branches of commercial banks in rural areas is constrained by poor infrastructures (including electricity) and weak communication network (IMF, 2016). In rural areas non-bank financial institutions play an important role and microfinance institutions offer financial services to rural communities and usually have less strict rules on borrowing but the land tenure problems represent also a significant constraint (NMCDP and GoL, 2103) and lending rates are more expensive than commercial banks (IMF, 2016).

The spread of mobile phone coverage is helping to improve financial inclusion in rural areas but an easy conversion between U.S. dollar and Liberian dollar is needed and a quick customer identification customer should be introduced to combat the AML/CFT (IMF, 2016).

Limited supply of inputs

There is a severe constraint of availability of commercial inputs as seed, fertilizers and farming tools affecting productivity of main crops and conditioning the transformation from subsistence farming to commercial agriculture. The lack of inputs is strongly related with the deficiencies in roads and financing and causes output far below potential. Estimates of % potential production realized in smallholder agriculture ranges from 5,7% in rice, 2,5% in cassava, 0,28% in cocoa and 0.21% in coffee (NMCDP and GOL, 2103).

Land Access

Disputes about land use, access and tenure are endemic in Liberia and important source of conflicts and in many cases is a consequence of ambiguities between customary and formal property rights. Access to land is important for smallholder agriculture and it is a key factor for poverty reduction as insecurity in tenancy hinder the investments and prevent using land as collateral to finance purchases of farming tools, seeds or chemicals to control pests. According to the study Talking Peace conducted by University of Berkeley in 2011, 23% of the respondents of a survey on attitudes about security and dispute resolution, mentioned a land dispute during or after the civil war, mainly related with land grabbing. Similar results are founded in the study Patterns of Conflict in Liberia, realized by Yale University where 25% of respondents were involved in a conflict over land use, being common disputes over boundaries and usage.

The land access constraint appears also to affect new agriculture concessions due to claims from agriculture communities around the country, anchored in customary law. This problem affects especially to palm oil concessions. These disputes may also damage investor confidence in Liberia and hold the potential for widespread community unrest (NMCDP and GoL, 2103). Problems related with land use have also a potential impact on corruption risk.

The situation makes low values to all indicators related with land governance. One of the most significant is the index of quality of land administration system included in the "Registering Property" of the WB Doing Business Indicator (2017), which covers five dimensions: reliability of infrastructure, transparency of information, geographic coverage, land dispute resolution and equal access to property rights. For Liberia the value in 2017 of the quality of land administration systems is 5.0 over 30, ranking 179 over 190 countries.

The Table 37 summarizes the importance and the effects of the main constraints agriculture faces.

Table 37: Main constraints affecting agriculture

Constraint	Index Score	Effects	Impact
Roads	Quality of roads index = 3.1 (1 to 7 scale) Ranking 104 over 138 countries (Global Competiveness index 2016/2017, WB)	High cost of transport Marketing difficulties specially during rainy season Long transport period with spoilage risk of products Difficulties in obtaining inputs and access to services	Very high
Electricity	Quality of electricity supply = 2.8 (1 to 7 scale) Ranking 117 over 138 countries (GCI 2016/2017, WB)	Difficulties of cold storage Limitations on value added activities and agro-processing	Very high
Finance	Ease of access to loans index = 3.6 (1 to 7 scale) Ranking 84 over 138 countries (GCI 2016/2017, WB)	Unavailability of getting equipment, tools, seeds and fertilizers Low investments	High
Land access	Quality of land administration system = 5.0 (over 30.0), ranking 179 over 190 countries (WB: Doing Business report, 2017)	Unavailability of collateral for credit Reduction of output requiring more intensive investment on land	High
Limited supply of inputs		Low levels of productivity	High

Source: Authors elaboration

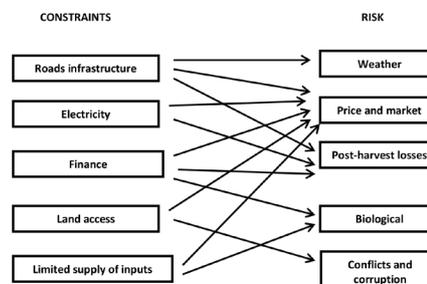
4.2.1.2. Relations among constraints and risks

The importance and severity of some constraints affect the vulnerability of farmers and their possibilities to manage risks in different ways and it is important to take them into account before prioritizing these risks.

Roads and electricity are the most binding constraints. The bad state of roads isolates farmers of markets, hindering the possibilities of selling their products and the access to inputs and services, increases the cost and periods of transport rising prices and post-harvest losses and impedes the way to health care centers. The lack of affordable and regular electricity condition the possibilities to establish storage or agro-processing facilities in rural areas increasing the possibilities of post-harvest losses and of investments in value added activities which rise agricultural incomes.

The difficulties in access to finance have also a significant impact conditioning the possibilities to buy commercial inputs and the investments in farm improvements and agro-processing activities. Part of the unavailability of financial services in rural areas is explained by the state of infrastructures and the problems related with the inexistence of formal land deeds and the impossibility to use as collateral. The land use problems, endemic in Liberia, have also a significant impact on institutional risks, as conflicts and corruption related with concessions. The Figure 40 shows the relations among the main constraints and risks.

Figure 40: Relations among constraints and risks



Source: Authors elaboration



4.2.2. Impacts on livelihood of farmers

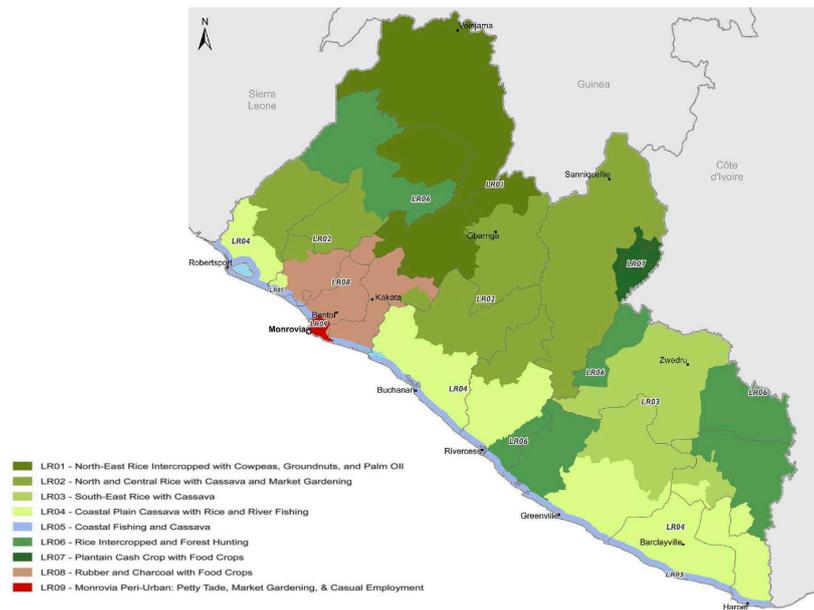
We present the main hazards which have a significant impact on livelihood of farmers based on the publication "Livelihoods zoning plus activity in Liberia" (FEWS NET, 2011). This study considers nine livelihood zones in Liberia and present the main shocks and hazards affecting livelihoods of farmers in Liberia and the key early warning indicators to monitor that hazards and shocks. The Table 38 summarizes the main hazards and shocks and the key early warning indicators for each livelihood zone.

Table 38: A summary of shocks and hazards in the different livelihood zones in Liberia

Livelihood Zones	Shocks and Hazards	Key Early Warning indicators
Zone 1: North-East Rice inter-cropped with Cowpeas and Groundnuts and Palm Oil	Rodent, bird and grasshopper damage to crops. Erratic rain at sowing / planting time	Erratic rains April-June during planting. Excessive rain in June-October. Staple food price spikes
Zone 2: North/Central Rice with Cassava and Market Gardening	Ground hog, bird and grasshopper damage to crops. Erratic rain at sowing/planting time	Staple food price spikes Erratic rains April-June during planting. Excessive rain in June-October
Zone 3: South-East Rice with Cassava	Erratic rain at sowing/planting time Rodent and grasshopper damage to crops	Erratic rains April-June during planting. Excessive rain in June-October. Grasshopper infestations in April and Sept-Oct. Staple food price spikes.
Zone 4: Coastal Plain Cassava with Rice and River Fishing	Excessive rain leading to water-logging of flooding. Rodent, caterpillar and grasshopper damage to crops	Staple food price spikes Excessive rain in June-October.
Zone 5: Coastal Fishing and Cassava	Rough seas in the rainy season leading to capcized boats, low catches, lost nets. Flooding of fields.	Staple food price spikes Cassava commodity price drops during peak selling months
Zone 6: Rice Inter-cropped and Forest Hunting	Wind/ storm, food price spikes.	Staple food price spikes, Flooding from June-September. Grasshopper infestation in May.
Zone 7: Plantain Cash Crop with Food Crops	Cut off from market transport. Crop pests	Grasshopper infestation in May. Fuel price spikes.
Zone 8: Rubber and Charcoal with Food Crops	Crop pests and rodents Food price spikes	Staple food price spikes Grasshopper infestation in May Flooding in Jun-Oct Fuel price spikes
Zone 9: Monrovia Peri-Urban: Petty Trade, Market Gardening and Casual Employment	Food price hikes. Garden pests. Livestock theft. Floods.	Staple food price spikes. Grasshopper infestation in May. Fuel price spikes.

Source: Livelihoods zoning "plus" activity in Liberia. FEWS NET, 2011.

Figure 41: Livelihoods zoning activity in Liberia



Source: A special report by FEWS NET (2011)

As we can see from the table, erratic rain, excess of raining and floods is one of the most important hazard in Liberia affecting livelihoods of farmers directly i.e. provoking reduction of crops production, and indirectly provoking the increasing of post-harvest losses and attack of plant pests and huge difficulties to transportation of products and access to markets due to bad road infrastructure. On the other hand, we have reliable information on time series of raining thanks to the satellite images and therefore we will analyze in depth in the next section the probability of excess of raining and the exposure for the main counties and crops. The other weather hazard that we may analyze in deep trough the satellite images is wind storm although is a much less important hazard affecting farmer's livelihood and is relevant just in some counties.

Floods

To estimate the exposure to a flood event on crop production, we should take in account the probability of a flood event and the concentration of the crop production in that county. Based on the methodology by the work Liberia: Risks (Annex 1) we elaborated a double entry table to estimate the exposure per crop and per county (Table 39). The likelihood of flood is already estimated in section 4.1.2. Based on several statistics we obtained the concentration of production for each crop and the area concentration for the Forest (Table 40). For rice and cassava were based on the percentage of production on 2008 statistics (MoA 2009). In the case of Palm Oil, Rubber and Cocoa the production was based on the number of hectares per county cultivated with those crops (Milbrandt, 2009; Verité, 2012; Hughes et al., 1989).

**Table 39:** Expected situational exposures during the year based on Likelihood of flood and production affected

Scale						
Impact by flood		On a scale of 1 to 25 using higher score to indicate higher expected situational exposures (over 12 months)				
Production affected (%)						
50	100	● 5	● 10	● 15	● 20	● 25
30	50	● 4	● 8	● 12	● 16	● 20
15	30	● 3	● 6	● 9	● 12	● 15
5	15	● 2	● 4	● 6	● 8	● 10
0	5	● 1	● 2	● 3	● 4	● 5
Likelihood of flood		2%	10%	25%	50%	100%
		Very unlikely	Unlikely	Moderate unlikely	Likely	Very Likely

Source: calculations of the authors

Table 40: Concentration of production in each county for several crops and area concentration of Forest, per county

County	% Production (Area for forest)					
	Rice	Cassava	Palm Oil	Rubber	Cocoa	Forest
Bomi	4.6	4.6	0.0	20.0	0.0	2.0
Montserrado	3.4	7.4	1.7	0.0	0.0	1.5
Grand Cape Mount	3.8	3.3	17.6	0.0	3.8	5.0
Margibi	3.3	6.0	0.0	32.0	0.0	2.4
Bong	16.8	7.3	3.5	6.0	10.2	8.2
Gbarpolu	5.5	1.9	0.0	0.0	0.0	10.2
Grand bassa	4.7	10.5	21.1	18.0	3.8	7.4
Lofa	14.9	6.6	8.8	0.0	31.6	10.6
River Cess	2.4	4.1	0.0	0.0	3.8	5.6
Nimba	20.0	26.6	0.0	6.0	35.1	12.3
Grand Gedeh	5.0	7.0	12.3	0.0	0.0	11.5
Sinoe	4.4	2.6	17.6	8.0	3.8	10.4
Grand Kru	3.6	5.0	0.0	0.0	3.8	3.8
Maryland	4.1	3.9	17.6	10.0	3.8	2.1
River Ghee	3.5	3.2	0.0	0.0	0.0	6.9

Source: Calculations of authors based on MoA 2009

The months that were taking in account for each crop is showed in Annex 1. In the case of forest, the likelihood of the flood event used was based in the percentage of area reduction estimated in 2000-2015. Several thresholds for exceed in rain were used depending on the crop: 280 mm for rice, 250 mm for cassava, 280 mm for Palm Oil, 300 mm for Rubber and 280 for Cocoa. The results of the exposure to flood are presented in Table 41.

**Table 41:** Exposure in each crop and forest for each county based on Table 39

County	Exposure in a range from 1 to 25					
	Rice	Cassava	Palm Oil	Rubber	Cocoa	Forest
Bomi	● 2	● 3	● 0	● 6	● 0	● 3
Montserrado	● 2	● 6	● 2	● 0	● 0	● 3
Grand Cape Mount	● 3	● 3	● 6	● 0	● 1	● 4
Margibi	● 2	● 6	● 0	● 8	● 0	● 3
Bong	● 6	● 6	● 2	● 4	● 4	● 6
Gbarpolu	● 4	● 3	● 0	● 0	● 0	● 4
Grand bassa	● 2	● 8	● 6	● 6	● 1	● 6
Lofa	● 6	● 8	● 4	● 0	● 8	● 4
River Cess	● 3	● 4	● 0	● 0	● 2	● 4
Nimba	● 6	● 9	● 0	● 2	● 4	● 4
Grand Gedeh	● 4	● 10	● 0	● 0	● 0	● 4
Sinoe	● 5	● 5	● 3	● 8	● 4	● 4
Grand Kru	● 5	● 5	● 0	● 0	● 4	● 2
Maryland	● 5	● 5	● 3	● 10	● 4	● 2
River Ghee	● 5	● 5	● 0	● 0	● 0	● 4

Source: calculations of the authors 0=no crop; 1= lowest exposure; 25= highest exposure

Wind storms

Analogously, to estimate the exposure to a harmattan (wind storm) event on crop production, we should take in account the probability of a harmattan event and the concentration of the crop production in that county. Based on the methodology by the work Liberia: Risks (Annex 1) we followed a double entry table to estimate the exposure per crop and per county (Table 39). The likelihood of harmattan during a season (from December to March) is already estimated in section 4.1.2 in Table 38 using as a threshold the NDVI value of 0.3.

**Table 42:** Exposure in each crop for each of the selected county based on Table 38

County	Exposure in a range from 1 to 25				
	Rice	Cassava	Palm Oil	Rubber	Cocoa
Bomi	● 2	● 2	● 0	● 6	● 0
Montserrado	● 2	● 4	● 2	● 0	● 0
Grand Cape Mount	● 3	● 3	● 9	● 0	● 3
Margibi	● 1	● 2	● 0	● 4	● 0
Bong	● 6	● 4	● 2	● 4	● 4
Gbarpolu	● 6	● 3	● 0	● 0	● 0
Lofa	● 4	● 4	● 4	● 0	● 8

Source: calculations of the authors. 0=no crop; 1= lowest exposure; 25= highest exposure

These results point out that, in general the Exposure due to excessive rain is much more important than the har-mattan event, in the number of counties affected as well as the exposure value.

5. Prioritization of agricultural risks and management tools/policies

5.1. Framework for agricultural risk management

The development of an Agriculture Risk Management (ARM) policy requires an appropriate institutional framework and complete, updated and reliable information systems and these are two conditions difficult to be fulfilled given that the agriculture faces a broad range and variety of risks that are sometimes interrelated among them. In the section 3.2 Institutional Framework we presented the different public units and bodies administration involved in agricultural risk management and we were able to identify some overlapping, lack of coordination and non-clear assignation of functions and responsibilities. It is therefore proposed to assign clear functions and responsibilities for ARM in order to drive the ARM initiative and that would be discussed in the forthcoming workshop.

Concerning information systems in Liberia the situation is dramatic as we mentioned in section a huge deficit of information and data time series exist and when they exist come from international institutions (WB, FAO, WFP, AfDB, USAID) and are mainly estimates and not always are reliable as the own international sources recognize as we explained with some examples in the introduction of chapter 4. Infact the dramatic lack and non-reliability of information systems is one of the main bottleneck for ARM in Liberia as we mentioned in section 3.3.1 on information systems and also is a serious constraint for this report.

5.2. Prioritization of risks

It was not possible to quantify the frequency, severity and the average economic losses for every agricultural risk due to the lack of data, statistics and information in some agricultural risks. For this reason we followed a methodology for risk prioritization which combines quantitative and qualitative risk assessments depending on the availability and reliability of data. That methodology was based on four elements: 1) the quantitative or qualitative assessments of frequency, severity and worst scenario for the different agriculture risks (Section 4.1); 2) the main constraints identified in Liberia which increase the impact of some agricultural risks and the vulnerability of farmers facing that agricultural risks (Section 4.2); 3) the academic literature review and the searching of reports and studies and analysis from NGOs, consulting, think tanks, cooperation agencies and national and international institutions; and 4) the interviews to experts from NGO, cooperation agencies, international institutions and officers of Liberian ministries and national institutions collected in the field work. Based on these four elements and using the scoring methodology (chapter 6) the Table 43 was elaborated to show the prioritization of the agricultural risks in Liberia.

Table 43: Risk scoring for Liberia.

Risk	Severity	Frequency	Worst scenario	Score
High precipitation (Floods)	● VERY HIGH	● HIGH	● VERY HIGH	4.60
Post harvest losses	● HIGH	● VERY HIGH	● HIGH	4.35
Crop pest and diseases	● HIGH	● MEDIUM	● VERY HIGH	3.85
Livestock pest and diseases	● MEDIUM	● VERY HIGH	● MEDIUM	3.65
Price risk	● HIGH	● LOW	● VERY HIGH	3.37
Politic risk	● MEDIUM	● MEDIUM	● MEDIUM	3.00
Inputs counterfeit	● MEDIUM	● LOW	● MEDIUM	2.59
Windstorm	● LOW	● MEDIUM	● LOW	2.34

Source: Authors based on qualitative assessments of risk and scoring methodology



Based on the analysis presented in this report, the most important risks to tackle for the agricultural development in Liberia are: 1) high precipitation (floods); 2) post-harvest losses; 3) crop pest and diseases; 4) livestock pest and diseases; 5) price risk; and 6) political risk.

The main risk (floods) has a high frequency, a very high severity and a very high worst scenario. In addition the impact of flood is dramatic due to the very bad infrastructure of feeder roads and storage facilities and there are dense interrelationships between the constraints and floods risk as we presented in the Figure 40, provoking all together a dramatic impact and huge vulnerability for farmers facing floods specially in the South of Liberia. The second most important risk is post-harvest losses due to the lack of very bad storage facilities at farm or wholesales and retailer level and the inadequate storage practices of farmers in Liberia. The next risk according to its relevance are crop pest and diseases and livestock pest and diseases, the first higher than the second. The frequency of animal health outbreaks is higher than the frequency of plant pest and diseases infection, but the severity and even more the worst scenario is much higher in plant pest and diseases than in animal pest and diseases due to the fact that the livestock GDP is just the 14% of the total agricultural GDP and therefore the economic losses that are caused by plant pest and diseases is higher than the one from the animal pest and diseases risk.

The next agricultural risk of relevance is the price risk for the food crops the best price information is from WFP but are retailer prices i.e. prices from consumer perspective (food security risk analysis) instead of producer prices which we need for agricultural risk analysis and not always the consumer and producer prices are correlated. For cash crops (exports) like rubber and cocoa we got international prices assuming that these prices are a proxy of the domestic prices perceived by farmers but this is not always true in Liberia. In addition to that, the setting mechanism prices for these crops in Liberia based on public intervention and regulation (LPMC) is not working at all and the growers complain about the low and unstable prices perceived for cocoa and rubber. We are in a transition period to implement a new regulation (LACRA) which means the liberalization of market and monitoring of standard of quality (the low quality provokes the low prices of cocoa and rubber exported by Liberia), but it is not working yet. The lack of added value generation for the cocoa and rubber chain (Liberia sell it as raw material) and the importance from the balance of trade of Liberia makes the potential impact of price risk for cocoa and rubber on farm incomes and balance of trade very high (the impact of worst scenario is very high in Table 43).

On the contrary the food crops mainly rice and cassava have low or medium risk according the time series of prices collected by WFP (retailer prices). In the case of rice almost 60-70% of the rice consumption in Liberia is imported and thus the price of imported rice is influencing the domestic prices although the price of domestic price is much lower than price of imported rice due to the very low quality of domestic rice. Most important, a lot of farmers produce rice or/and cassava for self-consumption and therefore they are not exposed to market price fluctuations. Taking all this into account we assessed that the market-price risk is in the fifth position in the Table 43. This table shows the risk prioritization at national and aggregate level but the risk prioritization is different in cash crops compared with food crops and this will be analyzed in the Table 44 (risk prioritization by subsectors).

The next risk according of importance is political risk as although the severity and worst scenario is medium the frequency is high. We refer to lack or inadequate regulatory framework, institutional weaknesses, poor implementation and enforcement of regulations, unstable political environment and corruption. All this is particularly important in the land rights issue and concessions where the lack of transparency and juridical security is a risk for farmers. Other problem is the slow pace to approve new regulations. At most all people support the change from LPMC to LACRA as it would benefice to the farmers with more high and stable prices for cocoa rubber and palm oil and would ensure the fulfillment of international quality standards and an Act transforming the Liberia Produce Marketing Corporation (LPMC) to the Liberia Agriculture Commodity Regulatory Authority (LACRA) was passed into law in September 2015 by the House of Representatives. Nevertheless, the Act has not been signed and implemented yet.

The next risk is input counterfeit which has a low ranking because the problem in Liberia is not the counterfeit of input but the lack of input which is not a risk but a constraint. The windstorm is a very low risk at national level due to the low frequency and medium severity and worst scenario. But as we will see in the Table 45 of risk prioritization according to regions, wind storm is an important risk in some counties in the North Central counties.

The Table 44 shows the prioritization of agricultural risk according to the different crops and animal production. We can observe that the high precipitation is a high risk for cassava and livestock but just medium score for rice as the excess of rain and floods is not a great problem for rice and cash crops as that crops are located in the North and Central part of the country which are not the most high risk regions of floods. The second risk according relevance is post-harvest losses as it is very high in cassava and rice the two main staple food in Liberia and therefore with a high potential negative impact on food security.

Table 44. Sub-sector breakdown of risk in Liberia

Risk Category	Risk	Cassava	Rice	Cash crops	Livestock
Weather risk	High precipitation	● VERY HIGH	● MEDIUM	● MEDIUM	● VERY HIGH
	Windstorm	● LOW	● MEDIUM	● LOW	● LOW
Biological Risk	Crop pest and diseases	● MEDIUM	● VERY HIGH	● MEDIUM	● MEDIUM
	Livestock pest and diseases/human health	● MEDIUM	● HIGH	● MEDIUM	● VERY HIGH
Infrastructure risk	Post-harvest losses	● VERY HIGH	● VERY HIGH	● LOW	● MEDIUM
Price risk	Price risk	● MEDIUM	● MEDIUM	● HIGH	● MEDIUM
Input risk	Inputs counterfeit	● LOW	● MEDIUM	● LOW	● HIGH
Politic risk	Politic risk	● VERY LOW	● MEDIUM	HIGH	● MEDIUM

Source: Authors elaboration

The crop pest and diseases risk is very high for rice provoking important reduction of rice harvest which implies increasing import and food aid to face food security problems. The lack of pesticides to fighting against the pest and diseases of rice is a constraint that increases the impact and harvest losses from rice pest and diseases. The livestock pest and diseases risk is very high for livestock farmers but the impact at national economy is not very relevant as the livestock subsector represents only the 14% of agriculture GDP. The three main diseases of livestock are Pest des Petit Ruminants (PPR) in goat and sheep, swine fever in pigs and ND in back-yard poultry production. These three are the most devastating diseases for livestock in Liberia, followed by the all sort of non-well defined diarrheal diseases. These diseases occur regularly and damage a great proportion of rural and peri-urban households. About 95% households reared chickens or ducks, 52% reared goats and at least 35% reared pigs in 2013. An important increase in the number of households with chickens, goats and pigs is taking place during the last five years and therefore the risk and impacts of animal and human health (zoonosis) is increasing.

Concerning the price risk we can observe in Table 44 a great difference between the price risks in food crops compared to cash crops. The price risk is high in cash crops which are exported as the farmers growing cocoa and rubber are subject to the volatility of the international markets and the mass of domestic market prices as the transition from LPMC to LACRA still pending. In the case of cassava, rice and palm oil the price risk is medium. But we are not completely sure of that as the data on domestic prices come from WFP and are retailer prices. Since we mentioned above the input risk is low or medium in all crops and livestock (feed and medicines) because the risk is not the low quality of inputs (seeds, fertilizer, pesticides, animal feed and medicines) the problem is the lack of inputs.

Lastly the political risk is very low in cassava, medium in rice and livestock is relevant (high) in cash crops. This can be explained because in that crops the goal is not self consumption i.e. food security but sell it in the market and to export and thus the growers are exposed to the international market volatility and even more to the mass of domestic market as the price setting mechanism is based in public market intervention and control (LPMC) and the transition to a more liberalized and transparent market (LACRA) is still pending. In addition, the cocoa and rubber and now for palm oil in the south the expansion of these cash crops are based on concessions and there are not clear criteria to grant that concessions and the farmers are complaining against corruption.

The Table 45 shows the prioritization of agricultural risk according to the different regions in the country. For this table we consider five regions in Liberia: Montserrado that includes Monrovia, North Western, North Central, South Central and South Eastern (Figure 42). As we can observe in that Table the main risk in Liberia flood is very high in the South regions provoking huge impacts in these regions due to the combination of very high risk of huge precipitations and very bad road infrastructure (constraint). Instead the risk of wind storm is very low or low in all country except in North Central Region where are the counties affected by this risk. The risk of post-harvest losses is very different across regions. Is low in Montserrado, medium in North Western, high in North Central and South Central and very high in South Western, More far from Monrovia more post-harvest losses risk as the road and storage facilities are much worst in the south and excess of raining in the South is negatively affecting post-harvest losses.

Concerning biological risks the crop pest and diseases risk is just high in North Central and South Central regions where the upland rice cultivation is concentrated. In Montserrado the risk is low and medium in North Western and South Eastern. In the case of livestock pests and diseases risk are relatively high throughout all the rural areas, except North Western Liberia and medium in Monrovia because of the establishment of animal farms in the peripheral areas.

The price risk is different in the North compared to the South. The Southern regions have a high price risk since they are the furthest regions from Monrovia and the frequent floods collapse the roads and prevent the transport to and from outside provoking impacts on food markets and prices. Lastly the input risk and political risk is very similar in all regions and ranking from low to medium risk.

Table 45. Geographical breakdown of risk for Liberia.

Risk Category	Risk	Montserrado	North Western	North Central	South Central	South Eastern
Weather risk	Rain	● HIGH	● MEDIUM	● HIGH	● VERY HIGH	● VERY HIGH
	Windstorm	● VERY LOW	● LOW	● MEDIUM	● LOW	● VERY LOW
Biological Risk	Crop pest and diseases	● LOW	● HIGH	● VERY HIGH	● MEDIUM	● MEDIUM
	Livestock pest and diseases/ human health	● MEDIUM	● MEDIUM	● HIGH	● HIGH	● HIGH
Infrastructure risk	Post-harvest losses	● LOW	● MEDIUM	● HIGH	● HIGH	● VERY HIGH
Price risk	Price risk	● LOW	● MEDIUM	● MEDIUM	● HIGH	● HIGH
Input risk	Inputs counterfeit	● LOW	● LOW	● MEDIUM	● LOW	● LOW
Politic risk	Politic risk	● LOW	● MEDIUM	● MEDIUM	● MEDIUM	● MEDIUM

Source: Authors elaboration

Figure 42: Region definitions by County.



Source: Household Income and Expenditure Survey 2014 - Statistical Abstract - March 2016

5.3. Improved use of risk management tools

The prioritization of risk based on their frequency, severity and the worst scenario is a necessary starting point for the development of a risk management strategy for Liberia. Based on this prioritization it is possible and necessary to decide which risk management tools and policies are most promising to mitigate or manage agricultural risks and provide the best investments cost-effectiveness.

Cost-effectiveness analysis of various risk management tools would require further research. That analytical work would be important to develop a sound basis for policy making and make decision on which investments in risk management tools would generate the largest possible benefits but the lack of full and reliable data and information in Liberia at this stage is a severe constraint to make this analytical work.

The Table 46 provides an overview on risk management tools that might be suitable to improve risk management in Liberia based on the risk prioritization in the previous section. But To decide which is the best combination of risk management tools and polices in Liberia, it is necessary to follow a holistic approach as there are important interrelationships among the different risks and thus risks can often not be managed in isolation: e.g. excess of rain and floods directly will lead to a weed environment affecting negatively plant pest infestation and diseases and post-harvest losses as well as market access and food prices due to the collapse of roads.

**Table 46:** Risk management tools for Liberia.

Ranking	Risk	Risk management option
1	Rain (floods)	Watershed management (Infrastructures improvement, roads, drainage); Information system and early warning;
2	Post-harvest losses	Infrastructure improvement (roads, storage facilities warehouse); Extension services (Adequately information, and training farmers)
3	Crop pest and diseases	Extension services (Adequately information, and training in plant health management); Diagnostic laboratories for analysis of plant health (Infrastructures improvement); Improvement of input availability (pesticides) Information system and early warning; Improved varieties
4	Livestock pest and diseases/human health	Improvement of Veterinary services, implementation of an epidemiology unit and diagnostic laboratories for animal health; Information system to improve preparedness and early warning; Reinforce implementation of WASH
5	Price risk	Market information system Strategic reserves Market Liberalization Quality standards regulation and control
6	Politic risk	Strengthening the institutional framework; Security of land rights (land tenure system)
7	Inputs counterfeit	Strengthening the agro-input market and distribution chain Extension services (Adequately information and training farmers)
8	Windstorm	Information system and early warning

Source: Authors elaboration

Risk management is a combination of risk mitigation, risk transfer and risk coping tools. We should clarify in coherence with the section 4.2.1 that agricultural risk mitigation can be done through the reduction of farmers exposure or the reduction of constraints e.g. improving roads infrastructure mitigate the risk and impacts of floods or improving availability and quality of inputs (pesticides) would reduce the risk and impact of crop pest and diseases.

The first stage in which risk management needs to be made is at farmer level through best practices and diversification (extension services) or transferring risks (crop insurances) which at present does not exist in Liberia. Other risks need investments from the Government of Liberia to provide public goods i.e. investments in public infrastructures feeder roads and storage facilities. That risk management policies are costly but the benefit might be very high and likely the internal rate of return (IRR) would be high. But given the scarcity of public resources the question to decide would be for instance what is the optimal level of road infrastructure investments and what are the priority roads, i.e. it would be necessary to draft and approve a road infrastructures plan. But even in systems with risk reduction and transfer systems, large scale events (natural or market disasters) can still harm the farmers at large. For these events, risk coping mechanisms have to be established such as social safety nets (cash transfers, food aid, food for work, cash for food, school feeding and others). The following sections highlight some issues related to the use of risk management tools in Liberia and provides some recommendations.

5.3.1. Risk reduction

5.3.1.1. Information and early warning systems

The information and early warning systems in Liberia are very poor. Most of information and data comes from the international information systems (FAO, WFP, USAID, AfDB, WB and others) and are not observed data but estimates not always reliable. To building a comprehensive set of updated, accessible and reliable national information systems for ARM should be a high priority for the GoL. This need an adequate institutional framework to delimit competences and responsibilities and avoid overlapping and vacuum, and the funds for the necessary investment to create or improve these systems and the stable financing to ensure the functioning and the sustainability of the information systems for ARM.

The cost-effectiveness of that ARM policy might be very high as the necessary investment would not be very high thanks to the ICT (the last generation of information and early warning system based on Mobil phones collection and dissemination of information is much cheaper) and the benefit for farmers and GoL policy makers could be very large. But in addition to improving the institutional framework and having investment financing, building capacity to build such information systems is needed.

The international organization that provide data and information for Liberia would be interested in improving the data and information on Liberian agriculture and therefore could provide technical assistance for capacity building, and financing assistance to build the national information and early warning systems complemented with donor contributions. But to ensure the sustainability of these national information systems, the financial engagement of GoL would be needed.

The GoL could use the risk prioritization presented in Table 43 to establish the priority information thematic areas in which the national ARM information systems should be built. The Table 42 could be used for prioritization of early warning indicators for farmers' livelihoods adding the indicators for food security early warning in coordination and cooperation with the current international food security early warning systems: GIEWS (FAO) WFP-VAN and FEWS NET (USAID).

5.3.1.2. Improving agricultural practices

It is important to raise awareness of farmers on the main risk that they are facing its impacts on farmer food security and income which will be different in each region according to the different ecosystems and the main crops or livestock present in the region. It is also important to promote a learning process of the farmers to know the best way to manage the risks and protect their livelihoods and income. This requires well trained and informed extension officers that can provide practical advice to farmers based on technical and scientific evidence which in turn needs that National Agricultural System (CARI) pay attention to research and experimentation in the best practices to reduce agricultural risk at farmer level.

To improving and strengthening the National Extension Services in Liberia and to integrate risk management into the core extension messages is key to help farmers to understand how they can mitigate, transfer or coping with agricultural risks. It will be needed to extend the geographical scope of extension agencies, to training the extension officers and to feed the network of extension offices with the main agricultural risks by region and crop or livestock. To achieve this feeding the Table 44 and Table 45 from this report might be used.

This risk management tool may be very cost-effective to mitigate some risk. Take the example of post-harvest losses risk. We can reduce that risk investing in improving the storage facilities infrastructure or improving storage practices. But the cost-effectiveness of improving practices would be surely higher than the cost-effectiveness of the investments in improving storage facilities at farm level.



5.3.1.3. Warehouse receipts

The warehouse receipts is an instrument to manage market risk. The warehouse receipts give titles to farmers after leaving the harvest in warehouse but before selling it and these titles allow farmers to access to services and credit. LATA proposed the establishment of a system of warehouse receipts but unfortunately that system is still pending

5.3.1.4. Improving access to inputs

Warehouse receipts titles may be used to buy inputs and that could improve the access to inputs. The recent creation of ADAL may also improve the transparency and functioning of input markets.

Improvement of accessibility to raw materials and other inputs for animal feed are highly recommended to increase productivity, animal health, food accessibility and food security.

The cost of transport of inputs is very high due to bad road infrastructures and storage facilities. Therefore improving the access to inputs needs complementary policies as improving infrastructures of roads and storage facilities. In addition the free distribution of inputs by cooperation agencies and NGOs may create difficulties in building a modern and efficient input sector.

5.3.1.5. Market liberalization, transparency and control of quality standards

The LACRA proposed in the context of LATA is an interesting Liberian initiative for liberalization of agricultural markets and regulate and control the quality standards of cash crops (cocoa and rubber), as the low prices paid to cocoa and rubber exported by Liberia is mainly due to the low quality of the product and the non-fulfillment of international standards. The change from LPMC to LACRA would benefit Liberian farmers as it would ensure the fulfillment of international quality standards and allow farmers to receive higher and more stable prices for cocoa rubber and palm oil. An Act transforming the LPMC to the LACRA has been passed into law in September 2015 by the House of Representatives but unfortunately the Act has not been signed and implemented yet. We encourage the GoL to proceed in signing and implementing the LACRA Act.

LACRA could play an important role in collecting and providing information and data on market prices which is one of the most important weaknesses of the ARM national information systems in Liberia. Therefore we recommend creating a complete, well disseminated, accessible and reliable price information system for food and cash crops based on LACRA.

Finally, we recommend putting in place a policy of strategic food reserves in Liberia but not for price stabilization but food security purposes. Nevertheless, we think that this kind of policy would have more sense at regional level (ECOWAS) than at national level. In fact the EU is funding a project to create a regional emergency food reserve for ECOWAS, and we suggest the GoL to be involved actively in this project.

5.3.1.6. Infrastructures investments (roads, storage facility, electricity and communications)

The lack or deficient infrastructures (feeder roads, storages facilities and electricity) is one of the most relevant constraints for the Liberian agriculture and increase largely the impact of some agricultural risks like floods, post-harvest-losses, food markets and food security. The problem is that the necessary investment might be very high and the Government of Liberian has a very limited budgetary capacity. Therefore a careful analysis of cost-effectiveness should be made to decide the optimal level of investment and the priority of roads and storage to be built or rehabilitated and to include all these questions into a National Infrastructures Plan for Liberia (NIPL) that should be financed mainly for the international cooperation agencies and development banks.

Currently there are a lot of small projects in which some components for improving feeder roads, storage facilities and warehouse are included (see Section 3.3.6). But it is not enough. Instead of an array of scattered small projects it would be much better to draft the National Infrastructures Plan for Liberia and to ask donors, international cooperation agencies and international development banks to co-finance that National Plan.

The infrastructure for communication (ITC) is very important as may connect the rural areas with the rest of country when the floods isolate the South, and this solution would be cheaper than to rehabilitate or build. Moreover ITC would facilitate the information collection and dissemination.

5.3.2. Risk transfer

To establish and implement an agricultural insurance policy in Liberia would be very costly and risky due to the lack of historical data on yields and prices for all crops and livestock products at national and county level. Thus, the first work to pave the way to establishing an insurance policy for agriculture in Liberia is to create and/or improve the ARM national information systems.

5.3.3. Risk coping

Some risks cannot be mitigated or transferred and the implementation of coping tools must be needed to help farmers to recover their impacts and to absorb losses (among them, social safety nets or livelihood recovery programs). Social safety nets programs have been implemented in many countries with the objective of reducing poverty. There are many kinds of social safety nets implemented to reduce the poverty, including cash transfers (cash or vouchers), in-kind transfers or food-for-work programs. These transfers can be unconditional or linked to health or education objective and even coping with price risk is not the objective of the safety nets, in some cases can limit the damage from high prices maintaining poor household the access to food and essential services and avoiding the resource to other measures less efficient.

6. Data sources and methodology

Weather risk

A carefully analysis of precipitation pattern was done based on data available from OAA/FEWS NET by county of monthly precipitation on crop land from 1996-2012.

The dry effect of the harmattan is to study de anomalies of the vegetation indexes during these months. One of the most common used is the Normalized Difference Vegetation Index (NDVI). This index has a range from 0 to 1, closer to the unit the vigour of the vegetation is better. Based on the available data from FAO the statistics of the NDVI per county has been recollected. All the vegetation indicators are based on 10-day (decadal) vegetation data from the MetOp-AVHRR sensor at 1 km resolution from 2007 onwards. Data at 1 km resolution for the period 1989-2006 was derived from the NOAA-AVHRR dataset at 16 km resolution.

Several natural and biological disasters were obtained from EM-DAT (2017).

Biological risk

In the section of crop pest and disease due to the lack of quantitative data, the assessment has been made through the compendium of international sources such as CABI, AfricaRice and CGIAR, scientific literature and travel information made in April (See details in following section).

In the section of animal health, a qualitative evaluation has been applied following a methodology proposed by the WB (2016) when no quantitative data are available. The prioritization presented below should be fine-tuned after additional interviews with local farmers and livestock officers at national and county levels. The estimated risk for farmers based on occurrence and severity for the main livestock diseases in Liberia has been analyzed with the feedback from a questionnaire sent to the Ministry of Agriculture.

Infrastructure risk

The post-harvest losses have been estimated for Sub-Saharan Africa. The main source has been APHLIS, is available on the web at <http://www.aphlis.net>.

Prices risk

The main data sources for the analysis of price risk has been the data based produced by the FAO-WFP (rice, cassava and palm oil), ICCO (Cocoa) and ANPRC (Rubber).

For the statistical analysis of prices, the coefficient of variation (CV) has been calculated, which measures the degree of variability of prices and yields time series. The CV is the standard deviation divided by the mean and its main advantage is that it can be compared across variables that are measured in different units, for instance a CV of prices can be compared with a CV of yields or revenues. The yield data was obtained from FAOSTAT. In general, it has been used data of prices and yields of the last seven years starting from 2008-2009 until 2014-2015, according to available data. In the case the cocoa price the data has been used of the last twelve years (2005-2016).

The analysis looks at both seasonal variations and variations between the years. Intra-annual variability is calculated for the 12 months of each year. Inter-annual variability is calculated for the average price across the 5-7 years.

Notes on risk scoring

Risk analysis was carried out first by looking at the average severity and frequency of shocks as well the worst-case scenario. The qualitative qualifications given were low, very low, medium, high, and very high. Then these qualifications were converted a scale 1 to 5.

The scores were weighted based on the following formula to reflect the greater importance of average loss as a better indicator for the long-term cost of risk:

$$\text{Risk Score} = 0.75 * (\text{Average Severity} * \text{Frequency})^{0.5} + 0.25 * \text{Worst Case}$$

Table 47: Risk scores in Liberia.

Risk	Severity	Frequency	Worst scenario	Score
Rain	5	4	5	4.60
Post-harvest losses	4	5	4	4.35
Crop pest and diseases	4	3	5	3.85
Animal health/human health	3	5	3	3.65
Price risk	4	2	5	3.37
Politic risk	3	4	3	3.35
Inputs counterfeit	3	2	3	2.59
Windstorm	2	3	2	2.34

Source: Authors elaboration

Field research

In April (from the 6th to the 14th) a trip to Liberia was made, in order to complete and corroborate the information gathered from the distance. Prior to the trip, an identification of the main offices and professionals responsible for the information that was needed for the RAS was conducted.

Subsequently, a follow-up work with the people interviewed was performed in order to obtain the required documents and to solve enduring doubts.

1. Stakeholder mapping

A desk stakeholder mapping work was conducted with the support of an external consultancy agency acting in Liberia (Liberia Monitors). Through these two procedures a mapping of the stakeholders in the fields of work of interest for the RAS (with reference people) was elaborated. This mapping was used to structure the list of questions to be made during the field trip.

2. Field trip

Several governmental ministries and agencies were visited, with the support of Mr. Jallah Kenedy. Table 48 shows a list of the visited offices and experts that were interviewed.

**Table 48:** Consultant team visits in Liberia.

Agency	People interviewed	Obtained information and data	Date
Association for Geographic Information (AGI)	Jonathan Said	LATA and LACRA current state and challenges, general agricultural risks	7 th April
Independent consultant	Samuel Koffa	Forestry	7 th April
CARI	Walter Wiles, Arthur Bob Karnuah	Crop varieties; livestock varieties, pests and diseases; market challenges	10 th April
LHS	Anthony Kpadeh, Victor Toby, Edward S. Page, Momo Kamara	Meteorology and associated risks	10 th April
EPA	Benjamin Karmoh, Berexford Kennedy	Power supply, general agricultural risks	11 th April
LPMC	Kafumba Kenneth, Rickard Mengle, Jonh Martin	LACRA, Warehouse Receipt Systems (requested for a list of cacao agrarian prices and exportation series)	11 th April
NSL	Samuel Liberty, Melvin A. Tukpah, Pins D. Adjanho, Weleegbeh Nicholas Williams	Laboratory functioning	12 th April
BNF	William Boeh	Fisheries	12 th April
Independent consultant	William K. Massaquoi (former USAID official)	Rice risks	12 th April
LISGIS	Ms. Garpou, Daniel F. Kingsley	LISGIS functioning	13 th April
MoT	Amos J., Borbor, Albert Sherman	Early Warning System Project	14 th April

A short visit to MoA (received by Mr. Patrick Worzie, on Monday the 10th April) was also made, in which the consultant team was required to ask for a formal meeting and to inform about the aims of the mission. Although this requirement was duly addressed, the consultant team was not received at MoA for an interview.

3. Follow-up

Once from Madrid, a follow-up with the interviewees was conducted in order to gather further data and information, signaled during the visits. Thus, several emails were exchanged with the following offices/experts: AGI, CARI, LPMC, BNF, William K. Massaquoi.



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PARM
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Liberia



Annexes



A.1. Seasonal exposure to weather risks per crop and per county based on livelihoods zoning “plus” activity in Liberia. Few's Net, 2011.

Rice

County	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Bomi					X	X	X	X	X	X	X	X
Montserrado					X	X	X	X	X	X	X	X
Grand Cape Mount					X	X	X	X	X	X	X	X
Margibi					X	X	X	X	X	X	X	X
Bong					X	X	X	X	X	X	X	X
Gbarpolu					X	X	X	X	X	X	X	X
Grand Bassa					X		X	X	X	X	X	X
Lofa					X	X	X	X	X	X	X	X
River Cess					X	X	X	X	X	X	X	X
Nimba					X	X	X	X	X	X	X	X
Grand Gedeh					X	X	X	X	X	X	X	X
Sinoe				X	X	X	X	X	X	X		
Grand Kru				X	X	X	X	X	X	X		
Maryland				X	X	X	X	X	X	X		
River Ghee					X	X	X	X	X	X	X	X

Cassava

County	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Bomi	X	X	X	X	X	X	X	X	X	X	X	X
Montserrado	X	X	X	X	X	X	X	X	X	X	X	X
Grand Cape Mount	X	X	X	X	X	X	X	X	X	X	X	X
Margibi	X	X	X	X	X	X	X	X	X	X	X	X
Bong	X	X	X	X	X	X	X	X	X	X	X	X
Gbarpolu	X	X	X	X	X	X	X	X	X	X	X	X
Grand Bassa	X	X	X	X	X	X	X	X	X	X	X	X
Lofa	X	X	X	X	X	X	X	X	X	X	X	X
River Cess	X	X	X	X	X	X	X	X	X	X	X	X
Nimba	X	X	X	X	X	X	X	X	X	X	X	X
Grand Gedeh	X	X	X	X	X	X	X	X	X	X	X	X
Sinoe	X	X	X	X	X	X	X	X	X	X	X	X
Grand Kru	X	X	X	X	X	X	X	X	X	X	X	X
Maryland	X	X	X	X	X	X	X	X	X	X	X	X
River Ghee	X	X	X	X	X	X	X	X	X	X	X	X



Palm Oil

County	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Bomi												
Montserrado		X	X	X	X	X						
Grand Cape Mount		X	X	X	X	X						
Margibi												
Bong		X	X	X	X	X						
Gbarpolu												
Grand Bassa		X	X	X	X	X						
Lofa		X	X	X	X	X						
River Cess												
Nimba		X	X									
Grand Gedeh	X	X	X								X	X
Sinoe	X	X	X								X	X
Grand Kru												
Maryland	X	X	X								X	X
River Ghee												

Rubber

County	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Bomi	X	X	X	X	X	X	X	X	X	X	X	X
Montserrado												
Grand Cape Mount												
Margibi	X	X	X	X	X	X	X	X	X	X	X	X
Bong	X	X	X	X	X	X	X	X	X	X	X	X
Gbarpolu												
Grand Bassa	X	X	X	X	X	X	X	X	X	X	X	X
Lofa												
River Cess												
Nimba	X	X	X	X	X	X	X	X	X	X	X	X
Grand Gedeh												
Sinoe	X	X	X	X	X	X	X	X	X	X	X	X
Grand Kru												
Maryland	X	X	X	X	X	X	X	X	X	X	X	X
River Ghee												



Cocoa

County	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Bomi												
Montserrado												
Grand Cape Mount						X	X	X	X	X	X	X
Margibi												
Bong						X	X	X	X	X	X	X
Gbarpolu												
Grand Bassa						X	X	X	X	X	X	X
Lofa						X	X	X	X	X	X	X
River Cess						X	X	X	X	X	X	X
Nimba						X	X	X	X	X	X	X
Grand Gedeh												
Sinoe						X	X	X	X	X	X	X
Grand Kru						X	X	X	X	X	X	X
Maryland						X	X	X	X	X	X	X
River Ghee												



A.2. Field questionnaire to be completed by experts

Initiatives: verify information of the table. Are they working yet? What is the Budget?

Plant health. Crop and pests diseases

Policies, organization

1. What are the official **policies, legislation and/or standards** related to plant health? (scope, year of enactment, implementation advances)
2. What division is in charge of **biosecurity**? (how many workers, reporting division, training)
3. In what international biosecurity organizations is Liberia a part? (activities carried out in the country...)
4. How do the different **national agencies** working in biosecurity-related areas communicate? And at a regional and international level?

Management

5. Strengths and weaknesses in each of these areas:
 - Inspection
 - Quarantine
 - Certification/ verification
 - Enforcement
 - Diagnostic services/ laboratories
6. Are there any facilities available to assist producers / processors in your field?
7. What do you think are the biggest risks/ threats to plant protection?

Information systems

8. What emergency system do you have and how does they work (identification of the pest, solution...)?
9. NSL: Do they work with pants too (pest identification)?

Crop production and protection

Information systems

10. Which is the most important source of the data? (Statistical Agencies, Ministries, Private companies...)

For the most important sources, answer the following questions.



Data collection

- a. Where are the data collected? (Data collection level: Agro ecological region, County, Farm holder...)
- b. How and who collects the data?
- c. How often are the data collected?

Product	Seasonal survey	Annual survey	Census	Other
Harvest				
Damages (*)				
Management (fertilizer, seed, pesticides)				
Storage				

(*): including birds, locus, hailstorms, floods, droughts, pests, diseases

- d. How is the input, harvest and storage quality control done? Mark with an x

Product	Farmer/holder	Cooperatives	Official surveys	Private companies	Export companies	Others
Seeds						
Fertilizers						
Pesticides						
Comments						

- e. Are the data validated? How is the data validated? (Supervisors, Ministries, Private companies, no validation) are they published?
- f. Can I have a pest and diseases series?

Services provided/Agrarian extension

- g. What information is provided? Enumerate. (production, area cultivated, crop damages, statistical bulletins...)
- h. How is the access to the information? (Free, Fees, under demand...)
- i. What other support do you give?
- j. Do you do any surveillance of the progress achieved with these services?
- k. Do you have any register of inputs & yields?
- l. Do you follow the way made by seeds? What seeds (kind, variety) are given to farmers?
- m. How do you manage language diversity?

Policies:

11. How are the different harvest strategies integrated? (cassava, rubber, palmoil, rice...)
12. What is their level of implementation?
13. Are they designed for national consume or for exportation? Do you already have demand of these products?
14. How do they interfere with **forestry**?



CARI

15. What seeds/varieties are analyzed, certified and distributed? What seeds have been certified? Are they local varieties?
16. How does the certification system work?
17. Where do the seeds come from?
18. Who finances the certification program?

Meteorological risks

Meteorological services

19. Is there a meteorological service? What ministry and department are responsible for it? Who finance it / how is it financed?
20. Where are the meteorological stations located? What information do they get (T, ppt, radiation, evapotranspiration...)? How often do they take the information?
21. LWB: ask for the 53 year series (Dr. Koffa, UNDP, 2008 published)

Information systems

22. Do you have any information/alert system? How does it work (radio, mobile...)? Is it free? When is it activated?
23. What data series do you have? Floods, storms, heat-waves...? (with location and date)

Fisheries

24. "National fisheries and aquaculture": is it already been implemented? Could I get the document?
25. How are fishing concessions given?
26. Have you seen any evolution of fisheries (fish quantity, species...)?
27. Do you do biological stops in the fishing activity?
28. How do you control the evolution of the fisheries?
29. How do you control the markets and the catches?
30. Who controls the ports?
31. Do you make any control of **climate change** influence in fisheries? How? Have you notice any influence?

Animal and human biological risks

Animal health

32. What animal diseases are currently more significant in Liberia?

Trans-boundary Animal Diseases (TADs)

In bovines:

- Contagious Bovine Pleuropneumonia (CBPP)
- Foot and Mouth Disease (FMD)
- Blackquarter (BQ)
- Lumpy Skin Disease (LSD)

In small ruminants:

- Contagious caprine pleuro-pneumonia (CCPP)
- Pest des petits ruminants (PPR)

In poultry:

- Newcastle Disease (ND)
- Avian Influenza (AI)

33. Are of the following animal diseases, which were listed by the GOL in 2007, of any significance for the Liberian livestock currently?:

- African Swine Fever (ASF)
- Rabies
- Tuberculosis
- Swine flu
- Brucellosis
- Anthrax
- Salmonellosis
- Fluke (water and fish parasite)
- Tick (external parasites)
- Mange (skin parasite)
- Trypanosomiasis
- Pastoralosis hemorrhagic septicemia
- Piroplasmosis
- Anaplasmosis
- Babesiosis
- Theileriosis

34. Are there official veterinary campaigns being implemented currently or only within selected counties where NGOs operate? How are they implemented? Who finances them?

35. What is the probability of having an outbreak of any major contagious animal disease in Liberia? (very low, low, moderate, high, very high) What animal disease is more frequent? And more severe?

36. What is the estimated humanitarian impact of contagious animal diseases outbreak? (very low, low, moderate, high, very high) what animal disease poses more risks of humanitarian impact?

37. The policy of the Ministry of Agriculture and Ministry of Health and welfare mentions that veterinary vaccination and disease prevention plans are to be implemented. Is there any plan currently being implemented in practice?



Human health: Communicable diseases:

38. Have vaccination and/or prevention campaigns been fully reactivated after Ebola crisis or only partially? What counties/zones are better and which are worse? How is this measured?
39. Which are the most relevant diseases Liberian people? Give a value from 1 to 10, being 1 very low and 10 very high
 - Malaria
 - Diarrheal disease
 - Cholera
 - Lassa fever
 - Yellow fever (Transmitted by rats)
 - Acute respiratory illness,
 - Measles
 - Schistosomiasis
 - Tuberculosis
 - River Blindness (Onchocerciasis)
 - Aedes (Transmitted by mosquitoes)

Other questions related to biological risks:

40. Is clean water available and water sanitation infrastructure being improved sufficiently in urban and rural areas? Are there new programs? Who finances? Period?
41. Are personal hygiene practices and education programs being implemented? Who implements them? How? What program? Who finances? How is success being measured?
42. What is the capacity of Liberian institutions to cope with animal diseases and other biological shocks: (Very low, Low, Moderate, High, Very high)
43. Flooding has been identified as a risk factor which increases occurrence and vulnerability to waterborne diseases (Malaria, Cholera, Diarrhea, Paludism). What increases the risk of flooding?
 - Deforestation: Yes or No
 - Poor drainage systems: Y or N
 - Poor water waste management: Y or N
 - Urbanization obstructing the waterways: Y or N
44. Do Liberia households have increased their vulnerability to waterborne diseases in urban areas? And in rural areas? For example:
 - Monrovia slum areas
 - River Cess
 - Grand Cape Mont
 - Grand Kru
45. Do Liberia households have access to improved water sources and improved sanitation in urban and rural areas?
46. Is the situation in the following areas better today than after Ebola in 2015?
 - Monrovia slum areas
 - River Cess
 - Grand Cape Mont
 - Grand Kru
47. Which of the following are main reasons for a high vulnerability to biological risks and communicable diseases outbreak for humans? And for animals?:
 - Socio-economic
 - Institutional
 - Infrastructure



48. Is Liberian people still fearful of visiting health facilities to avoid infection with Ebola virus? Has this situation improved significantly since 2015?
49. A 75% reduction in vaccination was reported after Ebola outbreak because people were fearful of infection. As a consequence, cholera, measles, malaria and polio incidence increased greatly as major causes for mortality of children under 5 years old. What is the current situation?
50. Is there any Information system currently working nationally and or regionally to communicate with farmers?
51. Is there any "Rapid Alert System" to reduce vulnerability to environmental (flooding alert) or biological (Pest alert)?

Mapping of existing "BIOLOGICAL" risk management policies and tools

Questions about the IPMP (Integrated Pest Management Plan) for the Liberian REDISSE (Regional Disease Surveillance Systems Enhancement):

52. Within the IPMP it is mentioned that within the first two years of the project "relevant safeguard consultants will help building the capacity of the local health care institutions for the implementation of the disease surveillance systems enhancement". This point has been identified as critical for the biological risk management. Is it working efficiently currently?
53. How does the Health Management Information System (HMIS) interact or relates with the Regional Disease Surveillance Systems Enhancement project (REDISSE)?
54. There is US \$ 30M assigned to Liberia from the budget of US \$ 230M of REDISSE. Is part of this budget being assigned to increase the surveillance and control of main pests and animals diseases currently? Is it being used for capacity building of the local communities to improve preparedness of veterinary services for disease outbreaks?
55. Question about LASIP (Liberia Agriculture Sector Investment Program). This is a program to incentivize public and private investment in the agriculture sector of Liberia. There is a subprogram for Livestock Development and Promotion with a budget of US \$ 11.1M.
56. Is there any initiative or project identified in relation with the prevention or control of biological risks, pests and diseases of animals or humans?

Market, infrastructure and food security

57. LATA:

- a. What are its development and implementation advances
- b. Could I have the text?
- c. Advancements of the e-registration platform? And mobile wallets?

58. LACRA:

- a. Is it already approved? Is it already working?
 - b. Could I have the text law and its normative development?
 - c. How will it affect to prices and markets (staple products: rice, cassava) and exportation product (cacao, coffee, oil palm, rubber)?
 - d. How will LACRA inform farmers about their prices?
59. Are the Warehouse Receipts Systems being approved and working? How do they work?



Prices and markets

60. Are there any national information system with historical series of **agrarian prices**, in which we could see the frequency and severity of price rises/drops? (product prices vary a lot from one zone to another, take big zones and not counties)
61. How is market integration and national information about markets and food security at the regional level (ECOWAS)? Will taxes go up? When? For all crops (also rice)?
62. Any statistics about agrarian product importation and exportation? (ECOWAS, world) (tones, products, money)

Food security

63. Who is in charge of food security at the government level? Do you have national information systems with food insecurity historical series (frequency and severity)? Mainly for the South of the country?
64. Do you have data (historical serie) on the food security shocks and emergency food reserves?
65. Do you have early warning systems about food prices and food security? Who runs them? How do they work? When are they activated? Who do they reach?
66. How do you measure the annual food aid (volume and money)? Do you have a register?

Roads

67. Do you have new program to renovate the roads or build new ones? Local roads that connect exploitation to markets or what kind? Where will these roads be located? When will they be finished? Who finances? Budget?

Storage

68. Do you have new programs to renovate or build new crop storing facilities to reduce post-harvest loses and to better manage security stock? Who is managing them? How many? Where? When will they be finished? What crops? Who finances? Budget?

Insurance

69. What are the agricultural insurance initiatives/programs? Who manage them?
70. What risks are covered what losses are covered?

Microcredits

71. What are the existing microcredit initiatives/programs? Who finances them?
72. How do they work? What criteria is followed to give them? What period and quantity?



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