Ministry of Agriculture

GOVERNMENT OF THE REPUBLIC OF LIBERIA

West Africa Agricultural Transformation Project-P164810

Pest Management Plan

April, 2018

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ACRONYMS

ADA	Association of Agro-input Dealers
AfricaRice	Africa Rice Centre
CAO	County Agricultural Officer(s)
CARI	central Agricultural Research Institute
CEO	County Environment Officer
CERC	Contingent Emergency Response
CGAIR	Consultative Group on International Agriculture Research
CHAP	Community of Hope Agriculture Project
COD	Chemical Oxygen Demand
CORAF/WECARD	West and Central African Council for Agricultural Research
CSA	Climate Smart Agriculture
ESMU	Environmental and Social Management Unit
ECOWAS	Economic Community of West African States
EHS	Environment, Health and Safety
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMPs	Environmental and Social Management Plans
ESMT	Environmental and Social Management Team
FBOs	Faith Based Organizations
GoL	Government of Liberia
HIV/AIDS	Human Immuno Virus/Acquired Immuno Deficiency Syndrome
ILO	International Labor Organization
IPPC	International Plant Protection Convention
IPM	Integrated Pest Management
ITPGRFA	International Treaty on Plant Cenetic Resources for Food and Agriculture
IITA	International Institute for Tropical Agriculture
IVM	Integrated Vector Management
LASOP	Laboratory Standard Operating Procedures
M&E	Monitoring and Evaluation
MoA	Ministry of Agriculture
MoU	Memorandum of Understanding
NAIDAL	National Agro-Inputs Dealers Association, Liberia
OHS	Occupational Health and Safety
PCB	Polychlorinated bi-phyl
PCU	Project Coordination Unit
PDO	Project Development Objective
PPMP	Pest and Pesticides Management Plan
POP	Persistent Organic Pollutants
REDISSE	Regional Disease Surveillance Systems Enhancement Project
TAAT	Technology for African Agricultural Transformation
ToRs	Terms of Reference
UNEP	United Nations Environment Programme

USAID	United States Agency for International Development
WAAPP	West Africa Agricultural Productivity Project
WAATP	West Africa Agricultural Transformation Project
WBG-EHS	World Bank Group Environment, Health and Safety
WHO	World Health Organization
WTO	World Trade Organization

EXECUTIVE SUMMARY

INTRODUCTION

The West African Agricultural Project-WAATP

The proposed West Africa Agricultural Transformation Project (WAATP) will be one of the major projects that support the IDA 18 Business Plan for West Africa. The Project will contribute to scaling up the WAAPP achievements, while going beyond the WAAPP objective of increasing productivity by addressing use of a more holistic and broader issues of accelerating regional food availability in terms of both quantity and quality. The project will also contribute towards building enhanced agricultural impact with other regional agricultural projects financed by other institutions such as African Development Bank's (AfDB) financed Technologies for African Agricultural Transformation (TAAT), the Islamic Development Bank's (IDB) regional agricultural development program.

Project Development Objective-PDO

The PDO is to accelerate adoption of agricultural improved technologies and innovations by small scale producers and contribute to improve enabling environment for regional market integration in the ECOWAS region and enable the Governments to respond promptly and effectively to eligible emergencies.

PROJECT COMPONENTS

The project will have the following components:

Component 1- Strengthening the new model for innovation development in West Africa: This component will support: i) provision of additional infrastructure, equipment and grants for research activities for the RCoE (climate smart technologies, nutrition including bio fortification, soil health, etc.)

Component 2- Accelerating large-scale adoption of improved technologies and innovations: The component aims at scaling up adoption of improved agricultural technologies and innovations improving promoting innovation for youth that will accelerate productivity increases and thus contribute to higher food availability in the sub-region and enhanced regional trade flows.

Component 3- Policies, markets and institutional strengthening: The component is to create the enabling policy environment to accelerate agricultural transformation, connect production to markets and strengthen regional integration institutions.

Component 4. Contingent emergency response: This component, known as the Contingent Emergency Response Component (CERC), will be put in place should the need arise to redirect some of the project resources to contribute with other projects in the participating countries portfolio to respond to an eligible emergency or crisis. An Immediate Response Mechanism Coordinating Agency and expenditure management procedures will be defined in an Immediate Response Mechanism Operational Manual (IRM/OM), to be prepared separately and approved by the World Bank.

Component 5. Project management, learning, monitoring and evaluation: The Project will be coordinated: at the national levels by existing national Coordinating Units, which successfully

coordinated the implementation of WAAPP; and (ii) at the regional level by CORAF based on a well-defined mandate agreed by the Regional Steering Committee (RSC). This component aims to ensure that the project is efficiently managed and performance and impact are carefully tracked.

Need for a PMP

One of the steps to transform and increase food production is the reduction of current yield losses caused by pests, pathogens, and weeds in the field and during storage. The activities funded under WAATP may lead to inevitable use of agricultural pesticides, *inter alia*, in the project. To ensure these issues are managed in an integrated manner and are mainstreamed in the project and also to comply with national legislation and World Banks Safeguard Policies, it is imperative to have in place a Pest and Pesticides Management Plan to guide handling, application and disposal of agro-pesticides in the project activities thereby provide agricultural practices which can reduce problems associated with pesticide usage.

The PPM is also necessary for WAATP as the surveillance, monitoring and containment of project diseases that could lead to increased use of chemicals, reagents, and pesticides with potential negative impacts and risks on the environment and human health.

Objective of the PPMP

The objective of the Pest Management Plan is to promote the use of a combination of environmentally and socially friendly practices (hygienic, cultural, biological or natural control mechanisms and the judicious use of chemicals) and reduce reliance on synthetic chemical pesticides and ensure that health, social and environmental hazards associated with pesticides are minimized under the Project and within acceptable limit requirements of key stakeholders (i.e. primary users among farmers and their immediate defendants/families).

The specific objectives of the PPMP are to:

a. Ensure appropriate pest management techniques into technologies supported under the Project;
b. Effectively monitor pesticide use and pest issues amongst participating farmers;
c. Provide for implementation of an IPM action plan in the event that serious pest management issues are encountered, and/or the introduction of technologies is seen to lead to a significant decrease in the application of pesticides;
d. Assess the capacity of the country's regulatory framework and institutions to promote and support safe, effective, socially and environmentally sound pest management and to provide for appropriate institutional capacity support recommendations;
e. Ensure compliance with regional standards, laws and regulations; and
f. Ensure compliance with World Bank safeguard policy OP 4.09.
a.

Policy and Legal Framework

Policy Framework

The applicable policy instruments include:

National Environment Policy of Liberia (2002): Whose policy goal is to ensure long-term economic prosperity of Liberia through sustainable social and economic development, which enhances environmental quality and resource productivity on a long-term basis;

Land Administration Policy, 2015: This policy presents a framework for land administration in Liberia and focuses on the main features of good land administration and those pertaining to the identification, ownership, use and valuation of land amongst others;
Land Rights Policy (2013): provides the Land Commission's policy recommendations for land rights in Liberia and centered on basic types of rights;
The National Rice Development Strategy of Liberia (Republic of Liberia 2012a): Aims to improve food security and achieve self-sufficiency through the doubling domestic rice production by 2018; and
National Environmental and Occupational Health Policy, 2010: this policy is focused on the ensuring the working conditions in major work places are safe and healthy for the workforce for the purpose of protecting and promoting health in the workplace for all workers.

Liberian legal framework
The current Constitution of Liberia 1986: Article 7 of the Constitution obliges the state to manage the national economy and the natural resources in such manner ensuring that, the citizens enjoy maximum benefit so as to advance their general welfare and the economic development of Liberia.
Environmental Protection Agency (EPA) Act, 2003: creates the EPA as the principal authority in Liberia for the management of the environment and shall co-ordinate, monitor, supervise and consult with relevant stakeholders on all activities in the protection of the environment and sustainable use of natural resources.
Environmental Protection and Management Law, 2003: The law addresses a wide range of environmental issues including environmental impact assessment amongst others in development projects.

World Bank Safeguard Policies
The following safeguards polices are triggered in the project:
OP 4.01 Environmental Assessment: infrastructure refurbishing and rehabilitation in CARI and participating agencies which will involve construction works hence, triggering this safeguard policy which will necessitate some level of Environmental Assessment.
OP 4.09 Pest Management: Agricultural transformation will be aiming at improved production and productivity as such, usage of agro-pesticides is envisaged which will trigger this safeguards policy and has necessitated preparation of a PPMP alongside this ESMF.
OP 4.12 Involuntary Resettlement: The project will not undertake any activities that will displace people. Farmers who will be involved in the project will have interventions on their lands hence, minimal uptake of peoples' lands is envisaged. While these interventions are yet to be identified, a separate Resettlement Policy Framework is being prepared as part of the project environmental and social safeguards preparation process.

Stakeholder consultations
Stakeholder consultations were undertaken during the preparation of the ESMF and involved meetings with the client at the PIU to agree on the consultations road map and salient issues of discussions during the meetings. Meeting with Bank Senior Social Safeguards Specialist, the research scientists from International Institute for Tropical Agriculture (IITA), farmers groups, private sector actors especially National Agro-Dealers Association of *Liberia* (*NADAIL*) and NGOs.

Some of the key stakeholder concerns relating to pest and pesticides from the consultation meetings included the need for research on pests and diseases affecting rice. It is noted that, in rice fields farmers are experiencing increasing problems of rodent nuisance on rice which is attributed to after effect of the civil war during which, there was no hunting as such, the Grass Cutter Rats multiplied in absence of hunting. There is weak enforcement of agro-chemicals standards due to a combination of institutional and legal issues. MoA and EPA need their capacities built to be able to play over-sight role in regulating trade and application of agro-chemicals in the country. From the agricultural scientists' perspective, use of agro-chemicals needs urgently to be regulated including aspects of entry and importation of plant materials into the country. There are also instances of pesticides abuse by the farmers through instances of suicide and poisoning of birds in rice fields.

Pest and Pesticides Management Plan-PPMP

Pesticide Use Issues - Farmers are likely to misuse pesticides in at least six different ways:

a. Spraying too close to harvest, thus contaminating the crop after harvest;
b. Applying the wrong dosage, often over-applying. Farmers often spray hazardous insecticides like organochlorines over five times in a season when two or three times can be sufficient;
c. Applying pesticides intended for cash crops to growing food crops;
d. Spraying pesticides intended for growing crops on stored crops;
e. Using obsolete or expired pesticides;
f. Mixing different chemical pesticides together.
g. Inadequate or non-use of required PPE in handling and applying pesticides.
h. Insufficient or lack of knowledge on pesticides use and management by most farmers.
i. No use of PPE

Pest Management Plan Implementation

Key Strategies

The project will adopt the following programmes and strategies to achieve an effective pest and pesticide management process:

a. Formation of a Safeguard Team
b. Registration and training of all interested pesticide distributors/resellers under the Project
c. Education and awareness creation on safe pesticides use
d. Pests Monitoring and Surveillance Measures
e. IPM Capacity Building
f. Institutional Capacity Building and Training
g. Training of farmers in IPM and safe pesticide use
h. Participatory Monitoring and Evaluation

PPMP Implementation Budget

It is estimated that, about **$ 417,500** as the budget to implement the PPMP which should cover coordination, training of farmers in IPM and safe pesticide use, building capacity of the different stakeholders to monitor pests and diseases and to ensure safe storage, use and disposal of pesticides among others.

Key Recommended Interventions

a. It is key that, an effective organ for the effective management of agro-pesticides in the country be put in place. Such an agency should be charged with amongst others, overall streamlining of trade in agro-chemicals along its entire chain in view of current reportedly blatant mal-practices surrounding agro-pesticides;
b. Pest surveillance systems and early warning systems need to be revitalized in the sector as a strategy to avert havoc being meted by crop pests and diseases on the crops to ensure sustainability of agriculture to guarantee food security at household levels and development of the nation; and
c. Smallholder farmers need to have more reliable and timely access to agricultural advisory and extension services to provide them with the knowledge on how to identify and deal with pests and diseases on both crops and livestock.

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 PESTS AND DISEASES ATTACKS IN LIBERIA

In the rural areas, when farmers of rice are interviewed their concern is rice crop failure over the period of 2016-2017 and to them, they cannot fix the cause of the problem because even the rains on average seemed adequate like it has been in previous years. Others attribute it to an interplay of factors which include high incidence of pests mainly, Grass Cutters (Ground-Hogs) and birds throughout the country. In many areas, the loss is said to reach over 50% of the expected harvest. The extent of destruction of the rice crop has reached alarming levels gauging by the expression and commonality of the expression amongst communities interviewed coupled with discussions with some crop scientists. Therefore, an immediate action is recommended.

The phenomenon is said not to be new, though it intensified over years of the civil war in which communities allege that, near suspension of farming activities during the years of war brought to near a complete halt in farming practices through which pests and disease control measures used to be undertaken coupled with then cessation of hunting of wild animals gave opportunities for pests and diseases to multiply unchecked. 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. It is openly acknowledged by the farmers that, their hitherto traditional methods of control of pests which used to be efficient are now largely ineffective thus, calling for interventions to help avert the problems. Other pests reported include bush cow, and porcupines.

Serious rodent damage occurs to all stages of rice in the country. Damage occurs throughout the growing season but is probably most severe during the rainy season, April to October, when rice is 8-10 inches high. Preliminary data indicate that rats, mice, cause severe damage to the crop though there are no available estimates to that. The cassava crop is also infected with cassava mosaic virus which, in turn, is responsible of the low yields of this food crop. The Grass-Cutter also attacks cassava crop with devastating results.

1.1.2 THE WEST AFRICAN AGRICULTURAL PROJECT-WAATP

The proposed West Africa Agricultural Transformation Project (WAATP) will be one of the major projects that support the IDA 18 Business Plan for West Africa. The WAATP will contribute to bridging the gaps identified above. It will scale up WAAPP achievements, while going beyond the WAAPP objective of increasing productivity to address, using a more holistic approach, the broader issue of accelerating regional food availability in quantity and quality to feed a growing and urbanized population. The project will also build a coalition for more impact with Bank national and other regional projects, the African Development Bank's (AfDB) Technologies for African Agricultural Transformation (TAAT), the Islamic Development Bank's (ISDB) regional agricultural development program, USAID and AGRA new regional agricultural projects, and interventions of other development partners at participating countries levels. The WAATP will build on the existing

initiatives (deep dive activities) between the Bank, AfDB and ISDB to foster more effective collaboration in the agriculture sector. Several mechanisms will be put in place to ensure strong synergy between Bank regional programs and national projects including joint implementation support missions, joint annual work programs and budgets, memoranda of understanding outlining collaboration areas. The coalition for more impact will also rely on a different set of instruments, including the regional technology market and national and regional technology fairs, exchange visits and MOUs. WAATP will also build a more structured coalition with the CGIAR institutions to speed adoption of CGIAR technologies at a large scale through MoUs with the RCoEs. A task force composed of task team leaders of regional projects of AfDB, ISDB, USAID, AGRA and any other relevant institution will be set up and meet yearly to discuss synergies and common programs.

1.1.3 PROJECT DEVELOPMENT OBJECTIVE-PDO

The PDO is to accelerate adoption of agricultural improved technologies and innovations by small scale producers and contribute to improve enabling environment for regional market integration in the ECOWAS region and enable the Governments to respond promptly and effectively to eligible emergencies.

1.1.4 PROJECT COMPONENTS

The project has the following components:

a. Strengthening the new model of innovation delivery in West Africa;
b. Accelerating mass adoption of technologies and enhancing job creation in the agricultural sector;
c. Policies, markets and institutional strengthening; and
d. Contingent emergency response;
e. Project management, learning, monitoring and evaluation.

It is within this framework that the National Government of Liberia, in collaboration with CORAF and the World Bank, has undertaken the preparation of the WAATP for Liberia under the WB funding. Due to the nature, the characteristics and the scope of WAATP proposed activities, the potential social and environmental risks and impacts are low in scale, minimal mostly site specific, easily manageable and typical characteristics of category B operations.

1.1.4.1 PROJECT COMPONENTS LIKELY TO TRIGGER PEST AND PESTICIDE MANAGEMENT REQUIREMENTS

From the assessment of the project description, it is noted that, transformation of agricultural will inevitable imply application of agro-inputs such as pesticides and fertilizers which will trigger World Bank safeguards policy OP 4.06 Pesticides Management. Specifically, Component 2 which will address accelerating mass adoption of improved technologies and innovations under:

a. Sub-component 2.1 which addresses upgrading the national seed systems and regional seed market *(seed systems improvements will likely involve use of agro-pesticides for their preservation)*;

1 Scaling up of soil fertility management practices including soil mapping, soil testing, and fertilizer blending *(soil fertility improvements tend to call for application of fertilizers, hence need for PPMP in the project safeguards agenda)*.

1.2 VULNERABILITY OF LIBERIA TO CROP AND ANIMA PESTS AND DISEASE ATTACKS

1.2.1 KEY CONTRIBUTING FACTORS

According to Londa Vanderwal[1] and review of other literature sources as well as interviews with IITA Research Scientists[2] during this assignment it is noted that, increasing vulnerability of crops and livestock to pests and diseases is occasioned by an interplay of factors which can be summarized as follows:

a. ***Lack of adequate systems for disease control in the country***, particularly animal diseases, due to extremely limited human and physical capacity to conduct disease surveillance and implement control measures. Thus, any isolated cases of disease can easily become a large problem;
b. ***Lack of controls at the border points between Liberia*** and neighbouring countries in which case, plant and animal materials can be brought into the country without proper checking and any clearance/authorisation;
c. ***Imported animal and plant food products*** which are not properly inspected due to the weak inspection system;
a. ***Poor farm level management:*** One of the principle causes of poor pest management at farm level include; limited awareness of pest management solutions, farmers failure to follow extension advice;
b. ***Limited awareness of pest management solutions:*** Farmers have limited capacity to identify, differentiate and diagnose disease problems and effectively respond to them. In situations where they can identify the problems, they fall short on management practices both pre- and post-harvest. This lack of knowledge is partly blamed on inadequate supporting extension system as such, better access to sources of information on technical packages is needed;
c. ***Prevalence of counterfeit agro-chemicals:*** The looming challenges in the management of pests and diseases, particularly the lack of harmonized pest and disease control programs, limited feasible pest management options, and inadequate extension services, have led to the reactive use of pesticides for pest control which has provided fertile ground for increasing illegal imports of pesticides, proliferation of unlicensed dealers, and high incidence of counterfeit inputs. Counterfeit pesticides coupled with poor application methods by farmers have reportedly led to pesticide resistance in some instances;
d. **Landscape-level integrated pest management[3]:** There is considerable evidence that as agricultural production systems are intensified by increased use of external inputs to increase yield, and structural changes occur at landscape level, they tend to lose biodiversity and become destabilized, with increased frequency and extent of pest outbreaks;
e. ***Poor quality of planting material:*** The seed industry in Liberia is increasingly under scrutiny for selling and distributing poor quality seed and planting material. It is important that seed

[1] *Londa Vanderwal (2012), Standards and Trade Development Facility (STDF) Project Preparation Grant (STDF/PPG/324): Assessment of the biosecurity/ Sanitary and Phytosanitary (food safety, animal and plant health) situation in Liberia*

[2] *Michael Edet PhD Cassava Extension Agronomist, IITA and Wasiu Awoyale PhD Cassava Value Chain Specialist, SAPEC project-Ministry of Agriculture-Liberia.*

[3] *Francis E. Nwilene,1 Souleymane Nacro, Manuele Tamò, and Heinrichs,6 Abdoulaye Hamadoun, Managing Insect Pests*
of Rice in Africa.

put on the market is free of pests, diseases and obnoxious weeds. Ideally, under the MoA structure, all commercial seed should be inspected and certified.

f. ***Climate change related factors:*** Dwindling and erratic rainfall patterns, rising air temperature and extreme heat are having an impact on the spatial and temporal distribution and proliferation of insect populations. This may alter host plant–insect interactions and will thus, require new IPM strategies[4]. Climate change can increase the risk of pest outbreaks leading to greater yield losses with inherent negative consequences for food security in Africa with no exception on Liberia.

Lack of collective action by the farmers: Effective management of some pests requires concerted efforts and collective action. Collective action ensures community wide management of pests, because if only a few farmers implement pest management, their crops may still be infected as a result of poor practices their neighbours' fields.

1.3 PEST AND PESTICIDES MANAGEMENT PLAN-PPMP

1.3.1 OBJECTIVE OF THE PMP

The objective of the Pest Management Plan is to promote the use of a combination of environmentally and socially friendly practices (hygienic, cultural, biological or natural control mechanisms and the judicious use of chemicals) and reduce reliance on synthetic chemical pesticides and ensure that health, social and environmental hazards associated with pesticides are minimized under the Project and within acceptable limit requirements of key stakeholders (i.e. primary users among farmers and their immediate defendants/families).

The specific objectives of the PMP are to:

a. Ensure appropriate pest management techniques into technologies supported under the Project;
b. Effectively monitor pesticide use and pest issues amongst participating farmers;
c. Provide for implementation of an IPM action plan in the event that serious pest management issues are encountered, and/or the introduction of technologies is seen to lead to a significant decrease in the application of pesticides;
d. Assess the capacity of the country's regulatory framework and institutions to promote and support safe, effective, socially and environmentally sound pest management and to provide for appropriate institutional capacity support recommendations;
e. Ensure compliance with regional standards, laws and regulations; and
f. Ensure compliance with World Bank safeguard policy OP 4.09.

1.3.2 RATIONALE

The Pest and Pesticides Management Plan (PPMP) addresses relevant stakeholder concerns about pests and pesticides. It stresses the need to monitor and mitigate negative environmental and social impacts of the Project (which includes the use of pesticides) and promote ecosystem management with the human health risk being the underlying principle from seed usage, through planting and growth stage and also post-harvest issues including safe crops for consumption. It

[4] *Francis E. Nwilene,1 Souleymane Nacro, Manuele Tamò, and Heinrichs,6 Abdoulaye Hamadoun, Managing Insect Pests of Rice in Africa.*

emphasizes the need for an integrated approach to the management of pests in line with the nation's policy on IPM as well as funding agencies requirements on pest management and makes provision for adequate measures to enable the Project sustain the adoption of IPM techniques.

1.3.3 GENERAL APPROACH IN PREPARATION OF PPMP

With the introduction of commercial agriculture as part of the Project, pesticide use in the project area will be a major focus of project activity. The design and environmental impact screening of specific project options or interventions will consider on each case the likely pesticides to be used. An appropriate IPM technique will be incorporated into the project option or intervention to mitigate the need or demand for the use of chemical pesticides.

The Project will assist and train farmers to be able to develop their IPM approaches to the management of pests and diseases. This will be done holistically from seed selection, land preparation, through planting and farm maintenance to harvesting and post-harvesting issues. Farmers will have trained and encouraged to make detailed observations in their fields regularly so that they can detect early infestations and make the appropriate management decisions.

In this way, pest and disease problems do not escape notice and are not allowed to develop to the extent that they cause very severe damage and heavy crop losses. The decision to use chemical pesticides will be taken only as the very last resort. Pesticide use in general and pest issues amongst downstream project actors or participants (such as farmers, farm assistants, agro-chemical dealers, resellers, local communities, FBOs) will by surveyed regularly by MoA and EPA.

Communicating any decision on pest management strategy or measure from the project implementation level will be undertaken by experts (EPA, MoA, and CARI scientists).

1.3.4 METHODOLOGY

The preparation of the PMP involved extensive literature reviews and stakeholder consultations. Various documents and literature reviewed included:

a. ToRs for Preparation of PPMP for WAATP project, MoA-PCU 2018;
b. Draft PCN for WAATP April 2017;
c. Environmental and Social Management Framework: Strengthening Liberia Health System Project, (2016)
d. Integrated Pest Management Extension Guide for Ghana, Ministry of Agriculture;
e. ESMF for Liberia Land Authority (LLA) 2015;
f. Integrated Pest Management Practices for the Production of Cereals and Pulses, Ministry of Agriculture, Republic of Ghana;
g. Integrated Pest Management Extension Guide 4 Integrated Pest Management Practices for the Production of Vegetables, Ministry of Agriculture, with German Development Cooperation (GIZ);
h. Tanzania, Agricultural Sector Development Program (ASDP), IPMP, Revised Version, March 2009
i. Pest Management Plan for Agriculture Cluster Development Project (ACDP) Ministry of Agriculture, Animal Industry and Fisheries, Uganda;
j. Final ESMF for REDD Readiness Assessment, 2016, GoL; and

k. GoL Integrated Pest Management Plan (IPMP) for the Liberia under the West Africa Regional Disease Surveillance Systems Enhancement (REDISSE) Project

Stakeholder consultations and participation involved two public workshops, meetings with key officials of relevant organizations and administration of data request sheet.

1.4 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were undertaken during the preparation of the ESMF and involved meetings with the client at the PIU to agree on the consultations road map and salient issues of discussions during the meetings. Meeting with Bank Senior Social Safeguards Specialist, the research scientists from International Institute for Tropical Agriculture (IITA), farmers groups, private sector actors especially National Agro-Dealers Association of *Liberia* (*NADAIL*) and NGOs.

1.4.1 SUMMARY OF ISSUES DURING STAKEHOLDER CONSULTATIONS

Some of the key stakeholder concerns relating to pest and pesticides from the consultation meetings included the need for research on pests and diseases affecting rice. It is noted that, in rice fields farmers are experiencing increasing problems of rodent nuisance on rice which is attributed to after effect of the civil war during which, there was no hunting as such, the Grass Cutter Rats multiplied in absence of hunting. There is weak enforcement of agro-chemicals standards due to a combination of institutional and legal issues. MoA and EPA need their capacities built to be able to play over-sight role in regulating trade and application of agro-chemicals in the country. From the agricultural scientists' perspective, use of agro-chemicals needs urgently to be regulated including aspects of entry and importation of plant materials into the country. There are also instances of pesticides abuse by the farmers through instances of suicide and poisoning of birds in rice fields.

Figure 1: Field consultations in Bomi areas

2 POLICY FRAMEWORK

2.1 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

This section reviews the national policies, regulations, procedures and legal provisions relating to the environment and social issues in development interventions. The reviews have been made against the World Bank safeguards policies' requirements as well as Liberian applicable laws/policies as summarized below:

2.2 LIBERIA ENVIRONMENTAL POLICY REQUIREMENTS

2.2.1 NATIONAL ENVIRONMENT POLICY OF LIBERIA (2002)

The policy goal is to ensure long-term economic prosperity of Liberia through sustainable social and economic development, which enhances environmental quality and resource productivity on a long-term basis that meets the requirements of the present generation without endangering the potential of future generations to meet their own needs.

2.2.2 THE NATIONAL RICE DEVELOPMENT STRATEGY OF LIBERIA (2012A)

Aims to improve food security and achieve self-sufficiency through the doubling domestic rice production by 2018. Rice is a staple cereal crop in Liberia with great social and political significance. Demand far exceeds local production, however, which requires high imports and affects the country's trade balance and foreign exchange.

2.2.3 NATIONAL ENVIRONMENTAL AND OCCUPATIONAL HEALTH POLICY, 2010

In relation to the WAATP, the main objectives of the National Environmental and Occupational Health Policy is to assess the working conditions in major work places, establish data base, plan and implement workers' wellness programs, for the purpose of protecting and promoting health in the workplace for all workers in Liberia, to provide guidelines and standards for the effective implementation and rendering of occupational health services.

2.3 LIBERIAN LEGAL FRAMEWORK

2.3.1 THE CURRENT CONSTITUTION OF LIBERIA 1986

The Constitution is largely silent on the issue of natural resources and sustainable development. However, Article 7 of the Constitution states: "The Republic shall, consistent with the principles of individual freedom and social justice enshrined in this Constitution, manage the national economy and the natural resources of Liberia in such manner as shall ensure the maximum feasible participation of Liberian citizens under conditions of equality as to advance the general welfare of the Liberian people and the economic development of Liberia.

2.3.2 ENVIRONMENTAL PROTECTION AGENCY (EPA) ACT, 2003

The Act creates the Agency as the principal authority in Liberia for the management of the environment and shall co-ordinate, monitor, supervise and consult with relevant stakeholders on all activities in the protection of the environment and sustainable use of natural resources. Part III of the 2003 Law establishes a fairly comprehensive framework for EIA, including procedures and substantive standards for the approval and rejection of projects. It also provides for public participation and procedures for appeals against EPA decisions.

2.3.3 ENVIRONMENTAL PROTECTION AND MANAGEMENT LAW, 2003

The law forms the legal framework for the sustainable development, management and protection of the environment and natural resources by the Environmental Protection Agency in partnership with relevant ministries, autonomous agencies and organizations as well as in a close and responsive relationship with the people of Liberia. It addresses a wide range of environmental issues including environmental impact assessment amongst others in development projects.

2.3.4 PUBLIC HEALTH LAW, 1976

Mandates the Ministry of Health to ensure good and healthy environmental sanitation prevails in the communities as well as in private and public places. This law obliges those dealing in agro-

chemicals to be cognizant of the need to ensure safety of those involved in handling and general applications of such in-puts.

2.3.5 WORLD BANK OPERATIONAL POLICY ON PEST MANAGEMENT, OP 4.09

The Bank uses various means to assess pest management in a country and support integrated pest management (IPM) and the safe use of agricultural pesticides. It also supports economic and sector work, sectoral or project-specific environmental assessments, participatory IPM assessments, and adjustment or investment projects and components aimed specifically at supporting the adoption and use of IPM.

In Bank-financed agriculture operations, the Bank advocates pest populations reduction through IPM approaches such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest. According to the Bank, rural development and health sector projects have to avoid using harmful pesticides. A preferred solution is to use Integrated Pest Management (IPM) techniques and encourage their use in the sectors concerned.

If pesticides have to be used in crop protection or in the fight against vector-borne diseases, the Bank-funded projects should include a Pest Management Plan (PMP), prepared by the borrower, either as a stand-alone document or as part of an Environmental Assessment. The procurement of any pesticides in a Bank-financed project is contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users. With respect to the classification of pesticides and their specific formulations, the Bank refers to the World Health Organization's Recommended Classification of Pesticides by Hazard and Guidelines to Classification (WHO, 2009).

The following criteria apply to the selection and use of pesticides in Bank-financed projects:

a. They must have negligible adverse human health effects;
b. They must be shown to be effective against the target species;
c. They must have minimal effect on non-target species and the natural environment;
d. The methods, timing, and frequency of pesticide application must aim to minimize damage to natural enemies; and
e. Their use must take into account the need to prevent the development of resistance in pests. At a minimum, pesticide production, use and management should comply with FAO's

Guidelines for:

a. Packaging and storage;
b. Good labelling practice; and
c. Disposal of waste pesticide containers on the farm.

The Bank does not finance formulated products that fall in WHO classes Ia (extremely hazardous) and Ib (highly hazardous); or formulations of products in Class II (moderately hazardous), if (a) the country lacks restrictions on their distribution and use; or (b) they are likely to be used by; or are accessible to lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly.

The proposed project will trigger OP 4.09, since it will support post-harvest pest control, to minimize post-harvest pest damage from eroding crop productivity gained through the program's

improved technology adoption by farmers. Demonstrations may require pesticides based on the IPM approach but it should be noted that WAATP will not procure pesticides to be supplied to farmers. However, during implementation, particularly demonstrations, maximum caution should be taken into consideration to ensure that local capacity exists to adequately manage their post-harvest environmental and social impacts from use of pesticides, in compliance with OP 4.09 as described above.

2.4 INTERNATIONAL CONVENTIONS AND TREATIES

2.4.1 INTERNATIONAL PLANT PROTECTION CONVENTION

The International Plant Protection Convention (IPPC) is an international agreement on plant health to which 181 signatories currently adhere. It aims to protect cultivated and wild plants by preventing the introduction and spread of pests. The Secretariat of the IPPC is provided by the Food and Agriculture Organization of the United Nations. The Convention makes provision for the application of measures by governments to protect their plant resources from harmful pests (phytosanitary measures) which may be introduced through international trade. The IPPC came into force in 1952, superseding previous international plant protection agreements. The Convention was revised in 1979 and the amendments came into force in 1991.

The revision of the IPPC agreed in 1997 and which entered into legal force on 2 October 2005 represents an updating of the Convention to reflect contemporary phytosanitary concepts and the role of the IPPC in relation to the Uruguay Round Agreements of the WTO, particularly the SPS Agreement. The SPS (Sanitary and Phytosanitary) Agreement identifies the IPPC as the reference organization developing international standards for plant health (phytosanitary) measures. IPPC work includes standards on pest risk analysis, requirements for the establishment of pest-free areas, and others which give specific guidance on topics related to the SPS Agreement.

2.4.2 INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), adopted in 2001, is a global response to promote the conservation of plant genetic resources and to protect farmer's rights to access and have fair and equitable sharing of benefits arising out of their use. Sustainable use of plant genetic resources is fundamental for achieving food and nutrition security and for a progressive realization of the right to food.

The International Treaty on Plant Genetic Resources for Food and Agriculture is crucial in the fight against hunger and poverty and essential for the achievement of Millennium Development Goals 1 and 7. No country is self-sufficient in plant genetic resources; all depend on genetic diversity in crops from other countries and regions. International cooperation and open exchange of genetic resources are therefore essential for food security. The fair sharing of benefits arising from the use of these resources has for the first time been practically implemented at the international level through the Treaty and its Standard Material Transfer Agreement.

2.4.3 STOCKHOLM CONVENTION

The Stockholm Convention is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living

organisms and are toxic to humans and wildlife. In implementing the Convention, Governments will take measures to eliminate or reduce the release of POPs into the environment. The Stockholm Convention established an initial list of 12 key POPs chemicals (the so-called dirty dozen) for which signatories are required to reduce the risks to human health and the environment arising from their release. Enlisted parties are required to take measures (legal and/or administrative) to eliminate or heavily restrict the production and use of POP pesticides and PCBs, and to minimize the unintentional production and release of POPs. The Convention covers pesticides, and industrial chemicals and by-products i.e. Aldrin, Chlordane, DDT, Dieldrin, Dioxins, Endrin, Furans, Hexachlorobenzene, Heptachlor, Mirex, PCBs and Toxaphene. 15 of the 22 Chemicals listed under the Stockholm Convention are Pesticides or pesticide production by-products. Obsolete pesticide disposal must be in compliance with the Basel Convention.

2.4.4 BASEL CONVENTION

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal was concluded in Basel, Switzerland, on March 22, 1989, and entered into force in May 1992. Now ratified by 149 countries including 32 of the 53 African countries, the focus of this convention is to control the movement of hazardous wastes, ensure their environmentally sound management and disposal, and prevent illegal waste trafficking (UNEP, 2006). The parties to this convention recognize the serious problems posed by stockpiles of unused and unwanted chemical products which, as a result of their obsolescence, are now considered wastes.

2.4.5 ROTTERDAM CONVENTION

Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and pesticides in International Trade: This convention came into force on 24th February 2004 and Uganda acceded to the convention early 2007. The Rotterdam Convention aims to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use. Governments began to address the problem of toxic pesticides and other hazardous chemicals in the 1980s by establishing a voluntary Prior Informed Consent procedure. PIC required exporters trading in a list of hazardous substances to obtain the prior informed consent of importers before proceeding with the trade. In 1998, governments decided to strengthen the procedure by adopting the Rotterdam Convention, which makes PIC legally binding. The convention establishes a first line of defense by giving importing countries the tools and information they need to identify potential hazards and exclude chemicals they cannot manage safely. When a country agrees to import chemicals, the convention promotes their safe use through labelling standards, technical assistance, and other forms of support. It also ensures that exporters comply with the requirements.

2.4.6 THE FAO INTERNATIONAL CODE OF CONDUCT ON THE DISTRIBUTION AND USE OF PESTICIDES

It establishes voluntary standards for public and private institutions involved in the distribution and use of pesticides. The revised version of the Code, adopted in 2002, has become the globally accepted benchmark for pesticide management and has enabled many countries to establish and strengthen their pesticide management systems. The Code sets out a vision of shared responsibility between the public and private sectors, especially the pesticide industry and government, to ensure that pesticides are used responsibly, delivering benefits through adequate pest management without significant adverse effects on human health or the environment. It aims

to promote practices that reduce the risks of handling pesticides, prevent accidental poisoning, ensure pesticides are used effectively and efficiently, and encourage IPM and Integrated Vector Management (IVM). The 2002 revision of the Code puts greater emphasis on promoting IPM than the previous version and also specifically incorporates a focus on active food-sector participation in developing and promoting IPM.

2.4.7 THE SAFETY AND HEALTH IN AGRICULTURE CONVENTION

The Safety and Health in Agriculture Convention (Convention C 184) adopted by the conference of the International Labour Organization (ILO) addresses the protection of workers in the agricultural sector. More people work in agriculture than in any other sector, more workers are injured in agriculture than in any other sector, and pesticides are a major cause of injury and death. In addition, more children work in agriculture than in any other sector and they are differently and particularly vulnerable to the toxic effects of chemicals such as pesticides. A specific section of the convention deals with the sound management of chemicals and advises governments to adopt good management practices for chemicals, to inform users adequately about the chemicals they use and to ensure that adequate mechanisms are in place to safely dispose of empty containers and waste chemicals. Application of the Convention is an important step in improving pesticide management and preventing some of the problems that arise from pesticide distribution and use in developing countries in particular.

2.5 INSTITUTIONAL FRAMEWORK

2.5.1 MINISTRY OF AGRICULTURE-MOA

The Ministry also implements agricultural programs, protects farming interests, encourages investment in the agricultural sector, and monitors overall activities including the movement of agricultural commodities into and out of the country. The Ministry also regulates the harvesting of botanical species by herbalists and other farmers as a part of shifting cultivation practices. The MOA includes four departments: Administration; Planning and Development; Technical Services; and, Research and Extension. The Quarantine Service Responsible to check imported products for phytosanitary certificates; issue phytosanitary certificates for exports (including for timber and forestry products).

2.5.2 ENVIRONMENTAL PROTECTION AGENCY-EPA

In support of the establishment of the EPA, the EPA Act (GoL, 2003a) also established County and District Level environmental committees, responsible for the local delivery of national environmental policy and priorities. In a move towards a more bottom up approach, a key function of the committees is to articulate local level environmental issues to the EPA who in turn are charged with formulating and passing on a relevant response for local level implementation.

In addition, under Section 20 and 21 of the EPA Act (GoL, 2003a), the EPA is mandated to appoint environmental inspectors within districts to monitor the implementation of environmental standards as established under the EPML (GoL, 2003b). The power of these inspectors is wide ranging and includes the provision to close "any manufacturing plant, establishment or other activity which pollutes or is likely to pollute the environment, contrary to the provisions of the Act" (GoL, 2003a).

2.5.3 MINISTRY OF HEALTH

The Ministry coordinates and administers the general health services of the Country; ensures the availability of drugs; collects health statistics and monitors events and conditions affecting the general public. The Ministry is in charge of preventive and curative services and vital statistics for the registration of deaths and births. Under the WAATP, the Ministry of Health will be helpful in the collection and keeping of accurate statistics on pesticide poisonings events. The Ministry will undertake awareness creation targeting different pesticide users in order to avoid accidents and incidents relating pesticides poisoning.

2.5.4 CENTRAL AGRICULTURAL RESEARCH INSTITUTE (CARI)

CARI is an agricultural research facility that is slowly recovering from the civil conflict. CARI was amongst the GoL institutions hardest hit by the protracted civil conflict, because it served as the base for three successive warring factions, then was home to over 10,000 displaced persons for five years, and finally became an UNMIL sector base. Current emphases include rice, cassava, and yam improvement; maize, fruits and vegetable screening and evaluation; animal husbandry; and, aquaculture.CARI will coordinate all integrated agricultural research and development (R&D) activities required under the WAATP. When pest problems occur that are novel or beyond the scope of agricultural extension staff at the counties and district levels, advice will be obtained from CARI.

3 WAATP CROP AND ANIMAL COMMODITIES

3.1.1 CROP COMMODITIES

3.1.1.1 CASSAVA

3.1.1.1.1 VALUE OF CASSAVA PRODUCTS IN LIBERIA

Based on the work done on cassava value chain in Liberia by the International Institute of Tropical Agriculture (IITA) in collaboration with the Smallholder Agricultural Productivity Enhancement and Commercialization (SAPEC) Project, it is reported that, out of all the cassava products in Liberia, *gari* and *fufu* are generally consumed across all the communities[5]. However, other products are County specific.

In Rivercess County, cassava products such as boiled roots (77%), dumbo (71%) and fresh cassava leaves (59%) are consumed in high quantity monthly (24%) and fortnightly (12% and 53%) respectively. Grand Bassa (55%) consumed products like boiled roots weekly and dumbo fortnightly. Boiled roots (70%), dumbo (70%), and GB (55%) are consumed weekly and fresh cassava leaves fortnightly in Bomi County. Margibi preferred products such as raw roots (67%) and boiled roots (76%) weekly, while dumbo (95%), GB (91%) and depah (91%) are consumed fortnightly.

Gbarpolu (>89%) and Montserrado (50%) consumed all the cassava products except raw root and starch (0%) respectively. However, starch and fried chips are the least consumed cassava products in Liberia. Gbarpolu and Montserrado consumed boiled root monthly, dumbo and depah fortnightly, while GB and fresh cassava leaves are consumed fortnightly and monthly in the two Counties respectively. However, the consumers of cassava products faced challenges such as inadequate capital, inadequate storage facility, inadequate market information, inadequate transport facility, unfavorable government policy and poor quality, though these challenges vary from one County to another. In Rivercess County the severe challenges are inadequate capital (41%), inadequate storage (53%) and inadequate transportation facility very severe (59%). This is common to all other Counties but with varying percentages. It is important to add that poor product quality is not severe in Rivercess (53%), Grand Bassa (27%), Margibi (48%) and Gbarpolu (55%) compared to the other Counties.

3.1.1.1.2 DISEASES AND PEST RISKS ON CASSAVA

Cassava Mosaic Disease (CMD) is a viral disease spread by the white flies. The disease is common in all major cassava growing regions in the country. Symptoms of CMD infected plants include mosaic, mottled, deformed and twisted leaflets. There is observed overall reduction in size of

[5] *Wasiu Awoyale and Michael Edet (un pub. 2018): Baseline Information on the Cassava Value Chain in Liberia by the IITA in collaboration with the Smallholder Agricultural Productivity Enhancement and Commercialization (SAPEC) Project*

leaves and plants and such plants normally produce few or no tuber although this is dependent on the severity of the disease and the age of the plant at which it was infected.

Cassava brown streak disease (CBSD) is another viral disease transmitted by the white fly and causes serious economic losses in the yield and quality of the roots (Alicai *et al*., 2007). Especially in susceptible varieties, infestation renders the roots unusable particularly when left in the ground for longer periods. CBSD symptoms are observable on the leaves, stems and roots however; on the leaves, the symptoms are more prominent on older leaves than young ones. Unlike CMD, infected leaves do not become distorted. The characteristic symptom on the leaves appear as patches of yellow areas mixed with normal green color which may enlarge and join to form comparatively large yellow or necrotic patches. These yellow patches are more pronounced in mature than young leaves. On the stems, the disease appears as dark brown streaks and spots and is more prominent on the upper green portions of the stem. On the roots, the disease causes cracks, discoloration, root constriction and malformation. The harvested roots are corky with yellow-brown necrotic spots. The cassava green mite (*Mononychellus tanajoa*) is a spider mite, which causes serious infection on cassava. It feeds on young leaves and green stems and can easily be confused with effects cassava mosaic disease.

Figure 2: Severely affected cassava grown from a healthy cutting and subsequently infected during growth by *Viruliferous whiteflies*[6]

Figure 3: Severe CMD in an initially healthy planting of cassava[7]

[6] J. M. Thresh and R. J. Cooter *Plant Pathology* (2005): Strategies for controlling cassava mosaic virus disease in Africa 54, 587–614 *Natural Resources Institute, University of Greenwich, Chatham ME4 4TB, UK*

[7] J. M. Thresh and R. J. Cooter *Plant Pathology* (2005): Strategies for controlling cassava mosaic virus disease in Africa 54, 587–614 *Natural Resources Institute, University of Greenwich, Chatham ME4 4TB, UK*

Figure 4: Cassava Tuber Necrosis caused by Cassava Brown Streak

Table 1: Summary of Cassava WAATP Diseases and Pests and their control options.

Crop	Major Pest/Disease	Available Management Options
Cassava (*Manihot esculenta*)	Cassava brown streak disease [CBSD]	a. Use only healthy and disease-free cuttings for planting b. Plant tolerant/resistant varieties. c. Remove and destroy any plants with symptoms of the disease including alternative hosts. d. Early harvesting. e. Disease surveillance & quarantine. f. Control of whiteflies (insect vector).
	Cassava mosaic disease [CMD]	a. Inspect plants regularly for symptoms of disease and remove (roguing) and destroy any plant showing symptoms. b. Use resistant varieties. c. Use clean planting materials and avoid planting cuttings from plants showing symptoms of the disease.
	Cassava mosaic disease [CMD]	a. Inspect plants regularly for symptoms of disease and remove (roguing) and destroy any plant showing symptoms b. Use resistant varieties c. Use clean planting materials and avoid planting cuttings from plants showing symptoms of the disease
	Cassava bacterial blight [CBB], (*Xanthomonas axonopodis* pv. *manihotis*)	a. Crop rotation with non-host b. Intercropping with maize and melon c. Field sanitation: plough crop debris into soil after harvest or remove and burn, pruning infected parts of the plant d. Use clean planting cuttings obtained only from healthy plants
	Cassava green mite (*Mononychellus tanajoa*, M. *progresivus*)	a. Together with Cassava mealy bug (*Phenacoccus manihoti*), the green mite has been effectively controlled using biological control (*Typhlodromalus aripo*) b. Crop rotation, early planting, and intercropping

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

3.1.1.2 RICE

3.1.1.2.1 RICE PRODUCTION

The Comprehensive Assessment[8] of the Agriculture Sector prepared by Liberia's Ministry of Agriculture[9] suggests that Liberia's agriculture is reported that, rice is the main staple food, followed by cassava and other food crops. Production data for rice in particular and other crops is lacking, though for 2017, FAO estimates that, overall rice production outlook was favorable with preliminary estimates aggregate paddy production at about 275,000 tonnes which was about 2% above the previous year's output and slightly below the five-year average[10]. Upland rice cultivation is more prevalent, with 63% of producing households using this method of cultivation, as compared to 17% of households using and swamp rice cultivation methods (the rest, 21% of producers, combine both techniques). Upland cultivation is prevalent in RiverCess, Grand Kru and Nimba, while swamp rice is mainly cultivated in Lofa County. Even in swamp or lowland areas (Figure 5), productivity or yields per hectare are often low, and well below that of neighboring countries, and in the country as a whole, locally produced rice is used mainly for household consumption.

Figure 5: Lowland rice smallholder rice farming in Saukoko areas, Liberia

3.1.1.3 PEST AND DISEASES OF RICE

The major insect pests of rice in Africa include stem borers, African rice gall midge and termites. Pests cause considerable crop losses in the field and in storage. It is estimated that each year insects destroy between 10% and 30% of all food produced in Africa. The estimates of rice yield loss due to insects in Africa range between 10% and 15% (FAO, 2017). The major insects and

[8] *IFAD 2007: Comprehensive Assessment of Agricultural Sector in Liberia. Vol. 1 Synthesis Report. Ministry of Agriculture.*

[10] FAO 2017*: GIEWS - Global Information and Early Warning System for Liberia, Rome-Italy.*

associated damage differ regionally, by country and by rice variety, and in some years may exceed 90% (FAO, 2017).

Table 2: Summary of Major Pests and Diseases of Rice

Nº.	Major pests and Diseases	Comments
1	Armyworms (*Spodoptera exempta)*	Cause serious defoliation in upland rice plants, leaving only the stems. Are regarded as occasional pests but when there is outbreak they completely devastate farms.
2	African gall midges (*Orseolina oryzivora)*	bore into stems and up to the apical or lateral buds, feeding on the tissues of the buds. Attack young rice plants.
3	Stalked-eye shoot flies *(Diopsis spp)*	Dark brown fly. Lay eggs at the base of rice plants and hatched maggots feed on the stem tissues.
4	Stem borers *(Chilo spp, Maliarpha separatella, Sesamia calamistis)*	Caterpillars bore into the stem of rice, attack rice at full tillering stage prevent the grains from filling up and ripening. (e.g. white borer, striped borer, pink borer and yellow borer).
5	Rice blast (*Pyricularia oryzae)*	Most widespread and destructive disease. Affects all the leaves and stem of plant, starting with spots on leaves.
6	Rice brown leaf spot (*Helminthosporium oryzae)*	Fungus disease which starts as tiny brown spots on rice leaves. Attack seedlings more often.
7	Rice yellow mottle virus (RYMV)	Attacked rice plants show yellow leaves and stunted growth.

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

3.1.2 HORTICULTURE SUB-SECTOR

Liberia is the optimal country for horticulture production. Among the leading fruit and vegetable producing countries in Sub-Saharan Africa, Liberia has the largest renewable water assets. Its rainfall is 2,391mm per year, compared to 1,348 in Ghana, 1,187 in Côte d'Ivoire and 730 in Kenya. It has a large and growing domestic market, access to a large ECOWAS market and sea access to European and American markets. Liberia provides a great market opportunity for investors in horticulture production: the provision inputs such as seed and fertilizer, aggregation of produce, cold chain infrastructure and warehousing, and value chain addition such as packaging. The Liberia market for horticulture in 2013 was worth $103.6 million, of which $90.4 million was produced locally. In 2013 Liberia produced 291,000 tonnes worth of fruit and vegetables and imported 14,300 tonnes. There are 20 concessions operating in Liberia, with a potential to create 100,000 jobs and demand high quality produce. These provide big market opportunities though the sub-sector is faced with a range of pests and diseases as on Table 3.

Table 3: Major Pest and Diseases of Cabbage

Nº.	Major pests and Diseases	Comments
1	Diamond-back moth (DBM) (*Plutella xylostella)*	It is the most serious pest of cabbage. DBM female moth lays its eggs singly. Eggs are glued to the underside of leaves and hatch after 3-5 days into green larvae. Larvae creep to underside of leaf, pierce the epidermis and tunnel or bore through the leaf tissue. Progressively eat leaf from underneath leaving the upper cuticle intact creating a bizarre window,
2	Webworms or cabbage borer (*Hellula undulalis)*	The light brown larvae or caterpillars of the cabbage webworm bore into the main veins of the leaves of cabbages and later into the Centre of the stems, where they then feed. This makes these pests very difficult to control with pesticides.
3	Cabbage aphids (*Brevicoryne brassicae)*	Usually occur in large numbers, mainly during dry spells. Sucking pests, grey or green with soft pear-shaped bodies often in colonies on lower side of leaves. Suck sap causing stunting growth and honeydew excretes on leaves.
4	Cutworm (*Agrotis sp)*	Dull colored moths lay eggs in soil surface or on stems. Mature larvae hide during day and emerge at night to feed on crop causing damage by cutting young plant stems at the base and feeding on foliage.
5	Bacteria soft rot (*Erwinia carotovora)*	Is a major disease of cabbages attacking its leaves and affected areas take on a water-soaked appearance and start to decay and emitting an unpleasant smell. Cabbage heads decay rapidly and turn dark.
6	Root knot nematode	Nematodes invade roots causing swelling and deformation of roots (galls.
7	Black rot	Chlorotic discoloration on leaves, which turn to dark brown or black. Black discoloration of the vascular bundles and internal tissue break down.

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

Table 4: Pests and Diseases of Cucumbers

No.	Major pests and Diseases	Comments
1	Aphids *(Aphis gossypii)*	Are common on cucurbits. Occur in colonies of green to blackish aphids under leaves, where they suck the sap. Move from plant to plant in their winged form and transmit virus diseases.
2	Melon flies	Very small black fly that pierces fruits of plants of cucurbit family and lay eggs in them. Eggs hatch into white maggots which feed inside fruits, causing sunken, discolored patches and distortions and open cracks.

3	White flies *(Bemisia tabaci)*	White fly adults are small, winged insects that fly off readily when disturbed. Attack cucurbits, sucking sap and secreting sticky honey dew on which black mould develops. Adult transmits various virus diseases
4	Cucumber mosaic virus disease (CMV)	Major disease of cucumber transmitted by aphids. Attacked plant leaves become mottled, distorted and stunted, and the leaf edges curl downwards. Fruits produced by these plants show pale green areas mixed with dark green spots.
5	Powdery mildew (*Erysiphe cichoracearum)*	Is a very serious fungus disease that affects leaves of cucurbits, causing them to dry up and die. Can be recognized by white powdery spots on upper and lower leaf surfaces and spread from
6	Angular leaf spot	Is a major cucumber pest that attacks leaves, stems and fruits
7	Downy mildew	Is a major cucumber pest that attacks leaves

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

Table 5: Pests and Diseases of Lettuce

N°.	**Major pests and Diseases**	**Comments**
1	Cutworms (*Agrotis spp.)*	Large, brownish-black caterpillars of cut-worms damage young lettuces by cutting through stems at ground level at night, causing plant to collapse and die. Hide in soil during daytime and emerge at night to feed on lettuce.
2	Damping-off disease *(Pythium*	Fungus disease that is present in soil. It infects stems and roots of lettuce seedlings in the nursery or when just planted in the field.

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

Table 6: Pests and Diseases of onion

N°.	**Major pests and Diseases**	**Comments**
1	Onion flies (*Delia antique)*	A major pest of onions. Small, white, headless larvae (maggots) feed just above base of seedlings. Attacked plants die. Larvae are also found in developing onion bulbs.
2	Onion thrips (*Thrips tabaci)*	Are major pests of onions throughout Africa. In attacked onion plants, leaves show white and silvery patches, become distorted and may later wilt and die. Adult thrips are tiny, long, brownish-black insects that are very mobile and collect in large numbers at base of onion leaves, sucking the cells of leaves.
3	Bacterial soft rot (*Erwinia carotovora)*	In attacked plants, leaves rot and also the entire bulb rots. It is also a very serious disease in stored onions, if onions are not mature, mechanically damaged during harvest and there is poor aeration and high humidity in the store room.
4	Downy mildew disease (*Peronospora destructor)*	Caused by a fungus that attacks onion leaves. Fungus bodies develop as purple areas on fully mature leaves. Affected leaves drop off and die.

5	Mould *(Aspergillus niger)*	Unlike bacterial rot, mould cause dry rot. Immature onions when harvested (still moist, and neck intact) and then stored without curing (sun drying) under poor conditions (without aeration and in humid conditions), black mould develops and onions become unfit for human consumption.
6	Purple blotch (*Alternaria porri)*	Disease affects all parts of onion plant. Infected leaves and flowers show small, sunken, white areas with purple centers which become enlarged and encircle entire leaves. Tips of leaves become dry and collapse.

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

Table 7: Pests and Diseases of Tomatoes

Nº.	**Major pests and Diseases**	**Comments**
1	Aphids *(Aphis gossypii)*	Occasionally attack tomato heavily. Feed on the soft terminal shoots and on the underside of leaves. May also transmit virus disease during feeding. Honeydew produced by aphids causes unsightly black moulds on tomatoes which reduces their market value. Attacked plants may wilt and die.
2	Fruit borers (American bollworms [Helicoverpa armigera] and leaf-eating caterpillars (cotton leafworms [Spodoptera littoralis])	Different kinds of caterpillar attack developing and mature fruits of tomato. The American bollworm comes in various colours. A single caterpillar can bore into m ay tomato fruits in one night. Fungi and bacteria enter these fruits through the holes and cause the fruits to rot and become worthless. The cotton leaf worm feeds on leaves of tomato and bores into the fruits, especially those lower down the plant.
3	Fruit fly (Rhagoletis ochraspis)	It is an important pest of tomato at the fruiting stage. It pierces fruits and leaves rotten spots. Adult fly pierces fruit to lay eggs inside. The small white maggots or larvae develop in the fruit and pupation occurs in the soil below the host plant.
4	Root-knot nematodes (*Meloidogyne spp.)*	Nematodes are one of the most important pests of tomato. These same species also attack egg-plant, pepper, cabbage, carrot and other vegetables. They are microscopically small worms that live in the roots of their host and cause galls or root-knots. Some affected plants may show yellow leaves, poor growth and even wilting. Affected roots are short and have many swellings or galls. Plant become stunted and may die.
5	Tomato mirid bugs *(Cyrtopeltis teriuis)*	Adults and nymphs of slender, dark green mired bugs feed on tender terminal stems and flower stalks of tomato plants. Inject a toxic substance/saliva into the tissues, causing small, brown necrotic spots to develop. Adult female mirids pierce tomato stems to lay eggs resulting in major damage to stems.

6	White flies (Bemisia tabaci)	White fly adults are small, white, winged insects that fly off readily when disturbed. They attack tomatoes from seedling stage to maturity. White fly adults and nymphs occur under tomato leaves, sucking the sap and secreting a sticky honeydew on which black mould develops. The adult transmits the leaf curl virus disease, which causes considerable damage to tomato plants.
7	Dumping-off disease *(Pythium spp.)*	Is a major disease that attacks tomato seedlings. Water-logging creates conditions that favour development and spread of disease. Is a soil fungus and attack causes young stems to rot. Affected seedlings wither.
8	Early (or dry) tomato blight *(Alternaria solani)*	Is a major disease during the rainy season. It is caused by a soil-borne and air borne fungus. Symptoms are brownish-black angular spots with concentric circles on the leaflets. Black or brown sunken lesions develop on stems and fruits.
9	Late blight (*Phytophtora infestans)*	Symptoms show as necrotic spots on leaves which enlarge rapidly to become water-soaked areas on leaves and fruits. Infestation leads to defoliation and fruit blotches.
10	Rots and cankers *(Phoma spp., Phomopsis spp.)*	Rots and cankers are caused by fungi and bacteria that infect tomato stems and roots. Root and stem rot fungus is present in soil and attacks roots, causing collars to rot. The bacteria that attack plants cause blight and cankers of stems, leaves and fruits.
11	Tomato yellow leave curl virus (TYLCV)	It is the most serious disease of tomatoes. Transmitted by white flies feeding on tomato leaves. Plants infected by disease are stunted and turn yellow, and leaves curl. Affected flowers and fruits drop off.
12	Wilts *(Fusarium oxysporum)*	Caused by a soil-borne fungus that attacks roots through small wounds (made during transplanting or resulting from nematode attack). Plant wilt from lower leaves and leaves turn yellow and die; later whole plant wilts and dies.

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

Table 8: pests and Diseases of pepper

No.	Major pests and Diseases	Comments
1	Root-knot nematodes (*Meloidogyne spp)*	Are same nematodes that attack eggplant and okra. Affected roots develops gall become malformed inhibiting plant growth; leaves become yellow, then curl and drop- off before they mature. Pepper plants attacked by nematodes are also easily infected by wilt diseases and attacked by termites.
2	White flies (*Bemisia tabaci)*	White flies and aphids are important as vectors of virus diseases. Same
3	Leaf spot *(Cercospora capsicii)*	Disease affects mainly leaves of pepper seedlings. Initial symptoms are small dark spots on leaves and these spots later enlarge to cover whole

4	Pepper leaf curl mosaic virus	Virus disease infects pepper leaves, stems and fruits and is transmitted by white flies. Leaves become yellow, mottled, distorted, small and
5	Pepper mottle virus	Is transmitted by aphids. Leaves and fruits of infected plants are badly formed; become mottled, twisted and curled. Plants are stunted, turn
6	Pepper wilt disease *(Fusarium oxysporum)*	Soil-borne disease caused by two species of fungi that infect roots, stems and leaves of pepper. Seedlings wilt and die and old leaves turn

(Source: PMPP Ghana Commercial Agriculture Project, Ministry of Agriculture, 2011)

No.	Major pests and Diseases	Comments
1	Aphids *(Aphis gossypii, Myzus persicae)*	Several species of aphids affect okra leaves and young fruits. Are very small, light to dark green, round insects that suck sap from okra leaves, causing leaves to turn yellow and become twisted; later plants may wilt and die.
2	Cotton stainers (*Dysdercus spp.)* and other sucking bugs (*Nezara viridula)*	Cotton stainer adults and nymphs are very common on okra plants at fruiting stage and abundant during dry season. When strainers attack mature fruits, they damage the seeds. The bugs are conspicuously red, with black bands. They pierce through both young and mature fruits and suck the seeds inside. Attacked fruits shrivel and then fall. Other bugs that attack okra plants are stink bugs and shield bugs. These bugs make feeding holes in okra fruits causing necrosis and these results in spotting, deformation and shedding
3	Flea beetles (*Nisotra spp., Podagrica spp.)*	Very common pest that occur on almost all okra plants. Feed on okra leaves and make many small holes in the leaves.
4	Root-knot nematodes (*Meloidogyne spp.)*	Several species of soil-living root-not nematodes are major pests of okra plants. These same species also attack eggplant, tomato, pepper, cabbage, carrot and other vegetables. Form swellings known as galls and other malformations on okra roots. Plant become stunted and may die.
5	Anthracnose disease *(Colletotrichum spp.)*	Disease affects leaves of okra, on which dark necrotic spots will begin to appear; later leaves become badly wrinkled and are then completely destroyed. Sometimes affects petioles of okra flowers and fruits causing many to drop off.
6	Leaf curl virus and mosaic virus	Okra suffers from these two major virus diseases. In affected plants, leaves become small, cup-shaped and/ or yellow (chlorotic), mottled.
7	Wilt disease (*Fusarium pallidoroseum)*	This soil-borne disease is caused by two species of fungi that infect the roots, stems, leaves and fruiting stalks. Leaves initially show dark patches of mould on lower surface, then roll, wilt and drop off.

3.1.3 PEST PROBLEMS AND CONTROL PRACTICES

Common pests in the project areas include: rodents and migratory and outbreak pests such as birds, locusts and armyworms. IPM strategies are recommended and used by some farmers as much as it is possible because there is no one control practice/measure that can provide acceptable control of the target pest.

3.1.3.1 RODENTS

Rodents, particularly the field rats (*rattus rattus*), the small house mice (*rattus norwegicus*) and multi- mammate shamba rat, (*Mastomys natalensis*) are key pests of food crops. The most affected crops are maize, millets, paddy and cassava. The damage caused by rodents starts at early booting and continues through the mature grain stage as well as the storage stage. Rice is the most susceptible of all the crops. At the pre-harvest stage, rice is attacked at planting (the rodents retrieve sown seeds from the soil causing spatial germination). The rodents cut and eat the fresh stems and parts of the panicle.

3.1.3.1.1 CONTROL OF RODENTS

Farmers are strongly advised to do the following to reduce potential damage to crops and the environment:

a. Weeding for clean bunds and fields;
b. Regular surveillance such that, the earlier incidence of rodents is detected making it cheaper and simpler to effect control measures to keep loses low and negligible;
c. Sanitation: it is much easier to notice the presence of rodents if the store is clean and tidy;
d. Trapping: by placing the traps in strategic positions to catch the rats (Figure 6);
e. Encourage farmers to synchronize field husbandry where fields are grouped together; and
f. Predation. Keep cats in stores and in the homesteads.

Figure 6: A mazing catch of rats using net traps in a rice field

3.1.3.2 MIGRATORY AND OUTBREAK PESTS OF BIRDS, LOCUSTS AND ARMY WORMS

3.1.3.2.1 ARMY WORMS

The key migratory and outbreak pests of economic significance in West Africa (including Liberia) are armyworm (*Spodoptera exempta*), birds, and the red locusts whose management is coordinated by the Ministry of Agriculture of Liberia. The African armyworm (*Spodoptera exempta*) is a major threat to cereal production in a number of African countries. It is a major pest of cereal crops (maize, rice, sorghum and millets) as well as pasture (grass family) and therefore a threat to food security and livestock. The problem with armyworms is that they are highly migratory so that larval outbreaks can appear suddenly at alarming densities, catching farmers unawares and unprepared. The worms destroy crops in the grass family like maize, rice (Figure 7) and millet and in addition, animals that feed on infested pasture get bloated and can even die.

Figure 7: Infestation of Army Worm in recently transplanted rice field

3.1.3.2.2 MIGRATORY BIRDS

It is recognized that, birds are serious migratory pests of cereal crops, namely rice, maize, sorghum and millet. With birds, the time of damage starts at heading (formation of the grains) or the early milky stage. Damage involves the sucking of juice from grains or the removal of whole grains from the plant's spike. The major culprits are the weaver birds and the *quelea quelea* (Figure 8).

Bird pest problems in agriculture have proved difficult to resolve due in large part to the behavioral versatility associated with their flocking ability as well as the array of food choices available to the flocking birds. Based on these two factors, effective control is information intensive and therefore rather challenging. Several techniques have been tried to reduce bird populations to levels where crop damage is minimal. Traditional methods, slings, bird scares, and scarecrows, are still being used in many parts.

Figure 8: Swarming Birds in rice fields

3.1.3.2.3 LOCUSTS

During periods with favorable weather, locusts multiply rapidly and form large swarms that can cause huge damage to plants in a very short period of time. Grasshopper has become increasingly damaging on cereal crops especially maize and rice in parts of the country (Figure 9). There being no tangible research currently on the management of the pests in rice fields in the country, farmers reportedly use any available insecticide whenever outbreaks occur.

Figure 9: Section of locusts swarming on rice fields

3.2 LOSSES AND COSTS ASSOCIATED WITH CROP PESTS AND DISEASES ATTACKS IN LIBERIA

3.2.1 CASSAVA

According to the Crop and Food Security Assessment for Liberia report commissioned by WFP and FAO in 2006[11], it is noted that, 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. The study noted, that pests eat over 50% of the expected harvest and the loss is enormous as concluded in the report. Based on available information during meetings with IITA Team working on AfDB funded Smallholder Agricultural Productivity Enhancement and Competitive Project (SAPEC) under MoA, it is clear, there is no data on crop losses due to pests and diseases in Liberia (Michael Edet & Wasiu Awoyale *per.com.,*). It is therefore evident that, for definitive estimates to be made on this subject, detailed information is required, not only on the incidence and severity of the disease in different areas, but also on the prevalence, type, productivity and sensitivity to infection of the main varieties being grown.

3.2.2 POST-HARVEST LOSSES ON CROPS IN LIBERIA

According to USAID 2016[12], amongst factors affecting the profitability and marketing of agricultural produce in Liberia include post-harvest losses caused by pests, humidity, and the lack of good storage and processing facilities for farmers. The study further notes that, Liberian farmers lose up to half of their harvest due to poor storage conditions and preservation methods, a factor that contributes to the country's insufficient food supply. Many farmers reportedly interviewed in that study acknowledged that, pests especially birds were a big problem in rice production while the Groundhogs (Grass Cutters) affected rice, root and vegetable crops. In addition, a variety of insects including locusts were a nuisance on almost all crops. The high likelihood of post-harvest loss is a disincentive for farmers to grow more food than necessary to feed their families.

Furthermore, in rural areas, farmers use traditional granaries to store rice and cassava, which are prone to pest infestation- and humidity-related losses of up to 25% (GOL, WFP et al. 2006). Farmers may lose 45% of their vegetable production due to poor handling, limited road infrastructure, and lack of cold storage (Ibid). Further, bulk storage facilities are lacking, which would allow farmer groups and cooperatives to store large amounts of produce for longer periods after the harvest and give them greater bargaining power with traders. As a result, Liberia imports large amounts of food from neighboring countries to meet household consumption requirements, despite the general availability of land, sufficient rainfall, and fertile soil in the country.

In all, these estimates show that, pests and diseases are threat to sustainable crop production in Liberia as such, a need for a PPMP in WAATP.

3.3 LIVESTOCK AND POULTRY SUB-SECTORS IN LIBERIA

[11] *FAO/WFP February, 2006 Crop and Food Security Assessment for Liberia, Monrovia.*
[12] USAID 2016 Food Security Desk Review for Liberia, 2016–2020

3.3.1 POULTRY AND PIGGERY COMMODITIES IN LIBERIA

The livestock sub-sector plays a minimal role in the Liberian economy, which is about 14% of the agricultural GDP. Animals are reared by traditional farmer's using local, low productive breeds of animal and inappropriate techniques. Household-based chicken, goats, ducks, pigs, sheep and cattle rearing predominates. Farmers have access to few service delivery inputs and receive limited or no public support services. Total livestock population has declined during the civil war from 1990-2003, but the numbers (7%) is increased by 2010 (FAO, 2012).

Livestock including poultry, an integral part of the mixed farming system, play an important role in the economy of Liberia. Most livestock is reared by subsistence farmers. Small-scale farmers and the landless including women are responsible for rearing most livestock in Africa. Liberian's animal density is less than 0.1 head of cattle, 2.2 of sheep, and 2.1 goats/Km^2. Meat, milk and egg consumption is 11.0 kg, 9.8 kg and 3.0 kg/person/year, respectively. Only 9.2% of these needs are covered by local production and no milk is produced locally (Rhissa, 2007).

3.3.2 ADVANTAGE, PROFITABILITY AND COMPARATIVE STRENGTH

Poultry, pigs and goats farming has certain advantages over crops, fisheries and forestry. They require less land, least influenced by climatic change and the supply of food of animal origin is disproportionately low against high demand. The current meat consumption is about 11.0 kg per person and per year on average, which is covered by 2.6 kg from live animals, 4.0 kg of imported meat/person/year and 4.4 kg of wild meat (FAO/AGAL, 2005). In order to meet the shortfall, meat, milk, eggs are being imported expending huge amount of foreign currency ($5,906,552 USD: 2005-2006) every year. The production of meat, milk and eggs needs to grow to meet the increasing demand. This illustrates the need for increasing the efficiency of meat, milk and egg production in the country to increase the intake of animal protein and reduce dependence on other countries for importation of animal products. It has been found that small ruminants (goats & sheep), pigs and chicken generate more regular cash income and its processing and marketing create more employment per unit value added compared to crops.

3.3.3 LIVESTOCK SUB-SECTOR CHALLENGES

The livestock sub-sector has a number of challenges which range from ensuring quality control of feeds, medicines, biologic, semen, and day-old-chicks. Veterinary public health, food hygiene, and control of zoonoses as areas that are weakly addressed and require improvement. A close collaboration is very much essential between human public health and veterinary public health in controlling zoonoses and implementing food safety program. Access of small scale livestock including poultry farmers to disease diagnosis and veterinary services is one of the key challenges confronting livestock development. In addition, ensuring the quality feeds, vaccine and medicines and rationalizing their price, mitigating the scarcity of those items is also a major challenge.

Limited availability and lack of quality feed ingredients and balanced feed is a serious constraint to livestock development especially in poultry and pigs' industries. In Liberia, livestock farmers rely on a combination of both local and imported feeds and other inputs (medicine, vaccines), a trend that is expected to intensify. Similarly, low coverage of veterinary/animal health care services (disease diagnosis, delivery of veterinary clinical services, medicines and vaccines) and

irregular supply of vaccines in the market pose a serious threat to smallholder livestock (including poultry) farms.

At present livestock services are rendered by "the National Livestock Bureau (NLB) of the Ministry of Agriculture (MoA), which is unable to deliver adequate services to livestock (including poultry) producers. Efficient performance of the livestock sector would contribute toward development of agrarian economics. The availability and quality of animal health services can play a key role in increasing the productivity of livestock (Umali et al., 1994). The inadequate supply of veterinary services has commonly been attributed to poor public-sector performance (de Haan and Bekure, 1991).

3.4 PEST AND DISEASES PROBLEM IN ANIMAL HEALTH IN LIBERIA

3.4.1 ECONOMIC PESTS AND DISEASES OF ANIMALS IN LIBERIA

Ectoparasites is a serious threat to both animals and humans West African region including Liberia. The painful bites of parasites could be a great nuisance, leading to loss of large amount of blood (Walker, 1996; Natala, 1997). Ticks alone transmit several important protozoal, rickettsial, bacterial and viral diseases to animals, thereby causing great economic losses. Lice and mites usually cause dermatitis, which is characterized by alopecia and necrotic foci. There is also intense pruritus (especially with mange) which leads to biting and vigorous scratching of affected parts (Lapage, 1968; Yeruham, 1985; Taylor et al., 2007).

3.4.2 CONTROL OF PESTS AND DISEASES IN ANIMALS IN LIBERIA

Generally, pest and disease management in livestock in Liberia is largely by use of chemical methods mainly pesticides and a range of agro-chemicals. However, the use of pesticides has a range of issues such as:

3.4.2.1 ENVIRONMENTAL AND PUBLIC HEALTH CONCERNS ON THE USE OF PESTICIDES

Pesticides are toxic substances released most times intentionally into our environment. This includes substances that kill weeds (herbicides), insects (insecticides), fungus (fungicides), rodents (rodenticides), and others. The use of toxic pesticides to manage pest problems has become a common practice around the world. Though they could be very useful in managing pest problems, they are also a great environmental and health risk.

3.4.2.1.1 PERSISTENT ORGANIC POLLUTANTS (POPS)

In May 2001, Liberia became a signatory to the Stockholm Convention on Persistent Organic Pollutants and ratified in 2004. These obsolete pesticides are characterized by a high persistence in the environment (e.g. half-life for DDT in soil ranges from 22 to 30 years, Toxaphene -14 years, Mirex -12 years, Dieldrin- 7 years, Chlordecone up to 30 years), low water solubility and thus, potential to accumulate in fatty tissue of living organisms including humans and toxicity to both human and wildlife. Most agricultural pesticides could constitute any of the POPs chemicals, which if are in use, pose adverse environmental, animal and human health risks. Considering that Liberia is a Signatory, the country is obligated to stop the use of POPs pesticides if still in use. For

other pesticides, which are not POPs, the issue of toxicity still remains and the consequence of application on agricultural farm land, and resultant wider environmental and social impacts.

3.4.2.1.2 PESTICIDES AND HUMAN HEALTH IMPACTS

Pesticides have been linked to a wide range of human health hazards, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, reproductive abnormalities, and endocrine disruption. Chronic health effects may occur years after even minimal exposure to pesticides in the environment, or result from the pesticide residues, which we ingest through our food and water. Pesticides can cause many types of cancer in humans. Some of the most prevalent forms include leukemia, non-Hodgkins lymphoma, brain, bone, breast, ovarian, prostate, testicular and liver cancers.

3.4.2.1.3 POTENTIAL HARM TO NON-TARGET SPECIES

The environmental impact of pesticides consists of the effects of pesticides on non-target species. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, because they are sprayed or spread across entire agricultural fields. Runoff can carry pesticides into aquatic environments while wind can carry them to other fields, grazing areas, human settlements and undeveloped areas, potentially affecting other species. Other problems emerge from poor production, transport and storage practices. Over time, repeated application increases pest resistance, while its effects on other species can facilitate the pest's resurgence. WAATP Pest and Pesticides Management Plan

3.5 RATIONALE FOR PREPARING PPMP

The Pest and Pesticides Management Plan (PPMP) is aimed at addressing relevant stakeholder concerns about pests and pesticides. It stresses the need to monitor and mitigate negative environmental and social impacts of the Project (which includes the use of pesticides) and promote ecosystem management with the human health risk being the underlying principle from seed usage, through planting and growth stage and also post-harvest issues including safe crops for consumption. It emphasizes the need for an integrated approach to the management of pests in line with the nation’s policy on IPM as well as funding agencies requirements on pest management and makes provision for adequate measures to enable the Project sustain the adoption of IPM techniques.

Integrated Pest Management (IPM) brings together, into a workable combination the best strategies of all control methods that apply to a given problem created by the activities of pests. IPM has been defined in various ways but a more scientific definition describes it as, "the **practical** manipulation of pest populations using sound **ecological** principles to keep pest populations below a level causing economic injury".

The surveillance, monitoring and containment of diseases including zoonosis anticipated under the WAATP could lead to increased use of chemicals, reagents, and pesticides with potential negative impacts and risks on the environment and human health. Given the situation-driven nature of the project, the extent of such an increased use cannot be ascertained in advance and requires the borrower to prepare a Pest and Pesticides Management Plan to identify the potential risks and ways to adequately mitigate them.

3.5.1 SCOPE OF THE PPMP

The PPMP covers the existing national and international legislations on the use of chemicals for pest management. It also assesses the Liberian experience in pest management and capacity on integrated pest management approach. Other areas addressed by it include training and awareness for the public and users of pesticides on safety measures, description of pesticides banned for use in Liberia as well as those approved for use. Specifically, it identifies institutional responsibility with regards to mitigation measures and monitoring indicators to be observed in order to evaluate the performance and effectiveness of the PPMP.

The PCU will make copies of the PPMP available in selected public places as required by law for information and comments as well as in the media. The PPMP will be announced and published on an official Government website. EPA and PCU/MoA will upload the PPMP and other safeguards for WAATP onto its website https://www.moa.gov.lr/ and invite the public to access and review the documents. The PCU will also provide copies of the ESMF, PPMP, RPF and other safeguards documents for WAATP in the project to the public in its Secretariat, CORAF and at CARI from where the public can access it for any comments. The ESMF, PPMP and RPF alongside other safeguards documents will be disclosed at the World Bank's website and made available to any interested persons for public access and for public information and comments/feedback as will be necessary.

3.6 INTEGRATED PEST MANAGEMENT OPTIONS FOR CROPS AND LIVESTOCK MEASURES

In general terms, there are three possible approaches to decreasing the losses due to a virus disease:

decrease the proportion of plants that become infected. In general terms, there are three possible approaches to decreasing the losses due to a virus disease:

a. decrease the proportion of plants that become infected;
b. delay infection to such a late stage of crop growth that losses become unimportant;
c. decrease the severity of damage sustained after infection has occurred. These objectives can be achieved in diverse ways (Thresh, 2003) and the main possibilities for controlling CMD are phyto-sanitation, disease-resistant varieties, cultural practices, vector control and mild-strain protection.

3.6.1 CROP INTEGRATED PEST MANAGEMENT MEASURES

These include:

3.6.1.1 PHYTO-SANITATION

This term is used in a general sense for the various means of improving the health status of cassava planting material and for eliminating sources of inoculum from which further spread of CMD can occur through the activity of the whitefly vector. There are three main features of phyto-sanitation for the control of CMD:

a. crop hygiene involving removal of all diseased cassava or other host plants from within and immediately around sites to be used for new plantings;
b. use of CMD-free stem cuttings as vegetative planting material;
c. removal (rouging) of diseased plants from within crop stands.

3.6.1.2 CROP HYGIENE

This is a basic means of facilitating control of many pests and diseases by removing the debris and surviving plants of previous crops to decrease the risk of carry-over of pests or pathogens to any new plantings at the site or nearby. Little attention has been given to adopting this approach with cassava and CMD, and the benefits to be gained have not been demonstrated. They could be substantial because cassava plants, including those affected by CMD, regenerate readily from stems left in or on the ground at harvest.

3.6.1.3 USE OF DISEASE FREE PLANTING MATERIAL

A basic approach to disease control is to use uninfected propagules for all new plantings. The benefits to be gained with cassava and CMD are considerable because healthy stem cuttings establish more readily and grow more quickly than infected ones. The subsequent yields of initially healthy plants are also substantially greater, even if they are infected during growth by whitefly. Moreover, the use of healthy cuttings together with crop hygiene means that initially there are no foci of infection within or alongside new plantings from which spread can occur. This avoids, or at least delays, the onset of CMD and decreases the period over which spread can occur during the early, most vulnerable stages of crop growth.

3.6.1.4 ROGUING

Roguing is a well-known means of virus disease control of wide applicability. It has been recommended repeatedly to control CMD. For example, it is advised that cassava plantings should be inspected at least weekly for the first 2–3 months of growth, to find and remove immediately any diseased plants that occur. Thus, unless diseased plants are removed promptly, they can be expected to make a disproportionately large contribution to the overall flux of vector activity in the area.

3.6.1.5 USE OF RESISTANT SPECIES

Resistant and tolerant rice cultivars play an important role in the reduction of yield losses due to insect pests and assessment of different rice varieties for insect resistance is an integral component of pest management. Because of its unique advantages (e.g. generally compatible with other control measures), host-plant resistance is a key component in the integrated control of rice insect pests in Africa.

Success in identifying resistant material depends to a large extent on the ability to adequately evaluate germplasm and improved genotypes. Screening germplasm under artificial and natural pest infestations is essential for identifying better sources of resistance to major insect pests of rice. Knowledge of the mechanisms and factors contributing to host-plant resistance to insects is useful in selecting suitable criteria and breeding methodology for the genetic improvement of rice plants for insect resistance. Some of the factors associated with resistance, such as silica content and longer internode elongation in *Oryza sativa* varieties, can be used as 'marker traits' to screen and select for resistance to pests. Considerable progress has been made by the Africa Rice Center (AfricaRice) in the development of NERICA varieties that combine the high yield potential of Asian rice (*Oryza sativa*) with many useful traits from the African cultivated

3.6.1.6 BIOLOGICAL CONTROL AGENTS

Biological control means use of living organisms to suppress pest populations and damage. These living organisms can be parasitoids, predators and use of sterile males during breeding or pathogens. Environmentally friendly chemical interventions such as the use of semio-chemicals (e.g. pheromones and parapheromones), biopesticides and relatively less toxic insecticides can be used together with biological control agents. This tactic takes advantage of the fact that organisms depend or even feed on each other for survival. Thus, biological control method tries to ensure that pests are reduced by organisms which are their natural enemies. These natural enemies can be conserved by taking care with farming practices so that they are not killed but are actually encouraged. Under WAATP, biological control will be considered by the Project as the first line of control for pests and diseases, when incidence is noticed and where an appropriate biocontrol agent is available.

3.6.1.7 CULTURAL CONTROL PRACTICES

Cultural control means use of usual crop and livestock production practices to suppress pest population and damage in the field. These practices include ploughing to expose and kill soil pests, using pest and disease-free seed, planting in time, intercropping, timely weeding, mulching, field sanitation, harvesting in time to minimize exposure of the crop to pests, practicing crop rotation,

selection of breeding livestock with the desired traits, general hygiene for livestock and practicing all in all out-livestock production systems.

Other cultural practices include:

a. Crop rotation - crop rotation helps to prevent pest populations building over a number of years,
b. Inter-cropping practices,
c. Field sanitation and seed bed sanitation,
d. Use of pest-resistant crop varieties,
e. Managing sowing, planting or harvesting dates;
f. Water/irrigation management,
g. Scarecrow materials (Figure 10),
h. Practices to enhance the build-up of naturally existing predator populations;
i. Hand-picking of pests or hand-weeding;
j. Sometimes use of local concoctions to treat livestock such as poultry (Figure 11);
k. Use of traps or trap crops. Other special considerations.

Figure 10: Scare crow in a rice fields.

Figure 11: Chicken being local herbs to treat coccidiosis in Lofa areas in Liberia

3.6.2 INTEGRATED VECTOR MANAGEMENT-IVM OPTIONS FOR LIVESTOCK UNDER WAATP

3.6.2.1 INTRODUCTION

Establishing an IVMP for vectors of animals is a function of the following 5 steps:

a. ***Detection:*** Pest detection requires thorough and regular monitoring of animals for pest invasions and/or other signs and symptoms that indicate a pest is present on the animal or in the environment where animals live. This is done by observing an animal's body, faeces, living quarters, bedding, surroundings and behaviours. Under WAATP project, any unusual change noticed in an animal shall be recorded and brought to the attention of a veterinarian;
b. ***Identification:*** Identification step is required to determine if the pest detected is actually the organism causing the discomfort or disorder in the animal. This is best performed by a trained farm manager or a veterinarian;

c. ***Economical or Medical Significance:*** A medical judgment of the state of health of an animal is made on the basis of symptoms caused by pests. On the economic side, estimated losses which the pest has caused such as reduction in diary, meat production and egg production are the variable indicators, but high economic loss can be a function of duration of pest invasion or period within which it took for effective mitigation response to take place;
d. ***Method Selection:*** This involves selecting a method or methods for managing the observed vector such as are contained in this IVMP; and
e. ***Evaluation:*** It is necessary under WAATP to evaluate the effectiveness of the applied pest management procedures. Keeping records and evaluating pest control techniques will be followed as monitoring task for the WAATP IPM outcome evaluation.

3.6.2.2 METHODS OR TECHNIQUES THAT WILL BE USED FOR ANIMAL VECTOR MANAGEMENT

IVM for animals includes biological, cultural, mechanical, physical, chemical (use of pesticides), use of resistant breeds and sanitation in the animal's environment.

3.6.2.2.1 BIOLOGICAL CONTROL

This project will introduce, encourage and artificially increase plants and animals that are parasites or predators of identified pests. This will be effective in managing insects and mites.

3.6.2.2.2 CULTURAL CONTROL

a. It is recommended that under WAATP, maintaining overall good health of the animals should be a priority in pest management. This is necessary to keep the animal healthy which enhances its tolerant level to pests.
b. Animal diets should be well balanced and provided at consistent intervals and in appropriate portions;
c. Adequate ventilation should be provided for animals kept indoors to prevent heat, stress or the spread of diseases; and
d. Ensure that animals are not over crowded to avoid pest outbreaks.

3.6.2.2.3 MECHANICAL TOOLS

Mechanical tools to be employed under WAATP may include:

a. Grooming combs, brushes and flea combs with closely spaced teeth to monitor for insects and ticks;
b. Use of electronic devices such as lights that attract flying insects around barns or other animal quarters to reduce some nuisance pests;
c. Use of traps for rodents that may be carriers of vectors.

3.6.2.2.4 PHYSICAL CONTROL

This may involve the following measures:

a. Use of sticky flypaper to reduce nuisance flying insects in confined areas;
b. Use of cages that separate animals from contact with one another which reduces the spread of insects from infested animals to non-infested ones;
c. Use of pest resistant breeds and breeds adapted to the climatic conditions of the surrounding environment where they are raised can avoid or reduce the effect of the pests.

3.6.2.2.5 SANITATION

Implementation of WAATP IPM shall accord great importance to sanitation as measure to avoiding pest and diseases in animals. Keeping barnyards, stables, kennels, exercise areas and surrounding areas as clean as possible and ensuring that animals drink from safe water points can prevent reasonably pest invasion, and therefore highly recommended. Cleaning animal bedding and the surfaces of cages and other animal confinement with disinfectants also kills pathogens and reduces the tendencies of spread of diseases.

3.6.2.2.6 USE OF PESTICIDES

Pesticides may be used in WAATP for animal pest control in combination with other methods of prevention and control or used when other methods have failed or considered in applicable. For example, cultural or other management strategies discussed earlier may not be applicable to control or prevent deer flies and horse flies. In that or similar cases, the use of repellants or chemicals at appropriate application, quantities and methods for the environment are conceivable options. Nonetheless, banned and obsolete pesticides shall not be procured nor be used in any case under WAATP.

4 GUIDANCE ON PESTICIDE TO BE PROCURED AND USED UNDER WAATP

4.1 WORLD BANK SAFEGUARDS REQUIREMENTS UNDER OP4.09 PEST MANAGEMENT

Envisaged agricultural transformation resulting from WAATP interventions may lead to increased use of pesticides in cultivated land in intervention areas. Due to an absence of import controls, there are indications that poor quality, unregistered, and unregulated pesticides are being imported to Liberia, and that farmers who lack knowledge on their appropriate handling and use are using them (USAID FED, 2013[13]). While pesticides are designed to kill specific pests, they can easily reach destinations other than their targets through entering the air, water, and sediments during handling, storage, application, and disposal of material and containers.

Without specific management, impacts could include:

a. Destruction of crop pollinators leading to poor crop yields;
b. Elimination of the natural enemies of crop pests and consequent loss of natural pest control that keeps the pest population low;
c. Development of resistance to pesticides, encouraging further increases in the use of chemical pesticides;
d. Contamination of soil and water bodies;
e. Toxicity to fish and birds;
f. Proliferation of aquatic weeds;
g. Pesticide poisoning of farmers and deleterious effects on human health;
h. Unacceptable levels of pesticide residues in harvested produce and in the food chain; and
i. Loss of biodiversity in the environment, particularly of the aquatic non-target species.

Use of pesticides can present acute and/or long-term and eco-toxicological hazards, especially if used incorrectly. This is particularly relevant in the Liberian context, since EIA/permitting systems in this area are not yet established and there is currently no functioning system for the import and safe use of pesticides and the management of associated wastes.

Notably:

a. Liberia has a list of pesticides banned under the Stockholm conventions, but there are inadequate
b. controls on imports and it is understood that some Liberian farmers use banned pesticides.
c. Few pesticides and choices of active ingredients have been available in Liberia, due to lack of good infrastructure and capital. Some of those available pesticides contain generic versions of off patent pesticide, some of which may be of low quality and come without proper agro-dealer technical support.
d. The EPA does not have the infrastructure or resources to test, register, and manage pesticides entering Liberia, or to ensure adequate training is undertaken to those using such products.
e. Liberia does not have an established system to regulate spraying of pesticides by spraying providers or individuals.

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As a result, the pesticide risk profile for Liberia is higher than in some other emerging market countries, and extra care will be needed to develop and implement risk mitigation and management measures that can function in this context. The EPML (Sections 35 & 37) establishes a number of important principles to safeguard the quality of the freshwater environment (56, 57, and 61) and soils (Sections 52 and 53). The EPML makes specific provisions for the management of pesticide and toxic and hazardous chemicals and materials. However, the regulations to implement such requirements are not yet in place.

Liberia, as a signatory to the Stockholm convention, is required to take measures (legal and/or administrative) to eliminate or heavily restrict the production and use of persistent organic pollutant (POP) pesticides and polychlorinated biphenyls (PCBs), and to minimize the unintentional production and release of POPs. Substances are listed in three categories: elimination, restricted use, and unintentional production.

WB OP 4.09, Pest Management, requires WB-funded projects to include a Pest Management Plan prepared by the borrower. This can be a stand-alone document or part of an EA. The Pest Management Plan is meant to promote the use of biological or environmental control methods and reduce reliance on synthetic chemical pesticides through implementation of Integrated Pest Management (IPM) techniques. These involve the integration of cultural, physical, biological and chemical practices to grow crops with a minimal use of pesticides.

The WB applies the following criteria to the selection and use of pesticides:

a. Have negligible adverse human health effects.
b. Be effective against the target species.
c. Have minimal effect on non-target species and the natural environment.
d. Take into account the need to prevent the development of resistance in pests.

4.2 OVERALL STANDARDS

The World Bank has been a longtime partner in the agricultural sector. Given its safeguard policies, it has to ensure that the procurement/use of pesticides is done as cautiously as practicable, with proper safeguards in place, and through the use of the least toxic means of effective pest control. In that regard, the following criteria will apply to the selection and use of pesticides in activities under WAATP:

a. Pesticide financed under WAATP must be manufactured, packaged, labelled, handled, stored, disposed of, and applied according to standards that, at a minimum, comply with the FAO's Pesticide storage and stock control manual (FAO, 1996), Revised guidelines on good labelling practice for pesticides (FAO, 1995), Guidelines for the management of small quantities of unwanted and obsolete pesticides (FAO, 1999), Guidelines on Management Options for Empty Pesticide Containers (FAO, 2008), and Guidelines on personal protection when using pesticides in hot climates (FAO, 1990).
b. Consistent with World Bank OP 4.09, WAATP financing will not be used for formulated products that fall in WHO classes IA and IB, or formulations of products in Class II, if (a) the country lacks restrictions on their distribution and use; or (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly.

c. WAATP financing will not be used for any pesticide products which contain active ingredients that are listed on Annex III of the Rotterdam Convention (on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade), unless the Country has taken explicit legal or administrative measures to consent to import and use of that active ingredient.
d. WAATP financing will not be used on any pesticide products which contain active ingredients that are as per the Stockholm Convention on Persistent Organic Pollutants, unless for an acceptable purpose as defined by the Convention, or if an exemption has been obtained by the Country under this Convention.
e. WAATP financing will not be used for any pesticide products which contain active ingredients that are listed on Annex III of the Rotterdam Convention (on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade), unless the Country has taken explicit legal or administrative measures to consent to import and use of that active ingredient.

4.3 PESTICIDES USAGE RECORDS

Under circumstances where CARI and its stakeholders directly procure pesticides for distribution to the farmers, the PIU will be required to maintain records of all pesticides annually applied under the project. The following usage information will be reported:

a. Pesticide trade name(s)
b. Active ingredient(s)
c. Total acres treated
d. Total amount of pesticides used
e. Total amount of active ingredient(s) used
f. Target pest(s)
g. Efficacy (percent control)
h. Total number of containers returned to the stores where chemicals are purchased

4.3.1 USE OF PESTICIDES

4.3.1.1 GENERAL CRITERIA FOR PESTICIDE USE

An approved list by the Agricultural Chemicals Board exists (see Annex 1) will be used according to their labeled uses when all of the following criteria are met:

a. The activity is part of an IPM strategy that seeks to minimize pesticide use or use pesticides as a last resort;
b. Best technology-based practices are followed, leaks or spills are reduced, and application equipment is maintained in good working order;
c. Timing of pesticide application corresponds to the life cycle of the pests to be treated, and the life cycle is monitored appropriately;
d. Pest population action thresholds are determined, and monitoring ensures treatment only when the threshold is exceeded;
e. Weather conditions are appropriate for the application;
f. Applicators adhere to all of the label requirements concerning the safe and effective use of the pesticide(s); and
g. Activity minimizes pesticide application within 50 meters buffer of streams or other water bodies.

4.3.1.2 PESTICIDE APPLICATION DECISIONS AND PROCEDURES

Pesticides should be applied by directed, low volume, single wand sprayers, wiping, daubing and painting equipment, or injection systems. Boom application shall be limited to large scale (>5 acres) natural resources enhancement or farming activities. It is important to manage pesticide drift when surface waters or beneficial plants are nearby. Control nozzle size, pressure and droplet size to minimize drift. Application checklist shall include the following procedures:

a. Read pesticide label.
b. Check and calibrate application equipment for safety and efficiency.
c. Check the weather conditions. Unless otherwise indicated on the product label, avoid pesticide use it is raining or expected to rain within 24 hours, or wind speed is very high
d. Post notification signs at all entrances to sites associated with pesticide applications.
e. List re-entry specifications on the signs if required by the label.
f. Apply material according to the label.
g. Record pesticide application on application forms.
h. Remove signs when the liquid pesticide has dried, unless indicated otherwise on the label.

4.3.1.3 RULES AND PROCEDURES FOR APPLICATION OF PESTICIDES

It is virtually impossible to train all small-scale farmers in Liberia in the safe and responsible use of pesticides. The solution, therefore, is the concept of Spray Service Providers (SSPs) as part of an initiative to promote the safe and responsible use of pesticides and timely control of outbreaks and occurrence of new pests, or to manage regular pests, to benefit small-scale farmers. This approach will recruit trained and certified lead farmers in the application of pesticides and they will hire out their services to fellow farmers to spray their lands/crop. This implies that untrained farmers will no longer handle pesticides and that this application will only be undertaken by those who are properly trained and certified.

4.3.1.3.1.1 SAFETY AND PROTECTION

There are certain measures which should always be undertaken by pesticide operators to help protect against contamination during the handling and application of pesticides. These measures should always be followed.

4.3.1.3.1.2 READING AND UNDERSTANDING LABELS

The first principle is to always read and follow the label recommendations on the pesticide container. If the label information cannot be read or understood for any reason, then the operator should find someone who can explain the instructions to him. Apart from the written instructions, the operator should also look for pictorial information on the label which will indicate the degree of hazard presented by the pesticide formulation. Similarly warning symbols, such as skull and crossbones, give information on the type of chemical hazard.

4.3.1.3.1.3 AVOIDING CONTAMINATION

Direct exposure of the skin, nose, mouth or eyes should be avoided or minimized when working with pesticide products to reduce the chances of personal contamination. When pouring and mixing the concentrated product, every effort should be made to avoid splashing or spilling onto skin or clothing. If any product falls on the skin, or into the eyes, then this should be washed off as soon as possible. Heavily contaminated clothing must be removed and washed with detergent and water. The likelihood of contamination can be greatly reduced by using suitable equipment for measuring out and

transferring the product. In particular the hands must never be used as scoops nor should the hands or arms be used to stir liquids.

The most appropriate application technique should be selected to control the pest problem. It is very important that the application equipment is in a good state of repair and that it is properly maintained and calibrated. When spraying the diluted product, the applicator should always work upwind of the spray to avoid coming into contact with it. He should also avoid contact with freshly sprayed foliage as far as possible.

4.3.1.3.1.4 PERSONAL HYGIENE

Another basic principle of personal protection is good hygiene when working with pesticides. This is to ensure that if any contamination occurs then it is removed in good time. In addition, personal habits will help avoid direct contamination in itself.

Operators should not eat, drink or smoke during work and should not touch their face or other bare skin with soiled hands or gloves. They should always wash their hands and face after handling pesticides and before eating, drinking, smoking or going to the toilet. When they have finished work for the day they should then wash themselves thoroughly. Their work clothes should also be washed after work, separately from other clothing, and then dried.

4.3.1.3.1.5 SAFETY GEAR

For the effective safety and protection of the workers handling agro-chemicals, the provision of the following is deemed necessary.

a. Helmet or cloth cap
b. Safety spectacles, goggles or face shield (attached to helmet)
c. Dust or light fume masks
d. Emergency vapor masks or half-face respirators with organic vapor cartridges
e. Nitrile rubber or neoprene gloves or gauntlets
f. Overalls
g. Nitrile rubber or neoprene aprons
h. Strong rubber or neoprene boots

Selection, care, and maintenance of work clothing and protective equipment will be paramount given the fairly hot/humid conditions in large parts of Liberia. This is because the wearing of additional protective clothing and other equipment can cause severe discomfort and even physical distress due to heat stress if they are made of inappropriate materials. In addition, because of the discomfort, operators may dispense with protective apparel and become subject to greater exposure and possible contamination. There are certain measures which can help reduce this problem, namely:

a. Where possible using a pesticide formulation which does not require the wearing of additional items of protective clothing;
b. Applying the pesticide in the cooler hours of the day when it is more comfortable to wear protective equipment.

4.3.1.3.1.6 INSTRUCTIONS ON WEARING OF PPE

Table 9: Appropriate PPEs for handling Agro-pesticides

Equipment	Protection	How to wear it
Coveralls	There are two types of coveralls: disposable and reusable. Disposable coveralls are lightweight and comfortable on warm days. They can be worn for mixing and applying pesticides, and then discarded at the day's end. If they become contaminated, they should be discarded at once. The second type of coverall is made of washable fabric and may be reused many times. These fabric coveralls are adequate for use with all but the most highly toxic and concentrated pesticides.	Button (or zip) right up to the neck. Loose coveralls around the neck will suck and blow pesticide in and out of the interior of the coveralls as you bend and move. Wear coveralls over a long-sleeved shirt and pants.
Aprons	When pouring or otherwise handling concentrated pesticides, it makes good sense to wear protection in the form of an apron. The apron protects the front of your body from spills or splashes of the concentrate. The apron should be made of rubber or synthetic liquid-proof material that will resist the solvents used in formulating the pesticide.	Make sure the apron covers your body from your chest to your boots.
Gloves	Protect your hands by wearing chemical- resistant gloves. Neoprene gloves provide the best protection. Natural rubber gloves may be used when handling organo-phosphorus or carbamate pesticides. Be sure that they are designed for use with solvents and pesticides. Never use lined gloves, gloves with wristbands or leather gloves.	Put gloves on and roll up the first inch or two of the cuff. That way when you lift your hands, any liquid on the gloves won't drip down your arms.
Hats	Use a chemical-resistant hat, preferably made of washable plastic. The hat may be a hard hat or made of flexible plastic. In either case, it should have a plastic sweatband. Wash and dry entire hat after each use and before storing. Ordinary baseball caps with cloth sweatbands are dangerous as they absorb the pesticide and re-contaminate the forehead each time you wear them. Even small amounts of moderately or slightly toxic pesticides may cause severe skin irritation or other illness if exposure continues for several days.	
Boots	Wear chemical-resistant, unlined boots. These boots are available in a variety of styles and materials. Neoprene boots are the best. Knee-length boots offer greater protection because they extend above the lower end of the apron. Avoid leather or fabric boots and shoes because these will absorb pesticides and cannot be cleaned effectively.	Wear your trouser legs outside the top of your boots. This will prevent spills and splashes from running into the boot and onto your leg.
Goggles	Chemical-resistant goggles keep your eyes safe from	Wear goggles snugly on your face so

	both splashing and, if using dry formulations, dusts or granules. Don't use goggles with cloth or elastic headbands as these will absorb pesticides.	that the sides of your head are protected from splashes. If you wear glasses, make sure you purchase goggles that fit snugly over them. Never wear contact lenses when working around pesticides.
Respirators	Only approved respirators should be used. Do not exchange parts of different respirators. (For example, do not use a cartridge produced by Company "A" with a respirator produced by Company "B" as the combination may not provide adequate protection to the user). Dust masks are ineffective in protecting against herbicide vapors. Similarly, the filters on tractor cabs are intended to remove dust and are not designed to protect against herbicide vapors or mists. Chemical cartridge respirators are recommended for outdoor use when mixing and applying herbicides.	When carrying out operations, change filters each day. The cartridge should be replaced when chemical odor becomes apparent or when breathing becomes difficult. New cartridges should always be installed at the beginning of the spray season. Prior to commencing work, check the face seal while the respirator is on the wearer's face. Regardless of design, respirators cannot be worn securely by people wearing beards, moustaches or sideburns.
Face Shields	Goggles offer some protection, but frequently full-face protection is advised or required according to the pesticide label. It is especially important to protect your eyes and face when pouring or mixing liquid concentrates. Effective face shields are made of clear plastic.	Since the shield attaches to the hard hat, you can raise or lower it as needed.

4.3.1.3.1.7 POST-APPLICATION VISUAL ASSESSMENT

All operators must conduct visual assessments of application sites. Visual assessments will consist of spot checks in the area in and around where pesticides are applied for possible and observable adverse impacts caused by an application of pesticides. Possible and observable adverse impacts include, but are not limited to, the unanticipated death or distress of non-target organisms, disruption of fish and wildlife habitat.

4.3.1.3.1.8 RECORDS KEEPING

All records will have to be documented as soon as possible but no later than 14 days following completion of each pesticide application in a treatment area. On or before the 14th day after any pesticide application, a copy of the below information will need to be on file with the Extension Workers. Information for each treatment area to which pesticides are discharged as follows:

a. Surveillance methods used, dates of surveillance, and findings of surveillance
b. Target pest(s) and explanation of the need for pest control
c. Pest or site-specific action thresholds prior to pesticide application
d. Description of pest management measures implemented prior to the first application
e. Company name and contact information for pesticide applicator
f. Pesticide application dates and time of day of application
g. Description of treatment area, including location and size of treatment area and identification of any waters
h. Name of each pesticide product used to include registration number

i. Quantity of pesticide applied
j. Concentration (%) of active ingredient
k. Effective concentration of active ingredient
l. Any unusual or unexpected effects identified to non-target organisms
m. Was a visual assessment conducted? Was it done during or post pesticide application, if not explanation why not
n. Assessment of environmental conditions relating to proper pesticide use.

4.3.2 CONTROLLING PESTICIDES USED IN CROP PROTECTION

In West Africa, there are no industrial units ensuring the synthesis of active materials through brandy laboratories. Thus, production of pesticides in the proper way is not effective in the whole of these countries. Finished products are rather imported notably through mother companies represented at the national level or active matters for formulation purposes. It is noted that, Liberia does not manufacture any pesticides and current supplies of pesticides are imported from Ghana, Mali, Cote D'Ivore and Gambia. This constitutes the primary barrier making it possible to filter the products entering the country amidst lack of effective framework for the regulation of the trade. In order to ensure that it is done, Phytosanitary Controls need to be stationed at the borders (sea ports, airports, and roads). The control of pesticides for now, is wanting in the country save for the large companies especially Firestone which endeavor to follow their company and international best practices while bringing pesticides into the country.

4.3.2.1 ORGANIZATION AND PRACTICE USED IN SELLING AND DISTRIBUTION

The distribution channel for agro-inputs is entirely private. Suppliers who import the products feed the market through distributors, retailers who supply traders and they display for sale. Certain distribution spots sales points try to abide by the terms in their licenses but there is no effective follow up the EPA is well kept and abide by commercial rules; in general, the products are well displayed on shelves. However, at the level of many retailers and traders who display for sale there are great risks.

On account of the low financial capacity of local farmers/peasants and other buyers, some of the products are sold in retail. This practice is carried out without caution notably with decanting. Smaller retailers may decant products into smaller containers to meet farmers' purchasing ability, usually without proper labels, which should describe active ingredients and concentration, dosage, handling instructions and hazards, batch and date of expiry.

Some retailers are polyvalent and therefore engage in other types of commerce in the same premises. Distribution is also carried out sometimes without authorisation as required by the regulation and with the personnel not having received any training in the pesticides chemical products domain in general. In actual fact many of these actors do not have the requisite approvals/permits/license. Nevertheless, retailers affiliated to suppliers receive this type of training through the suppliers themselves.

4.3.2.1.1 OTHER CHALLENGES

The problems associated with the adulteration of pesticides by some pesticide dealers have created real concern for a wide variety of interest groups in recent times. Stakeholders from the Environmental Protection Agency (EPA), Ministry of Agriculture (MoA) as well as NAIDAL observe that some pesticide dealers adulterate and fake pesticides, using methods such as the alteration of expiry dates of pesticides, the change of labels on pesticide containers, and the preparation and bottling of mixtures in already used pesticide containers.

These criminal and unethical practices are attributed to the desire of bad dealers to make huge profits. These unscrupulous dealers exploit the low literacy levels and financial capacity of their customers, most of whom are smallholder farmers, who cannot tell the difference between fake and genuine products and the implications and sources of low-priced pesticides.

4.3.2.1.2 USE OF PESTICIDES BY FARMERS

In most cases, farmers themselves or farm assistants spray the plant products. The protection of farmers and farm assistants against any type of contamination by pesticides is not guaranteed. Farmers use various types of applications and in most cases the appropriate personal protective equipment (PPEs) such as hand gloves, overalls etc are not worn. The time of spray during the day is sometimes not appropriate. Farmers have been observed spraying during hot afternoons when sunshine is at its peak and such farmers who are usually not in appropriate PPEs are exposed through inhalation and skin contacts.

As regards the bad use of pesticides, the treatments are done several times which leads to product waste but also to a lack of good judgement as regards their efficiency. The documents that allow to monitor product traceability are very scarce or even non-existent as well as the notification of product usage. All of this could lead to the availability of residues in the products with the associated difficulties to export these.

4.3.2.1.3 MANAGEMENT OF PESTICIDE CONTAINERS

The management of pesticides containers is under the responsibility of resellers and farmers because of the retail sales system. They find themselves with the most important share of the empty containers which are differently managed. Sales to pesticides buyers who do not have empty containers and who straightforward reuse these containers. However, with big commercial farms or companies (Firestone, Greenfield, Wienco and Sine-Darba) management of pesticide containers is in accordance with their environmental policies.

5 PPMP IMPLEMENTATION FRAMEWORK

5.1 ROLES AND RESPONSIBILITIES FOR PESTS MANAGEMENT AND RESEARCH

The Government of Liberia and other stakeholders are responsible for ensuring that the pesticides used nationally are safe; are marketed, applied, handled and disposed of appropriately; and, if used judiciously, do not leave harmful residues on agricultural produce and in the environment.

5.1.1 THE MINISTRY OF AGRICULTURE

By mandate, MOA ensures that agricultural challenges that impede production are investigated and lasting solutions found, and the farmers are provided with the supportive services and the enabling environment to produce. The core general areas of responsibility of MoA with respect to implementation of the PPMP under WAATP is to ensure farmers have access and are guided in their management of crop and animals' resources protection services.

Its Divisions of Quarantine and Crops Resources will be involved as follows:

5.1.1.1 NATIONAL QUARANTINE AND ENVIRONMENTAL SERVICES

The Ministry through its Division of National Quarantine and Environmental Services i.e. responsible for prevention of entry into Liberia of injurious plant and animal pests and diseases existing in foreign countries; prevents the spread of such pests and diseases should they become established in Liberia; and regulates the export of plants and animals to conserve dwindling species and prevents the food supplies of Liberia. The Division is in charge of all matters related to plant health, including issuance of import and export phytosanitary certificates for live plant material and horticultural crops, as well as for plant pest prevention or eradication programmes.

5.1.1.2 CROP RESOURCE DIVISION

The Division provides Technical Advisory Services in food and tree crops husbandry. It is also responsible for enforcing regulations on registration and the use of pesticides and other agrochemicals. MoA will be the responsible for implementation of this PPMP and shall coordinate its implementation through a harmonized information management system, financial mechanism and a monitoring and evaluation framework.

5.1.2 CENTRE FOR AGRICULTURE RESEARCH INSTITUTES

CARI has a research mandate over 7 themes covering crops and animals and therefore in their research program, they will inevitably be using agro-chemicals. It is important the Institute has a robust program for the management of agro-chemicals i.e. their application, storage and disposal of expired consumables. It is noted that, CARI has incinerator which should be provided as part of the WAATP. In addition, CARI will coordinate all integrated agricultural research and development (R&D) activities required under the WAATP. When pest problems occur that are novel or beyond the scope of extension staff in the counties, advice will be obtained from CARI.

5.1.2.1 CAPACITY OF MOA

Though the Ministry has in its establishment structures for oversight role on agro-chemicals and phytosanitary services. However, functionally, the sector has some on the ground challenges with

respect to proper over-sight role on the entry of plant and animals resources into the country. It has to develop its capacity to oversee issues of agro-chemicals entry, storage and trade in the country in terms of legislation, institutional staffing and operations.

5.1.3 ENVIRONMENT PROTECTION AGENCY-EPA

One of the key institutional mandates of EPA is ensuring the observance of proper safeguards in the planning and execution of all development projects. Therefore, the key role of the EPA will be to ensure the manufacture, importation, application and all the chain of agro-input handling is done in a compliance manner and will be the direct responsibility of its Environmental Standards and Research Unit.

5.1.4 MINISTRY OF HEALTH

In the absence of systematic data collection related to pesticide poisoning (accidental or intentional), it is difficult to understand and tackle the problem. The Ministry of Health is expected to keep records on pesticide poisoning and accidents. Currently, the data on pesticide poisoning and accidents resulting from pesticides use or disposal is fragmented and still remains in the various newspapers that have reported such cases, and various hospital cases.

5.1.5 MINISTRY OF COMMERCE AND INDUSTRY

The Ministry of Commerce and Industry is responsible for the growth and development of Liberia's economy and international trade. Specifically, its Division of Inspectorate has inspectors are assigned at the various border posts; thus, giving the regional supervisors greater oversight on not only inspection related activities, but the entire trade regime between Liberia and its neighbors. It is important, such staff at the border posts be trained in aspects of monitoring and regulating entry of both plant materials and agro-inputs into the country.

5.1.6 NATIONAL STANDARDS LABORATORY-NSL

National Standards Laboratory (NSL) of Liberia as a testing and calibration facility is linked to Liberia's initiative and processes to meeting World Trade Organization (WTO) regulations especially aiming at strengthening the SPS system in Liberia (enabling the country to prevent importation of sub-standard products that may threaten the safety of the public or the ecosystems.

5.1.7 LIBERIA AGRICULTURE COMMODITY REGULATORY AUTHORITY

Liberia Agriculture Commodity Regulatory Authority (LACRA) replaces the Liberian Produce Marketing Corporation (LPMC). The Authority is to promote production, processing and marketing of high quality agricultural commodities, to ensure the provision of a well-regulated market for the commodities for fair competition among all actors in the value chain and to facilitate standardization of quality of agricultural commodities in accordance with established regional and international standards. It is also responsible to enhance income earning capacity and general welfare of agricultural producers which includes their safety in handling of agro-inputs.

5.1.8 NATIONAL AGRO-INPUT DEALERS ASSOCIATION OF LIBERIA (NAIDAL)

The aims and objectives of NAIDAL are as below:

a. To represent all agro-input dealers in the country, and act as a negotiating body that speaks with one voice to support the interests of all members;
b. To provide professional support and networking among agro-input dealers, encourage and support the business development of individual members, and promote the exchange of ideas and skills in order to improve services to farmers;
c. To establish and enforce a code of fair business conduct for members and keep members informed of the legal codes regulating the industry; and
d. Take a lead in building the capacity building of its members in terms of safe handling and management of agro-chemicals.

The NAIDAL has gone steps to establish the numbers of agro-dealers and maintains a register of agro-inputs in Liberia. It has also conducted training on safe handling and application of agro-inputs in the country. The NAIDAL is well placed to mobilize and train the agro-input dealers on a range of aspects regarding the regulation of the trade.

5.2 CAPACITY NEEDS

IPMP is a knowledge intensive and interactive methodology which calls for a precise identification and diagnosis of pests and pest problems. Comprehending ecosystem interplays equips farmers with biological and ecological control knowledge and assists them in making pragmatic pest control decisions.

The success of IPMP is largely dependent on developing and sustaining institutional and human capacity to facilitate experiential learning. Experiential learning is a prerequisite to making informed decisions in integrating scientific and indigenous knowledge. This assists in tackling district, ward and village specific problems.

Capacity building will be achieved through farmer-based collaborative management mechanisms where all key stakeholders shall be regarded as equal partners. Beneficiary farmers shall be the principal actors facilitated by other actors from research institutes, academic institutions, sector ministries, NGOs, etc. as partners whose role will be to facilitate the process and provide technical direction and any other support necessary for the implementation of IPM.

5.2.1 TRAINING

Farmers should have the capacity to do basic diagnosis and identification of some common pests, pest problems and diseases in their crops and understand trophic relationships that underpin biological control opportunities and use such knowledge to guide pesticide and other kinds of interventions. Through the participatory approaches, the Project will build local capacity to ensure rapid spread and adoption of ecologically sound and environmentally friendly management practices among the smallholder farmers. They will learn cultural, biological and ecological processes underpinning IPM options, and use the newly acquired knowledge to choose compatible methods to reduce losses in production and post-harvest storage.

Training will be provided to targeted farmers organizations and retailers within the project areas through a training of trainers (ToT) scheme. Development and implementation of ToT courses will

be outsourced by PCU and MoA. Most of the project activities will be held in the counties and at those levels, technical support from the County Environment Officers and Agricultural Officers will also be brought on board to supplement the training skills needed based on their on-ground experience with the communities.

5.2.1.1 TRAINING FOR TRAINERS OF TRAINERS

This should target the Environmental Safeguards Officer from WAATP PCU, County Agricultural Officers, County Environment Officers and other extension staff in livestock and agriculture in the project areas. In the process of implementing various WAATP activities, the staff names have a direct role of ensuring that, application and handling of agro-chemicals is done in an environmentally sound manner in line acceptable best practices. On the basis of these, there is, need to equip the such officers with sound information on pest management strategies and safer pesticide use. They will in-turn train assistant field extension officers. The assistant field officers will then be responsible for training farmers at the grassroots level.

5.2.1.1.1 COURSE CONTENT

The course would consist of two main parts: (I) Principles of Pest Management and (II) Pesticide Management. The Principles of Pest Management course will emphasize pest management decision tools (including concepts of sampling and pest monitoring), ecological/cultural management, biological control, host plant resistance, genetic control, and a theoretical approach to integrated pest management, differentiating between IPM approaches for resource-poor farmers and resource-rich farmers. The Pesticide Management Course will emphasize various types of pesticides, pesticide formulations, active ingredients, pesticide application, calibration of sprayers, calculation of application rates, pesticide fate and toxicology, safety in pesticide handling, impact of pesticides on the environment, non-target organisms, and human beings, pesticides as part of integrated pest management, and pesticide regulations.

5.2.1.2 EXTENSION AGENTS

This is to target Assistant agricultural field extension officers. There is need for training of public sector extension agents to become better at providing objective and research-based knowledge of crop production and protection practices and strategies, including non-chemical alternatives. Field extension agents at sub-parish levels are concerned with advising farmers on all aspects of agricultural production, including pest management. Consequently, if field extension officers are to effectively advise on judicious use of pesticides, they need to be well-equipped with sound information on pesticides use and pest management systems. All Extension Staff will be trained in integrated pest management and safer pesticide use who will in turn train the farmers and those directly below them.

5.2.1.2.1 RECOMMENDED COURSE CONTENT

Extension workers need training in areas of pest and disease identification, IPM and alternatives to pesticide use as well as in-service training i.e. new areas of science to help them do their job. The following is recommended:

a. General introduction to causes of pest problems,
b. Introduction to use of participatory methods in understanding pest problems.
c. Introduction to insect pest sampling/monitoring and use of action thresholds.

d. Overview on use of cultural, biological, host plant resistance methods in control of crop pests.
e. Introduction to elements of pesticide control tactics
f. Impact of pesticides on the environment and
g. Integrating pesticides in an IPM program.

5.2.1.3 PESTICIDES USE TRAINING

It is one thing to have pesticide regulations in place, and another to have them adhered to. The only way of raising the population's awareness of problems associated with pesticides, and how those problems can be avoided, is through continuous training. Training for "safer pesticide use" is a common approach to mitigating the potential negative health and environmental impacts of pesticides. This conventional approach will promote reducing health risks of pesticides by safer use of the products through training, use of protective equipment and technology improvements, as well seeking to reduce pesticide hazards via regulations and enforcement.

5.2.1.3.1 TRAINING ASPECTS AND LEVELS

There is therefore great need for capacity building and human resource training in almost all areas of pesticides management. However, the key training needs that have been identified among others include the following with respect to pesticides management: storage; disposal as well as safe use and handling of pesticides. Not all workers need the same level of training since the intensity and length of exposure varies with different types of jobs. All individuals who may come in contact with pesticides as part of their work should receive a certain basic level of training, increasing in direct proportion to the exposure use level. Certainly, there is much useful information available, but until it is transmitted to the users, it is of little value.

5.2.1.3.2 PESTICIDE MANAGEMENT TRAINING OF PESTICIDE DEALERS

The target group is mainly business persons, whose main interest is making money. Consequently, this group has minimal interest in theoretical background and needs to be introduced to the practical aspects of pesticide management. Therefore, the course recommended here include types of pesticides, pesticide formulations, toxicity classification, types of pesticide labels, concentration mixing, fate of pesticides in the environment, safer use of pesticides (including selection, handling, application, storage, and protective clothing), and combining pesticides with non-pesticide methods.

5.3 PEST MONITORING PLAN

Successful implementation of the WAATP Integrated Pest Management Plan in the project locations will require regular monitoring and evaluation of activities undertaken by the farmers to be involved in the project. The focus of monitoring and evaluation will be to assess the build-up of IPM capacity among the farmers and the extent to which IPM techniques are being adopted in agricultural production, and the economic benefits that farmers derive by adopting IPM. It is also crucial to evaluate the prevailing trends in the benefits of reducing pesticide distribution, application and misuse.

Indicators that require regular monitoring and evaluation during the programme implementation include the following:

a. Number of farmers engaged in IPM capacity building in the project locations;
b. Number of farmers who have successfully received IPM training in IPM methods;
c. Number of trainees practicing IPM according to the training instructions; Number of women as a percentage of total participating in IPM and successfully trained;
d. Number of youth as a percentage of total participating in IPM and successfully trained;
e. Improvement in the health status of farmers
f. Efficiency of pesticide use and handling
g. Number of IPM participatory research project completed

Overall assessment of activities that are going according to IPMP; activities that need improvement; and remedial actions required.

5.3.1.1 ESTIMATED COSTS FOR PEST MANAGEMENT AND MONITORING ESTIMATED COSTS FOR PPMP

It is assumed that some of the mitigation measures will be part of the normal responsibility of the respective government ministries, agro- dealers, transporters, farmers and other relevant stakeholders, within their institutional mandates and budgets. It is important to appreciate that some of the stakeholder institutions may not have sufficient capacity to manage environmental and social impacts of pesticides and to adequately monitor implementation of the enhancement and mitigation measures. Therefore, it is necessary to train them. The cost of training for the managing impacts has been provided for Table 4. The table also includes costs for conducting awareness and sensitization campaigns on pesticides application, management and adoption of IPM in the project areas.

5.3.1.2 WORKPLAN AND BUDGET

Table below provides an indicative budget for implementation of the WAATP PPMP. The cost components cover IPM orientation workshop, capacity building and awareness program, and project management including the cost of monitoring.

Table 10: Budget summary for PPMP of the WAATP

Nº.	**Item/Activity**	**Total (USD.)**
A.	**Capacity building & Awareness**	
a.	All training programs (CEOs, CAO, Extension Staff, Staff of PIU)	25,500.00
b.	Awareness campaigns and sensitization for farmers	65,000.00
C	Support to MoA Dept. of Quarantine[14]	150,000.00
d.	Support to NAIDAL to streamline trade in Agro-inputs	60,000.00
	Incinerator at CARI[15]	
B.	**Environmental management**	
a.	Pest/vector surveillance	35,000.00

[14] *MoA needs to build its capacity to effectively play oversight role of phytosanitary aspects entering the country.*
[15] *These costs are covered under the WAATP ESMF Budget*

C.	**Occupational Health & Safety**	
a.	Personal Protective Equipment (Hand gloves, gas mask, safety boot and overall wear)	32,000.00
b.	Acquisition of chemical neutralizers and First Aid Kits for management of risks of agro-chemicals poisonings.	50,000.00
	GRAND TOTAL	**417,500**

5.3.2 KEY RECOMMENDED INTERVENTIONS

d. It is noted that, though Liberia has an institutional framework for management of pesticides does not have effective key that, an effective organ for management of pesticides in the country be put in place. The Agricultural Chemicals Board-ACB can at best be referred to as a register for will importers and dealers. A number of mal-practices on pesticides are being done in the nose of ACB by scrupulous dealers without any remorse. This intervention at best is, over-due to say the least;

e. Pest surveillance systems and early warning systems need to be revitalized in the sector as a strategy to avert havoc being meted by crop pests and diseases on the crops to ensure sustainability of agriculture to guarantee food security at household levels and development of the nation; and

f. Smallholder farmers need to have more reliable and timely access to agricultural advisory and extension services to provide them with the knowledge on how to identify and deal with pests and diseases.

6 ANNEXES

6.1 ANNEX 01: ATTENDANCE LISTS

Attendance Lists

Preparation of ESMF for West Africa Agricultural Transformation Project (WAATP)

No.	Name	Designation	Organization	Contact	Signature
1.	Edward P. Borlol	M&E Officer	START	0886524003	
2.	Henry H. Sele	Accountant	STAR-P	0886401506	
3.	J. Cyrus Saygbe, Sr.	Project Coordinator	STAR-P WAATP	0880828775	
4.	James B. Walker		STCRSP	0886743263	
5	Edward G. Wingbah	Asst Manager	EPA	0886576150	
6	Jerry T. Toe	Manager	EPA	0880662516	
7	Moretha Brown	Coordinator	EPA	0886516758	
8.	Henry D. Mayson	Accountant	CHAP	0775-587096	
9.	Esther S. Tuowal	Head of Fin	CHAP	0886901175	
10	Jeremiah P. Smith	Data Collector	CHAP	0886932562	
11.	J. Moses Harris	Cashier	CHAP	0776269072	
12.	Blamo Chea	M&E Officer	CHAP	0886457554	
13.	Marcus Jones	D. G.	CARI	0777-978-385	
14.	Epeg pewee	Sayeg town	Farmer	-o	E.pewee
15.	George D. Flomo	Rehand	Farmer	0886115165	
16	Sumo Kayeah	Rehand	Farmer	-o-	Sumo Yeah
17	Sy Moe Sackie	Roque town	Farmer	Farmers	

No.	Name	Designation	Organization	Contact	Signature
18	Flomo Kekula	Raymond town	farmer	0777838561	Flomo Kekula
19	Gloria Flomo	Raymond town	farmer	0886930873	Gloria Flomo
20.	TUTA NNG9	Raymond town	farmer	— " —	TUTA NNG9
21.	Nathan Miller	Raymond	farmer	0886930873	N. Miller
22.	J. Nitekah Kollie	Raymond town	farmer	0881~~3548~~8151	J. N Kollie
~~23~~	Mosey Flomo	Raymond	farmer	— " —	Mosey Flomo
22	Nathan Miller	Raymond town	farmer	— " —	N. Miller
23	Rebecca Kofee	Raymond town	farmer	0886343853	Rebecca Tofee
24	Kufa Kekula	Raymond town	farmer	0886124660	Kufa Kekula
25	Mary Jackson	Raymond	farmer	— " —	Mary Jackson
26	Nonie Mulbah	Raymond	farmer	— " —	N. Mulbah
27	Bognah Bdanah	Raymond	farmer	— " —	—
28	James Wompo	Raymond	farmer	0886930873	— " —
29	Yamah Keeli	Raymond	farmer	— " —	— " —
30	Moses S. Gbarbor	Raymond town	farmer	0888205989	
31	Washington popo	Raymond	farmer	— " —	— " —
32	Josephine Gong	Raymond	farmer	— " —	— " —
33	Cecelia Kojua	Raymond	farmer	0888287932	— " —

No.	Name	Designation	Organization	Contact	Signature
	Awoyale Wasiu	Postharvest specialist	IITA/SAPEC/ MDA	07700216777	
	Michael Edet	~~Extension~~ Agronomist	IITA/ ~~SAPEC~~	08580307646	

6.2 ANNEX 2: LIST OF BANNED PESTICIDES[16]

1. Aldrin
2. Chlordane
3. DDT (dichloro-diphenyl-trichloroethane)
4. Dieldrin
5. Endrin
6. Heptachlor
7. Toxaphene
8. Chlordimeform
9. Mercury Compounds
10. Lindane
11. Parathion
12. Methyl Parathion
13. Methyl bromide
14. Hexachlorobenzene

6.3 ANNEX 3: LIST OF APPROVED INSECTICIDES

Organochlorines insecticides	Organophosphorus insecticides	Carbamates	Pyrethroids
1. Endosulfan 2. Helptachlor 3. Lindane (Restricted to use on Cocoa only)	**Organophosphorus** i 1. Diazinon 2. Dichlorvos (DDVP) 3. Chlorpyrifos 4. Chlorpyrifos – Methyl 5. Dicrotophos 6. Dimethoate 7. Monocrotophos 8. Perimiphos – Ethyl 9. Perimiphos – Methyl 10. Ethion 11. Rugby (Cadusofas) 12. Malathion 13. Temeguard (Temephos) 14. Isazofos 15. Parathion – Methyl 16. Phosphamidon 17. Methidathion	1. Carbaryl 2. Carbofuran 3. Propoxur 4. Carbosulfan 5. Furathiocarb 6. Temik (Aldicarb	1. Lambda – Cyhalothrin 2. Cypermethrin 3. Deltamethrin 4. Phenothrin 5. Permethrin 6. Tetramethrin 7. Cyfluthrin 8. Allethrin

[16] *PMP for Integrated Pest Management for Liberian REDISSE Project*

6.4 ANNEX 4: HERBICIDES AND FUNGICIDES

Organophosphorus	**Carbamates**	Other herbicides	Fungicides
Organophosphorus 1. Anilofos 2. Piperophos 3. Glyphosate 4. Glyphosate Trimesium (Touchdown or Sulfosate) 5. Amideherbicides (Acetochlor; Alachlor; Propanil; Butachlor; Metalochlor) Triazines and Triazoles (Atrazine; Ametryn; Desmetryn; Terbuthalazine; Terbutrex Terbutryne) Chlorophenoxy herbicides (Prometryn; Simazine; 2.4-D (2.4 Dichlorphenoxy acetiacid) 7. Urea and guadinidines ; (Diuron ; Linurex (=Linuron); Fluometurone; Chloroxuron; Neburon) Quaternary nitrogen compounds (paraquat; diquat)	1. Asulam	1. Dimethachlor 2. Metazachlor 3. Monosodium Methyl Arsonate (MSMA) 4. Fluxixpyr 5. Imazaquine 6. Triassulfuran (Amber) 7. Osethoxydim 8. Oxadiazon (Ronster) 9. Clomaone 10. Trifluralin 11. Stamp 500 (pendimethalin) 12. Fluazifop – P.butyl	1. Benomyl (Nitroheterocyclic Compound) 2. Dazomet (Thiadiazine Fungicide) 3. Folpet (Phthalimide Fungicide) 4. Metalaxyl (Acylalamine Fungcide) 5. Cyproconazole (Alto – 100SL) 6. Bavistin (Carbon) – Benzimide 7. Triadmenol (Bayfidon GR Conzole Fungicide)

6.5 ANNEX 5: GOOD MANAGEMENT PRACTICES GUIDE AND PESTICIDES MANAGEMENT MEASURES

Required measures for the reduction of pesticides-related risks

Safe use of pesticides

Pesticides are toxic for pests and for humans. However, if sufficient precautions are taken, they should not constitute a threat either for the population or for non-targeted animal species. Most of them can have harmful effects if swallowed or in case of prolonged contact with the skin. When a pesticide is sprayed in the form of fine particles, there is a risk of absorbing them with the air we breathe. There is also a risk of water, food and soil contamination. Specific precautions should therefore be taken during the transportation, storage and handling of pesticides. The spraying equipment should be regularly cleaned and well maintained to avoid leakages. The individuals using pesticides should learn how to use them safely.

Insecticides Registration

Reinforce the registration process of insecticides by ensuring:

a. Streamlining, between the national pesticides registration system and other products used in Public Health;
b. Adoption of WHO specifications applicable to pesticides for national registration process purposes;
c. Reinforcement of the pilot regulatory body;
d. Collection and publication of data relating to imported and manufactured products;
e. Periodical review of registration.

When planning to buy pesticides to control vectors, consult the guiding principles issued by WHO. For the acquisition of insecticides intended for public health use, the following guidelines are recommended:

a. Develop national guidelines applicable to the purchase of products intended for vector control and ensure that all the agencies buying them strictly comply with those guidelines;
b. Use synthetic Pyrethroids: Deltamethrin SC, Permethrin EC, Vectron, Icon, Cyfluthrin, as recommended by the national policy;
c. Refer to the guiding principles issued by WHO or FAO on calls for tenders, to FAO recommendations regarding labeling and to WHO recommendations regarding products (for indoor spraying);
d. Include in calls for tenders, the details regarding technical support, maintenance, training and products recycling that will be part of the after-sale service committing manufacturers; apply the back-to-sender principle;
e. Control the quality and quantity of each lot of insecticides and impregnated supports before receiving the orders;
f. Ensure that the products are clearly labeled in English and if possible in local language and in the strict respect of national requirements;
g. Specify which type of package will guarantee efficiency, preservation duration as well the human and environmental security of handling packaged products while strictly complying with national requirements;

h. Ensure that donated pesticides intended for public health, comply with the requirements of the registration process in Liberia and can be used before their expiry date;
i. Establish a consultation, before receiving a donation, between the ministries, agencies concerned and the donors for a sound use of the product;
j. Request users to wear protective clothes and equipment recommended in order to reduce their exposition to insecticides to the strict minimum;
k. Obtain from the manufacturer a physic-chemical analysis report and the product acceptability certification;
l. Request the manufacturer to submit an analysis report of the product and of its formulation along with guidelines to follow in case of intoxication;
m. Request the buying agency to perform a physic-chemical analysis of the product before shipping and arrival.

Precautions

Labeling

Pesticides should be packaged and labeled according to WHO standards. The label should be written in **English** and in the local language (as applicable); it should indicate the content, the safety instruction (warning) and any action to be taken in case of accidental ingestion or contamination. The product should always remain in its original container. Take all appropriate precautionary measures and wear protective clothes in accordance with recommendations.

Storage and transportation

Pesticides should be stored in a place that can be locked up and is not accessible to unauthorized individuals or children. The pesticides, should, in no event, be stored in a place where they could be mistaken for food or beverage. They should be kept dry and out of the sun. They should not be transported in a vehicle that also carries food products.

In order to ensure safety during storage and transportation, the public or private agency in charge of managing purchased insecticides and insecticide-impregnated supports, should comply with the current regulations as well as the conservation conditions recommended by the manufacturer regarding:

a. Preservation of the original label;
b. Prevention of accidental pouring or overflowing;
c. Use of appropriate containers;
d. Appropriate marking of stored products;
e. Specifications regarding the local population;
f. Products separation;
g. Protection against humidity and contamination by other products;
h. Restricted access to storage facilities;
i. Locked storage facilities to guarantee product integrity and safety;
j. Pesticides warehouses should be located far from human residences or animal shelters, water supplies, wells and channels. They should be located on an elevated surface and secured with fences with restricted access for authorized individuals only;
k. Pesticides should not be stored in places where they could be exposed to sunlight, to water or to humidity, which could harm their stability. Warehouses should be secured and well ventilated;

l. Pesticides should not be transported in the same vehicle with agricultural products, food products, clothes, toys or cosmetics as these products could become dangerous in case of contamination;
m. Pesticides containers should be loaded in vehicles in order to avoid damages during transportation, that their labels will not tear off so that and they would slip off and fall on a road with an uneven surface. Vehicles transporting pesticides should bear a warning sign placed conspicuously and indicating the nature of the cargo.

Distribution

Distribution should be based on the following guidelines:

a. Packaging (original or new packaging) should ensure safety during the distribution and avoid the unauthorized sale or distribution of products intended for vector control;
b. The distributor should be informed and made aware of the dangerous nature of the cargo;
c. The distributor should complete delivery within the agreed deadlines;
d. The distribution system of insecticides and impregnated supports should be able to reduce the risks associated with the numerous handlings and transportations;
e. In the event the purchasing department is not able to ensure the transportation of the products and materials, it should be stipulated in the call for tenders that the supplier is expected to transport the insecticides and impregnated support up to the warehouse;
f. All pesticides and spraying equipment distributors should have an exploitation permit in accordance with the current regulation in Liberia.

Disposal of pesticide stocks

After the operations, the remaining stocks of pesticides can be disposed of without risk by dumping them in a hole dug specifically or in a pit latrine. A pesticide should not be disposed of by throwing it in a place where there is a risk of contaminating drinking water or for bathing or where it can reach a pond or a river. Some insecticides, such as pyrethroids, are very toxic for fish.

Dig a hole to at least 100 meters from any stream, well or habitat. If in hilly areas, the whole must be dug below. Pour all waters used for hand washing after the treatment. Bury all containers, boxes, bottles, etc. that have contained pesticides. Reseal the hole as quickly as possible. Packaging or cardboard, paper or plastic containers— the latter cleaned — can be burnt, if allowed, far away from homes and drinking water sources, regarding the re-use of containers after cleaning. Pyrethroid suspensions can be discharged on a dry soil where they are quickly absorb and then will go through a decomposition process making them harmless for the environment.

If there is an amount of insecticide solution left, it can be used to destroy ants and cockroaches. Simply pour a little bit of solution on infested areas (under the kitchen sink, in corners) or to rub a sponge soaked with water on it. To temporarily prevent insect proliferation, a certain amount of solution can be poured inside and around latrines or on other breeding places. Pyrethroid suspensions for mosquito nets treatment and other fabrics can be used days after their preparation. It can also be used to treat mats and rope mattresses to prevent mosquito to bite from the bottom. Mattresses can also be treated against bugs.

Cleaning of empty pesticide packaging and containers

Re-using empty pesticide containers is risky and it is not recommended to do so. However, it is estimated that some pesticide containers are very useful to be simply thrown away after use.
Can we therefore clean and re-use such containers? This depends both on the material and the content. In principle, the label should indicate the possibilities for re-using containers and how to clean them.

Containers having contained pesticides classified as hazardous or extremely dangerous should **not** be re-used. Under certain conditions, containers of pesticides classified as dangerous or that do not present any risk under normal use, can be re-used unless they are not used as food or drink containers or as food containers for animal food. Containers made of materials such as polyethylene that preferentially absorb pesticides, must **not** be re-used if they have contained pesticides whose active ingredient has been classified as moderately or extremely dangerous regardless of the formulation. Once a recipient is empty, it should be rinsed, then filled completely with water and allowed to stand for 24 hours. Then it should be emptied and this process should be done over again.

General Hygiene

Do not eat, drink or smoke when handling insecticides. Food should be placed in tightly closed containers. Measurement, dilution and transfer of insecticides should be done with the adequate material. Do not shake or take liquid with unprotected hands. If the nozzle is blocked, press the pump valve or unblock the opening with a flexible rod. After each fill, wash hands and face with water and soap. Eat and drink only after washing hands and face. Take a shower or a bath at the end of the day.

Individual protection

a. Adapted coveralls covering hands and legs;
b. Dust, gas and respirator masks, based on the type of treatment and product used;
c. Gloves;
d. Goggles;
e. Hoods (facial shield).

Protection of the population

a. Minimize the exposure of local populations and livestock;
b. Cover wells and other reservoirs;
c. Sensitize populations on risks.

Protective clothing

Treatments inside homes:

Operators should wear coveralls or a long sleeves shirt over a pair of pants, a flapped hat, a turban or any other type of headgear as well as boots or big shoes. Sandals are not suitable.
Nose and mouth should be protected using a simple method, for example a disposable paper mask, a disposable surgical or washable mask or a clean cotton cloth. Once the fabric is wet, it should be changed. Clothing must be in cotton for easy washing and drying. It must cover the body and contain no opening. In hot and humid climates, it can be uncomfortable to wear additional

protective clothing; therefore, one will be forced to spray pesticides during hours when it is very hot.

Preparation of suspensions

People responsible for bagging insecticides and preparing suspensions, particularly for the treatment of mosquito bed net units must take special precautions. In addition to the abovementioned protective clothing, they must wear gloves, an apron and eye protection. For example, a facial shield or glasses. Facial shields protect the entire face and keep less warm. Nose and mouth should be covered as indicated for treatment in homes. They should ensure that they do not touch any part of their body with gloves during pesticide handling.

Treatment of nets

To treat mosquito nets, clothes, grills or with tsetse traps with insecticides, it is necessary to wear long rubber gloves. In some cases, additional protection is required, for example against vapors, dusts or insecticide dusting that could be dangerous. These additional protective accessories should be mentioned on the product label and may consist of aprons, boots, facial masks, coveralls and hats.

Maintenance

Protective clothing should always be impeccably maintained and should be checked periodically to verify tearing, wearing that could lead to skin contamination. Protective clothing and equipment should be washed daily with water and soap. Particular attention should be paid to gloves and they must be replaced once they are torn or show signs of wear. After usage, they should be rinsed in water before removing them. At the end of each working day, they will need to be washed inside and outside.

Safety measures

During spraying

Spurt form the sprayer must not be directed towards a part of the body. A leaking sprayer must be repaired and skin must be washed if it is accidentally contaminated. The household and animals must stay outside during the whole spraying activity. Avoid treating a room where there is a person — a sick person for example — who cannot be taken outside. Before starting spraying activities, kitchen utensils should be taken out and all utensils as well as dishes containing drinks and food. They can be gathered in the center of the room and covered with plastic film. Hammocks and paintings should not be treated. The bottom part of furniture and the side against the wall should be treated while ensuring that surfaces are effectively treated. Sweep or wash the floor after spraying. Occupants should avoid contact with walls.

Clothing and equipment should be washed every day.

Avoid spraying organophosphate or carbamate for more than 5 to 6 hours daily and wash hands after each filling. If Fenitrothion is used or old stocks of Malathion are used, operators should control the level of cholinesterase in their blood every week.

Monitoring exposure to organophosphate

There are country kits available on the market to control cholinesterase activity in the blood. If this activity is low, it can be concluded that there are excessive exposure to organophosphate

insecticide. These dosages should be done every week with people handling such products. Any person whose cholinesterase activity is very low should be stopped from working until it returns to normal.

Fabric spraying

When handling insecticide concentrates or preparing suspensions, gloves should be worn. Attention should be paid particularly to spraying in the eyes. Big bowl not too high should be used and the room should be well ventilated to avoid inhaling smokes. Measures to minimize transportation, storage, handling and usage risks.

6.6 Annex 6: WHO Pesticides Classification

Pesticides product	Active ingredient	Chemical class	Toxicological class	Main use
BASUDIN	Diazinon	Organophosphate	11	Insecticide
HERBOXONE	2,4-D	Chlorophenoxy-acid	11	Herbicide
TOPIK	Clodinafop-Propargyl	Arylozyphenoxy propionics	111	Herbicide
AATREX	Atrazineq	Triazines	U	Herbicide
MACHETE	Butaclor	Chloroacetanilides	U	Herbicide
CERTAINTY	Sulfosulfurone	Sulfonylureas	U	Herbicide
ERADICANE	EPTC	Carbamides	11	Herbicide
LASSO	Alachlone	Chloroacetanilides	111	Herbicide
DECIS	Deltamethrin	Pyrethroides	11	Insecticide
ALTO	Cyproconazol	Triazoles	111	Fungicide
SENCOR	Metribuzin	Triazines	11	Herbicide
CONFIDOR	Imidacloprid	Neonicotinides	11	Insecticide
GRANDSTAR	Tribenulon-methyl	Sulfonylureas	U	Herbicide

6.7 ANNEX 7: WHO PESTICIDES CLASSIFICATION

Code of Conduct - 2001 revised version	**Code of Conduct - 1989 amended version**
10.1 All pesticide containers should be clearly labelled in accordance with applicable guidelines, at least in line with the FAO guidelines on good labelling practice (3).	**10.1** All pesticide containers should be clearly labelled in accordance with applicable international guidelines, such as the FAO guidelines on good labelling practice.
10.2 Industry should use labels that:	**10.2** Industry should use labels that:
10.2.1 comply with registration requirements and include recommendations consistent with those of the recognized research and advisory agencies in the country of sale;	**10.2.1** include recommendations consistent with those of the recognized research and advisory agencies in the country of sale;
10.2.2 include appropriate symbols and pictograms whenever possible, in addition to written instructions, warnings and precautions in the appropriate language or languages (3);	**10.2.2** include appropriate symbols and pictograms whenever possible, in addition to written instructions, warnings and precautions;
10.2.3 comply with national or international labelling requirements for dangerous goods in international trade and, if appropriate, clearly show the appropriate WHO hazard classification of the contents (3,35,36);	**10.2.3** in international trade, clearly show appropriate WHO hazard classification of the contents (11) or, if this is inappropriate or inconsistent with national regulations, use the relevant classification;
10.2.4 include, in the appropriate language or languages, a warning against the reuse of containers and instructions for the safe disposal or decontamination of used containers;	**10.2.4** include, in the appropriate language or languages, a warning against the reuse of containers, and instructions for the safe disposal or decontamination of empty containers;
10.2.5 identify each lot or batch of the product in numbers or letters that can be understood without the need for additional code references;	**10.2.5** identify each lot or batch of the product in numbers or letters that can be read, transcribed and communicated by anyone without the need for codes or other means of deciphering;
10.2.6 clearly show the release date (month and year) of the lot or batch and contain relevant information on the storage stability of the product (21).	**10.2.6** are marked with the date (month and year) of formulation of the lot or batch and with relevant information on the storage stability of the product.
10.3 Pesticide industry, in cooperation with government, should ensure that:	**10.3** Industry should ensure that:
10.3.1 packaging, storage and disposal of pesticides conform in principle to the relevant FAO, UNEP, WHO guidelines or regulations (27,28, 37, 39, 40) or to other international guidelines where applicable;	**10.3.1** packaging, storage and disposal of pesticides conform in principle to the FAO guidelines for packaging and storage, the FAO guidelines for the disposal of waste pesticides and containers, and WHO specifications for pesticides used in public health;

10.3.2 packaging or repackaging is carried out only on licensed premises where the responsible authority is satisfied that staff are adequately protected against toxic hazards, that the resulting product will be properly packaged and labelled, and that the content will conform to the relevant quality standards.	**10.3.2** in cooperation with governments, packaging or repackaging is carried out only on licensed premises where the responsible authority is convinced that staff are adequately protected against toxic hazards, that the resulting product will be properly packaged and labelled, and that the content will conform to the relevant quality standards.
10.4 Governments should take the necessary regulatory measures to prohibit the repackaging or decanting of any pesticide into food or beverage containers and rigidly enforce punitive measures that effectively deter such practices.	**10.4** Governments should take the necessary regulatory measures to prohibit the repacking, decanting or dispensing of any pesticide into food or beverage containers in trade channels and rigidly enforce punitive measures that effectively deter such practices.
10.5 Governments, with the help of pesticide industry and with multilateral cooperation, should inventory obsolete or unusable stocks of pesticides and used containers, establish and implement an action plan for their disposal, or remediation in the case of contaminated sites (41), and record these activities	*- new paragraph in revised Code -*
10.6 Pesticide industry should be encouraged, with multilateral cooperation, to assist in disposing of any banned or obsolete pesticides and of used containers, in an environmentally sound manner, including reuse with minimal risk where approved and appropriate.	*- new paragraph in revised Code -*
10.7 Governments, pesticide industry, international organizations and the agricultural community should implement policies and practices to prevent the accumulation of obsolete pesticides and used containers (37).	*- new paragraph in revised Code -*