GOVERNMENT OF THE REPUBLIC OF LIBERIA

MINISTRY OF AGRICULTURE

RURAL ECONOMIC TRANSFORMATION PROJECT -RETRAP

Integrated Pest Management Plan IPMP

Project ID No.: P175263

November 29, 2022

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ACRONYMS

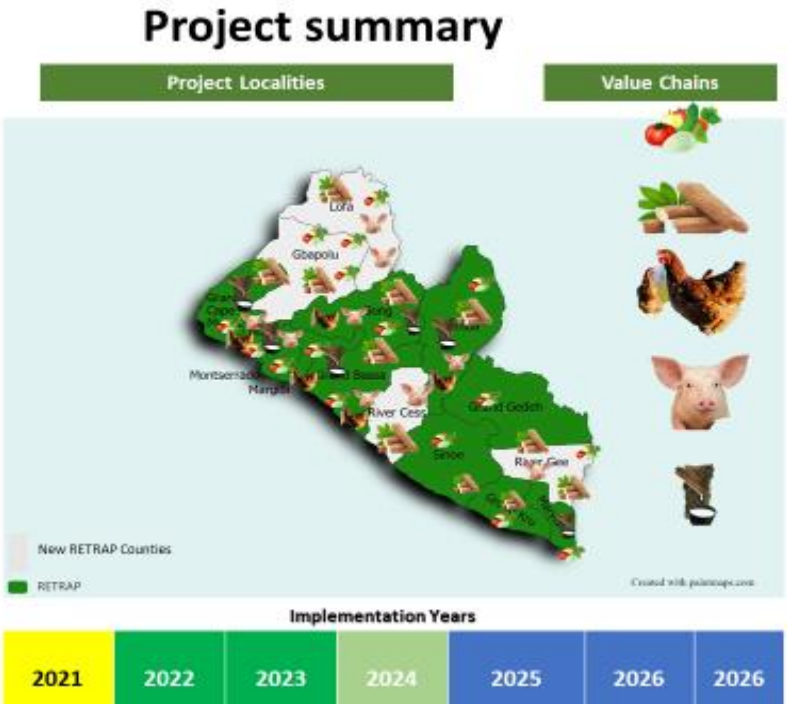
ACDI/VOCA	Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance
ADA	Association of Agro-input Dealers
AFL	Armed Forces of Liberia
AfricaRice	Africa Rice Centre
BIVAC	Bureau of Inspection, Valuation, Assessment and Control
CARI	Central Agricultural Research Institute
CBR	Cost Benefit Ratio
CDA	Cooperative Development Agency
CEO	County Environment Officer
CERC	Contingency Emergency Response Component
CGAIR	Consultative Group on International Agriculture Research
CLF	County Level Faccilitator
ECOWAS	Economic Community of West African States
EHS	Environment, Health and Safety
EPA	Environmental Protection Agency
ESF	Environmental Social Framework
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMPs	Environmental and Social Management Plans
ESS	Environmental Social Standard
FFB	Fresh Fruit Bunches
F2F	Farmer-to-Farmer
GAP	Good Agricultural Practices
GRWFMCS	Gbehlay Geh Rural Women Farmers Multipurpose Cooperative Society.
GoL	Government of Liberia
HIV/AIDS	Human Immuno Virus/Acquired Immuno Deficiency Syndrome
ILO	International Labor Organization
IPPC	International Plant Protection Convention
IPMP	Integrated Pest Management Plan
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LASOP	Laboratory Standard Operating Procedures
LNP	Liberia National Police
M&E	Monitoring and Evaluation
MoA	Ministry of Agriculture
NAIDAL	National Agro-Inputs Dealers Association, Liberia
OHS	Occupational Health and Safety
PIU	Project Implementation Unit

PDO	Project Development Objective
PLM	Participatory Learning Modules
PMU	Project Management Unit
IPMP	Integrated Pest Management Plan
PPRSBA	Plant Protection Regulatory Services Bureau
PPRSB	Plant Protection Regulatory Services Bureau Act
POP	Persistent Organic Pollutants
REDISSE	Regional Disease Surveillance Systems Enhancement Project
RETRAP	Rural Economic Transformation Project
SPGs	STAR-P Processor Groups
STAR-P	Smallholder Agriculture Transformation and Agribusiness Revitalization Project
UNEP	United Nations Environment Programme
CVF	Value Chain Finance
WAAPP	West Africa Agricultural Productivity Project
WHO	World Health Organization

EXECUTIVE SUMMARY

The Government of Liberia, through the Ministry of Agriculture, has received financing from the World Bank for the implementation of the Rural Economic Transformation Project (RETRAP). The RETRAP seeks to increase income of rural poor households through sustainable agricultural livelihood enhancements and improved rural access and agricultural marketing infrastructure services. As its focus, the project will support the Rice, Palm, Cassava, Rubber, Poultry & Pig husbandry Vegetable's value chain. The project will be implemented in all the 15 counties of Liberia over a period of 8 years five years. The project is expected to reach approximately 90,000 60,000 beneficiaries of which at least 50 percent are women.

RETRAP MAP



Project Development Objective-PDO

The Project Development Objective (PDO) of RETRAP will be to improve productivity and market access for smallholder farmers and agri-enterprises for selected value chains in project participating counties and mitigate food security risks posed by food supply shocks.. RETRAP focuses on addressing critical market failures limiting the development of the cassava, rubber, poultry and piggery value chains. The project would reach its objectives of increasing the income of rural poor households through accelerated agribusiness promotion and development for sustainable agricultural livelihood enhancements and improved rural access and agricultural marketing infrastructure services through business climate adaptation approaches and mitigation measures that will be applied for cassava, rubber, and poultry/piggery production to enhance the climate resiliency of production and to minimize climate risks.

A new Component 5 will be added to improve food availability and support community agricultural investments. Including rice production home gardens featuring nutrient-rich fruits, vegetables, bio-fortified crops, and other nutrient-dense food production.

Overview of the Project Components

Component 1: Improving the Enabling Environment For Agribusiness Development

The objective of this component is to improve the enabling environment for agribusiness development in Liberia.

Component 2: Enhancing Competitiveness and Market Access Through Productive Alliances

The objective of this component is to support smallholders and commercially oriented farmers to improve their capacity to operate competitively in selected value chains and have strengthened and more reliable linkages with buyers.

Component 3: Agri-Marketing and Road Infrastructure Investments

The objective of this component is to improve access to markets through the rehabilitation of existing roads, construction of short-span critical cross-drainage structures, and modernization of selected agri-markets.

Component 4: Project Coordination and Management and Contingency Emergency Response

The aim of this component is twofold: (i) establishing appropriate coordination, Monitoring and Evaluation (M&E), and communication regarding Project implementation; and (ii) ensuring that GoL is better equipped to respond to crises and emergencies.

Component 5: Support to Food Security and Community Agricultural Investments

The objective of this new component will be to both prevent a decline in food production and availability, and to stimulate a supply response to overcome the short-run deficit while community level agricultural development.

Rational for Pest Management Plan

The activities of RTRAP under component 2 are associated with the use of agrochemicals- including pesticides and fertilizers (phytosanitary and anti-vector control products) to boost agricultural productivity both in the crop and livestock sectors. However, unsupervised, and intensive application of these products could result in the reduction of crop aids. In addition, impacts on human and animal health, contamination of soil, surface and groundwater are some of the consequences that could compromise the achievement of the program objectives.

Hence, the Pest Management Plan sets out strategies to protect the biophysical and human environment through the promotion of the use of pest management methods, capacity building of farmers, environmental impact assessment of agricultural development projects likely to use a considerable quantity of pesticides, the provision to farmers of protection and spraying equipment the management of empty pesticide containers. The IPMP will enable actors and stakeholders to monitor and mitigate negative environmental and social economic impacts of the project arising from the use of agro-chemicals, by promoting and implementing Integrated Pest Management (IPMP) that will benefit crop and livestock producers in the counties. in addition, the help protect the environment, in the process increase crop production to enhance food security and reduce poverty in the farming community.

The IPMP also addresses the internal and external environmental factors affecting the production of rubber, cassava, vegetables, and livestock (poultry and small ruminants) for domestic production and marketing

The World Bank Environmental and Social Standard 3 – Resource Efficiency and Pollution Prevention is relevant for projects under which any procurement of pesticides (agricultural use, vector control, weed control, etc.) either directly by the project, or indirectly through on-lending, co-financing, or government counterpart funding, projects and programs that are expected to introduce new pest management practices or expand or alter existing pest management practices and subsequent environmental and health risks.

National Legislations and policies relevant to the project include:

a) National Environment Policy of Liberia (2002)
b) Land Administration Policy, 2015:
c) Land Rights Policy (2013)
d) The National Rice Development Strategy of Liberia (Republic of Liberia 2012)
e) Draft Liberia Plant Protection and Regulatory Policy
f) National Environmental and Occupational Health Policy, 2010

Existing and Anticipated Pest and Disease / Management Practices

Potential Impacts and Challenges Associated with RETRAP Interventions

The use of various agro-chemicals especially pesticides is more likely during project implementation stage. The potential risks/impacts associated with the procurement, transport, storage, use / handling, and disposal of pesticides are summarized in the table below:

Steps	Influencing factor	Risk		
		PUBLIC HEALTH	**ENVIRONMENT**	**PERSONNEL**
Transportation	Inadequacy of transport and emergency preparedness planning	Pollution of food and other products that has been exposed to pesticide contamination	Accidental discharge, water table pollution through leaching	Product inhalation : vapor, dust, risk of skin contact Skin and eye contact
Storage	Lack of means Deficit in pesticide management training Inadequacy of facilities	Accidental contamination Inconvenience of populations living in the vicinity	Soil contamination	Skin contacts through accidental spillage caused by the narrowness of the premises Skin and eye contact

Handling Manipulation	Deficit in training and sensitization	Contamination of water sources through washing of containers Accidental leaks	Soil contamination through accidental spillage or intentional discharge, water table pollution	Vapor Inhalation, skin contact through splashing during preparation or product transfer Skin and eye contact
Packaging disposal	Deficit in training, education, and sensitization Non availability of disposal facilities	Product ingestion by re-using containers		Skin contacts and respiratory tract Skin and eye contact
Washing of containers	Deficit in training, education, and sensitization	Skin contact, contamination of wells	Acute intoxication of fish and other crustacean, pollution of wells, ponds, water tables	Skin contact Skin and eye contact

PMP STRATEGIES,

RETRAP will adopt the following specific strategies to achieve an effective pest and pesticide management process:

1. Monitoring and Evaluation Plan
2. Training plan of actors involved in pest and pesticide management
3. Information and awareness raising among users and the public
4. Coordination and monitoring of the PMP
5. Institutional arrangements for the implementation and monitoring of the PMP
6. Reporting

PMP Implementation Budget

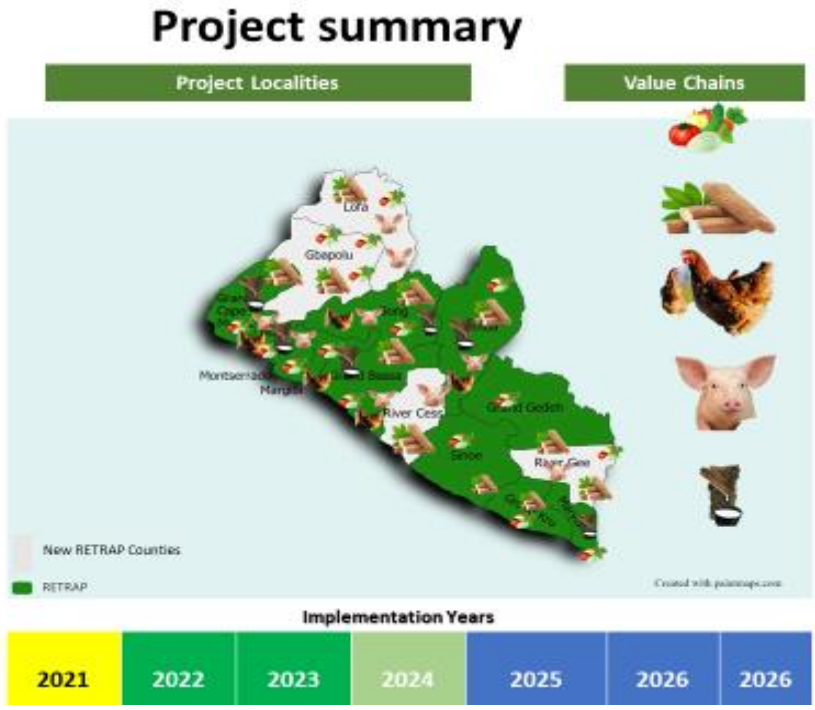
The costing for activities identified in the Budget is provided in Table X. It is estimated that an amount of about US$143,000 will be required to implement the PMP over the 5-yr period,

1.0 INTRODUCTION

1.1Background

The Government of Liberia, through the Ministry of Agriculture, has received financing from the World Bank for the implementation of the Rural Economic Transformation Project (RETRAP). The RETRAP seeks to increase income of rural poor households through sustainable agricultural livelihood enhancements and improved rural access and agricultural marketing infrastructure services. As its focus, the project will support the Rice, Palm, Cassava, Rubber, Poultry & Pig husbandry Vegetable's value chain. The project will be implemented in the 15 counties over a period of 8 years five years. The project is expected to reach approximately 90,000 60,000 beneficiaries of which at least 50 percent are women.

RETRAP MAP



This project will promote productivity by strengthening existing farmers' organizations to enable productive business linkages between organized groups of smallholder farmers and selected agribusiness firms. This will be done across targeted value chains with focus on improving production system, the extension services, and enhanced opportunities for value addition and access to markets. The project will establish partnership with the private sector and entrepreneurs for effective forward and backward linkages with producers. New marketing channels will be explored including commodity off-take arrangements, contract farming, out grower schemes etc. Agribusiness firms, Nucleus farms and SME groups will be selected based on their innovative plans and experience working with organized farmers' groups or cooperatives.

1.1.1Project Development Objective-PDO

The project development objective (PDO) is to improve agriculture productivity and access to markets for selected value chains in the Project targeted areas. RETRAP focuses on addressing critical market failures limiting the development of the cassava, rubber, poultry and piggery and Vegetables value chains.

The project would reach its objectives of increasing the income of rural poor households through accelerated agribusiness promotion and development for sustainable agricultural livelihood enhancements and improved rural access and agricultural marketing infrastructure services through business climate adaptation approaches and mitigation measures that will be applied for cassava, rubber, and poultry/piggery production to enhance the climate resiliency of production and to minimize climate risks. To support the development of decision-support systems to increase the effectiveness of agriculture and food crisis prevention and management, leveraging innovation, and technologies.

1.1.2 Project Components

To achieve the PDO, the project is structured around five components:

Component 1: Improving the Enabling Environment for Agribusiness Development

This component is to improve the enabling environment for agribusiness development in Liberia. This objective will be achieved through the following interventions: (i) building the capacity of public agribusiness services to deliver quality services to private investors, including smallholder farmers; (ii) enhancing value chain coordination and public-private dialogue; and (iii) supporting agricultural research and development (R&D) and extension.

Component 2: Enhancing Competitiveness And Market Access Through Productive Alliances

The objective of this component is to support smallholders and commercially oriented farmers to improve their capacity to operate competitively in selected value chains and have strengthened and more reliable linkages with buyers. Productive Alliance (PA), a globally recognized approach to enhancing farmer market access, involves three core agents: a group of smallholder producers, one or more buyers, and the public sector. These three agents are connected through a business proposition, or "business plan", which describes the capital and services needs of the producers and proposes improvements that would allow them to upgrade their production capacities and skills to strengthen their linkage with the market, i.e. the buyer(s).

Component 3: Agri-Marketing and Road Infrastructure Investments

The objective of this component is to improve access to markets through the rehabilitation of existing roads, construction of short-span critical cross-drainage structures, and modernization of selected agri-markets. The component is designed to improve infrastructure along a major corridor (Tappita–Zwedru road)[1] to unlock productivity in the agricultural sector and provide logistics support to the private sector. Component 3 is integrated with the government's larger national road and transportation agenda, which is intended to reduce transportation costs, improve communications, and increase the commercial viability of agriculture. The expected outcomes of investments under Component 3 are reductions in post-harvest

losses and marketing costs, closer links between producers and buyers, and increased competitiveness of domestic producers supplying food products to major consumption centers.

Component 4: Project Coordination and Management And Contingency Emergency Response

The aim of this component is twofold: (i) establishing appropriate coordination, Monitoring and Evaluation (M&E), and communication regarding Project implementation; and (ii) ensuring that GoL is better equipped to respond to crises and emergencies.

Component 5: Support to Food Security and Community Agricultural Investments

The objective of this new component will be to both prevent a decline in food production and availability, and to stimulate a supply response to overcome the short-run deficit while community level agricultural development. The component will have three subcomponents that address: (i) upgrading National Food Crisis Prevention and Monitoring Systems; (ii) Support Rice Production and Household Nutrition; and (iii) Support for Sustainable Community Agricultural Investments. To address nutrition-related risks, the AF will support investment in home gardens featuring nutrient-rich fruits, vegetables, bio-fortified crops, and other nutrient-dense food production.

1.1.3 Background of Geographical Description of Liberia

Liberia is situated in West Africa, bordering the North Atlantic Ocean to the country's southwest. It lies between latitudes 4° and 9°N, and longitudes 7° and 12°W. The landscape is characterized by mostly flat to rolling coastal plains that contain mangroves and swamps, which rise to a rolling plateau and low mountains in the northeast.

Tropical rainforests cover the hills, while elephant grass and semi-deciduous forests make up the dominant vegetation in the northern sections.

Liberia's watershed tends to move in a southwestern pattern towards the sea as new rains move down the forested plateau off the inland mountain range of Guinée Forestière, in Guinea. Cape Mount near the border with Sierra Leone receives the most precipitation in the nation.

Liberia's main northwestern boundary is traversed by the Mano River while its southeast limits are bounded by the Cavalla River. Liberia's three largest rivers are St. Paul exiting near Monrovia, the river St. John at Buchanan, and the Cestos River, all of which flow into the Atlantic. The Cavalla is the longest river in the nation at 320 miles (510 km).

The highest point wholly within Liberia is Mount Wuteve at 4,724 feet (1,440 m) above sea level in the northwestern Liberia range of the West Africa Mountains and the Guinea Highlands. However, Mount Nimba near Yekepa, is higher at 4,724 feet (1,440 m) above sea level but is not wholly within Liberia as Nimba shares a border with Guinea and Ivory Coast and is their tallest mountain as well.

The equatorial climate, in the south of the country, is hot year-round with heavy rainfall from May to October with a short interlude in mid-July to August. During the winter months of November to March, dry dust-laden harmattan winds blow inland, causing many problems for residents. Climate change in Liberia causes many problems as Liberia is particularly vulnerable to climate change. Like many other countries in Africa, Liberia both faces existing environmental issues, as well as sustainable development challenges. Because of its location in Africa, it is vulnerable to extreme weather, the coastal effects of sea level rise, and changing water systems and water availability. Climate change is expected to severely

impact the economy of Liberia, especially agriculture, fisheries, and forestry. Liberia has been an active participant in international and local policy changes related to climate change.

Forests on the coastline are composed mostly of salt-tolerant mangrove trees, while the more sparsely populated inland has forests opening onto a plateau of drier grasslands. The climate is equatorial, with significant rainfall during the May–October rainy season and harsh harmattan winds the remainder of the year. Liberia possesses about forty percent of the remaining Upper Guinean rainforest. It was an important producer of rubber in the early 20th century. Four terrestrial ecoregions lie within Liberia's borders: Guinean montane forests, Western Guinean lowland forests, Guinean forest–savanna mosaic, and Guinean mangroves.

Liberia is a global biodiversity hotspot—a significant reservoir of biodiversity that is under threat from humans. Pygmy hippos are among the species illegally hunted for food in Liberia. The World Conservation Union estimates that there are fewer than 3,000 pygmy hippos remaining in the wild Endangered species are hunted for human consumption as bushmeat in Liberia. Species hunted for food in Liberia include elephants, pygmy hippopotamus, chimpanzees, leopards, duikers, and other monkeys. Bushmeat is often exported to neighboring Sierra Leone and Ivory Coast, despite a ban on the cross-border sale of wild animals.

2.0 INTEGRATED PEST MANAGEMENT PLAN

2.1 Objective of the IPMP

The objective of the Integrated 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 IPMP are to:

a. Ensure incorporation of appropriate pest management approaches 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 Environmental Social Standard 3: Resource Efficiency and Pollution Prevention and Management

2.2 Rational

The Integrated Pest Management Plan (IPMP) 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 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 to sustain the adoption of IPM techniques.

2.3 General Approach

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 be trained and encouraged to make detailed observations in their fields regularly so that they can detect early infestations and make the appropriate management decisions on the control of pests and diseases.

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 under the project.

Pesticide use in general and pest issues amongst downstream project actors or participants (such as farmers, farm assistants, agro-chemical dealers, resellers, local communities, Faith Based Organization etc.) will by surveyed regularly by MoA and, EPA and environmentalist.

Decision making on pest management strategies and measures at the Project implementation level will be influenced by suggestions and recommendations from the downstream project actors. Communicating any decision on pest management strategy or measure from the project implementation level will be undertaken by educated or experts or trained and well-informed project actors in the project and its stakeholders.

3.0 COMMON APPROACHES TO CROP PEST AND DISEASES MANAGEMENT IN LIBERIA

Mainly farmers use the following methods to control pests and diseases on their crops:

3.1 Use of Cultural Practices

A cross-section of the farmers dealing in crop products to be supported under RETRAP acknowledge that, pests and diseases are a big challenge to their production. As such, they try to employ the following measures to curb the problems:

a. Use of bird scarecrows on cereal crops such as maize and rice (Figures 13 and 14).
b. Vegetable farmers reported that, once they prepare their nursery beds, sometimes they boil water and pour on the prepared soil as a way of killing nematodes before they plant the seeds though this can have impact on beneficial soil organisms to the soil ecology and the welfare of the seedlings.
c. Farmers endeavor to keep their fields free of weeds and regularly removing diseased plants from the fields.
d. Use of traps to capture rodents especially in rice and oil palm plantations.
e. Planting resistant varieties adapted to harsh weather and diseases.
f. Planting the seeds early to allow early crop maturing crop before the fall of pests and disease; and
g. Use of Neem trees leaves extracts on vegetables.

Despite farmers' effort to use the above measures to curb disease and pests in crops, farmers engaged in Cassava, Rubber and Vegetable commodities still count loses and find themselves resorting to use of chemical pesticides amidst their inherent environmental, social and economic impacts and limitations.

3.2 Use of Chemical Pesticides

Generally, pest management in Liberia is characterized by a combination of methods mainly cultural and use of chemicals. The cultural methods employed usually include the use of manual traps and some predators to check some kind of pest's species.

3.2.1 Challenges in Chemical Pest Control

Chemical methods generally imply the use of pesticides and herbicides and have a host of challenges such as.

3.3 Continued Use of Persistent Organic Pollutants (Pops)

In May 2001, Liberia became a signatory to the Stockholm Convention on Persistent Organic Pollutants and ratified in 2004. Under Annex A of the Convention, Parties must take measures to eliminate the production and use of the chemicals listed under Annex A. Obsolete pesticides are characterized by a high persistence in the environment, 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 farmland, and resultant wider environmental and social impacts.

3.4 Prevalence of Adulterated and Expired Pesticides

Challenges associated with direct procurement of pesticides by smallholder farmers in Liberia include the proliferation of illegal imports by unscrupulous private companies and the presence of unlicensed dealers. While it is illegal to sell unregistered pesticides, some pesticides are being sold without registration. Similarly, there are cases of pesticides being re-packaged, and sold in smaller amounts without any, or at least proper, labels.

It is important to note that, the labels on the pesticide's containers have information on the pesticide in terms of;

a. what is it used for,
b. how to mix it,
c. what pests it will control,
d. what plants and animals may be particularly harmed if one is careless,
e. protective equipment needed for proper handling and use,
f. hazard statements, and
g. environmental hazards and compatibility with other pesticides or agro-chemicals.

3.5 The Misuse of Pesticides

From the consultations, farmers commonly do misuse pesticides through:

a. Spraying of produce too close to harvest time which contaminates the crop at its 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; and
e. Mixing different chemical pesticides together.

3.6 Insufficient Training and Advice

Most of these problems the farmers face involved in the value chain products under RETRAP, and other agricultural crops at large can also be attributed to lack of knowledge on the subject of pests and disease of crops. For instance, in Dolo Town, Margibi County, Ms. Martha Kombe a vegetable belonging to Kokovile Community AGROGEM Group said, "*where we live, we grow our vegetables such as cabbages, pepper and tomatoes and after planting and germinating, something from underground eats up all the seedlings and the next morning the nurseries are empty is it an evil spirit or what?*"

Training and advice are especially critical given that, most farmers are unable to read and write. More training and advice need to be done by the extension service by MoA. It is important to note that, even if farmers benefit from workshops, it is critical to have follow-up through and implementation of what they have learnt; even after basic training, some bad habits can persist. All these tell a story about the perceptions and the understanding of the farmers regarding crop pests and diseases.

3.7 Non-Use of Personal Protective Equipment-Ppe

Pesticide users are generally advised to wear an overall, a hat, gloves, eye protection or a respirator, and good quality boots made of rubber with socks. However, from discussions with farmers, some of their testimonies with respect to pesticides usage documented during the study are: a. "I simply utilize my worn out rugged old cloths to cover my body, neither do I wear gumboots, overall, goggles nor utilize face masks'' ……Mohamed Kamara, a Rice Farmer from Margibi. b. "In circumstances, where we cannot afford to hire napkin spray pump, we resort to use of common household water basins and hand brooms to sprinkle the pesticide, said Varney Mary from Bomi. c. "At times, some of use use hand spray pump. All this makes us prone to inhaling the toxic agro-chemicals." d. "Sometimes after using agro-pesticides, you go home with an itching body and you take a shower scrubbing yourself hard as a person who has been in a sugarcane plantation," said Ruth, an elderly woman in Margibi growing vegetables.

These testimonies revealed that there is very low awareness and laxity with regard to proper pesticide handling and utilization which cuts across the board range from the agrochemical dealers (selling or outlet points), transportation, storage, use, re-use, recycling and disposal (Figure1

Figure 1: Application of agro-chemicals without any PPEs by a rice farmer

3.8 Unsafe Storage

Farmers in many cases keep agro-pesticides containers near or even in food stores which, no doubt, possess a health risk to the lives of the farmers and that of their households. In some stores, agro-inputs are sold alongside (within the same shop) other merchandise and groceries while in others, bags of agro-chemicals are placed on bare floors (Figure 2).

Figure 2: Informal storage of agro-pesticides in outskirts of Liberia

Figure 3: Inside a standard agro-pesticides store

3.9 Weak Policing of The Borders to Curb Illicit Entry Of Agroinputs

From discussions with staff from the Department of Technical Services in MoA, it emerged that, one of the challenges in the management of trade in agro-pesticides is the weak control of the country border entry points. Agencies responsible for control of entry of plant materials into the country do not have the capacity to effectively police the border posts with relevant staff hence, there is unregulated entry of both pesticides and plant materials into the country.

3.10 Weak Policing Of The Borders To Curb Illicit Entry Of Agroinputs

From discussions with staff from the Department of Technical Services in MoA, it emerged that, one of the challenges in the management of trade in agro-pesticides is the weak control of the country border entry points. Agencies responsible for control of entry of plant materials into the country do not have the capacity to effectively police the border posts with relevant staff hence, there is unregulated entry of both pesticides and plant materials into the country.

3.11 Mislabeling

This is where the label does not reflect contents in the package. This is often with imports where genuine agro-in puts are deliberately given wrong names with the objective of misleading users to think they are purchasing the original product.

3.12 Adulterated Products

An adulterated product is one in which, the authentic product that has been diluted or entirely fake products product may be packaged in re-used branded or in imitation packaging/labels.

3.13 Label Imitation

Where a premium brand is imitated but a sub-standard product or an adulterated one or sometimes the labels and packages are tampered with, and the product itself may look and smell like an authentic product which is common in seeds of maize.

3.14 Continued Sale of Expired Pesticides

Lack of sufficient human resources and limited facilities to effectively inspect and enforce the agro-inputs regulations are some of the main causes of non-compliance of many pesticide dealers. Due to this, agro-outlets sometimes continue to sell not only unauthorized but also expired drugs to unsuspecting farmers which when applied on the pests, destruction on the crops continue. One farmers remarked: "*when you buy seeds from the seed dealers, they do not germinate and even when you apply pesticides on the crops, destruction by the pests will even worsen and seems that makes the pests annoyed and very destructive than ever*", Alphonso Quamble, Margibi areas.

4.0 PUBLIC CONSULTATIONS

The preparation of the PMP was undertaken through consultative meetings with a cross-section stakeholder as follows:

Meetings With PCU-MoA

The Consultant interacted with the Project Coordination Unit to discuss details of the project and to gain insight into the stakeholders and contact persons to be met during field studies. It also provided an opportunity for the consultant to request for a list of documentation for the assignment. Other issues focused on stakeholders to be contacted, plan for the consultations and scheduling of meetings, modalities for the logistics with emphasis on ensuring the assignment is kept within the project processing timelines as set out by the Bank. Contacts of stakeholders were compiled to enable scheduling of the meetings. At the end of the PMP preparatory Mission, the Consultant held a de-briefing meeting with the Project Coordinator to share findings and next steps in the assignment.

Meeting With World Bank Safeguards Unit

During the study, the Consultant met World Bank Environmental Specialist to discuss issues relating to the preparation of the IPMP. In the meeting, aspects of consultation with relevant stakeholders was emphasized especially the women groups and agro-chemicals dealers. Institutional issues relating to the management of agro-chemicals were key and the Bank emphasized the need for the study to interphase with MoA regarding institutional framework for agro-chemicals management including progress with preparation of an Act to provide for regulation and establishment of an Agency for agro-chemicals regulation in the country.

Meeting With MoA

As part of the IPMP preparatory process, a meeting was also held with the technical staff in the Department of Technical Services and the discussion centered on their mandate with respect to plant protection services and Resources

Meetings With the Environment Protection Agency-EPA

Through the PIU, the Consultant placed meetings with the management of EPA on matters relating to the management of agro-chemicals in the country. In the meeting it emerged that, institutional and regulatory aspects in the trade and application of agro-chemicals in the country is still a challenge which is further worsened due "porous" borders i.e. there is weak enforcement of control on the entry of agro-chemicals into the country. The Meeting with the EPA Manager for Compliance and Enforcement echoed the challenges of on-ground inspection and monitoring of agro-chemicals in that, there are a number of unlicensed dealers who even adulterate the agro-chemicals and such need to be curbed as a matter of urgency.

Meetings with The Private Sector Players and NGOs

The Consultant held meetings with agro-chemicals private sector players especially National Agro-Dealers Association of *Liberia* (*NADAIL*) in which, the discussions focused on the management and application of agro-pesticides, pesticides abuse and health risks. NAIDAL for now is compiling a database of agro-chemicals dealers but the process has many challenges ranging from institutional

capacity, conflict of interest (the dealers cannot be regulators themselves) and absence of acceptable and binding legal framework which can be used to bring some errant members to order. The agro dealers and farmers were willing to embrace IPM for pest control.

Meetings With Farmer Groups

The Consultant held meetings with stakeholder farmers in the planned RETRAP areas in Zwedru, Ganta, and Gibi in Margibi. Meeting was also held with National Federation of Cooperatives Societies in Liberia as well as Kokovile Community agro group. The meetings focused on the current threats posed by pests and diseases on their crops, access and their knowledge on the safe application and management of agro-chemicals as well as disposal of used and expired agro-inputs. In all, there is a clear and urgent need to streamline the trade in agro-chemicals and other inputs as farmers in some sections are ignorant of the causes of crop failures with others reporting failures of seeds purchased from agro-stores to germinate. Across section of farmers seem ignorant of long-term risks of agro-pesticides on their lives as evidenced by reluctance to use PPEs while applying agrochemicals. Photographs of some scenes during the consultations are as below (Figures 4-7) herein.

Figure 4: Farmer group in Nimba

Figure 5: Meeting elders in Voinjama

Figure 6: Meetings with some farmers in Gibi in Margbi

Figure 7: Public discussions in Zwedru, Grand Gedeh

5.0 CURRENT MANAGEMENT OF CROPS PEST AND DISEASES IN LIBERIA

5.1Current Pest or Disease Vector Problems Relevant to the Project

Pests and disease vectors constitute serious hazards to public health, food security and general welfare of the people in Liberia. It is estimated that agricultural pests destroy about 40%-60% of crops, fruits, ornamental plants, vegetables and livestock annually both in field and storage. Domestic pests also destroy property such as furniture items, clothing, books, etc. Estimated cost of damage caused by pests runs into millions of dollars.

The production of agricultural crops is hampered by vertebrate pests such as rodent, etc. invertebrate pests including whiteflies, thrips, variegated grasshoppers, stem borers, caterpillars, etc. and pathogenic pests such as fungus (anthracnose, fusarium wilt and root rot), bacteria (bacterial blight), virus (cassava mosaic virus), nematode (root knot nematode) and parasitic higher plants. Vectors transmit several diseases of agriculture and public health concern in Liberia. Cassava Mosaic Virus (CMV), which is transmitted by whiteflies, is responsible for considerable damage of the crop with significant yield loss, cassava green mite, meal bug, rodents, etc. The invertebrate pests mentioned above are serious agricultural pests found in all sites selected for the RETRAP in Liberia. Some of these are key and persistent pests, while others are occasional (Achaea spp.) with the introduction of the fall armyworm in Liberia in 2017.

For the past 10 years, farmers often respond to pest infestations in crops by substantial applications of pesticides, which threaten environmental quality and pose risks to human and livestock health. Pesticides used in vegetable agro-ecosystems, for example, include WHO toxicity Class 1a & 1b, (parathion and Furadan/carbofuran, respectively) The careless reliance on chemical pest control options demoralizes national economic growth through farmers' non-compliance with trade barriers on pesticide residues in export produce. According to EC directive 91/414, for instance, approximately 80% of the active ingredients used in Africa will be banned for use in Europe, and IPMP is a fast-emerging trade policy issue.

5.2 Current Pest Management Practices

Pest management approaches in Liberia vary with the type of pests and agriculture production. The most pest control action in the country today is the predominant use of pesticide products. The principal use of pesticides in Liberia started when agriculture activities increased and migration of young people to urban communities due to various attractions, which has led to the decrease in manpower in farming communities.

Pesticides are seen as the only answer to most of the pest problems. Now, due to the increasing concerns about the environment, the development of pest resistance to pesticides and the increasing economic pressures on farming and the food industry, they are progressively being seen as just one of a choice of control measures available.

Other pest control options include Cultural control: which refers to the adjustment of crop husbandry techniques by the farmer. The approach includes crop rotation, alteration of planting date, disposal of crop residues, choice of resistant crop variety, hand picking and management of irrigation. Biological Control: which involves either encouraging or introducing natural enemies of the pest or interfering with the life cycle of the past.

Mechanical methods employed usually include the use of manual traps for rodents, and scarecrows for birds.

5.3 Assessment of Pest Management Approaches

The review of current management approaches concluded that there is no organized structure of pesticides management in the country. However, there are agencies who cater to pesticides importation and distribution in the country.

The Plant Quarantine Services within the Ministry of Agriculture (MOA), Environmental Protection Agency (EPA) and the Ministry of Health and Social Welfare (MOHSW) grant permit to agrochemical dealers or importers for the importation of these substances. Currently, the Ministry of Agriculture submitted a validated plant protection policy for cabinet approval which is before the House of Legislature for legislation. The plant protection policy also includes aspects of pesticides management. The Environmental Protection Agency is also in the process of setting up a National Pesticide Committee which draw membership from relevant institutions. The functionality of these organizations is not effective due to the lack of policy and organizational framework that would standardize or supervise the affairs of pesticides management in the country.

There are limited number of bulk storage facilities at the port of entry – National Port Authority (NPA), whereas there is no storage facilities at out – country for retailers. It was also observed that Pesticides are stored with other commodities, which is therefore attributed to lack of capacity. Considering the above-mentioned factors, there is no organizational structure to regulate pesticide management.

5.4 Pests and Diseases In Rubber Plantation

Rubber is very sensitive to pests and diseases, from the nursery stage to the trees in full production and as such, pests and disease control in rubber is therefore essential for the plant to be economic. A summary of the main pests and diseases of rubber can be summarized as follows:

a. Fungi: fungi that attack and eventually kill the roots

b. **Nematodes** – They develop on rotting tissues and can cause serious economic loss to tree crops Rhadinaphelenchus cocophilus, the causal agent of red ring disease, and carried by the palm weevil Rhyncophorus palmarum.

c. **Ants and termites**: Most ants cause little harm, except leaf-cutting ants which cut laminar tissues for the construction of their subterranean nests. The termite's tunnel through the palm, preferring to attack the upper stem tissues. Ultimately, the trunk is so weakened that it collapses. Palms killed by termites should be evacuated from the grove.

d. **Rhinoceros Beetles**: Rhinoceros beetle (Oryctes rhinoceros) is a pest which mostly infects immature oil palms. Rhinoceros beetles breed in rotting wood on the plantation floor, so good maintenance of the plantation is essential because it can help to prevent outbreaks. The damage caused by rhinoceros beetle to immature palms can be recognized in terms of: Holes on the leaves/bases of the fronds; Fronds bend or 'break' where they are damaged; and New fronds are deformed.

e. **Leaf miners cause defoliation**. Typically, the damage is caused by the larvae burrowing beneath the upper epidermis of the pinnae, usually of rubber over 3 years old in the field, and feed on the mesophyl tissues so that the pinnae are hollowed out. In Liberia, the common leaf miner is Coelaenomenodera elaedis;

f. **Weevils** – Damage by various weevil species arises after penetration of surfaces first affected by rodents, or after burrowing through the cut ends of frond butts after pruning. Many species of weevil are attracted by the odour and exudates of exposed tissues. Species of Rhyncophorus occur in almost all oil palm areas. Their control is difficult and estate sanitation has been widely recommended, with removal and destruction of dead palms.

5.5 **Diseases in Poultry and Piggery-Based Enterprise**

Most diseases of any economic significance affecting poultry and piggery are associated, at least in the initial stages, with better treatment, sickness can be avoided, while they are still in the spear stage. Tissues during this phase are much softer than they are at maturity.

Impacts relating to odors: Poultry and piggery facilities are a source of odor and attract flies, rodents and other pests that create local nuisances and carry disease. Odor emissions, caused by a large number of contributing compounds including ammonia (NH3), volatile organic compounds (VOCs), and hydrogen sulphide (H2S), from poultry and piggery farms can affect the life of people living in the vicinity. Flies are of concern for residents living near poultry and piggery facilities.

There are reports that, residences in close proximity to poultry and piggery facilities equally suffer health impacts arising from nuisance by flies and mosquitoes emanating from such enterprises because dampness due to poor handling of water and poor drainage.

Flies nuisance is largely due to the poor handling and management of animal-feeds and associated waste in the pens which can be addressed through observation of good hygiene in the enterprises and extension services support. Poultry and piggery enterprises can have challenges of sick or dead pigs and poultry.

To avoid spread of disease and loss of such animals and widespread disease to the neighboring areas; Sick animals should be quickly isolated from the rest of the stock into well-constructed isolation units in the farms where such animals can continue receiving treatment.

Dead animals should be subjected to post-mortem examination to ascertain cause of death before their disposal; Dead animals should be buried and such sites properly backfilled to avoid dogs and scavengers exhuming such carcasses and spreading disease germs to the environment; and all workers in the farms to have changing rooms where they thoroughly clean up before and after work to avoid carrying disease agent to animals and, to the communities.

5.6 Rice Gall Midge

The Rice Gall Midge is a flying insect pest, the larvae of which feed on the growing tips of new rice shoots. The adult midge is mosquito-like and small, up to 5 mm long. In the few days it is alive, the female can lay 200-400 eggs at or near the base of shoots. African rice gall midge is mainly a pest of rain fed and irrigated lowland rice. The insect prefers high humidity and in wetter years the risk of infestation is higher.

5.7 Bacterial Leaf Blight

Bacterial leaf blight of rice kills seedlings and destroys the leaves of older plants. The disease is extremely serious worldwide and has emerged as a major problem in irrigated crops in the Sahel. Wild hosts maintain the disease between crops and its spread occurs in irrigation, floodwaters, in wind and rain, and in seed. Management requires planting resistant or tolerant varieties, good drainage of fields and removal of weeds, ploughing under of stubble.

5.8 Rice Blast

Is caused by the fungus Magnaporthe grisea, which attacks leaves, stems and flowers, killing plants up to their tillering stages, or reducing grain yield and quality on plants that reach maturity.

5.9 Bacterial Blight

Bacterial Blight of rice, caused by *Xanthomonas oryzae* pv. *oryzae*, is another major biotic constraint to rice production and productivity. Typical bacterial blight symptoms include leaf blight, pale yellow leaves and wilting. Leaf blight is most common between maximum tillering and maturity stages.

5.10 Rice Yellow Mottle Disease

Rice yellow mottle disease (RYMD) causes major epidemics and yield loss in lowland irrigated rice throughout sub-Saharan Africa. Leaves turn yellow or orange with green streaks, plants are stunted, tiller number is reduced and panicles produce unfilled or sterile grain (Figure 14).

Figure 14: Rice growing showing symptoms of yellow mottle disease.

5.11 Pests on Rice

5.12 Fall Armyworm

The Fall Armyworm-FAW (*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 (Figure 15). The worms destroy maize, rice and millet and in addition, animals that feed on infested pastures get bloated and can even die. Currently these are mainly controlled through use agro-chemicals by the farmers.

Figure 15: Fall Armyworm (FAW) caterpillars on a cereal crop leaf

5.13 Rodents on Rice

Serious rodent damage on rice reportedly occurs at all the stages of rice cultivation 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, and voles cause the damage. At the farms, farmers effort of trapping seems not to doing much due to bushes and prolific population of rodents.

5.14 Problem of Quelea Birds

5.14.1 Problem of Quelea 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 16).

Figure 8: ***Juvenile, female and male red-billed quelea.***

5.15 Cultural Methods Used To Control Pest On Cassava And Vegetable

5.15.1 Use of Fence

Farmers in Bong County report that, they try to control pests and diseases in their fields. They collect chaff, and scatter in the cassava plots and believe that the chaff will attract ants to feed on. It is believed that the presence of the ants as a result of the chaff, drives a way frogs and rats from the plot. Farmers in Bomi areas report that, they try to control pests and diseases in their rice fields. They collect the chaff from the palm fruits after extracting palm oil, they scatter the chaff in the rice plots and they believe, the chaff will attract ants to feed on. It is believed that the presence of the ants as a result of the chaff, drives a way frogs and rats from the plot.

5.15.1 Use of Scarecrow Techniques

Farmers use a range of techniques and approaches to scare off birds from rice fields. These include use of catapults, scare-crows and string cables on which, are tied some rattling plastic bottles half filled with stones and occasionally shaken from one end and the resultant noise scares birds.

5.15.2 Use of Neem Tree Leaves Crashed Materials

The stored rice sometimes gets attacked by weevils which inflict loses to the crop harvests. Framers reportedly collect and dry the leaves of Neem trees (Figure 19) under shade, they pound them and put them in seeds' bags of rice or other crops such as groundnut, cowpea and pigeon pea and this is believed to keep a way the pests from destroying the harvested crop till appropriate time for its sale. The bitterness of the neem tree is extracted from the leaves. The neem extract obtained is sprinkled on the crops that the farmer wants to protect. When trying to eat the crops, the insects lick the neem solution and feel its bitter taste which makes them fly away.

Figure 9: Part of a Neem Tree

5.15.3 Control of Rodents

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

a. Regular weeding and cleaning of bunds and plantation fields.
b. Regular surveillance for early detection of any rodent incidences for institution of 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.
e. Train farmers to synchronize cropping seasons and grouping fields for enhanced pest management; and
f. Predation. Keep cats in stores and in the homesteads.

5.15. 4 Vegetable Sub-Sector

Vegetables do not only supply cheap and readily available sources of essential minerals and vitamins, but some are also considered as having important medicinal values for human health. In addition to their nutritional and medicinal values, vegetables are also becoming an important source of income especially to peri-urban farmers (Figure 20). In spite of their significance, more than 80% of the farmers have not attended training or workshop on vegetable cultivation. To make matters worse, with the exception of tomatoes, very little research has reportedly been carried out on these food resources. Furthermore, most of the vegetables cultivated are reportedly done in mixed cropping systems (87.5%) and is mainly by the women (85%). Vegetables that can easily be integrated into plantation crops alongside other crops such as bitter leaf, pepper, cocoyam leaves, and tomatoes.

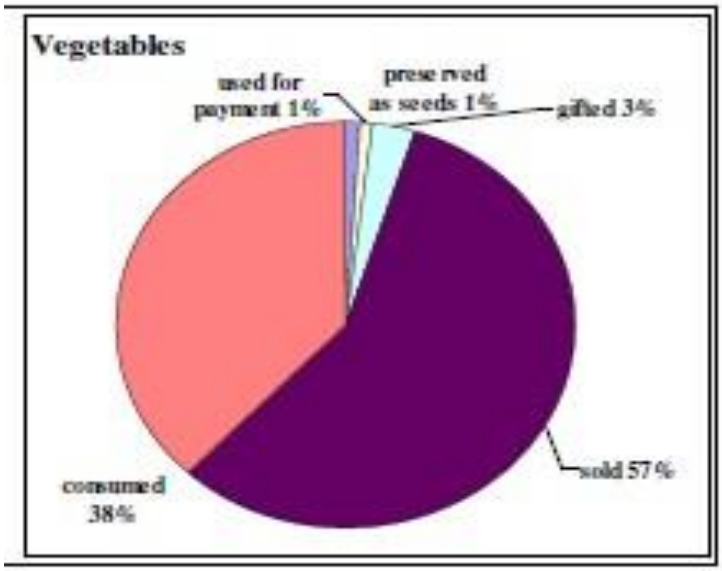


Figure 10: Current Horticulture Value Chain in Liberia[2]

Generally, throughout the country and with reference to agriculture and horticulture in particular, it is noted that, biotic factors are the major constraints hindering their production (Figures 21-22). Of all the biotic stresses, insects and fungi are the most serious on all vegetables causing losses that can reach 100% during severe infestation (pers. commun… DG CARI July 2018.

[2] *Proceedings of a workshop on Capacity Assessment and support identification for Farmer Cooperatives in the Value Chains of `, Rice and Horticulture for the STAR-P in Lofa, Nimba, Margibi, Bomi and Cape Mount Counties in Liberia, 11th July 2018 at PMU-MoA Monrovia*

Figure 11: Tomato eaten by Aphids

Figure 12: Damage on cabbages by Leaf-miners pests on the vegetable plants

Protection of vegetables from biotic constraints by the farmers (largely disease) is mainly through use of a g r o - pesticides i.e. insecticides and fungicides. According to the farmers, in spite of their continued and/or heavy use of agro-pesticides, they continue to experience heavy crop losses and more so, the agro-pesticides are quite expensive as such some of them have resorted to applying some cultural remedies as summarized below (Table 2).

Table 2: Summary of Pests and Diseases in horticultural crops[3]

Some of the common Pests and Diseases of Cabbage	
Major pests and Diseases	**Comments**
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
Bacteria s o f t 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
Pests and Diseases of Cucumbers	
Major pests and Diseases	**Comments**
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.
Pests and Diseases of Lettuce	

[3] *Adapted from PMP for WAATP 2018 MoA*

Major pests and Diseases	**Comments**
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.
Damping-off disease *(Pythium spp.)*	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.
Pests and Diseases of Onions	
Major pests and Diseases	**Comments**
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.
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
Pests and Diseases of Tomatoes drop off and die	
Major pests and Diseases	**Comments**
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.
Late blight (*Phytophtora infestans)*	Symptoms show as necrotic spots on leaves which enlarge rapidly to become water-soaked areas on leaves and fruits.
Tomato yellow leave curl virus (TYLCV)	IItn feiss tatthioe n mleoadsts sto eridouefos liadtiiseona sane do ffr utito mblaottcoehse.s. Transmitted by white flies feeding on tomato leaves. Plants infected by disease are stunted and turn yellow, and leaves curl. Affected flowers
Pests and Diseases of pepper	
Major pests and Diseases	**Comments**
Root-knot nematodes (*Meloidogyne spp)*	Are same nematodes that attack eggplant and okra. Affected roots develops g a l l become malformed i n h i b i t i n g plant growth; leaves become yellow, then curl and drop- off before
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 Yellow.
Pests and Diseases of Okra	
Major pests and Diseases	**Comments**
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;
Anthracnose (Colletotrichum spp.) disease	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

Neem extract is also suitable in the control of aphids, leaf-miners, mealy bugs, beetles (including flea beetles), nematodes, grasshoppers, mites, cabbage worms, moth larvae, thrips, caterpillars, beetles, whiteflies plus many more.[4] Neem seed extract is also a powerful antifungal and antiviral agent. It is effective against blackspot (roses), powdery mildew, anthracnose, and rust. *Unlike agro-chemicals, residue of Neem extract on plants is not poisonous to man or animals, unlike most chemical insecticides.* 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.

6.0 CROP INTEGRATED PESTS' APPROACHES IN THE COUNTRY AND DISEASES MANAGEMENT

Integrated pest management is a combination of physical, mechanical, cultural, chemical, biological control actions including the use of botanicals, with chemical application being the last option to reduce pest population during farm production practices. Agriculture technology to farmers is usually transferred by the MoA agriculture technicians. Some of the farmers have the knowledge of IPM practices but it is practiced at a low scale. Many times, the agriculture technicians are confronted with the request of pesticides from peri-urban and urban farmers. These farmers are mainly vegetable growers. Generally, most of the rural farmers do not request pesticide except fertilizers.

Currently, with the adoption of the Farmer Field School concept, many rural farmers have the knowledge of IPM practices as a result of the intensive training conducted by the MoA and the Food and Agriculture Organization of the United Nations (FAO). However, vigorous monitoring and evaluation needs to be carried out to confirm this. Development partners and NGOs intervening in the agriculture sector may have trained farmers in IPM practices. On a general note, it is important to mention that most of the farmers, especially rural farmers, may not have knowledge in the use of IPM. The same may also apply to the extension workers who are generally crop technicians and not subject matter specialists.

6.2 NATIONAL STRATEGIC ACTION ON IPMP

In terms of the strategic action required to sustain crop and animal health, it can be said that, the country is characterized by general lack of preparedness, insufficient human, physical and financial resources, and the lack of cross-sector collaboration to address promptly and efficiently disease outbreak disaster scenarios such as it happened with Ebola and associated ailments.

Similarly, as a result of the protracted period of civil war in Liberia coupled with slow socioeconomic and political building process, Liberia has not been able to build or develop capacities required for implementing IPMP. Therefore, this project will assist the Government of Liberia with relevant start up

[4] *Prof. P.S. Amaza Crop Scientist, Faculty of Agriculture, University of JOS, Nigeria (per.comm…2018).*

resources for the build-up of its safeguard profile for implementation of IPMP as well as and build the capacity in the PIU in MoA and sectoral research institutions within the period of the project.

6.3 CROP INTEGRATED PEST MANAGEMENT MEASURES

These include:

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.

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.

Biological control Agents

Biological control means use of living organisms to suppress pest populations and damage. Such 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 biopesticides and relatively fewer 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.

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.

70. Other cultural practices include:

a. Crop rotation which 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 to avoid synchronizing with pest out-breaks;
f. Water/irrigation management;
g. Use of scarecrow materials;
h. Hand-picking of pests or weeding fields; and
i. Use of traps or trap crops.

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. In Liberia and in collaboration of partners, considerable progress has been made by the Africa Rice Center (AfricaRice) in the development of rice varieties with promising traits that combine the high yield potential, disease resistance and climate smart and are being adopted by the farmers at the moment with promising results (Figure 23).

Figure 13: Improved Rice Varieties produced and cultivated in Liberia[5]

[5] *Information on the projects supported under MoA and some of the outcomes*

6.4 Issues In The Use And Management Of Systemic Chemical Pesticides In Liberia

According to the Liberia National Situation Report on the Sound Management of Chemicals of 2013, it is noted that, it is very challenging to obtain up-to-date and accurate data on the import, export, use, production and disposal of chemicals in the country, and if data is available, it is in most cases outdated. This means, reliable date on the volumes, types, approval and suspension etc. aspects on the management of agro-chemicals in Liberia is not readily available.

The majority of Liberia's country's population depends on agriculture with shifting cultivation, low input/low output and mixed crops as the principal farming system. The UNITAR National Chemicals Profile (2010) acknowledges that, the use of chemical inputs such as pesticides and fertilizers is not widespread among traditional farms, mainly because of poverty and customary practices. However, modern vegetable gardeners, using small plots of land, usually employ pesticides. Unfortunately, Liberia has never conducted an inventory of its agro-chemical stocks, import, usage and export and thus, the degree of potential environmental and health risks posed by these agrochemicals is unknown.

6.4.1 Health Problems And Environmental Hazards Associated With Pesticides

There are acute and chronic health effects and these effects may manifest as local or systemic effects. They include skin irritations, such as itching, rashes, blisters, burns, wounds, irritation of throat leading to cough or difficulty in breathing with or without wheezing or choking, chest pain, burning mouth and throat with pain on swallowing, runny nose, sore throat, head ache, dizziness, sudden collapse with or without unconsciousness.

Others include eye irritation, blurred vision, lots of tears or saliva or mucus secretion and sweating, nausea, vomiting, chest infections due to aspiration of vomits, fever, abdominal pain or discomfort, diarrhea, uncontrolled urination and defecation, slowing of heart beat or rapid heartbeat, weakness including muscles for breathing, muscle twitching or pains, tremors, convulsion, coma, hallucinations, pain and numbness in legs, allergic reactions. Others are problems with liver, kidney, or nerves functions, improper functioning of the heart etc.

Potential environmental impacts from the unsound management, use and disposal of chemicals in the agricultural sector could be (among else), water, soil and air pollution. The causes of pollution are relatively similar for each media as summarized below here as follows:

6.4.2 Risks On Water- (Ground And Surface)

This can have impact on soil- and air- pollution resulting from:
Inappropriate application and over-use of pesticides/fertilizers resulting in run-off due to overapplication, contaminating fish-stocks and causing nitrification (among else);
Runoff from farmlands to streams resulting from e.g. the coagulating of latex on trees (the main cause of acidity in rural streams and nitrification); production of palm oil on water banks (effluent containing phospholipids, run-off into the water killing fish, and promoting parasitic life forms). o Lack of awareness on Good Agricultural Practices (GAP);
Inappropriate storage and disposal of (obsolete) agrochemicals (including POPs);
Lack of good waste management practices in combination with the unavailability of suitable temporary storage/disposal sites; and

a. Unsafe storage, disposal and re-use of old containers.

6.4.3 Risks On Human Health

Human health effects from exposure to agrochemicals can occur through various way, for example from drinking contaminated water, eating contaminated food, occupational exposure, or living in areas that are contaminated with hazardous or toxic agro-chemicals.

The unsound management of agrochemicals can result in health expose and ill health as a result of chemical residues in foodstuffs for consumption, as a result of:

a. Inappropriate application of agricultural chemicals;
b. Insufficient monitoring of food quality;
c. Use of illegal pesticides (e.g. POPs) from obsolete stocks or from illegal import; and
d. Inappropriate re/packaging of agricultural chemicals resulting in chemicals that are often not labelled and don't contain information on handling, storage, disposal, etc.

6.4.4 Application Based Risks

Pesticide poisonings, because of:

a. Inappropriate labelling often as a result of re/packaging of agricultural chemicals, resulting in chemicals that are often not labelled and don't contain information on handling, storage, disposal, etc;
b. Inappropriate use and application; and
c. Suicides.

6.4.5 Occupational Health and Safety Risks From Agro-Chemicals

Human health effects from occupational exposure to agro-chemicals, as a result of:

a. Lack of adequate labor protection regulations and their enforcement;
b. Lack of training/awareness on safe use;
c. Inappropriate personal protection and hygiene of pest control operators and agricultural workers;
d. Growers making their own formulations;
e. Use of illegal/hazardous substances; and
f. Inappropriate labelling.

Table 3: Summary of Pesticide Management Methods and Associated Risks

Step	Influencing factor	Risks		
		Public health	**Environment**	**Personnel**
Transportation	Lack of training Inadequacy of transport Emergency preparedness planning		Accidental discharge, water- table pollution through leaching	Product inhalation: vapor, dust, risk of skin contact Skin and eye contact

Transportation	Lack of training Inadequacy of transport Emergency preparedness planning	Accidental contamination Inconvenience of populations living in the vicinity	Accidental discharge, water- table pollution through leaching	Product inhalation: vapor, dust, risk of skin contact Skin and eye contact
Transportation	Lack of training Inadequacy of transport Emergency preparedness planning	Contamination of water sources through	Accidental discharge, water- table pollution	Product inhalation: vapor, dust, risk of skin contact
		washing of containers Accidental leaks	through leaching	Skin and eye contact
Transportation	Lack of training Inadequacy of transport Emergency preparedness planning	Product ingestion by re-using containers	Accidental discharge, water- table pollution through leaching	Product inhalation: vapor, dust, risk of skin contact Skin and eye contact
Transportation	Lack of training Inadequacy of transport Emergency preparedness planning	Skin contact, contamination of wells	Accidental discharge, water- table pollution through leaching	Product inhalation: vapor, dust, risk of skin contact. Skin and eye contact.

6.4.6 Control Of the Distribution and Use Of Pesticides

In all, some information on chemicals use by category exists for agricultural chemicals, but records differ between departments/databases and are not up to date. The National Situation Report on the Sound Management of Chemicals reports that in 2010, MoA imported pesticides worth a total value of 154,000 US$ (according to the MoA all pesticides are imported into the country as no manufacturing of agrochemicals take place in Liberia). It has to be noted that all of these pesticides are for distribution by the MoA's extension officers the 14 MoA District Offices and are intended for small-scale farmers. However, commercial farmers and plantations import their agro-chemicals themselves through distributors. Considering the porous border, MoA believes that (illegal) pesticides very much do enter into the country without any controls.

In addition, though MoA has a list of banned chemicals, at the moment it is unable to effectively control aspects of their use, storage, and application. It is further noted that, MoA does not have much control over the use and/or management of pesticides as these are most often distributed to farmers without the necessary training/information under decentralized governance arrangement in the country.

6.5 Ability to Manage/Dispose Polluted Packaging

The management of pesticides containers is currently 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. There is widespread re-use of containers for storing food or water for humans or livestock. Indeed, this may well be the most hazardous practice associated with pesticide use in Liberia. Many farmers wash the containers before reuse, but often less thoroughly than is needed.

Currently, the management of pesticides containers is basically under the responsibility of resellers and farmers because of the retail sales system. However, with big commercial farms or companies, the management of pesticide containers are expected to be clearly stated in their environmental management plans (EMP) to the EPA. Usually, these companies indicate that they will liaise with the appropriate MoA office to provide guidance to the disposal of the containers. Equipment for the treatment of large empty containers is not known to be installed or in use in the country at the moment. Such equipment will be useful for the treatment of high-capacity drums for recycling or reuse. A collection and disposal system and cleaning of pesticide containers need to be put in place by MoA and the EPA as a matter of a priority. Because of this limitation in terms of infrastructure for disposal of agro-chemicals hazardous waste amongst others in the country, the ESMF for WAATP (a project to be managed alongside Projects under the Project Management Unit (PMU) at the MoA) has provided a budget for construction of a standard incinerator at CARI which is expected to be used in the disposal of agro-pesticides.

7.0 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:

7.1 LIBERIAN LEGAL FRAMEWORK

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.

Liberia Environmental Policy Requirements

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 comprehensive framework for EIA, including procedures and substantive standards for the approval and rejection of projects.

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.

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.

National Environmental and Occupational Health Policy, 2010

The main objective of this 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.

PUBLIC HEALTH LAW, 1976

The mandate the Ministry of Health is to ensure good and healthy environmental sanitation prevails in the communities as well as in private and public places in the country. 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.

7.2 International Framework

7.2.1 ECOWAS Regulations, 2014

The Government of Liberia activated national seed, fertilizer and pesticide regulations after publishing ECOWAS regulations in the country's National Gazette in September 2014. This move towards a more harmonized and regulated regional sector is meant to provide farmers and agribusinesses with protective measures that will assure quality and safety when acquiring and using agro-inputs. It is noted that, having access to quality inputs is an important step for Liberia to achieve food security and reduce reliance on imported food, specifically rice.

7.2.2 World Bank Environmental Social Standards

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 an Integrated Pest Management Plan (IPMP), 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).

92. 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 trigger ESS3, since its transformation and revitalization process hinges on improved production and productivity amidst evident challenges of crop pests and diseases with farmers grappling with management of pests using cultural and sometimes, ad hoc methods. In this case, demonstrations on safe and better handling of pesticides should form a center stage in the project taking IPM dimension. It should be observed that, such initiatives should be undertaken taking into account, the need for maximum caution to ensure that local capacity exists to adequately manage their post-harvest environmental and social impacts from use of pesticides, in compliance with ESS 3 as described above.

7.3 International Conventions and Treaties

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 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. 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 protection SPS Agreement.

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. International cooperation and open exchange of genetic resources are therefore essential for food security.

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. Enlisted parties are required to take measures to eliminate or heavily restrict the production and use of POP pesticides and PCBs, and to minimize the unintentional production and release of POPs.

Basel Convention

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.

Rotterdam Convention

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.

The Safety and Health In Agriculture Convention

The Safety and Health in Agriculture Convention (Convention C 184) adopted by the conference of the International Labor Organization (ILO) addresses the protection of workers in the agricultural sector. 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.

8.0 PROJECT INTEGRATED PEST MANAGEMENT MEASURES

8.1 Key Principles To Follow

IPM strategies will be applied according to the local circumstances. The smallholder farmers will be encouraged to find specific solutions to the pest problems they encounter in their fields based on understanding of agro-ecological principles, monitoring interactions among crops, pests and natural enemies of pests, and selecting and implementation of adequate control measures.

The World Bank sets the following principles for IPM and will serve as guiding principles for IPM implementation:

a. ***Grow a healthy crop***. The focus will be on cultural practices aimed at keeping the crop healthy. Selection of varieties that are resistant or tolerant to pests will be an important aspect. Attention to soil, nutrient and water management is part of growing a healthy crop and therefore a wider range of agro-ecological parameters related to crop production will be considered; and

b. ***Manage the agro-ecosystem*** in such a way that pests remain below economic damaging levels, rather than attempt to eradicate the pest. Prevention of pest build up and encouragement of natural mortality of the pest is the first line of defense to protect the crop. Non-chemical practices are used to make the field and the crop inhospitable to the insect pest species and hospitable to their natural enemies, and to prevent conditions favorable to the build-up of weeds and diseases.

Decisions to apply external inputs as supplementary controls will be made locally based on monitoring of pest incidence and are site-specific. External inputs may include predators or parasites (bio-control), labor to remove the pest manually, pest attracting lures, pest traps, or pesticides. The choice of external input will vary for each situation.

8.2 IPMP Pest Management Practices

The following measures will be adopted by all farmers where feasible

8.3 Pest Preventive Measures

The following measures will be adopted by all farmers where feasible:

Diseased plants or affected portions of the plant will be removed and burned. Phytosanitary measures, such as physical removal of pests, affected plant parts, infected plants (virus-infected plants, severely disease-infected or pest-infested plants should be undertaken. It may also be possible for farmers to minimize pest attack through good timing.

8.4 Use Of Host Resistance And Early Maturing Varieties

Choice of crop and variety can help to reduce pest problems. An important result consistent across countries and crops is that, growing more varieties of the same crop within the farm, leads to a decreased variance of pest and disease damage. Some varieties of crop have been developed that have resistance to certain pests and the Project will ensure that the smallholder farmers plant them if pests are a major cause of lost harvest. Effort will be made by the Project

for the farmers to select and use crop varieties resistant or tolerant to disease and pests in an attempt to check on regular usage of agro-chemicals.

8.5 Biological Control

This approach takes advantage of the fact that, organisms depend or even feed on each other for survival. Thus, biological control methods attempt 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 RETRAP, biological control will be considered by the Project as the first line of control for pests and diseases, when incidence is noticed and where appropriate biocontrol agent is available. In this case, the project will adopt measures such as ensuring existence of an environment conducive to the proliferation of pests' bio-control agents is to be maintained in the crop amongst farms especially oil palm plantations in which, Barn Owls, snakes amongst others are enemies of rodents on plantations.

8.6 Cultural Practices

Cultural control methods will include:

a. Crop rotation – which helps to prevent pest populations building over a number of years.
b. Inter-cropping,
c. Field sanitation and seed bed sanitation, implying keeping field clear of rotting debris etc.,
d. Use of pest-resistant crop varieties,
e. Synchronizing planting dates so that crops mature before fall of pests especially Quelea birds on rice;
f. Hand-picking of pests or hand-weeding;
g. Use of traps or trap crops to capture pests and vermin.

8.7 Chemical Control

With the above measures for control pests and diseases, chemical control will therefore be an addition and its application will be undertaken with utmost care as per applicable standards governing safe applications of agrochemicals (e.g. FAO Guidelines) to ensure safety of the environment and the farmers. Agro-chemicals to be used should be those registered for use in Liberia and not banned under international treaties as well as acceptable for procurement under World Bank Safeguard Policies. In all, the application of agro-chemicals shall follow recommended FAO practices (http://www.fao.org/sustainable-agricultural-mechanization/guidelines-operations/pesticides-application-guidelines/en/) as well as ILO

8.8 Specific Criteria for Choosing A Pest Management Method

When choosing a pest management method or pesticide material under the project, will have to consider a number of factors. At a minimum, farmers and extension staff shall consider the following factors during the selection of management methods and products.

8.9 Special Consideration In The Application Of Pesticides

Nature of the Site or Region

- The feasibility of the method given the area and scope of the problem
- Site conditions such as soil type, grade, drainage patterns, and presence of surface water; and
- Erosion susceptibility and potential movement of soil through runoff

Possible Health and Safety Effects

a. Consider both short- and long-term toxicological properties and any other related potential health effects of the materials or methods, both to the applicator and the public;
b. Equipment operation safety issues for both the operator and the public; and
c. Farmer safety and injury issues involved with carrying out the method.

Possible Environmental Effects

a. Consider both acute and chronic toxicity and any other related potential effects of the material or method to non-target organisms;
b. Environmental effects from potential bioaccumulation;
c. Potential impacts to non-target plants and other organisms from materials or methods;
d. Potential impacts to threatened or endangered species;
e. Possible introduction or establishment of invasive plants; and
f. Water pollution.

Costs

Both short and long-term costs as they relate to:

a. Costs of the material or method;
b. Application and labor costs;
c. Length and quality of pest control;
d. Feasibility of using a particular method or product; and
e. Costs associated with not treating or delaying treatment.

Characteristics Of The Product

In terms of:

a. Target pests and target sites of the product being used;
b. Possible residual effect, decomposition pathways, rates, and breakdown products; c. Volatility and flammability;
d. Product formulation and package size;
e. Leachability, solubility, and surface and soil bonding characteristics of the product;
f. Ease of cleaning equipment after use;
g. Positive and negative synergistic effects of pesticide combinations;
h. Post-harvest interval.

Other Special Considerations

Covering the following:

a. Availability of equipment for effective and appropriate application of the pesticide;
b. Method of delivery/application;
c. Current and anticipated weather conditions especially during time of application; and
d. Previous pesticide applications to the site and the interval between treatments (where such data exists).

8.10 Safe Use of Pesticides

8.10.1 Measures for Safe Handling and Application of Pesticides

When using pesticides, it is important to use them safely in order to protect both the farmer and the consumers, to reduce environmental contamination and to maintain the efficacy of the pesticides. Farmers must use appropriate safety precautions when mixing and using pesticides. This includes reading and following the label recommendations for use, using the right personal protective equipment (PPE) and practicing personal hygiene.

Information that can be found on the product label includes:

a. PPE required;
b. What crops and pests the product can be used for;
c. Dosage rate;
d. Timing of application;
e. The time required before anyone can re-enter the field after spraying (REI);
f. The number of days a product must be sprayed prior to harvest (PHI); and g. Other precautions.

It is important that farmers read and understand what is on the label prior to use. If they are unable to read it or do not understand it, then they should find someone to help them, such as a local extension agent or family member. Farmers should be encouraged to use personal protective equipment (PPE) when mixing and spraying pesticides (Figure 24).

At a minimum, a farmer should wear:

a. Long sleeved shirt;
b. Long trousers.
c. Goggles, glasses or a face shield to protect the eyes.
d. Boots (preferably rubber or impermeable boots);
e. Gloves (preferably rubber or impermeable gloves);
f. Dust mask (for dry formulations) or respiratory protector; and
g. Hat

Warning symbols are used on labels to indicate what type of PPE should be used for both mixing and spraying the product.

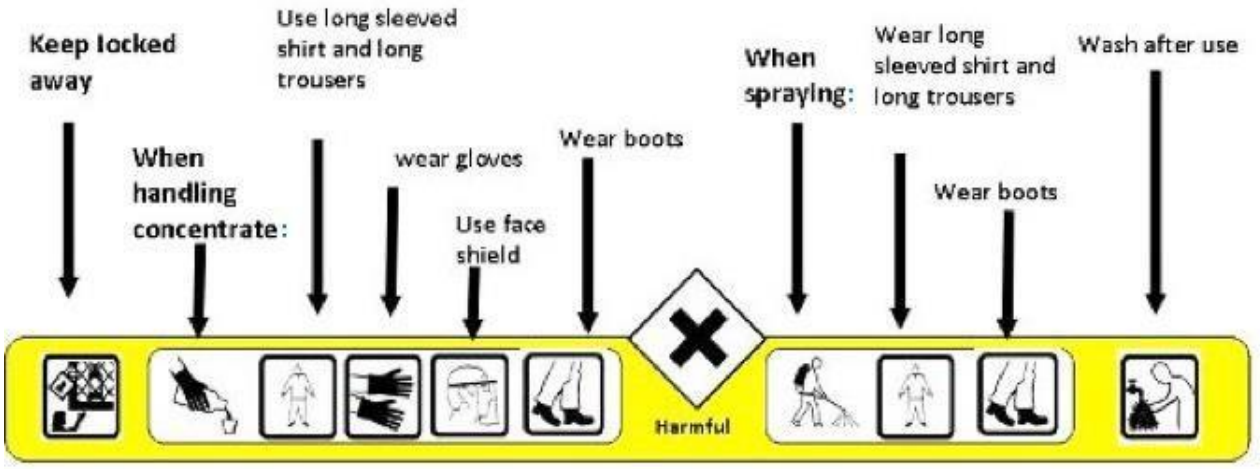


Figure 14: Comparative Summary on safe and unsafe handling and application of pesticides

Who Color Codes for Agro-Chemicals

A color code system, based on the WHO pesticide toxicity classification, is used on labels to inform farmers about the level of toxicity of the product: red indicates the most dangerous pesticides (Table 4).

Table 4: WHO Color Codes for Agro-chemicals[6]

WHO Class and Colour Code	
Ia	Extremely hazardous
Ib	Highly hazardous
II	Moderately hazardous
III	Slightly hazardous
U	Unlikely to present acute hazard
O	Obsolete as a pesticide

8.11 RETRAP Integrated Pest Management Plan Decision Tree

IPMP is based on the life cycles of pests and their interactions with the environment and manages pest damage while limiting the hazard to people, property, and the environment. The IPMP approach sets thresholds, conducts evaluations and makes decisions that may result in the use of physical, cultural, mechanical, biological and chemical controls or a combination of means (Figure 25).

[6] *Eric Boa: Crop Pests and Diseases Manual. Africa Soil Health Consortium Nairobi 2015. A manual on the most important Pests and Diseases of the major crops grown by Farmers in Africa.*

Monitoring programs along with action thresholds have to be conducted to quantify pest abundance as a guideline to initiate pesticide usage. Knowing when to act includes an explanation of the thresholds that farmers need to know, in order to decide whether or not to use a pesticide. *Action Threshold* is the point at which pest populations or environmental conditions can no longer be tolerated, necessitating that pest control action must be taken based on economic, human health, aesthetics, or other effects. Once the "action threshold" has been reached, spraying a pesticide may be warranted to protect the crop. However, once levels of damage reach a certain point, it will no longer be cost effective for a farmer to spend more money on spraying the crop. This is known as the 'economic injury level'. *Detecting a single pest under the Project will not always mean control is needed. A decision to use pesticides will be taken only as the very last option based on a range of considerations. The decision under RETRAP will also depend on the number of pests and diseases found in the respective crop commodities and the level of damage they are inflicting. If it is absolutely necessary to spray crops with pesticides, use of selective rather than broad-spectrum pesticides shall be strictly observed. The following decision-tree will guide decision making of pesticide use under RETRAP.*

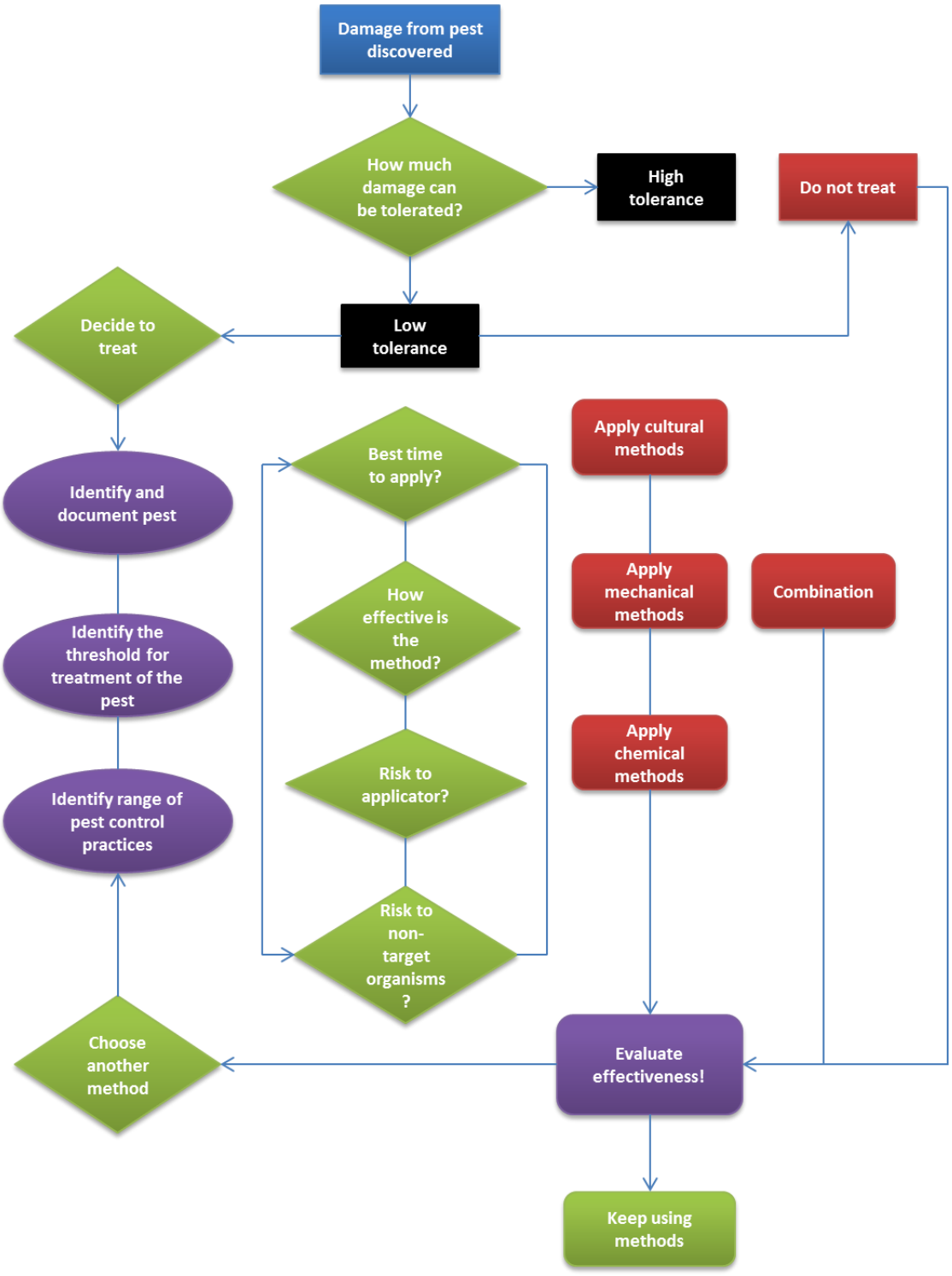


Figure 15: Schematic Illustration of Pest Management Approaches[7]

[7] *Source: Pest Management Plan for Agricultural Cluster Development Project, Ministry of Agriculture, Animal Industry and Fisheries Uganda, 2014*

8.12 Monitoring, Evaluation and Reporting Of The Action Plan

8.12.1 Monitoring and Evaluation

Successful implementation of the RETRAP Integrated Pest Management Plan in the project locations will require regular monitoring and evaluation of activities undertaken by the farmers who will 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 the production process as well as 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 project implementation will include:

a. N^{o}. of farmers engaged in IPM capacity building in the project locations;
b. N^{o}. of farmers who have successfully received IPM training approaches;
c. N^{o}. of trainees practicing IPM according to the training instructions;
d. N^{o}. of farmers and stakeholders aware of the risks of agro-pesticides;
e. N^{o}. of women as a percentage of total participating in IPM and successfully trained;
f. Improvement in the health status of farmers;
g. Reduction in the use and application of pesticides in the area;
h. Level of understanding of World Bank operational policy on pest management among PCUs and farmers associations; and
i. N^{o}. of IPM participatory research project completed.

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

8.12.2 Reporting

Implementing agencies for RETRAP will be required to report on the progress of project implementation in line with its financing agreement. It is expected that, such reports should capture the experience with implementation of the IPM strategies and measures provisions and the reports will amongst others, provide an indication of diseases and pest risks in the project, an assessment of extent of IPM success in the project; and a record of progress, experiences, challenges encountered, lessons learnt and emerging issues from year-to-year implementation of IPM that can be used to improve performance. It is possible, the report could provide input to be part of the overall report for the project.

8.13 Institutional Arrangements in The Implementation Of The IPMP

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.

8.13.1 Government Ministries and Departments

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 PMP is to ensure farmers have access and are guided in their management of crop and animals' resources protection services.

National Quarantine And Crop Resources Services Division On Moa

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 programmers.

Capacity Of Moa

Though the Ministry has in its establishment structures for oversight role on agro-chemicals and phytosanitary services, functionally, the sector has some on-the-ground challenges with respect to proper over-sight role on the entry of plant resources into the country. It has to develop its capacity to oversee issues of agro-chemicals entry, storage, trade and use in the country in terms of legislation, institutional staffing and operations.

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 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.***

8.13.2 Statutory Agencies

Centre For Agriculture Research Institute

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 could be provided with an incinerator facility under WAATP and that could serve pesticides needs under RETRAP. In addition, CARI will coordinate research on aspects of horticulture crop commodities under RETRAP as such, its facilities for storage of agro-pesticides need to be developed. For any pests and diseases outbreaks which cannot be handled by the extension staff in the project areas, advice will be sought from CARI.

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.

Liberia Revenue Authority (LRA)

The Customs Department is one of the departments under the LRA which is relevant to pesticides management by nature of its operational mandate. With regard to agro-chemicals, LRA is empowered to refuse/allow import of any restricted goods or any goods the import of which has been limited until an import license is produced and he or she is satisfied that the import of goods in question in no way contravenes any of the conditions of the license. In all, LRA is well placed to regulate and charge fees for trade in agro-chemicals.

Cooperatives Development Agency-CDA

By statutory mandate the CDA is the Legal technical, educational as well as overall administrative regulatory arm of the GOL responsible for cooperative activities in the 15 counties of Liberia, specifically the agency:

a. Facilitates the organization of grassroots associations, farmers & non-farmer-based organizations, into viable cooperative societies throughout Liberia;
b. Registers and issues certificates, regulates and supervises the activates of all registered cooperative societies;
c. Provides technical expertise including training, conducts financial audits at least one a year) to ensure human resource development, accountability, transparency and economic growth; and
d. Settles disputes among cooperative societies & their members.

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.

National Agro-Input Dealers Association of Liberia (NAIDAL)

The aims and objective of NAIDAL is to represent all agro-input dealers in the country, and act as a negotiating body that represents their interests on matters of trade in agro-inputs. It also provides 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; and lead aspects of capacity building for its membership.

8.14 Role of Counties

The County is the primary level for the operationalization of RETRAP as such, it is well placed to provide extension services to the farmers on agricultural and specifically, pest and disease issues on crops. Its entities have obligation to report on any diseases and pest outbreaks and accordingly notify MoA for planned actions.

8.15 Capacity Building Aspects

Management of agrochemicals in the country has a number of stakeholders and as seen in the study, the stakeholders have capacity issues which cascade right from national to the farmer levels and as such, capacity needs need to be tailored to the functional and operational needs of the entities as follows:

8.16 Support the Establishment of National Agro-Inputs Regulatory Agency

Liberia urgently needs to finalize its Draft Plant Protection Regulatory Services Bureau Act to pave way for the establishment of a Plant Bureau Regulatory Agency whose mandate will be to oversee, advise the Minster of Agriculture on the registration and control of agricultural chemicals and exercising responsibility for all policy matters affecting agricultural chemicals in Liberia (Box 1 below). It is suggested that, the Bureau (through the Act) will work out its operational modalities for effective execution of its mandate in liaison with key stakeholders such as EPA, MoCI, LRA and MoA.

Box 1 Vision and Mission of the Liberia Plant Protection and Regulatory Services Bureau, LPPRSB.

The ***Vision*** of the Liberia Plant Protection and Regulatory Services Bureau is to render expert technical services to achieve effective and efficient, ecologically friendly and environmentally safe sustainable plant protection and regulatory services in response to the requirements of the food and agricultural production industry and thereby contribute to sustainable food production and national food security as well as the production of agricultural raw materials for the manufacturing industry.

The ***Mission*** of the Liberia Plant Protection and Regulatory Services Bureau is to provide services that will guarantee safeguards for the quantity and quality of losses caused by hazardous native and new invasive pest species to cultivated crops and livestock.

Adapted from Draft Liberia Plant Protection and Regulatory Policy document 2010

That a side, the Bureau will be expected to issue permits to suitable and approved importers of agrochemicals and maintain a statistical database of agro-chemicals in the country as well. In all, its role will be***: registration and regulation of use of agricultural chemicals; regulating the quality, importation and distribution of agro-inputs; and licensing as well as playing advisory role to MoA***.

Capacity Building For Border Management Agencies

The entry points to into the country are manned by staff from Ministry of Commerce and Industry (MoCI), Liberia Revenue Authority (LRA), security agencies (Liberia National Police-NLP and Armed Forces of Liberia-AFL) and Immigrations Department. By nature of their work, it is suggested that, the staff manning border points be trained in basic aspects of handling and characterizing agro-inputs and general phytosanitary management measures for their effectiveness in handling agro-input related issues.

Extension Agents And County Technical Staff

In this category, the target groups will include; Assistant Agricultural Field Extension Officers, County Environment Officers (CEOs) and community mobilizers. 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. This is because, they are well placed to advise farmers on all aspects of agricultural production, including pest management as well as environmental protection. This category will be trained in integrated pest management and safer pesticide use who will in turn train the farmers and those directly below them.

Some of the training aspects could include:

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.

Training Of Farmers

Farmers being the end users of agro-inputs will need to be trained more on aspects relating to transportation, storage, use and disposal of used and obsolete inputs. The course is more suited to be delivered closer to the farms to allow for hands on aspects too. The training should include aspects of safe application of agro-pesticides.

Capacity Of NAIDAL And Training of Pesticide Dealers

This is to be approached through a double approach:

Capacity of NAIDAL

Discussions with NAIDAL revealed that, the Association envisages a scenario where it is able to make as a pre-condition that: any agro-dealer before registration of his/her business, a dealer must attend, pass examination and obtain a certificate on safe use and handling of pesticide. The training could be offered by CARI or University of Liberia, College of Agriculture and Forestry, and NAIDAL could be responsible to see members attend the training. ***This could be the direction of RETRAP towards supporting streamlining of agro-chemicals trade in the country.***

Capacity Of Pesticides Dealers

In this category, the target group will mainly be businesspersons mainly dealing in agro-inputs and whose interest will not be on theoretical aspects of agro-inputs but, will require to be introduced to the practical aspects of pesticide management. Therefore, the focus of their training will be on the types of pesticides, pesticide formulations, toxicity classification, importance of pesticide labels, concentration mixing, fate of pesticides in the environment, safer use of pesticides (including selection, handling, application, storage, and protective clothing).

8.17 GRIEVANCE REDRESS MECHANISM

The Grievance Redress Mechanism (GRM) will provide a way to provide an effective avenue for expressing concerns and achieving remedies for communities. The goal is to promote a mutually constructive relationship and enhance the achievement of project development objectives. The GRM is to ensure that complaints are directed and expeditiously addressed by the relevant agencies which is to enhance responsiveness and accountability. While a project-specific feedback and complaints

mechanism is set up, the RETRAP will incorporate the existing grievance mechanism that uses the chiefdom-based approach in areas of the project.

Likely common grievances related to IPMP can include abuse or improper use of pesticides, failure by employers to provide PPEs to workers engaged in the use and handling of agro-chemicals and improper disposal of used agro-chemicals or their containers.

At project level, each Implementing Partner is expected as an operational institution to have in place, its mechanisms of handling feedback and complaints which the RETRAP will essentially build on. Such a mechanism will be checked to ascertain its effectiveness, accessible and transparent procedures to receive and resolve complaints and where need be and for purposes of delivering this project, it shall then be reviewed and modified accordingly.

Feedback/ complaints shall be encouraged among all workers and community members throughout the project and resolved without undue delay. This will also be closely monitored and reported. It is important that, concerns are raised on project level before they are brought to the PCU level.

Local grievance redress committees (LGRC) will be initiated at the village level to record grievances and also help in mediation. This committee will comprise the area local chief or a trusted village elder, a religious representative, and specific vulnerable group representatives of relevance to the village i.e. women and the disabled. Disputes will be resolved at the village level as far as possible. The GRC at the district and county levels will be resolved under a County/District GRM constituted by the Project. At the County Level, the Grievance Redress Committee will be established to deal with any grievances unsettled at the village level. More serious grievances must immediately be referred to the police. It is important to note that, not all conflicts and grievances in the project are to be concluded under RETRAP GRM. More serious cases that involve assault, gender-based violence, rape and "serious" theft will not be resolved under this framework but are instead referred to the police for appropriate prosecution process.

8.17 Capacity Needs

Capacity to inform: Types and number of participatory learning modules (PLM) delivered; category and number of extension agents and farmers trained and reached with each PLM; category and number of participants reached beyond baseline figures; practical skills/techniques most frequently demanded by extension agents and farmers; and crop/livestock management practices preferred by farmers.

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 PMP 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.

8.18 Estimated Costs For Pest Estimated Costs For PMP

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 and therefore, the cost of training for the managing impacts has been provided for Table below.

8.19 Budget

Table below provides an indicative budget for implementation of the PMP.

Nº.	**Item/Activity**	
A.	**Capacity Building and Awareness**	**Total (USD.)**
i.	Training farmer groups in the project areas on agro-pesticides	82,000.00
ii.	Refresher training for Technical County Staff on agro-pesticides and WB Environmental and Social Framework (CEOs, CAO, Extension Staff, Staff of PIU)	10,000.00
iv.	Construction of agro-chemicals storage facilities in the Farmer Groups areas	35,000.00
v.	Acquisition of chemical neutralizers and First Aid Kits for management of risks of agro-chemicals poisonings to be supplied to the farmers groups	13,000.00
GRAND TOTAL		**140,000**

CONCLUSION

a. Overall, the farmers in Liberia are well aware of the gravity of pests and diseases on their crops. However, they have huge problems in terms of accessing reliable and effective agrochemicals from the market. The agro-chemicals supply chain is largely unregulated as such, importers do not adhere to any standards, labels and expiry dates on agro-inputs are freely altered, adulteration of the products amongst a host of vices in the trade. All these have compromised the usage and effectiveness of the products leaving the farmers grappling with pests and diseases on their crops and they resort to ad hoc methods of controlling pests.
b. In view of the above (a), the study notes that, the key limitation affecting effective regulation of agro-inputs is largely institutional. The country needs an institution with a mandate to directly and autonomously play oversight role on the importation, licensing, and regulating entry and

usage of agro-inputs in Liberia. To this effect, it is urgent that, the Draft Liberia Plant Protection Regulatory Services Bureau Act is finalized paving way for the establishment of a Semi-Autonomous Liberia Plant Protection and Regulatory Services Bureau (PPRSB) whose mandate will be management of agro-pesticides in the country. This is very urgent in view of challenges at hand with agro-pesticides and could be considered for support in the RETRAP.

c. No doubts, from the grappling of the farmers to control diseases and pests on their crops, some of their practices merit further scientific enquiry and could lead to potentially effective remedies to address the pest and diseases problems on crops in the country. For instance, Neem tree extracts are applied across various stages of the crops right from nursery bed preparation to post harvest handling with promising results. It is here suggested that, some scientific studies could be undertaken on some of the natural products used by the farmers to control pests and diseases preferably at post-graduate levels with resources and support from RETRAP.

8 ANNEXES

8.1 ANNEX 2: LIST OF BANNED PESTICIDES[8]

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

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

8.2 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 –	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
	Methyl 16. Phosphamidon 17. Methidathion		

8.3 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)

8.4 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; and
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 absorbed 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.

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 5-6 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 is 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.

Agricultural chemical records: A person who uses an agricultural chemical product must ensure that their chemical use is recorded. The following records must be made within 48 hours of using an agricultural chemical product and kept for a period of two years from the date of use:

a. Date the product was used;
b. Application rate of the product or sufficient information to allow it to be calculated;
c. Crop/commodity that was treated or the situation in which the product was applied;
d. Specific location at which the product was used;
e. Wind speed and direction at the time of application (if spraying outdoors);
f. Name and contact details of the applicator;
g. Name and contact details of the supervisor (if applicable); and
h. Name and contact details of the person for whom the application was carried out (if applicable).

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.

8.5 Annex 6: WHO Pesticides Classification[13]

Pesticides product	Active ingredient	Chemical class	Toxicological class	Main use
BASUDIN	Diazinon	Organophosphate	11	Insecticide
HERBOXONE	2,4-D	Chlorophenoxy-acid	11	Herbicide
TOPIK	ClodinafopPropargyl	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	Tribenulonmethyl	Sulfonylureas	U	Herbicide

8.5 ANNEX 7: WHO PESTICIDES CLASSIFICATION[14]

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	**10.2.3** in international trade, clearly show appropriate WHO hazard classification of the contents (11) or, if this is inappropriate or

[13] *PMP WAATP MoA 2018*
[14] *Ibid*

show the appropriate WHO hazard classification of the contents (3,35,36);	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,	- *new paragraph in revised Code* -
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.	
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* -