PEST MANAGEMENT PLAN THE SIERRA LEONE RICE SPECIAL AGRO-PROCESSING ZONE (SAPZ) PROJECT

The Ministry of Agriculture & Food Security

July 2025

CONTENTS

Tables

Figures

Abbreviations

Abbreviation	Full Term
AC	Aggregation Centre
AfDB	African Development Bank
AIH	Agro-Industrial Hub
ATC	Agricultural Transformation Centre
CPU	Crop Protection Unit
DAOs	District Agricultural Offices
EPA-SL	Environment Protection Agency – Sierra Leone
FBOs	Farmer-Based Organizations
FAO	Food and Agriculture Organization
FFS	Farmer Field School
FPIC	Free, Prior, and Informed Consent
GoSL	Government of Sierra Leone
GRM	Grievance Redress Mechanism
HHPs	Highly Hazardous Pesticides
IA	Class Ia (WHO Pesticide Hazard Classification – Extremely Hazardous)
Ib	Class Ib (WHO Pesticide Hazard Classification – Highly Hazardous)
IMMP	Integrated Pest Management Measures
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
ISS	Integrated Safeguards System (AfDB)
MAFS	Ministry of Agriculture and Food Security
MoHS	Ministry of Health and Sanitation
MoTI	Ministry of Trade and Industry
MSDS	Material Safety Data Sheet
NGO	Non-Governmental Organization
OS	Operational Safeguard
PIU	Project Implementation Unit
PMP	Pest Management Plan
PPE	Personal Protective Equipment
R&D	Research and Development
RYMV	Rice Yellow Mottle Virus
SAPZ	Special Agro-Processing Zone
SLSB	Sierra Leone Standards Bureau

SLARI	Sierra Leone Agricultural Research Institute
ToT	Training of Trainers
UNEP	United Nations Environment Programme
WHO	World Health Organization

EXECUTIVE SUMMARY

A. INTRODUCTION

The Government of Sierra Leone (GoSL), through the Ministry of Agriculture and Food Security (MAFS), is implementing the Sierra Leone Special Agro-Processing Zone (SAPZ) Project with financing and technical support from the African Development Bank (AfDB). The SAPZ aims to transform the rice sector through enhanced production, value addition, and rural livelihood improvements in Kambia and Port Loko Districts. Given the potential scale-up of agrochemical use, a Pest Management Plan (PMP) has been prepared in compliance with AfDB Operational Safeguard 4. It addresses the environmental, health, and social risks associated with pest control under the SAPZ Project.

The PMP promotes Integrated Pest Management (IPM) as a sustainable solution to pest issues while minimizing chemical reliance. Improper pesticide use can lead to water pollution, biodiversity loss, resistance build-up, and severe health consequences. The PMP outlines practical steps to guide safe pesticide use, build stakeholder capacity, and establish monitoring systems to ensure project alignment with national and international safeguards.

B. PROJECT DESCRIPTION

The SAPZ Project will be implemented across approximately 100,000 hectares in Samu and Mambolo Chiefdoms (Kambia) and Loko Massama and Bureh Chiefdoms (Port Loko).

The project includes:

- Deployment of climate-resilient seeds, fertilizers, and irrigation systems to help farmers improve rice yields;
- Construction of Agricultural Transformation Centres (ATCs) and Aggregation Centres (ACs); Development of a centralized Agro-Industrial Hub (AIH) for large-scale rice processing and marketing.

PMP Interventions will include:

- Farmer training in biological, mechanical, and cultural pest management;
- Promotion of environmentally benign alternatives and safer pesticide handling;
- Establishment of monitoring and evaluation systems for pesticide use and pest resistance;
- Coordination with institutions for training, monitoring, and enforcement.

C. CURRENT APPROACHES TO PEST MANAGEMENT

Rice farmers in the SAPZ project area employ a mix of cultural, chemical, and traditional methods for pest control. While hand-weeding, crop rotation, and field burning are still used, there is increasing, often unregulated, reliance on synthetic pesticides such as cypermethrin and glyphosate. Extension support is limited, and most farmers lack protective gear or access to information on safe use practises.

The Ministry of Agriculture and Forestry through its Crop Protection Unit is responsible for pest surveillance, farmers training and promotion of Integrated Pest management. The importation of chemicals should be controlled via import licenses issued by the Environment Protection Agency in

collaboration with the Ministry of Agriculture. The use of agrochemicals including pesticides is guided by the Environmental Impact Assessments and the terms and conditions of environmental permits of formal agricultural companies. However, there is widespread bypassing of the licensing requirements for the import of these chemicals and most agrochemicals available on the market are imported illegally according to the EPA-SL.

IPM pilot programs in Bombali and Bo Districts have demonstrated success in reducing pesticide use by 40% and improving yield and food safety. However, uptake of IPM in SAPZ target areas remains constrained by weak outreach, limited demonstration sites, and low farmer awareness.

D. Pesticide Use Issues and Risks

The current pesticide management system in Sierra Leone suffers from:

- Widespread use of unregistered, expired, or hazardous chemicals;
- Poor pesticide handling and limited protective equipment use;
- Unsafe storage and disposal of agrochemical containers;
- Weak regulatory enforcement and control;
- Informal and illicit market;
- Inadequate awareness of pesticide safety among farmers and dealers.

Documented incidents, such as the fatal parathion poisoning in 1986, highlight the serious health risks. Environmental risks include groundwater contamination, degradation of aquatic ecosystems, and harm to pollinators. The regulatory framework is fragmented, and enforcement capacity is low.

E. Policy, Legal and Institutional Framework

The PMP primarily aligns with Sierra Leone's National Integrated Pesticide Management Policy (2016), Environment Protection Agency Act (2022), the Standards Act (1996) and the African Development Bank Integrated Safeguards Standard 3 (: Resource Efficiency and Pollution Prevention and Management).

Institutional actors include:

- Ministry of Agriculture and Food Security / Crop Protection Unit for pest surveillance and farmer training;
- Sierra Leone Environment Protection Agency for agrochemical licensing and environmental enforcement;
- The Sierra Leone Standards Bureau for pesticide standards and product certification.

Despite strong mandates, capacity gaps exist in staffing, laboratory infrastructure, and coordination. IPM is referenced in policy but under-implemented due to funding and training shortfalls.

F. Integrated Pest Management Measures (IPMM)

The PMP outlines targeted interventions:

1. Capacity Building for 3,000+ Farmers and Extension Agents

The PMP includes comprehensive training programs targeting over 3,000 farmers, extension workers, agro-dealers, and local agricultural officers. Activities include:

- Orientation workshops at district level;
- Training of Trainers (ToT) for MAFS Crop Protection Unit (CPU), Extension Services, and District Agricultural Officers (DAOs);
- Farmer Field Schools (FFS) and group training on Integrated Pest Management (IPM), pesticide safety, and non-chemical control strategies;
- Awareness campaigns using visual aids, handbooks, and community radio.

2. Safe Pesticide Handling and Protective Equipment Provision

- Training modules focus on safe pesticide use, personal protective equipment (PPE) usage, and emergency response procedures.
- Farmers and agro-dealers will receive instruction on proper mixing, application, storage, and disposal of pesticides.
- The project budget includes procurement of certified spraying equipment (e.g., knapsack sprayers, mist blowers), though PPE provision will be partly facilitated through agro-dealer training and public awareness.

3. Monitoring of Pesticide Use and Residues

The PMP establishes a monitoring framework to:

- Track pesticide usage patterns;
- Monitor IPM adoption rates and pest outbreaks;
- Conduct residue sampling in soil and water near treatment areas (with support from research partners such as Njala University and SLARI);
- Use structured tools like farmer surveys, pesticide audits, and environmental sampling to generate data;

Responsibilities for monitoring are assigned to MAFS/CPU, EPA-SL, DAOs, and the PIU.

4. Grievance Mechanism for Pesticide-Related Issues

- A tiered Grievance Redress Mechanism (GRM) is established to handle complaints related to pesticide use, exposure, or environmental damage.
- Grievances can be submitted in-person, in writing, or digitally via SMS/WhatsApp, extension officers, or local grievance boxes.
- Community-level GRM committees will address local concerns; unresolved cases escalate to District and then National GRM Committees (involving PIU, EPA-SL, and MAFS).
- Regular reporting and feedback loops are integrated into the GRM process.

5. Prioritization of Non-Chemical Methods of Pest Control

The PMP strongly emphasizes Integrated Pest Management (IPM) with chemical pesticides treated as a last resort. Priority is given to:

- Cultural methods (e.g., synchronized planting, crop rotation, field sanitation);
- Mechanical measures (e.g., handpicking, traps, fencing);
- Biological control (e.g., natural predators, neem-based and microbial biopesticides like *Bt*, *Trichoderma*, *Beauveria*);
- Pest scouting and threshold-based decisions before applying chemicals.

WHO Class Ia and Ib pesticides are discouraged unless under strict emergency protocols.

6. Stakeholder Consultations and Involvement

The PMP was informed by field consultations and aligns with national policies developed in collaboration with key stakeholders. Implementation will involve:

- Farmers and Farmer-Based Organizations (FBOs) in training, monitoring, and early warning systems;
- Agro-dealers and NGOs in outreach and input quality control;
- SLARI, Njala University, and district councils in training and awareness-raising efforts.

Ongoing stakeholder engagement is planned through quarterly coordination meetings, annual review workshops, and inclusive feedback mechanisms.

7. Institutional Arrangements for Monitoring the PMP

The following institutions have clearly defined roles:

- MAFS/CPU – lead technical implementation, pest surveillance, IPM training;
- EPA-SL – regulate pesticide import, licensing, storage, and environmental monitoring;
- SLSB – enforce standards and pesticide quality;
- DAOs – deliver training, support field-level M&E;
- PIU – overall coordination and reporting to AfDB;

A multi-tiered coordination mechanism (national, district, community) ensures aligned monitoring and decision-making.

8. Cost Estimates

The total estimated cost for PMP implementation is **US$127,000**, broken down as follows:

Budget Category	Description	Estimated Cost (US$)
A. Capacity Building and Awareness	Orientation, ToT, farmer training, distributor training, field visits, materials, research, inventory	$120,000
-IPMP Orientation Workshops	Sessions across SAPZ project regions	$15,000
- Training of Trainers (ToT)	For MAFS Crop Protection and Extension staff	$10,000
- Farmer Group Training	Pesticide safety and IPM practices	$25,000
- Training on Use and Storage of Pesticides	Demonstrations and safe storage training	$20,000
- Training of Pesticide Distributors	Registration and awareness	$10,000
- Follow-up Field Visits	On-site IPM adoption checks	$5,000
- IPMP Field Materials	Handbooks, posters, and visual tools	$10,000

- Support to IPMP Research and Development	Sample analysis and exposure validation	$5,000
- Pesticide Inventory	National and district-level inventory database	$20,000
B. Equipment and Materials	Certified spraying equipment	$7,000
- Procurement of Certified Spraying Equipment	Knapsack, backpack sprayers, mist blowers	$7,000
Total Estimated Budget		$127,000

G Stakeholder Consultations

The Pest Management Plan was developed through an inclusive process involving key institutions such as MAFS, EPA-SL, SLSB, agro-dealers, farmers, and civil society. Consultations were held in Port Loko and Kambia Districts, alongside national validation workshops. Key concerns included pesticide safety, counterfeit products, training needs, and interest in non-chemical alternatives. The PMP reflects these priorities by promoting Integrated Pest Management (IPM), safer pesticide use, and continued community engagement throughout implementation.

H. Conclusion

This PMP is a strategic safeguard tool designed to ensure that SAPZ agricultural transformation is achieved without compromising health, environmental sustainability, or social equity. By prioritizing IPM, building institutional capacity, and promoting safer alternatives, the SAPZ Project can protect both people and ecosystems while delivering on its food security and rural development goals.

1 INTRODUCTION

1.1 PROJECT BACKGROUND & CONTEXT

The Government of Sierra Leone (GoSL), through the Ministry of Agriculture and Food Security (MAFS), is implementing the Sierra Leone Special Agro-Processing Zone (SAPZ) Project with financial and technical support from the African Development Bank (AfDB). The SAPZ initiative is designed to catalyse inclusive agricultural transformation by boosting rice production, strengthening value addition through agro-industrial infrastructure, and improving rural livelihoods in two priority districts: Port Loko and Kambia.

The development objective of the project is to contribute to inclusive and sustainable agro-industrial development in Sierra Leone by reducing rice imports, creating employment, and alleviating poverty. This objective will be achieved by enhancing the enabling environment for a private sector-led, government-enabled rice value chain—anchored on improved production and productivity, modern processing technologies, and the marketing of import-grade milled rice to drive domestic rice self-sufficiency.

As a flagship intervention under the national Feed Salone Strategy (2023), the SAPZ Project is structured around four components:

1. Enhancement of agricultural productivity and production systems, including the provision of improved climate-resilient rice varieties, mechanization services, irrigation infrastructure, and land development.
2. Development of Agro-Industrial Hubs (AIHs), Agricultural Transformation Centres (ATCs), and Aggregation Centres (ACs) to support post-harvest handling, primary processing, storage, and market integration.
3. Market development and institutional capacity building across the rice value chain, with a specific focus on empowering youth, women, and farmer-based organizations.
4. Project coordination and management, ensuring effective planning, implementation, monitoring, and stakeholder engagement.

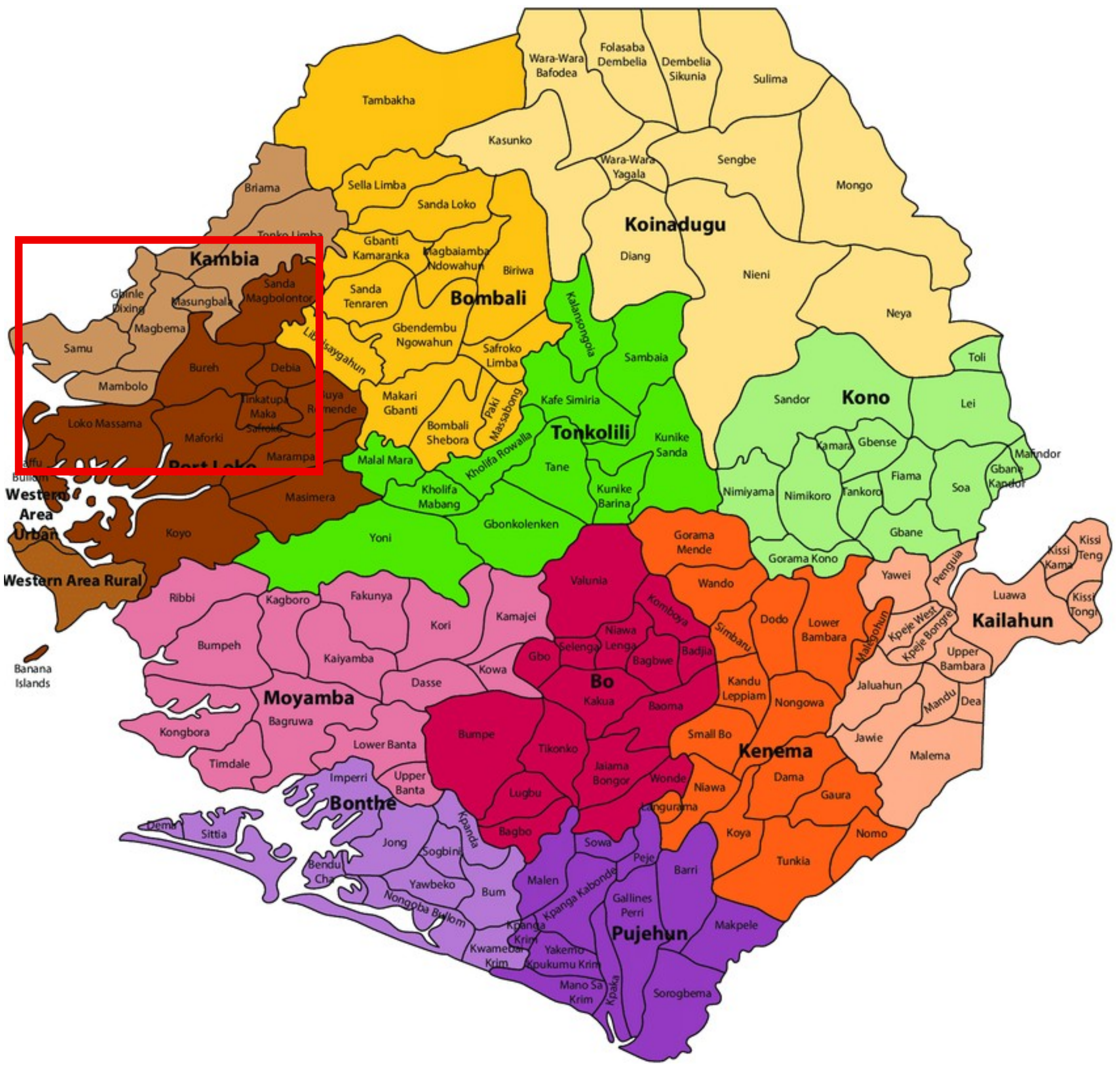
The intensification of rice cultivation and expansion of agro-processing facilities under the SAPZ may necessitate the use of chemical pesticides, fertilizers, and other crop protection inputs. While these inputs can be essential for boosting yields and controlling pest infestations, their improper use poses significant environmental, public health, and social risks. These risks are particularly relevant in the context of climate change vulnerability, limited regulatory enforcement, and low farmer awareness of pesticide safety. A dedicated Pest Management Plan (PMP) is therefore required to guide safe and sustainable pest control under the project.

1.1.1 Project Footprint

The SAPZ Project will be implemented in both Kambia and Port Loko Districts, supporting farmers in the development of up to 100,000 hectares of climate-resilient rice production across four chiefdoms: Samu and Mambolo in Kambia District, and Loko Massama and Bureh in Port Loko District.

The project will establish Agricultural Transformation Centres (ATCs) and Aggregation Centres (ACs) in both districts to support the collection, storage, and primary processing of paddy rice. These facilities will also serve as input distribution hubs, providing farmers with access to quality seeds, fertilizers, agrochemicals, and mechanization services. Paddy collected at these centres will be transported to a centrally located Agro-Industrial Hub (AIH) in Mambolo, Kambia District, where industrial-scale processing and value addition will take place.

The Agro-Industrial Hub will feature modern rice milling infrastructure capable of producing milled white rice, broken rice, and by-products such as rice bran and husks. It will also include supporting infrastructure such as drying yards, storage warehouses, quality control laboratories, packaging units, and administrative facilities. The AIH will play a central role in ensuring efficient post-harvest handling, reducing losses, and improving the market competitiveness of locally produced rice. It is expected to significantly boost rural employment and contribute to national food security objectives..


Kambia
Port Loko
Bombali
Koinadugu
Tonkolili
Kono
Kailahun
Kenema
Bo
Moyamba
Bonthe
Pujehun
Western Area Urban
Western Area Rural
Banana Islands
Tambakha
Wara-Wara Bafodea
Folasaba Dembelia
Dembelia Sikunia
Sulima
Kasunko
Wara-Wara Yagala
Sengbe
Mongo
Briama
Sella Limba
Sanda Loko
Gbanti Kamaranka
Magbaiamba Ndowahun
Biriwa
Diang
Nieni
Masungbala
Sanda Magbolontor
Sanda Tenraren
Samu
Magbema
Gbendembu Ngowahun
Neya
Safroko Limba
Sambaia
Toli
Bureh
Debia
Mambolo
Makari Gbanti
Kafe Simiria
Sandor
Lei
Loko Massama
Maforki
Bombali Shebora
Kunike Sanda
Gbense
Kamara
Marampa
Malal Mara
Tane
Fiama
Soa
Nimiyama
Nimikoro
Tankoro
Kholifa Mabang
Kunike Barina
Masimera
Gbane
Koyo
Yoni
Gbonkolenken
Gorama Mende
Gorama Kono
Valunia
Wando
Yawei
Luawa
Ribbi
Kagboro
Fakunya
Kori
Kamajei
Dodo
Lower Bambara
Bumpeh
Kaiyamba
Gbo
Badjia
Bagbwe
Upper Bambara
Kowa
Dasse
Kandu Leppiam
Nongowa
Jaluahun
Kakua
Baoma
Kongbora
Bagruwa
Bumpe
Small Bo
Jawie
Lower Banta
Tikonko
Timdale
Dama
Malema
Imperri
Upper Banta
Jaiama Bongor
Wonde
Niawa
Gaura
Lugbu
Sittia
Bagbo
Sowa
Koya
Nomo
Jong
Sogbini
Peje
Barri
Tunkia
Malen
Yawbeko
Bum
Gallines Perri
Makpele
Sorogbema

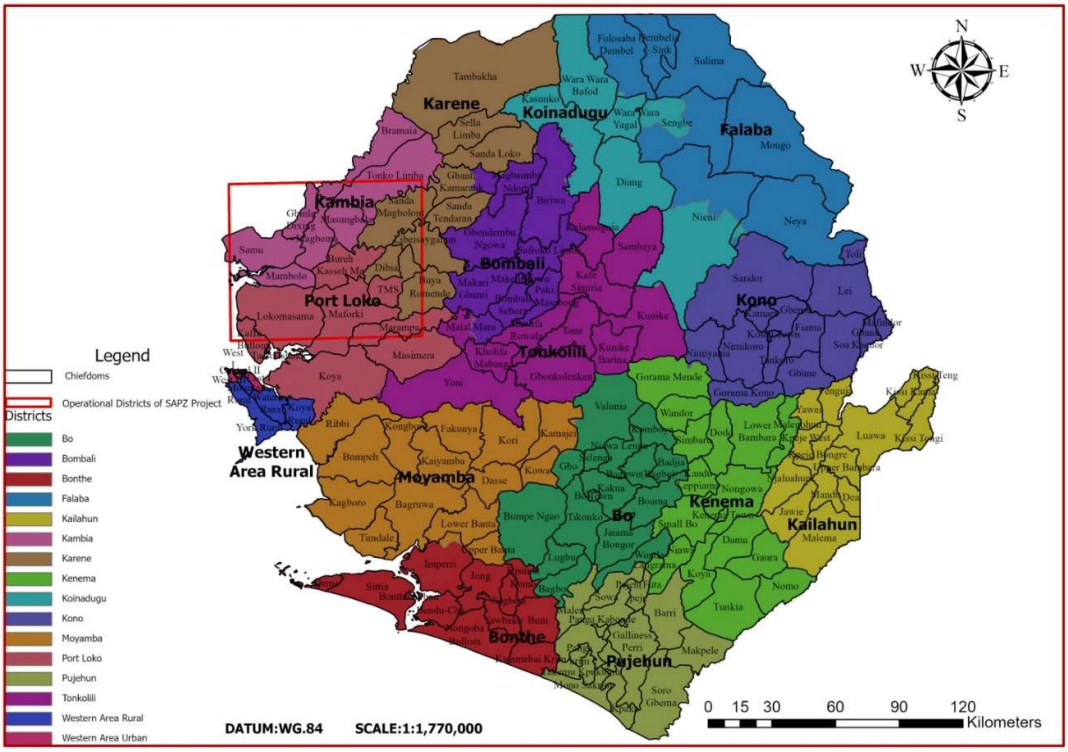


Figure 1: Map of Sierra Leone showing operational Districts of SAPZ Project

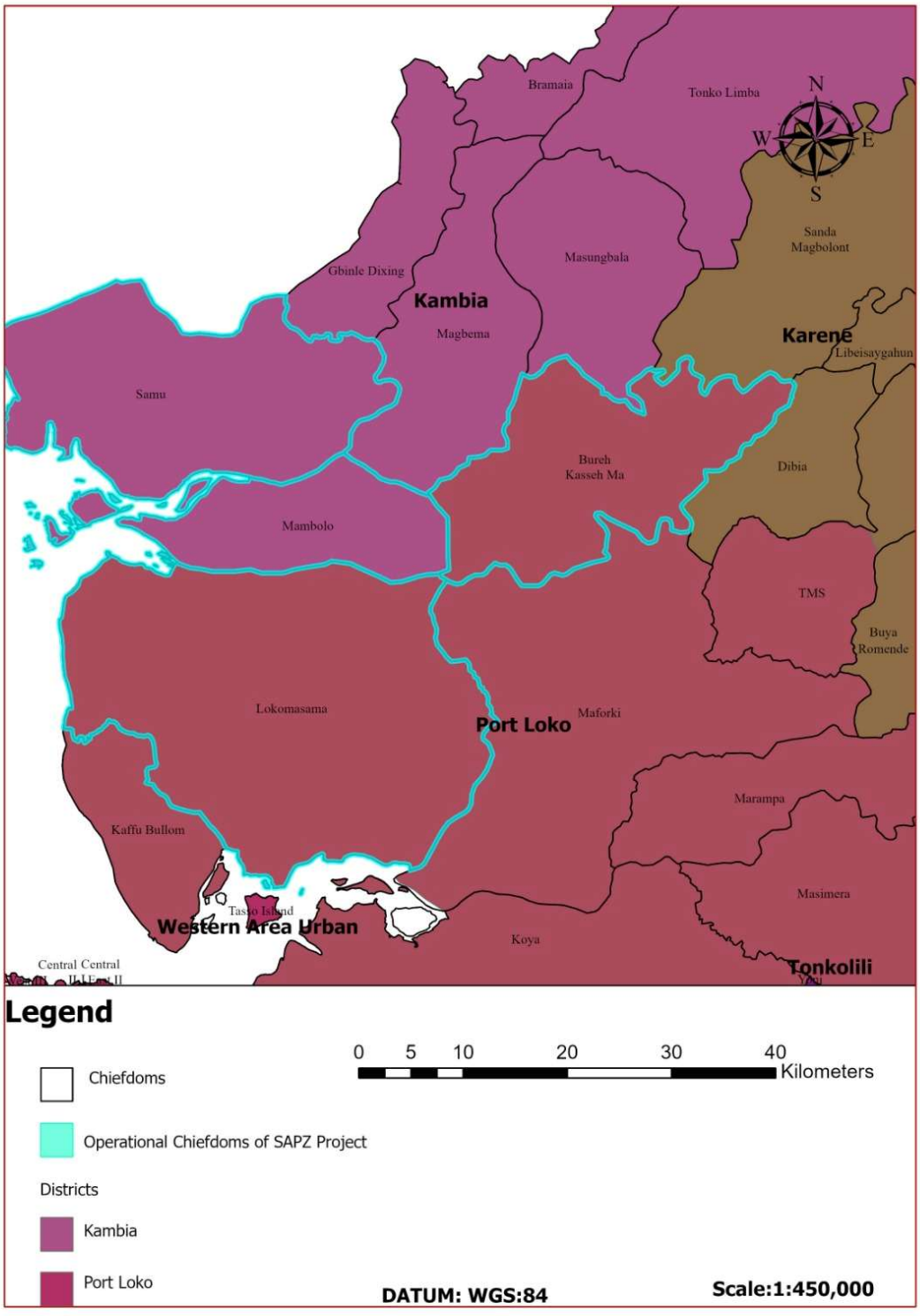


Figure 2: Project Chiefdoms- Loko Massama & Bureh (Port Loko District); Mambolo & Samu (Kambia District)

1.2 JUSTIFICATION FOR THE PEST MANAGEMENT PLAN

The implementation of the Sierra Leone Special Agro-Processing Zone (SAPZ) Project involves significant investments in rice production intensification, agro-processing, and infrastructure development. As the project scales up rice cultivation across 100,000 hectares and introduces centralized agro-industrial operations, the potential for increased pest and disease pressure is substantial. This, in turn, is likely to drive greater reliance on chemical pesticides and other crop protection products to safeguard yields and ensure the quality of rice destined for national markets if [1]Integrated Pest Management Principles are not applied.

Without a structured approach, the increased use of agrochemicals poses several environmental and social risks, including:

- Contamination of surface and groundwater resources;
- Adverse impacts on non-target organisms, including pollinators and aquatic life;
- Pesticide resistance due to misuse or overuse;
- Human health hazards for farmers, workers, and communities;
- Poor disposal of pesticide containers and residues.

Furthermore, the pesticide distribution and use landscape in Sierra Leone is marked by weak regulatory enforcement, low public awareness, poor storage and handling practices, and widespread informal sales of unregistered and hazardous products. These factors increase the likelihood of exposure to highly hazardous pesticides (HHPs) and persistent environmental pollutants, particularly among vulnerable groups such as women, children, and smallholder farmers.

To mitigate these risks, and in accordance with the African Development Bank's Integrated Safeguards System (ISS, 2023), specifically Operational Safeguard 4 (Pollution Prevention and Control, Hazardous Materials, and Resource Efficiency), the preparation of a Pest Management Plan (PMP) is required. The PMP provides the necessary framework to ensure that pest control under the SAPZ Project is guided by:

- The principles of Integrated Pest Management (IPM), which emphasize prevention, ecological balance, and minimal pesticide use;
- Compliance with national legislation and international best practices governing pesticide registration, use, storage, transport, and disposal;
- Capacity building for key stakeholders—including farmers, extension officers, agro-dealers, and processors in safe handling and alternative pest control techniques;
- A clear monitoring, reporting, and grievance resolution mechanism for pesticide-related incidents.

The PMP also supports the long-term sustainability of the SAPZ by reducing reliance on chemical inputs, promoting agro-ecological resilience, and protecting the health of both people and ecosystems. It will be implemented in close coordination with national institutions such as the MAFS

[1] Integrated Pest Management (IPM) uses a combination of methods to control pests, emphasizing prevention and minimizing pesticide use. It involves identifying pests, monitoring their populations, and implementing appropriate control strategies, including biological, cultural, and mechanical methods, to maintain pest populations below economic injury levels.

Crop Protection Unit, the Environment Protection Agency (EPA-SL), the Sierra Leone Agricultural Research Institute (SLARI), and other partners involved in agricultural regulation and public health.

Ultimately, the PMP is an essential safeguard tool to ensure that the benefits of the SAPZ, higher rice yields, job creation, rural development, and import substitution are achieved without compromising environmental sustainability, human health, or social equity.

1.3 Objectives of the Pest Management Plan

The Pest Management Plan (PMP) for the Sierra Leone Special Agro-Processing Zone (SAPZ) Project provides a strategic framework for ensuring that pest and disease control measures adopted under the project are safe, effective, and environmentally sound. In line with the AfDB Operational Safeguard 4 and national regulatory requirements, the PMP seeks to reduce the environmental and health risks associated with pesticide use while promoting the adoption of Integrated Pest Management (IPM) as the primary approach to pest control in rice production.

1.3.1 General Objective

To ensure that pest and pesticide management practices under the SAPZ Project support sustainable rice production while minimizing adverse impacts on human health, biodiversity, and the environment.

1.3.2 Specific Objectives

The specific objectives of the PMP are to:

1. Identify major rice pests and diseases relevant to the agro-ecological zones and production systems in Kambia and Port Loko Districts;
2. Assess current pest management practices, including chemical, traditional, and mechanical methods used by farmers, agro-dealers, and processors;
3. Promote the adoption of Integrated Pest Management (IPM) approaches that prioritize cultural, biological, and ecological control methods over routine chemical use;
4. Provide guidance on the safe selection, handling, application, storage, and disposal of pesticides, with reference to national regulations, WHO hazard classifications, and FAO/WHO standards;
5. Strengthen the capacity of key stakeholders, including farmers, extension officers, agro-input dealers, and project implementers on pest surveillance, pesticide safety, and alternative control measures;
6. Develop a monitoring and evaluation system to track pest incidence, pesticide usage patterns, and compliance with IPM practices;
7. Ensure the availability and use of protective equipment (PPE), first aid, and emergency procedures in the handling and application of pesticides;
8. Establish a grievance redress mechanism (GRM) for pesticide-related complaints and incidents affecting farmers, workers, or nearby communities;

9. Support national institutional frameworks, including the Crop Protection Unit (CPU), Environment Protection Agency (EPA-SL), and Sierra Leone Agricultural Research Institute (SLARI), in regulating and overseeing pest management activities;
10. Encourage the phased elimination of highly hazardous pesticides (HHPs) and promote the registration and adoption of safer, environmentally benign alternatives.

By achieving these objectives, the PMP will help to ensure that pest management under the SAPZ Project enhances productivity without compromising environmental integrity, food safety, or community well-being.

1.4 SCOPE AND LIMITATIONS

1.4.1 Scope

This Pest Management Plan (PMP) has been developed specifically for the Sierra Leone Special Agro-Processing Zone (SAPZ) Project, with a primary focus on rice production activities in the Kambia and Port Loko Districts. The PMP covers pest management issues associated with the full rice value chain from pre-planting land preparation to post-harvest processing within the designated intervention areas of the project.

The scope of the PMP includes:

- Geographical Focus: Samu and Mambolo Chiefdoms (Kambia District) and Loko Massama and Bureh Chiefdoms (Port Loko District);
- Production Scope: Up to 100,000 hectares of rice cultivation under intensified, climate-resilient systems;
- Infrastructure Scope: Agricultural Transformation Centres (ATCs) and Aggregation Centres (ACs) in Kambia and Port Loko Districts, and the Agro-Industrial Hub (AIH) in Mambolo, Kambia District;
- Pest Management Coverage: Identification of major rice pests, assessment of current control measures, promotion of Integrated Pest Management (IPM), and management of pesticide use;
- Stakeholder Engagement: Inclusive of public institutions, private agro-dealers, farmers, cooperatives, civil society, and local communities;
- Environmental and Health Risk Management: Covers storage, handling, application, and disposal of pesticides, including risks to non-target organisms, water resources, and human health;
- Capacity Building and Monitoring: Institutional strengthening, training programs, monitoring indicators, and a grievance redress mechanism tailored to pest management concerns.

This PMP applies to all pest control activities directly or indirectly supported by the SAPZ Project, whether implemented by public sector partners, private enterprises, or local farming communities under the project framework.

2 Limitations

While the PMP provides a comprehensive strategy for pest and pesticide management under the SAPZ Project, its implementation may face the following constraints:

- Data Limitations: Limited availability of current and localized pest surveillance data, pesticide use patterns, and pesticide residue testing in Sierra Leone;
- Capacity Constraints: Inadequate staffing and logistical resources within national institutions (e.g., Crop Protection Unit, EPA-SL) may hinder consistent enforcement, monitoring, and training;
- Market and Supply Chain Challenges: The informal nature of agrochemical sales in Sierra Leone, limited access to quality-assured inputs, and weak regulatory oversight may undermine efforts to promote safe pesticide use;
- Behavioural Practices: Entrenched reliance on chemical control, low literacy levels among smallholder farmers, and poor adherence to protective practices may pose challenges for IPM adoption;
- **Climate Variability**: Shifting weather patterns and climate-related stressors may lead to pest dynamics that are unpredictable and difficult to manage using existing protocols.

Despite these limitations, the PMP provides a structured framework for risk mitigation, capacity building, and institutional coordination that can be strengthened over time through adaptive implementation, ongoing stakeholder engagement, and targeted technical support.

2 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

2.1 OVERVIEW

Effective pest and pesticide management under the SAPZ Project requires alignment with relevant national legislation, regional regulations, and international standards. This chapter outlines the legal instruments, policy frameworks, and institutional mandates that govern pest control and pesticide use in Sierra Leone. It also identifies key institutional roles and existing capacity gaps relevant to the implementation of this Pest Management Plan.

2.2 NATIONAL POLICY FRAMEWORK

Pesticide use and pest control in Sierra Leone are governed by a number of overarching policies that aim to safeguard public health, promote sustainable agriculture, and protect the environment. Of particular relevance to the SAPZ Project is the National Integrated Pesticides Management Policy (2016), which outlines the national vision for the sound management of pesticides across their entire lifecycle.

The policy advocates for an integrated approach to pesticide management that balances productivity goals with environmental and public health protection. Its key objectives include:

- Ensuring the safe and rational use of pesticides in agriculture, public health, and other sectors;
- Promoting Integrated Pest Management (IPM) as the preferred approach to pest control;
- Establishing institutional coordination for pesticide regulation, importation, distribution, use, and disposal;
- Strengthening pesticide monitoring, enforcement, and public education mechanisms;
- Reducing reliance on highly hazardous pesticides (HHPs) and encouraging the adoption of safer alternatives, including biopesticides and traditional methods;
- Building national capacity for pesticide residue testing, surveillance, and risk communication.

The policy mandates the involvement of multiple institutions, including the Ministry of Agriculture and Food Security (MAFS), Environment Protection Agency (EPA-SL), Ministry of Health and Sanitation (MoHS), and Sierra Leone Standards Bureau (SLSB). This is to ensure a coordinated national response to pesticide-related risks. It also promotes the development of national action plans, strengthening of legal and institutional frameworks, and improved stakeholder participation in pesticide-related decision-making.

Other relevant national policies that intersect with the PMP include:

- **National Agricultural Policy (2010)**: Supports sustainable agriculture and pest control strategies such as IPM and regulated pesticide use.
- **Feed Salone Strategy (2023)**: Encourages food self-sufficiency and promotes climate-smart agriculture, which includes responsible pest and input management.

- **National Environment Policy (1994)**: Advocates for the protection of ecosystems from hazardous substances, including agrochemicals.
- **National Health & Sanitation Policy (2021)**: Emphasizes the need to prevent health risks associated with environmental exposures, including pesticide poisoning.
- **National Climate Change Policy (2021)**: Recognizes the vulnerability of agricultural systems to climate shocks and supports adaptive, low-risk farming practices.

Together, these policies provide a strong foundation for integrated pest and pesticide management under the SAPZ Project. However, effective implementation remains dependent on inter-sectoral coordination, enforcement of pesticide regulations, and sustained investment in institutional capacity building.

2.3 NATIONAL LEGAL FRAMEWORK

Pest and pesticide management in Sierra Leone is governed by a suite of national laws that regulate the importation, distribution, application, and disposal of agrochemicals, as well as broader environmental protection measures. The key legal instruments relevant to the SAPZ Project are:

1. Environment Protection Agency Act, 2022 (Act No. 15 of 2022)

This Act establishes the Environment Protection Agency (EPA-SL) as the principal authority for environmental governance in Sierra Leone. Pertinent provisions include:

- **Import and Export Controls**: Section 42 mandates that individuals or entities wishing to import or export controlled substances or products, including agrochemicals, must obtain a permit from the EPA. The Agency is authorized to issue such permits only if satisfied that the applicant has adequate facilities and equipment to handle these substances without causing environmental harm.
- **Storage Requirements**: Section 47 stipulates that controlled substances or products must be stored in secure facilities approved by the EPA, ensuring safe handling and minimizing environmental risks.
- **Record-Keeping Obligations**: Importers and exporters are required to maintain detailed records of transactions involving controlled substances or products and make these records available to the EPA upon request.

2. Environment Protection Agency (Agricultural and Agro-Based Industrial Activities) Regulations, 2023

These regulations provide specific guidance for agricultural and agro-industrial activities, emphasizing environmental sustainability. Key provisions include:

- **Licensing Requirements**: Entities engaged in agricultural activities involving significant use of agrochemicals must obtain a license from the EPA. The application process requires prior notification to local environmental committees and may involve environmental assessments.
- **Agrochemical Management Plans**: Applicants must prepare agrochemical management plans to address issues such as fertilizer leaching, pesticide runoff, and the mitigation of environmental and health risks.

- **Applicability to Sustainable Agriculture**: The regulations apply to both conventional and sustainable agricultural practices to ensure consistent oversight.

3. Standards Act No. 2 of 1996

This Act establishes the Sierra Leone Standards Bureau (SLSB) and mandates it to develop, publish, and enforce national standards across various sectors, including agrochemicals. Key responsibilities include:

- **Standards Development**: Setting and updating standards to ensure the safety and quality of products, including pesticides and fertilizers.
- **Certification and Compliance**: Conducting inspections and product testing to verify compliance with national standards, protecting consumers and the environment.

4. Fisheries (Management and Development) Act, 1994 (as amended in 2007)

Although primarily designed to regulate fisheries, this Act includes provisions relevant to pest management where pesticide runoff affects aquatic ecosystems. Key provisions include:

- **Environmental Protection**: The Act mandates the conservation of aquatic ecosystems that could be compromised by agrochemical contamination.
- **Regulatory Oversight**: It authorizes the regulation of upstream activities, including agriculture, that may impact fishery resources through pollution.

5. Factories Act, 1974

This legislation governs occupational health and safety in industrial facilities, including those involved in the manufacturing, handling, or storage of agrochemicals. Relevant provisions include:

- **Safety Measures**: The Act requires employers to implement measures to prevent harm from hazardous substances, including appropriate handling, ventilation, and emergency preparedness.
- **Inspections and Compliance**: The Ministry of Labour is empowered to conduct inspections to ensure worker protection and compliance with safety regulations.

Other Relevant Legislation

6. Public Health Ordinance (Revised 2004)

This ordinance authorizes the Ministry of Health and Sanitation to regulate exposure to environmental pollutants and respond to public health risks, including pesticide poisoning. It also supports disease vector control and monitoring of chemical-related health impacts in agriculture.

7. Local Government Act (2004, amended 2017 and 2022)

The Act decentralizes environmental and development oversight to district councils. Local authorities play a growing role in supervising agrochemical use, public health risks, and environmental protection at the community level.

8. Customary Land Rights Act (2022)

This Act governs the acquisition, use, and governance of customary land. It ensures community landowners retain control over land-use decisions and introduces legal requirements for free, prior, and informed consent (FPIC), especially for agricultural and chemical-use projects on community land.

2.4 Regional and International Agreements

Sierra Leone is a signatory to several international and regional agreements that establish standards, obligations, and best practices for the management of pesticides, hazardous chemicals, and pest control activities. These frameworks complement national legislation and guide the SAPZ Project in aligning with globally accepted environmental and health safeguards.

1. Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (2004)

This Convention promotes shared responsibility and cooperation among countries in the international trade of hazardous chemicals. It requires exporting countries to obtain **prior informed consent** from importing countries before exporting listed pesticides and chemicals. The Convention supports informed decision-making on pesticide use and import controls.

2. Stockholm Convention on Persistent Organic Pollutants (2001)

This Convention aims to eliminate or restrict the production and use of persistent organic pollutants (POPs), including several older-generation pesticides (e.g., DDT, Aldrin, Chlordane). It obliges parties to phase out hazardous substances and adopt safer alternatives. This is particularly relevant to controlling pesticide residues in the environment and food systems.

3. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989)

The Basel Convention regulates the movement and disposal of hazardous waste, including obsolete pesticides and contaminated containers. It promotes environmentally sound waste management practices and prohibits the export of hazardous waste to countries lacking the capacity to manage them safely.

4. Bamako Convention on the Ban of the Import into Africa of Hazardous Wastes (1991)

As a regional counterpart to the Basel Convention, the Bamako Convention prohibits the import of hazardous waste into African countries, including pesticide waste. It reinforces Sierra Leone's commitment to regional standards for environmental protection and public health.

5. ECOWAS Regulation on Pesticide Registration and Use (C/REG.3/05/2008)

The Economic Community of West African States (ECOWAS) adopted a harmonized framework for pesticide registration across member states. This regulation ensures that only regionally approved and registered pesticides are marketed, improving safety, traceability, and consistency in pesticide use throughout West Africa.

6. FAO/WHO International Code of Conduct on Pesticide Management (2020)

This voluntary code sets the global standard for pesticide lifecycle management, including the manufacture, labelling, distribution, use, and disposal of pesticides. It promotes:

- Use of safer alternatives and biopesticides;
- Training for safe application and handling;
- Regulation of highly hazardous pesticides (HHPs);
- Public access to pesticide information and safety data.

7. Codex Alimentarius – Maximum Residue Limits (MRLs)

Developed by the FAO/WHO Codex Alimentarius Commission, MRLs define safe levels of pesticide residues in food and animal feed. Although not legally binding, Codex standards inform national food safety policies and help protect consumer health.

8. International Plant Protection Convention (IPPC)

This Convention promotes the development of plant health standards and encourages countries to adopt integrated, non-chemical pest management strategies. It supports the use of IPM and quarantine controls to prevent the introduction and spread of pests.

2.5 AFRICAN DEVELOPMENT BANK INTEGRATED SAFEGUARDS SYSTEM (ISS 2023)

The African Development Bank's Integrated Safeguards System (ISS 2023) is the core environmental and social risk management framework that applies to all Bank-financed projects, including the SAPZ Project in Sierra Leone. The updated ISS became effective on May 31, 2024, replacing the 2013 version.

2.5.1 Relevance of the ISS 2023 to the Pest Management Plan (PMP)

Pest and pesticide management activities under the SAPZ Project fall within the scope of several core safeguards outlined in the ISS 2023. The most directly relevant are Operational Safeguards 3 & 4, but additional safeguards also reinforce the environmental, health, and stakeholder obligations of the PMP.

2.5.1.1 Operational Safeguard 3 (: Resource Efficiency and Pollution Prevention and Management)

This safeguard directly addresses the need for careful management of hazardous materials, including agrochemicals and pesticides. It requires the borrower to:

- Avoid or minimize the use of highly hazardous pesticides (HHPs);
- Promote integrated pest management (IPM) as the preferred pest control method;
- Ensure safe procurement, handling, storage, application, and disposal of pesticides;
- Comply with international codes of conduct such as the FAO/WHO International Code on Pesticide Management;
- Conduct a risk assessment and implement appropriate mitigation measures related to agrochemical use;
- Establish training, monitoring, and reporting systems for pesticide-related activities.

These requirements form the foundation of this PMP and guide all technical, institutional, and capacity-building measures to be undertaken across the project's lifecycle.

2.5.1.2 Operational Safeguard 4 (OS4): Community Health, Safety and Security

This safeguard focuses on preventing and mitigating risks to the health, safety, and security of communities arising from project activities. It is directly relevant to pest and pesticide management due to potential risks from agrochemical exposure. It requires the borrower to:

- Identify and manage risks related to the use, storage, and disposal of hazardous materials such as pesticides;
- Promote community awareness and preparedness on health and safety risks associated with pesticide use;
- Coordinate with health authorities to support response to incidents of pesticide exposure or poisoning;
- Protect vulnerable groups such as women, children, and persons with disabilities from disproportionate harm.

These requirements are addressed in the PMP through measures such as public sensitization, training on pesticide safety, the promotion of protective equipment, and the establishment of a grievance redress mechanism for pesticide-related complaints. These actions are designed to enhance community resilience and health safeguards throughout the project lifecycle.

2.5.1.3 Operational Safeguard 1 (Assessment and Management of Environmental and Social Risks and Impacts)

This safeguard ensures that projects identify, assess, and manage environmental and social risks throughout the design and implementation phases. It reinforces the need to integrate pest management concerns into project-level Environmental and Social Impact Assessments (ESIAs) and Environmental and Social Management Plans (ESMPs).

2.5.1.4 Operational Safeguard 2 (Labour and Working Conditions)

This safeguard reinforces the need to protect workers, particularly pesticide applicators and agricultural labourers from exposure to hazardous substances. It supports the provision of personal protective equipment (PPE), first aid training, and compliance with safe handling protocols.

2.5.1.5 Operational Safeguard 7 (Vulnerable Groups)

Recognizes the need to safeguard groups who may be disproportionately affected by pesticide exposure, including women, children, the elderly, and persons with disabilities. It aligns with this PMP's emphasis on inclusive training and risk communication.

2.5.1.6 Operational Safeguard 10 (Stakeholder Engagement and Information Disclosure)

This safeguard requires meaningful and inclusive engagement with stakeholders throughout the project cycle. For the PMP, this includes consulting farmers, agro-dealers, local authorities, and affected communities on pest management practices, pesticide risks, and grievance mechanisms.

2.5.1.7 Integration with the SAPZ Pest Management Plan

The ISS 2023 provides the policy justification and procedural framework for developing and implementing this Pest Management Plan. The SAPZ Project has adopted the following measures to ensure alignment with the ISS:

- Development of a standalone PMP as a safeguard instrument for addressing pesticide-related risks;

- Integration of IPM strategies and guidance on pesticide selection based on WHO hazard classifications;
- Establishment of a monitoring and evaluation system for pesticide use and pest resistance;
- Commitment to capacity building, community sensitization, and information disclosure;
- Inclusion of a pest-specific grievance redress mechanism (GRM) aligned with OS10 requirements.

By aligning the PMP with the ISS 2023, the SAPZ Project ensures that pest and pesticide management is compliant with AfDB safeguards, reduces environmental and health risks, and contributes to sustainable agricultural development.

2.6 INSTITUTIONAL FRAMEWORK

Pest and pesticide management in Sierra Leone involves several government institutions, regulatory bodies, research organizations, and local actors.

The table below outlines the key institutions and their respective roles and responsibilities:

Institution	**Mandate and Roles in PMP Implementation**
Ministry of Agriculture and Food Security (MAFS) / Crop Protection Unit (CPU)	Lead technical institution for pest surveillance, farmer training, and promotion of Integrated Pest Management (IPM); coordinates with EPA and other stakeholders on pesticide regulation; monitors field-level pest dynamics; manages pesticide registration and quality control through the National Pesticide Committee (if established). Issue agrochemical permits in conjunction with EPA.
Environment Protection Agency (EPA-SL)	Issues permits for import, storage, and use of agrochemicals (per EPA Act 2022); monitors environmental impacts of pesticide use; conducts inspections of agrochemical storage and disposal practices; enforces compliance with national environmental regulations and AfDB safeguard requirements.
Sierra Leone Standards Bureau (SLSB)	Develops and enforces standards for agrochemicals, including formulation, labelling, and packaging; conducts quality assurance testing of imported and marketed pesticides; certifies compliance with national product safety regulations.
Sierra Leone Agricultural Research Institute (SLARI)	Provides scientific advice on pest identification, thresholds, and control measures; supports the validation and scaling up of IPM practices; conducts research on pest resistance and agroecological risk factors.
Ministry of Health and Sanitation (MoHS)	Monitors human health risks linked to pesticide exposure; manages pesticide poisoning cases through public health clinics and laboratories; provides input to pesticide safety training; contributes to vector control measures involving insecticides.

Institution	Mandate and Roles in PMP Implementation
Ministry of Trade and Industry (MTI)	Regulates market access for agrochemical products; supports registration and licensing of pesticide distributors; may contribute to private sector engagement in supply chain regulation.
Ministry of Local Government and Rural Development / District Councils	Supports local enforcement of pesticide safety and environmental bylaws; coordinates with chiefdom authorities on land use and pesticide awareness campaigns; participates in local-level monitoring and grievance resolution.
Customs and Phytosanitary Services (under MAFFS)	Ensures that only registered pesticides are imported into Sierra Leone; inspects agrochemical consignments at points of entry; works with EPA and CPU on enforcement actions for non-compliant imports.
Njala University / Department of Crop Protection	Provides academic and technical support on pest management curricula, training programs, and applied research; may be involved in third-party evaluations and development of training content for Farmer Field Schools.
Farmer-Based Organizations (FBOs) and Agro-Dealers	Responsible for adopting and promoting safe pesticide use and IPM practices; serve as entry points for training and awareness campaigns; distribute agro-inputs under regulatory supervision.
Civil Society and NGOs	Play a role in advocacy, public awareness, and capacity building at the community level; may support grievance handling, monitoring of vulnerable groups, and training on agroecological alternatives.

2.7 Capacity Assessment and Institutional Gaps

An effective Pest Management Plan requires that institutions tasked with regulating, supporting, and monitoring pesticide use and pest control have adequate capacity in terms of technical expertise, logistics, coordination, and enforcement. A capacity assessment of key institutions involved in the implementation of the SAPZ PMP reveals important strengths but also critical institutional and operational gaps.

2.7.1 Institutional Capacity Assessment: Key Regulatory and Technical Agencies

A functional pest management system depends on a network of institutions with clearly defined mandates, sufficient resources, and technical expertise. In Sierra Leone, three institutions are central to pesticide regulation and oversight under the SAPZ Project. The Sierra Leone Standards Bureau (SLSB), the Crop Protection Unit (CPU) of the Ministry of Agriculture and Food Security (MAFS), and the Environment Protection Agency (EPA-SL). A deeper assessment of these institutions reveals important structural strengths, but also significant technical, logistical, and legal constraints that may hinder effective implementation of the Pest Management Plan.

1. Sierra Leone Standards Bureau (SLSB)

The SLSB is legally mandated under the Standards Act No. 2 of 1996 to develop and enforce national standards for products, services, and processes. This includes agrochemicals such as pesticides and

fertilizers. In theory, the SLSB should play a leading role in quality assurance and consumer protection by verifying that pesticides meet national and international standards before they enter the market.

However, in practice, the institution's capacity is constrained in several key areas. While it has published general product standards, there are currently no fully enforced or updated technical standards for pesticide formulation, packaging, labelling, or shelf-life. Furthermore, the Bureau lacks in-house laboratory capacity for chemical residue analysis, toxicity profiling, or counterfeit detection. Product quality testing is rarely conducted systematically at border points, markets, or agro-dealer shops. There is also no certification system for agrochemical suppliers or a traceability mechanism for pesticide batches in circulation.

As a result, the SLSB's enforcement role is limited to ad hoc inspections and reactive responses to reported complaints. Without investment in testing equipment, regulatory training, and structured coordination with the EPA and MAFS, the Bureau's ability to regulate pesticide quality will remain significantly underdeveloped.

2. Ministry of Agriculture and Food Security / Crop Protection Unit (MAFS / CPU)

The Crop Protection Unit is the government's lead technical agency for pest surveillance, extension support, and pesticide management within the Ministry of Agriculture and Food Security. It maintains a presence in all 15 agricultural districts and has historically played a critical role in responding to pest outbreaks (e.g., Grasshopper swarms, Fall Armyworm), training farmers, and promoting Integrated Pest Management (IPM). The unit the Crop Protection Unit of MAFS issues permits for the importation and use of agricultural pesticides. The permit is valid for a period of one year from the date of issue.

Despite this, the CPU's effectiveness is compromised by both institutional and operational limitations. Firstly, the unit lacks formal legal recognition, as it has not yet been established through an Act of Parliament. This limits its autonomy and influence in inter-ministerial coordination and funding allocation.

Secondly, while the CPU has qualified staff at central and district levels, it faces an acute shortage of field personnel, pest surveillance tools, protective equipment, and vehicles for field deployment. In many cases, district-level officers operate without functional offices or logistics support. Additionally, the CPU does not maintain a digital pest database or early warning system, and its ability to undertake pesticide efficacy trials or resistance studies is minimal due to underinvestment in research and laboratory facilities.

Lastly, while the CPU leads farmer outreach through extension agents, most agents lack up-to-date training in pesticide safety, toxicity, and new IPM techniques. Without refresher curricula or dedicated funding for farmer field schools, the quality and coverage of training efforts remain inconsistent.

3. Environment Protection Agency of Sierra Leone (EPA-SL)

The EPA-SL is the statutory agency responsible for environmental governance, including the regulation of agrochemicals under the EPA Act of 2022 and the 2023 Agricultural and Agro-Based Industrial Activities Regulations. The Agency has a central role in issuing import permits for pesticides, regulating chemical storage facilities, and overseeing environmental assessments of agricultural projects. It should be noted that most, if not all agro-dealers currently bypass the needs for import permits and import pesticides without acquiring import permits from the EPA.

While the EPA has a strong legal mandate and a growing track record in environmental permitting, its operational presence remains centralized, with limited resources available for routine inspections at district level. The Agency lacks dedicated agrochemical inspection teams or mobile testing units and depends heavily on information provided by applicants during the permitting process. There is currently no formal pesticide residue monitoring program, no centralized database of pesticide-related complaints or incidents, and no routine audits of agrochemical storage, distribution, or disposal practices in rural areas.

EPA staff are well-trained in environmental impact assessment (EIA) procedures, but often lack specialized training in pesticide risk analysis, formulation chemistry, or toxicology. Furthermore, coordination between the EPA, MAFS, and border/customs officials remains weak, resulting in gaps in enforcement and information flow. Strengthening this coordination and enhancing EPA's technical and logistical capacity is critical for the proper oversight of pesticide use under the SAPZ Project.

2.7.2 Summary of Institutional Capacity and Gaps

Institution / Area	Current Capacity	Key Gaps and Limitations
MAFS / Crop Protection Unit (CPU)	Present in all 15 districts; experienced in pest surveillance, IPM promotion, and emergency pest response (e.g., Fall Armyworm).	Limited staffing at field level; insufficient pest diagnostic labs; inadequate funding for regular monitoring; lack of equipment (sprayers, PPE, transport). No Act of Parliament formally institutionalizing CPU's mandate and making it a full division comparable to other divisions in the Ministry.
EPA-SL	Well-established environmental regulator; mandates pesticide import licensing and storage regulation; experienced in ESIA reviews.	Resource constraints for district-level monitoring; weak coordination with agriculture and customs for joint enforcement; limited capacity to monitor pesticide residues and agrochemical disposal.
Sierra Leone Standards Bureau (SLSB)	Mandated to set and enforce standards for agrochemicals, including formulation, labeling, and packaging.	Weak enforcement of product quality; limited testing infrastructure for agrochemicals; no certification scheme for agro-dealers.
SLARI / Njala University	Strong academic base for IPM research and training; ongoing trials for improved rice varieties and pest resistance.	Research outputs not fully integrated into farmer outreach; underfunded field research and extension linkages; outdated pest laboratory infrastructure.
MoHS / Public Health and Vector Control Units	Able to respond to poisoning cases; links to health surveillance systems.	No centralized database on pesticide-related illnesses; lack of toxicologists and training in pesticide exposure diagnosis; weak collaboration with MAFS for joint field monitoring.

District Councils and Local Authorities	Increasingly responsible for land use, environmental oversight, and agricultural extension coordination.	Low technical capacity; limited budget allocation for environmental monitoring; weak enforcement of local bylaws related to pesticide handling and open burning.
Agro-Dealers and FBOs	Key role in input distribution; extensive reach at community level.	Often unlicensed or poorly trained in pesticide safety; little awareness of regulatory requirements or FAO/WHO codes of conduct; frequently stock expired or unregistered products.
Extension Services / Farmer Field Schools	Recognized model for IPM and participatory learning; some support from NGOs.	Inconsistent coverage; under-trained facilitators; absence of pest-specific training modules or refresher curricula on pesticide handling and residue minimization.

2.7.3 Cross-Cutting Challenges

- Training and Knowledge Transfer: There is no systematic program for continuous training on pesticide management, IPM techniques, and environmental risk monitoring. This gap affects frontline staff, agro-dealers, and farmers alike.
- Enforcement and Regulatory Overlap: Poor coordination among EPA, MAFS, and customs weakens enforcement of import restrictions, licensing, and safe use protocols.
- Data and Information Management: Pest surveillance and pesticide use data are not digitized or centrally available. There is no national pesticide residue monitoring program or risk mapping system.
- Infrastructure Deficits: Laboratories for residue analysis and pest diagnostics are outdated or non-functional. There is also a lack of protective equipment and transport for field inspections and emergency response.
- Inclusion and Community Engagement: Most pest control and pesticide safety training programs do not fully consider the needs of women, youth, or persons with low literacy, which limits uptake of IPM practices.

3 CURRENT APPROACHES TO PEST MANAGEMENT IN THE RICE SECTOR

3.1 OVERVIEW OF RICE PRODUCTION AND ASSOCIATED PEST CHALLENGES

Rice is the primary staple crop in Sierra Leone and forms the central focus of the SAPZ Project. Cultivated across upland, inland valley swamp (IVS), mangrove swamp, and [2]boli land ecologies, rice production is largely dominated by smallholder farmers using low-input systems. Traditional cultivation methods prevail, with limited use of mechanization, irrigation, and improved agro-inputs.

In the SAPZ operational areas of Kambia and Port Loko Districts, rice is cultivated primarily in IVS and boli land zones. These ecologies support two cropping seasons in some cases but are highly vulnerable to weed infestations, insect pests, vertebrate damage, and fungal diseases, especially under high humidity and low-input conditions.

Farmers in these districts report frequent and increasing pressure from pests such as the African Rice Gall Midge, Rice Yellow Mottle Virus (RYMV), Stemborers, and Armyworms, along with bird predation and rodent damage during the reproductive stage. Seasonal flooding and poor drainage can exacerbate fungal outbreaks such as blast and sheath blight.

3.2 CURRENT PEST MANAGEMENT APPROACHES IN USE

Current pest control strategies among smallholder rice farmers in the SAPZ zones are shaped by a mix of traditional knowledge, availability of agrochemicals, and limited extension support. Four broad approaches dominate:

3.2.1 Traditional and Cultural Practices

- Hand weeding, early planting, field burning, and crop rotation are commonly practiced to control weed pressure and disrupt pest life cycles.
- Bird scaring and physical removal of egg masses or larvae are practiced manually, particularly in smaller plots.
- Farmers occasionally use ash application, soaked neem leaves, or pepper sprays as rudimentary botanical repellents.

3.2.2 Chemical Pesticide Use

- Pesticide use is increasing but remains inconsistent. Farmers typically apply broad-spectrum insecticides and herbicides, often without guidance on dosage or timing.
- Agro-dealers serve as the main source of both inputs and information, although many operate informally without training or certification.
- Commonly used chemicals include cypermethrin, glyphosate, paraquat, and chlorpyrifos, some of which are considered highly hazardous pesticides (HHPs) by international standards. See Annex 1: Pesticides Available In Sierra Leone & Their Hazard Classification for more details.

[2] Seasonal swamp land - boli being a Temne word for those lands that are flooded in the rainy season and dry and hard in the dry season

- There is limited or no use of protective equipment, and pesticide containers are often discarded unsafely.

3.2.3 Mechanical and Physical Measures

- Tools such as hoes and cutlasses are used for manual land clearing and weed control.
- Farmers create bunds and drainage channels to manage field moisture, reducing conditions favourable for fungal pathogens and certain pests.

3.2.4 Biological Control and IPM

- Integrated Pest Management (IPM) is promoted in policy but remains underutilized in practice due to low awareness, limited demonstrations, and weak extension coverage. That being said there have been some IMP driven successes from [3] Farmer Field School interventions with farmers trained in Bombali and Bo Districts. Farmers[4] reported 40% reduction in pesticide use, yield increases of 20 – 35% and improvements in household food security and health.
- Occasional biological products such as Bacillus thuringiensis (Bt) are reported in donor-led pilot sites, but adoption remains low.

Table 1: Current Approaches to Major Rice Pests

Pest	Disease	Damage caused	Current Pests management approaches
Rice Stem Borers	Blast	Dead hearts (central leaves) Whiteheads (inflorescence)	• Removal and destruction of infected plants i.e. good field sanitation • Maintain proper plant spacing to reduce humidity and spread disease. • Implement sustainable weed management

[3] Farmer Field Schools (FFS) in Sierra Leone are a participatory extension method that promotes farmer-to-farmer learning and knowledge sharing, aiming to improve agricultural practices and increase productivity. FFS programs have been implemented in Sierra Leone since the early 2000s, with significant support from organizations like FAO and WFP. These schools focus on practical, hands-on learning in the field, allowing farmers to experiment with new techniques and technologies in a safe and supportive environment.

[4] Key person interview with staff of Crop Protection Unit, Ministry of Agriculture and Food Security

Rice Leafhoppers	Sheath Blight	Leaf and sheath lesions Rotting of stems and panicles	• Monitor and use chemical control if necessary • Apply pesticides preventatively • Ensure proper drainage and water management • Utilize resistant rice varieties and seed treatments • Conduct regular scouting and monitoring for early detection
Rice Gall Midge	Bacterial Leaf Blight	Wilting and drying of leaves Yield reduction	• Use resistant rice varieties • Apply appropriate pesticide if necessary • Ensure proper irrigation and drainage • Avoid overhead irrigation • Maintain field hygiene by removing crop residues • Conduct regular field inspections and disease monitoring
Rice Bug	Brown Spot	Brown lesions on leaves and panicles	• Use resistant rice varieties • Apply appropriate fungicides if necessary • Ensure proper water management • Ensure proper water management • Utilize trap crops to reduce pest populations • Implement proper weed management to reduce pest habitat • Use insecticides judiciously and consider their impact on beneficial organism
Armyworms	Narrow Brown Leaf Spot	Brown, necrotic lesions on leaves	• Monitor and use chemical control if necessary • Apply insecticide preventatively • Ensure proper field drainage and irrigation • Implement early planting to avoid peak pest populations • Promote plant health through proper fertilization and irrigation • Conduct regular field monitoring and scouting for pest activity
Grasshopper	Rice Yellow Mottle Virus	Yellowing and mottling of leaves	• Use virus-free seeds • Control insect vectors such as leafhoppers • Remove and destroy infected plants • Implement cultural practices such as deep plowing to disrupt overwintering sites • Utilize resistant rice varieties and plant early to avoid peak vector activity

3.3 Comparative Assessment of Pest Control Approaches: Non-Chemical, Integrated, and Chemical-Only Strategies

In the context of rice production under the SAPZ Project, pest management strategies must balance productivity gains with long-term environmental and human health considerations. This section presents a comparative assessment of three distinct approaches:

i. Non-Chemical Pest Control Only

ii. Integrated Approach (Non-Chemical + Proportionate Chemical Use)

iii. Chemical-Only Pest Control

3.3.1 Non-Chemical Pest Control Only

Definition: Utilizes cultural, biological, physical, and mechanical control methods without the application of synthetic pesticides.

Productivity Implications:

- Moderate to high effectiveness under low to moderate pest pressure.
- May fall short during outbreaks or with highly mobile pests like armyworms or leafhoppers.
- Yield impacts are variable depending on pest load, local ecology, and availability of natural enemies.

Sustainability Implications:

- High ecological sustainability due to minimal environmental pollution and low risk of pest resistance.
- Favors preservation of beneficial species and promotes agroecosystem resilience.
- Lower financial input costs, though labor intensity may be high (e.g., manual weeding or pest removal).

Limitations:

- Requires high farmer knowledge and continuous monitoring.
- May not be sufficient as a standalone approach in high-intensity production areas.

3.3.2 Integrated Pest Management (IPM) – Combination of Non-Chemical and Proportionate Chemical Use

Definition: Emphasizes non-chemical methods but allows for targeted, minimal use of low-toxicity pesticides when economic thresholds are exceeded.

Productivity Implications:

- Provides the most reliable yield protection under diverse pest conditions.
- Flexibility to escalate response proportionately ensures pest suppression without over-reliance on chemicals.
- Studies in Sierra Leone (e.g., FFS evaluations in Bo and Bombali) have shown yield increases of 20–35% under IPM.

Sustainability Implications:

- Balanced approach minimizes environmental harm while maintaining economic viability.
- Reduces likelihood of pesticide resistance, residue accumulation, and non-target impacts.
- Encourages adaptive management and farmer decision-making.

Limitations:

- Requires training, pest threshold awareness, and access to both biocontrol and safe chemical options.
- Needs institutional support for monitoring and extension.

3.3.3 Chemical-Only Pest Control

Definition: Relies solely on synthetic pesticides to suppress or eliminate pest populations.

Productivity Implications:

- Immediate and often effective control of a broad pest spectrum.
- Tends to maximize short-term yield, especially in high-intensity, monoculture systems.

Sustainability Implications:

- Long-term risks include pesticide resistance, environmental degradation, water contamination, and loss of biodiversity.
- Health risks to applicators and communities if safety protocols are not rigorously followed.
- Escalating costs due to resistance and repeated applications may reduce profitability over time.

Limitations:

- Disrupts natural pest-predator balance.
- Undermines resilience of agroecosystems and increases dependence on external inputs.

3.3.4 Conclusion

While chemical-only approaches may provide quick gains in pest suppression, they present substantial risks to sustainability and long-term productivity. Non-chemical methods are environmentally preferable but insufficient in isolation under intense pest pressure. The integrated approach (IPM) emerges as the optimal strategy for the SAPZ Project—offering a pragmatic balance between productivity, ecological health, and farmer safety.

3.4 Institutional and Market Constraints on Effective Pest Control

A number of systemic factors limit the adoption of effective and sustainable pest management practices in the SAPZ areas:

- **Limited access to quality inputs**: Many farmers rely on informal markets where product quality, authenticity, and labelling are unreliable.
- **Low awareness of pest identification and thresholds**: Pest control is often reactive rather than preventive or strategic.

- **Weak extension support**: Many districts have few trained agricultural officers able to deliver pest management guidance at scale.
- **Lack of regulatory enforcement**: Unregistered pesticides are widely available, and the system for agro-dealer licensing, inspection, or accountability is not enforced.
- **No structured IPM programs**: Although IPM is referenced in national policies, there are little to no coordinated field programs or curriculum integration at farmer level in most SAPZ communities.

4 Pest and Disease Profile for Rice

4.1 Introduction

Rice production in Sierra Leone is constrained by a wide range of biotic stressors, including insect pests, weeds, pathogenic diseases, and vertebrate pests. These threats vary by agro-ecological zone, cropping season, and farming system. The SAPZ Project, which will intensify rice cultivation over an estimated 100,000 hectares, will likely exacerbate these pressures if pest management is not integrated at scale. This chapter profiles the major pest and disease challenges anticipated within the project intervention areas and forms the basis for the subsequent design of an Integrated Pest Management (IPM) strategy.

4.2 Insect Pests

Pest	Scientific Name (where available)	Damage Symptoms	Ecology / Timing
African Rice Gall Midge	*Orseolia oryzivora*	Gall formation on tillers, stunting, poor panicle emergence	Most common in IVS and bolilands during early tillering
Rice Yellow Mottle Virus Vector (Leafhoppers)	*Nephotettix spp.*	Yellowing and mottling of leaves, stunted growth	Spread during transplanting and early vegetative phase
Stem Borers	*Chilo spp.*, *Sesamia spp.*	Dead hearts in early stages, whiteheads at maturity	Present throughout growth stages; more severe in dry seasons
Armyworms	*Spodoptera spp.*	Defoliation of seedlings and young plants	Outbreaks common in uplands and after first rains
Rice Hispa	*Dicladispa armigera*	Leaf scraping and skeletonization	More common in uplands and poorly managed IVS fields
Rice Bug	—	Sucks sap from panicles causing shriveled grains and brown spots	Most damaging at flowering to grain-filling stage
Grasshoppers	—	Defoliation and damage to young rice plants	Found in uplands and margins; peaks during dry-to-wet season transition

Figure 4: Rice stem borer (Scirpophaga incertulas)

Figure 3: Rice bug (Leptocorisa acuta)

4.3 WEEDS

Common Name	Scientific Name	Impact
Speargrass	*Imperata cylindrica*	Highly competitive perennial; difficult to control manually
Jungle rice	*Echinochloa colona*	Mimics rice morphology; causes severe yield loss
Goosegrass	*Eleusine indica*	Rapidly spreads in dryland conditions
Water hyssop / creeping weeds	*Bacopa spp.* and others	Difficult to uproot; flourish in IVS fields
Sedges	*Cyperus spp.*	Thrive in swampy fields and interfere with transplanting

4.4 Fungal and Viral Diseases

Disease	Causal Agent	Symptoms	Conditions Favouring Outbreaks
Rice Blast	*Magnaporthe oryzae*	Leaf lesions, neck rot, panicle breakage	Common in high humidity and nitrogen-rich fields
Sheath Blight	*Rhizoctonia solani*	Lesions at waterline; sheath discoloration	Stagnant water and dense crop stands
Bacterial Leaf Blight	*Xanthomonas oryzae*	Leaf tip browning, wilting	Spread by contaminated seed or water splash
Rice Yellow Mottle Virus (RYMV)	*RYMV*	Yellowing, mottling, poor grain fill	Transmitted by insect vectors or mechanical injury
Brown Spot	*Cochliobolus miyabeanus*	Brown lesions on leaves and panicles	Favoured by poor nutrition and drought stress
Narrow Brown Leaf Spot	*Cercospora oryzae*	Narrow, dark brown lesions along leaf margins	Exacerbated by excessive nitrogen and poor field sanitation

4.5 Vertebrate Pests

Pest	Impact	Remarks
Birds (e.g., Quelea spp., weavers)	Panicle feeding, significant pre-harvest losses	Most damaging at grain-filling stage
Rodents (field rats, *Mastomys* spp.)	Seedling uprooting, stem cutting, grain loss	Damage occurs from sowing to harvest; also contaminate stored grain
Monkeys (localized areas)	Uprooting and panicle feeding	Reported in isolated upland fringe areas; damage often patchy but severe
Domestic Livestock (e.g., goats, cattle)	Trampling of seedlings, grazing on shoots, destruction of bunds	Occurs due to open grazing, especially near communal plots or unfenced areas

Figure 5: Red-billed quelea (Quelea quelea)

Figure 6: Red-billed quelea (Quelea quelea)

4.6 Invasive and Emerging Threats

Climate change, trade flows, and changing farming systems are contributing to the emergence of new or increasingly problematic pests in Sierra Leone. Examples include:

- Fall Armyworm (*Spodoptera frugiperda*), now affecting some rice fields beyond maize zones
- Golden Apple Snail, detected in rice irrigation schemes in other West African countries, posing a future threat to lowland systems
- Pesticide resistance, observed anecdotally in stem borers and common weeds due to repeated use of the same chemical classes

The SAPZ Project areas face high and diverse pest and disease pressures. These will likely increase with expanded production unless proactive and ecologically grounded measures are implemented.

5 ENVIRONMENTAL AND HEALTH RISKS OF PESTICIDE USE

5.1 INTRODUCTION

As the SAPZ Project expands rice production and promotes agro-industrial intensification, pesticide use is expected to increase significantly. While pesticides can play a vital role in controlling pests and enhancing crop productivity, their improper use presents serious environmental and public health risks. These risks are especially pronounced in contexts like Sierra Leone, where regulatory oversight is limited, and farmers often lack protective equipment or training on safe pesticide handling.

This chapter outlines the key environmental and health risks associated with pesticide use in the SAPZ Project areas and identifies the major exposure pathways, vulnerable populations, and recorded or anticipated negative outcomes.

5.2 MAJOR ENVIRONMENTAL RISKS

A. Water Contamination

- Runoff from treated fields into streams, wetlands, and irrigation canals can contaminate surface water.
- Leaching of pesticide residues into groundwater threatens drinking water quality, particularly in lowland areas with shallow aquifers.

B. Soil Degradation

- Prolonged use of certain herbicides (e.g., glyphosate, oxadiazon) may alter soil microbial composition and reduce soil fertility.
- Accumulation of residues in the rhizosphere may disrupt beneficial root–microbe interactions.

C. Non-Target Organism Impacts

- Pollinators (e.g., bees) and natural pest predators (e.g., parasitoid wasps) may be harmed by broad-spectrum insecticides.
- Aquatic invertebrates and amphibians are highly sensitive to organophosphates and pyrethroids.

D. Bioaccumulation and Ecosystem Effects

- Persistent and lipophilic compounds (e.g., chlorpyrifos) may bioaccumulate in aquatic food chains, affecting fish and birds.
- Repeated exposure in floodplains and boli lands may contribute to long-term ecological imbalance.

5.3 HUMAN HEALTH RISKS

A. Occupational Exposure

- Farmers, agro-dealers, and sprayers are often directly exposed to pesticides during mixing, application, and equipment cleaning.
- Lack of personal protective equipment (PPE) such as gloves, masks, and coveralls is a common problem.

B. Acute and Chronic Effects

- Short-term health effects include headaches, nausea, dizziness, eye and skin irritation.
- Chronic exposure is linked to endocrine disruption, neurological disorders, respiratory illness, reproductive harm, and in some cases, cancer.

C. Residues in Food

- Over-application and failure to observe pre-harvest intervals can lead to pesticide residues in milled rice.
- Storage insecticides (e.g., pirimiphos-methyl, carbamates) pose risks if improperly dosed or applied.

D. Accidental Poisoning

- Children and household members are vulnerable to unintentional exposure from poorly stored chemicals and unwashed clothing.
- Reuse of pesticide containers for food or water is a widespread and dangerous practice in some areas.

5.4 Vulnerable Populations

- Women and children are at higher risk due to secondary exposure and participation in informal pesticide use.
- Farmworkers often have inadequate training, protection, and agency to refuse unsafe practices.
- Residents near sprayed fields may experience pesticide drift, especially in poorly buffered areas.
- Agro-dealers handling concentrated products face risks if storage, labelling, and ventilation are inadequate.

5.5 Reported Incidents and Observations

While comprehensive pesticide incident data is lacking in Sierra Leone, field observations and stakeholder consultations indicate:

- Use of banned or highly hazardous pesticides (e.g., carbofuran, chlorpyrifos) is still occurring due to informal markets.
- Pesticide handling and mixing are frequently done without gloves, goggles, or masks.

- Many agrochemical containers are disposed of in open fields or waterways, creating persistent contamination risks.

In one of Sierra Leone's most serious pesticide poisoning incidents, 49 people were acutely poisoned and 14 died in May and June 1986 after consuming bread contaminated with parathion, a highly toxic WHO Class Ia organophosphate pesticide. The outbreak occurred in Kenema and Lalehun and primarily affected children, many of whom experienced vomiting, dizziness, respiratory distress, and rapid unconsciousness after eating bread made from flour contaminated during domestic transport.

Investigations confirmed that the contamination occurred when parathion spilled onto a bag of flour during its shipment from Freetown to Kenema. The bread was later baked and distributed without awareness of the contamination. Most deaths occurred within hours, and the tragedy was exacerbated by a lack of national regulations on the transport and use of highly toxic pesticides. The epidemic highlighted the acute risks of accidental ingestion due to improper handling, storage, and transport of hazardous agrochemicals.

5.6 Risk Amplification Factors in the SAPZ Context

- Rapid scale-up of cultivation may outpace safe input supply systems.
- Informal agro-dealer networks often sell unpackaged or counterfeit products.
- Weak enforcement of labelling, licensing, and product registration undermines safe use.
- Low literacy rates reduce the effectiveness of pictogram-based safety instructions.
- Climate stressors, including flooding and temperature shifts, may alter pesticide behaviour and effectiveness

6 INTEGRATED PEST MANAGEMENT STRATEGY

6.1 INTRODUCTION

Integrated Pest Management (IPM) is a sustainable, ecosystem-based strategy that focuses on the long-term prevention and control of pests through a combination of techniques. These include biological control, cultural practices, mechanical methods, and the judicious use of chemical pesticides. Under the SAPZ Project, IPM is a critical tool for minimizing the environmental and health risks of pest management while enhancing rice productivity.

6.2 IPM PRINCIPLES FOR SAPZ RICE SYSTEMS

The IPM approach for SAPZ rice production will be guided by the following core principles:

- **Prevention first**: Emphasize healthy crop practices and ecosystem balance to deter pest outbreaks.
- **Monitoring-based action**: Rely on regular field scouting and threshold-based decision-making to avoid unnecessary interventions.
- **Least-toxic methods**: Prioritize non-chemical options (e.g. biological controls) and use pesticides only as a last resort, based on informed choice.
- **Farmer capacity-building**: Ensure farmers understand pest lifecycles, monitoring tools, and the safe use of inputs.
- **Protection of human health and environment**: Align pest management practices with AfDB OS4 safeguards and national standards.

6.3 CULTURAL, BIOLOGICAL, AND MECHANICAL CONTROL MEASURES

A. Cultural Practices

- Early and synchronized planting to avoid peak pest periods.
- Crop rotation (especially in upland areas) to disrupt pest cycles.
- Field sanitation: Removal of stubble, weeds, alternate hosts, and pest-infested plants.
- Balanced fertilization: Avoid excessive nitrogen which increases susceptibility to diseases and pests.
- Water management: Maintain optimal irrigation levels to discourage pest buildup (e.g., gall midge, stem borer).
- Use of local deterrents like wood ash and pepper in nurseries to prevent termite and stem borer attacks.

B. Biological Controls

- Conservation and identification of natural enemies such as parasitoid wasps, spiders, lady beetles, ants, and ground beetles.
- Promotion of biopesticides like neem oil, *Trichoderma* spp., *Beauveria bassiana*, *Metarhizium anisopliae*, and *Bacillus thuringiensis* (Bt).

- Farmers to be trained in recognizing these agents, with special use of ants and beetles in upland systems.

C. Mechanical and Physical Measures

- Manual removal of egg masses or pest colonies (e.g., Hispa, grasshoppers).
- Light traps and pheromone traps for pest monitoring and reduction.
- Physical barriers and fencing to prevent intrusion by rodents and domestic animals.

D. Responsible Use of Chemical Pesticides

When chemical control is necessary, the following measures will apply:

- Selection of approved products only: Use pesticides registered by EPA-SL and listed in ***Annex 2:*** **MAFS-Approved Pesticide Products**, with preference for WHO Class III or U compounds.
- Rotation of chemical classes to prevent resistance development.
- Training on application technique: Dosage, equipment calibration, and weather conditions.
- Observance of pre-harvest intervals to minimize residue in food.
- Avoidance of WHO Class Ia and Ib pesticides, except under emergency government-authorized circumstances.
- Use of protective equipment (PPE) to reduce occupational exposure.

6.4 Criteria for Pesticide Selection

Pesticides used under the SAPZ Project will be selected based on:

- Efficacy against target pest or disease
- Low environmental persistence and bioaccumulation
- Low toxicity to non-target organisms and humans
- Recommendations from Ministry of Agriculture and Food Security
- Compatibility with IPM and organic principles
- Availability of Material Safety Data Sheets (MSDS)

6.5 Promotion of Biopesticides and Alternatives

The SAPZ PMP encourages the adoption of environmentally friendly alternatives such as:

- Neem-based products for insect control
- Pheromone traps for pest monitoring and disruption
- Botanical fungicides derived from locally available plants
- Microbial agents like *Bt*, *Beauveria bassiana*, *Metarhizium anisopliae*, and *Trichoderma harzianum*

These will be promoted through extension materials, demonstration plots, and integration into Farmer Field Schools (FFS).

6.6 Core IPMP Intervention Principles

The SAPZ Pest Management Plan is aligned with internationally recognized IPMP principles endorsed by development partners such as the World Bank, FAO, and the Ministry of Agriculture and Food Security. These principles promote sustainable, safe, and inclusive pest management practices across the rice value chain.

Principle	Description
1. Prevention First	Emphasize preventive measures such as resistant varieties, crop rotation, and good field hygiene.
2. Integrated Approach	Combine cultural, biological, mechanical, and chemical control methods in a complementary manner.
3. Pesticide as Last Resort	Use chemical control only when other methods are insufficient, and only in a targeted, regulated way.
4. Environmental and Human Safety	Promote use of low-risk, WHO-approved pesticides and practices that reduce exposure.
5. Stakeholder Participation	Involve farmers, communities, and extension agents in planning and implementation.
6. Capacity Building	Train farmers, extension agents, and staff on IPM and safe pesticide use.
7. Monitoring and Surveillance	Regularly assess pest populations and adapt interventions accordingly.
8. Promotion of Biopesticides	Encourage locally available bio-controls and botanicals (e.g., neem, *Trichoderma*).
9. Safe Handling and Disposal	Ensure PPE availability, proper storage, and safe container disposal.
10. Legal and Standards Compliance	Align with Sierra Leone laws and safeguards such as the AfDB OS4.

6.7 Measures Already Adopted by Farmers to Reduce Pesticide Use

In Sierra Leone, both farmers and competent authorities are increasingly adopting various measures to reduce the use of pesticides, in line with sustainable agriculture and Integrated Pest Management (IPM) principles. These actions aim to minimize health and environmental risks while ensuring effective pest control.

Measure	Description
Adoption of Integrated Pest Management (IPM)	Use of IPM techniques such as crop rotation, resistant varieties, trap cropping, and manual weeding.
Use of Biological Control Agents	Introduction and conservation of beneficial predators and parasitoids to naturally regulate pests.
Mechanical and Physical Methods	Handpicking pests, installing physical barriers, and using traps like pheromone or sticky traps.

Cultural Practices	Early planting, intercropping, and hygiene to interrupt pest life cycles and reduce infestation.
Traditional and Botanical Alternatives	Use of neem sprays, wood ash, or pepper extract as low-toxicity pest deterrents.
Reducing Overuse through Awareness	Farmer training and awareness programs help reduce indiscriminate or unnecessary chemical use.
Participating in Farmer Field Schools (FFS)	Capacity-building platforms for learning and adopting ecological pest control practices.

6.8 Rice Pest-Specific IPM Strategy Tables

This sections provides tabulated summaries of IPM strategies for key pest types identified in Sierra Leone's rice production systems. The tables include major insect pests, diseases, and vertebrate threats alongside their associated damage and recommended IPM control measures. These tables consolidate inputs from national institutions including MAFS.

6.8.1 Major Insect Pests of Rice

PEST	DAMAGE CAUSED	IPM CONTROL MEASURES
Rice stem borers	Dead hearts in young plants Whiteheads (unfilled panicles) in mature plants	Use resistant/tolerant varieties Early planting to escape peak infestation Removal and destruction of stubble after harvest Biological control using parasitoids (e.g., Trichogramma spp.) Avoid staggered planting
Rice Leafhoppers	Sap sucking: Leafhoppers feed on plant sap from phloem tissues. Yellowing or browning of leaves Stunted plant growth Leaf tip drying Hopper burn	1. Cultural Control Early and synchronized planting to escape peak leafhopper population. Crop rotation to break pest lifecycle. Proper spacing and weed management to reduce humidity and pest habitat. Rogueing (removal) of infected plants to limit virus spread. 2. Host Plant Resistance Use resistant varieties: Some NERICA (New Rice for Africa) and improved local varieties have resistance to leafhoppers and Tungro. Contact local agricultural extension for up-to-date resistant varieties. 3. Biological Control Encourage natural enemies: Predators: spiders, ladybird beetles (Coccinellidae)

		Parasitoids: Anagrus spp. (egg parasitoid) Minimize broad-spectrum insecticide use to conserve these beneficials.
Rice Gall Midge	Formation of galls (silver shoots) replacing normal tillers Reduced tillering and grain yield Yield reduction	Resistant varieties (e.g., WARDA-released varieties) Timely planting and synchronized sowing Destruction of alternate hosts (e.g., wild rice) Field sanitation
Rice bug	Grains become empty or shriveled (called "buggy grains"). Emission of a foul odor in the field. Discoloration or brown spots on grains. Can cause significant yield and quality loss.	A. Cultural Control Timely planting to avoid peak bug population during grain filling. Synchronized planting across farms to break pest cycles. Removal of alternate hosts (e.g., weeds and wild grasses near the field). Harvest promptly after maturity to reduce exposure to bugs. B. Mechanical Control Hand-picking during early morning or late evening when bugs are inactive. Use of light traps or pheromone traps to monitor or reduce adult population. C. Biological Control Encourage natural enemies like: Predatory ants (e.g., Oecophylla smaragdina) Spiders and predatory beetles Avoid broad-spectrum insecticides that kill beneficial organisms. D. Chemical Control (only when pest population exceeds economic threshold level – ETL) Use selective insecticides like: Lambda-cyhalothrin Deltamethrin Neem-based biopesticides (Azadirachtin)
Armyworms	Brown, necrotic lesions on leaves.	Feed on leaves, causing skeletonization or complete defoliation Reduced photosynthetic ability Yield loss due to stunted growth or poor panicle development In severe infestations, entire fields can be defoliated in a few days
Grasshopper	Feeding on Leaves: Grasshoppers chew on	1. Cultural Control

	leaves, especially in the seedling and tillering stages, leading to defoliation. Stem and Panicle Damage: In heavy infestations, they may chew stems and young panicles, reducing grain formation. Patchy Crop Stand: Severe attacks can lead to irregular growth, poor tillering, and significant yield loss. Indirect Damage: May act as secondary pests by weakening plants, making them more susceptible to diseases.	Timely Planting: Synchronize planting to avoid peak grasshopper population periods. Weed Management: Remove weeds and grass around rice fields that serve as breeding and hiding sites. Tillage: Deep ploughing after harvest destroys eggs laid in the soil. Field Sanitation: Clean field borders and remove crop residues where grasshoppers may lay eggs. 2. Biological Control Natural Enemies: Birds, spiders, frogs Parasitoids (e.g., Scelio spp. that attack eggs) Pathogens (e.g., Metarhizium anisopliae, Beauveria bassiana) Conservation: Avoid broad-spectrum pesticides to conserve natural enemies. Botanical Pesticides Neem Extract (Azadirachta indica): Acts as antifeedant and repellent. Spray during early morning or evening hours. Mix 100 ml of neem oil with 10 liters of water + a few drops of soap. 4. Chemical Control (Last Resort) Apply only if population exceeds economic threshold level (ETL). Use selective insecticides such as: Lambda-cyhalothrin Deltamethrin
Rice Leaf Folder (Cnaphalocrocis medinalis)	Larvae fold leaves and scrape green tissues, reducing photosynthesis	Use of light traps to monitor moth activity Manual removal of infested leaves Avoid excessive use of nitrogen fertilizer Encourage natural enemies like spiders and parasitoids
Brown Planthopper	Sucks sap from phloem, causing hopper burn Transmits viral diseases (e.g., grassy stunt virus)	Use resistant varieties Avoid overuse of pesticides that kill natural enemies Maintain proper spacing to reduce humidity Introduce natural predators (e.g., Cyrtorhinus lividipennis)
African Rice Hispa (Dicladispa gestroi)	Adults and larvae scrape leaf tissue, leading to reduced photosynthesis	Use resistant varieties Manual removal of infested leaves Intermittent flooding to reduce egg-laying

Stalked-eyed flies	Larvae tunnel through the leaf sheath and midrib, disrupting nutrient flow. Leads to the formation of "dead hearts" (central leaf wilts and dies in young plants). Stunted plant growth and reduced tillering. Severe infestations during the early vegetative stage can cause major yield losses.	a. Cultural Control Early planting: Plant early in the season to escape peak fly populations. Synchronized planting within a community to break pest life cycles. Crop rotation to reduce pest build-up. Field sanitation: Remove and destroy rice stubble and volunteer plants after harvest (overwintering sites). Clean bunds and remove alternative grass hosts. b. Host Plant Resistance Use resistant or tolerant varieties where available (some NERICA and WARDA varieties show moderate resistance). c. Biological Control Natural enemies such as parasitic wasps (Tetrastichus diopsis, Trichogramma spp.) can help suppress populations. Promote habitat for natural enemies (e.g., reduce broad-spectrum pesticide use). d. Light traps and yellow sticky traps can help monitor and reduce adult populations. e. Chemical Control (Use only when necessary) Insecticides such as lambda-cyhalothrin or cypermethrin may be used early in the crop cycle. Apply based on pest monitoring; avoid indiscriminate spraying to preserve beneficial insects.
Caseworm	Larvae scrape the green tissues from leaves, leaving transparent, papery leaf blades (called "windowpanes"). Heavy infestations can make the rice field appear scorched or burnt. Reduced photosynthesis Delayed plant growth and reduced tillering Yield loss if damage occurs early or is prolonged	1. Cultural Control Timely planting: Helps escape peak population periods. Proper water management: Intermittent draining reduces larval development. Avoid continuous standing water. Removal of weeds: Reduces alternate habitats for larvae. Roguing: Remove infested leaves in nursery. 2. Mechanical Control Light traps: Set up to attract and trap adult moths. Sweep nets: Used for monitoring and mechanical reduction of adults in small plots.

		3. Biological Control Natural enemies: Predators: spiders, dragonflies Parasitoids: Trichogramma spp. (egg parasitoid), Telenomus spp. Biopesticides: Bacillus thuringiensis (Bt) can be effective against young larvae. 4. Host Plant Resistance Use of resistant or tolerant varieties, if available and suitable for the region. 5. Chemical Control (as last resort) Apply selective insecticides only if economic threshold is reached (e.g., 10–15 larvae per m^2). Recommended options: Neem-based botanicals (eco-friendly) Contact insecticides like chlorantraniliprole or lambda-cyhalothrin, used sparingly and with caution to protect beneficial organisms.
Termite	Attack stored rice straw, panicles, and sometimes stored grain. Attack on germinating seeds, especially in direct-seeded upland rice. Results in poor plant stand and patchy emergence. Attack stored rice straw, panicles, and sometimes stored grain.	1. Cultural Control Crop rotation: Avoid continuous rice cropping, especially in upland systems. Field sanitation: Remove and burn infested stubble and straw after harvest. Avoid piling organic matter near the rice fields. Timely planting: Early planting helps rice plants establish before termite populations peak. Deep ploughing: Exposes termite colonies and destroys nests. 2. Physical/Mechanical Control Flooding: Maintain adequate soil moisture where possible (e.g., through irrigation) to deter termite activity. Destruction of termite mounds: Dig out and destroy termite mounds in and around fields. 3. Biological Control Use of entomopathogenic fungi:

		Metarhizium anisopliae and Beauveria bassiana are effective biological agents. Encourage natural predators: Birds, ants, and ground beetles can help regulate termite populations. 4. Resistant Varieties While few rice varieties are specifically bred for termite resistance, choosing locally adapted and vigorous varieties can reduce susceptibility. 5. Chemical Control (as a last resort) Seed treatment: Treat seeds with safe, recommended insecticides before sowing (e.g., fipronil or chlorpyrifos at safe rates). Soil treatment: Apply insecticide granules to termite-prone areas (only where infestation is severe and persistent). Note: Avoid indiscriminate pesticide use to prevent harm to beneficial organisms and reduce resistance buildup.

6.8.2 Major Diseases of Rice

No.	Disease	Symptoms	Damage Caused	IPM Control Measures
1	**Rice Yellow Mottle Virus (RYMV)**	Yellow mottling on leaves, stunted growth, twisted leaves	Stunted plants, poor tillering, reduced panicle emergence and yield	Use resistant varieties, avoid infected fields, sanitize tools, control insect vectors, synchronize planting
2	**Rice Blast**	Diamond-shaped lesions on leaves, neck and node blast	Severe yield loss due to neck blast and incomplete grain filling	Grow resistant varieties, avoid excess nitrogen, ensure good drainage, remove crop residues, apply fungicides if necessary
3	**Brown Spot**	Round brown lesions with yellow halos on leaves	Reduced seedling vigour, grain discoloration, yield reduction	Use certified seeds, balanced fertilization (especially potassium), improve soil fertility, crop rotation
4	**Sheath Blight**	Irregular lesions on lower leaf sheaths, plant lodging	Lodging, poor grain filling, reduced yield	Avoid dense planting, balanced fertilizer use, remove infected residues, use biofungicides (e.g. *Trichoderma*), apply fungicides if needed
5	**Sheath Rot**	Brownish lesions on flag leaf sheaths,	"Choked" panicles, sterile grains, yield loss	Use clean seeds, control insect vectors, avoid mechanical injury, apply fungicides (where

		poor panicle emergence		economic), remove infected plant debris
6	**Leaf Scald**	Reddish-brown, wavy lesions from leaf tips downward	Reduced photosynthesis, yield loss in severe infections	Use resistant varieties, practice good field sanitation, ensure balanced fertilization
7	**False Smut**	Green velvety balls replace some grains, later turn orange or black	Minor yield loss, quality reduction of harvested grain	Use clean seeds, apply balanced nutrients, avoid late harvesting, remove infected panicles, practice crop rotation
8	**Kernel Smut**	Black powdery mass replaces grain contents	Poor grain quality, shrivelled kernels, loss during threshing	Use resistant varieties, remove crop residues, avoid high nitrogen rates, treat seeds with fungicides
9	**Grain Rot**	Discoloured and shrivelled grains, panicle rot	Low grain quality, partial or full sterility of panicles	Avoid panicle injury, manage insect pests (e.g. stem borers), ensure good drainage, apply fungicide at booting stage if needed
10	**Algal Leaf Spot (Red Rust)**	Orange to red, velvety spots on older leaves	Rarely causes yield loss, weakens photosynthesis	Improve drainage, reduce shade, apply copper-based fungicides if necessary, avoid overwatering

6.8.3 Major Vertebrate Pests of Rice

Vertebrate Pest	Damage Caused	IPM Control Measures
Village weaver Bird	- Nesting in rice fields can damage crops and reduce yield	• Install scarecrows or reflective tape in rice fields to deter birds • Utilize netting or bird repellents around rice paddies • Implement noise deterrents such as bird distress calls
Quelea quelea	- Massive flocks can consume rice grains, leading to significant crop losses	• Implement bird-scaring techniques such as loud noises or visual deterrents in rice fields • Use chemical repellents or bird traps in severe infestations

Rodents (Rats and Mice)	• Nursery Stage: Feed on seeds and seedlings. • Vegetative to Maturity Stage: Gnaw stems and eat developing grains. • Harvest and Storage: Eat stored grains, contaminate with urine and feces. • Cause yield losses of 5–20% or more if unmanaged.	• Field sanitation: Remove weeds, bund vegetation, and hiding places. • Community-based trapping programs using baited traps. • Rodent-proof storage structures (e.g., metal bins or raised platforms). • Encourage predators (e.g., owls, snakes, domestic cats). • Use of mechanical barriers (e.g., metal collars on storage poles). • Coordinated baiting with anticoagulant rodenticides (as last resort and with caution).
Monkeys	• Uproot seedlings and feed on young shoots. • Pull and eat mature panicles during the ripening phase. • Damage is usually patchy but can be substantial in fields near forests.	• Human guarding during vulnerable periods. • Use of dogs or trained deterrents. • Barriers (fencing) in high-risk areas. • Community awareness and coordinated control.

Domestic Animals (Cattle, Goats, Sheep, Pigs)	• Trample rice seedlings and mature plants. • Graze on young shoots and leaves. • Cause lodging and destruction of bunds.	• Keep domestic animals away from rice fields

6.9 Recommended Pesticides for IPM Use in Sierra Leone

The Ministry of Agriculture and Food Security (MAFS) has identified a range of pesticides for selective use within an Integrated Pest Management (IPM) framework in Sierra Leone. These products are intended for use under strict adherence to national safety guidelines, and only when non-chemical methods are insufficient.

6.9.1 Summary of Recommended Pesticides

Type	Active Ingredient	Subgroup / Classification	**WHO** Hazard Class
INSECTICIDES	Imidacloprid	Neonicotinoid	II (Moderately hazardous)
	Alpha-Cypermethrin (Alphamethrin)	Pyrethroid	II (Moderately hazardous)
	Cypermethrin	Pyrethroid	II (Moderately hazardous)
	Deltamethrin	Pyrethroid	II (Moderately hazardous)
	Chlorpyrifos	Organophosphate	II (Moderately hazardous)
	Diazinon	Organophosphate	II (Moderately hazardous)
FUNGICIDES	Captan	Phthalimide	U (Unlikely to present hazard in normal use)
	Mancozeb	Dithiocarbamate	U (Unlikely to present hazard in normal use)
	Propineb	Dithiocarbamate	U (Unlikely to present hazard in normal use)
	Difenoconazole	Triazole	III (Slightly hazardous)
	Tebuconazole	Triazole	III (Slightly hazardous)
	Cupric oxide (Copper II Oxide)	Inorganic Fungicide	III (Slightly hazardous)
HERBICIDES	Ethofumesate	Benzofuran	III (Slightly hazardous)
	Glyphosate	Phosphonoglycine	U (Unlikely to present hazard in normal use)
	Metamitron	Triazinone	III (Slightly hazardous)
	Propanil	Anilide	III (Slightly hazardous)
FUMIGANTS[5]	Zinc Phosphide	Inorganic compound / Acute rodenticide	Ia (Extremely hazardous)
	Aluminium phosphide	Inorganic phosphide / Fumigant	Ib (Highly hazardous)

[5] It should be noted that the Fumigants (zinc Phosphide and aluminium phosphide) are classed as Restricted Use Only by the Ministry of Agriculture and Food Security and are not distributed to farmers. They are meant for use in grain silos and applied only under controlled conditions by Crop Protection Specialists from the Ministry of Agriculture or trained technicians.

These substances are recommended based on their efficacy, relative safety (when used according to guidelines), and their role within an environmentally sound and economically sustainable pest management approach.

Note: Full details in *Annex 2:* MAFS-Approved Pesticide Products

7 ENVIRONMENTAL AND HEALTH RISK ASSESSMENT OF PESTICIDE USE

7.1 INTRODUCTION

This chapter assesses the potential environmental and public health risks associated with pesticide use in the implementation of the SAPZ Project in Sierra Leone. The analysis focuses on the hazards posed by various classes of pesticides, routes and levels of exposure, affected populations and ecosystems, and provides a framework for risk classification and mitigation.

7.2 HAZARD IDENTIFICATION

The SAPZ Project involves the use of insecticides, herbicides, fungicides, and rodenticides as part of its integrated pest management strategy. While these chemicals serve critical agricultural functions, many contain active ingredients with known toxicological effects. WHO classifies pesticide hazards into several classes, with Class Ia (extremely hazardous) and Class Ib (highly hazardous) compounds posing the most significant health and environmental threats.

The following active ingredients, identified as part of the recommended pesticide list by MAFS, carry varying levels of hazard:

- Chlorpyrifos (Class II - moderately hazardous)
- Dimethoate (Class II – moderately hazardous)
- Mancozeb (Class U - unlikely to present hazard under normal use)
- Zinc Phosphide (Class Ib - highly hazardous)

7.3 EXPOSURE PATHWAYS

Potential exposure to pesticides may occur through multiple pathways:

- Occupational exposure: Farmers and pesticide applicators may be exposed through skin contact, inhalation, or ingestion during mixing, application, or disposal.
- Community exposure: Nearby residents may be exposed through spray drift, contaminated water sources, or residues on food crops.
- Environmental exposure: Pesticides may contaminate soil, surface water, and groundwater. Non-target species including beneficial insects, aquatic fauna, birds, and mammals may also be affected.

7.4 VULNERABLE POPULATIONS AND ECOSYSTEMS

Groups at elevated risk include:

- Women and children in farming communities (due to their proximity to treated fields and limited protective equipment)
- Extension workers and untrained applicators
- Aquatic ecosystems near rice paddies and irrigation canals
- Pollinators and beneficial predators (e.g., bees, ladybirds)

7.5 Risk Classification

Risk levels are assessed based on a combination of:

- Hazard potential of the pesticide (toxicity class)
- Frequency and method of application
- Proximity to sensitive receptors (e.g., water bodies, schools)
- Availability and use of protective measures (e.g., PPE, buffer zones)

Each pesticide used under the SAPZ project is evaluated for acute toxicity, chronic exposure effects, potential for environmental persistence, and bioaccumulation.

7.6 Risk Mitigation Measures

The following strategies are proposed to minimize risk:

- Enforce the use of PPE during application
- Implement buffer zones between treated fields and water bodies
- Promote selective, lower-toxicity pesticide use (Class III and U)
- Train applicators and farmers on safe handling and emergency response
- Establish community pesticide storage and disposal facilities
- Conduct routine environmental monitoring of soil and water samples
- Promote adoption of biopesticides and non-chemical control methods
- Class 1a and 1b are Restricted Use Only and to be applied by Crop Protection Specialists of the Ministry of Agriculture or trained technicians

7.7 Institutional Responsibilities

- **MAFS and CPU**: Lead farmer training, supervise field use, and promote safer alternatives
- **EPA-SL**: Oversee environmental permitting, inspect storage facilities, and ensure compliance with the Environment Protection Agency Act 2022
- **District Councils**: Enforce by-laws on pesticide safety and monitor community-level exposure

7.7.1 Conclusion

The implementation of pest management under the SAPZ Project must be balanced with robust measures to prevent and mitigate environmental and public health risks. This chapter provides a foundation for proactive risk management aligned with international best practices and national regulatory standards.

Annex 3: Risk Assessment Matrix and Toxicological Profiles of Selected Pesticides provides detailed risk evaluations of individual active ingredients recommended under the project.

8 INSTITUTIONAL ROLES AND RESPONSIBILITIES

Effective implementation of the Pest Management Plan (PMP) for the Sierra Leone SAPZ Project requires the active participation and coordination of a range of national, district, and community-level institutions. This chapter outlines the mandates, roles, and responsibilities of key stakeholders involved in pest and pesticide management across the project lifecycle. The objective is to ensure clarity in institutional engagement, accountability, and collaboration to promote sustainable and safe pest control practices.

8.1 LEAD IMPLEMENTING INSTITUTIONS

8.1.1 Ministry of Agriculture and Food Security (MAFS) / Crop Protection Unit (CPU)

MAFS, through its Crop Protection Unit (CPU), holds the technical lead on pest management and agricultural extension. Its key responsibilities include:

- Leading the development and implementation of Integrated Pest Management (IPM) strategies
- Coordinating pest surveillance and response across target districts
- Delivering training to extension agents and farmers on safe pesticide use and IPM
- Promoting biological control methods and sustainable alternatives
- Participating in pesticide registration processes in collaboration with EPA-SL and SLSB

8.1.2 Environment Protection Agency – Sierra Leone (EPA-SL)

EPA-SL is the statutory body responsible for environmental protection and regulatory oversight of agrochemical use. Its core roles include:

- Licensing the importation, storage, and distribution of pesticides in accordance with the EPA Act, 2022
- Reviewing and approving agrochemical management plans for SAPZ project interventions
- Monitoring environmental compliance at project sites
- Coordinating with MAFS and SLSB on enforcement of pesticide regulations
- Supporting awareness campaigns on pesticide risks and safety measures

8.1.3 Sierra Leone Standards Bureau (SLSB)

The SLSB is mandated to develop, enforce, and monitor quality standards for pesticides and related agricultural inputs. It is responsible for:

- Establishing and revising national standards for pesticide formulation, packaging, labelling, and storage
- Certifying pesticide products for quality assurance
- Supporting training for agro-dealers on handling and sales of regulated products
- Coordinating with EPA-SL on product quality inspections and market surveillance

8.2 SUPPORTING INSTITUTIONS

8.2.1 District Agricultural Offices (DAOs)

DAOs serve as decentralized arms of MAFS and provide frontline implementation support. Their responsibilities include:

- Conducting community-level sensitization on IPM and pesticide safety
- Organizing Farmer Field Schools and trainings
- Monitoring pest outbreaks and pesticide use trends
- Reporting to CPU and supporting data collection for M&E

8.2.2 Agro-Dealers

Agro-dealers serve as key private sector actors in the supply of pesticides and related inputs. They are expected to:

- Stock and sell only approved and licensed pesticide products
- Receive training and adhere to national safety and labelling requirements
- Provide end-users with usage guidance and promote PPE use
- Cooperate with regulatory inspections and compliance reviews

8.2.3 Farmers and Farmer-Based Organizations (FBOs)

Farmers and FBOs are the primary users of pest control technologies and essential partners in IPM adoption. Their responsibilities include:

- Participating in training on IPM, safe pesticide use, and residue minimization
- Reporting suspected pesticide-related health or environmental issues
- Practicing triple-rinsing and proper disposal of containers
- Participating in community surveillance and early warning systems

8.2.4 NGOs, SLARI, and Njala University

These institutions provide research, training, and field validation support. Their roles include:

- Conducting trials on resistant rice varieties and biopesticides
- Supporting development of pest diagnostic tools and forecasting models
- Providing technical backstopping for Farmer Field Schools and extension agents
- Linking research findings with policy and farmer outreach

8.3 COORDINATION MECHANISM

To ensure effective implementation of the PMP, a multi-tier coordination mechanism will be established:

- **National Level:** Joint technical committee comprising MAFS, EPA-SL, and SLSB to oversee PMP roll-out and harmonize regulatory approaches.

- **District Level:** DAOs will convene quarterly stakeholder meetings involving agro-dealers, local NGOs, and FBOs to share updates and address challenges.
- **Community Level:** Village-level pest surveillance groups will be established with support from DAOs and FBO leaders to serve as first responders in early warning systems.

A summary of institutional roles and responsibilities is presented in Annex 4: Implementation Matrix.

9 MONITORING AND EVALUATION FRAMEWORK

9.1 OBJECTIVES OF MONITORING AND EVALUATION

The Monitoring and Evaluation (M&E) framework for the Pest Management Plan (PMP) aims to:

- Track the effectiveness of pest management strategies and pesticide use.
- Identify early warning signs of pest outbreaks and pesticide misuse.
- Assess compliance with national regulations and AfDB environmental safeguards.
- Facilitate adaptive management and continuous learning across stakeholders.
- Ensure that health, environmental, and productivity outcomes are aligned with PMP goals.

9.2 8.2 KEY INDICATORS FOR PMP MONITORING

The table below summarizes proposed indicators for tracking the performance of PMP implementation.

Indicator	Means of Verification	Frequency	Responsible Entity
% of farmers trained on IPM and pesticide safety	Training reports, attendance sheets	Quarterly	DAOs / MAFS-CPU
Number of pest outbreaks detected and reported	Field reports, surveillance records	Monthly	DAOs / CPU
% reduction in pesticide use in target areas	Agro-dealer records, farmer surveys	Annually	MAFS / FBOs
% of pesticides used that are on the approved list	Agrochemical purchase records, inspection data	Semi-annually	EPA-SL / SLSB
Number of poisoning incidents reported	Clinic and community reports	Quarterly	MoHS / EPA-SL
Number of IPM demonstration plots established	Extension reports, field visits	Annually	DAOs / NGOs
Functioning grievance channels on pesticide use	GRM records, community feedback	Ongoing	Project PIU / DAOs
Number of agro-dealers within the project zones	Inventory of pesticides dealers	Annually	MAFS-CPU, EPA, MoH, PIU, SLSB, NU

9.3 MONITORING TOOLS AND METHODS

- **Pest Surveillance:** Routine field scouting (data collection on pest prevalence and threshold) and mobile alerts via extension agents.
- **Farmer Surveys:** Structured interviews to assess knowledge, practices, and pesticide exposure.
- **Pesticide Use Audits:** Spot checks at agro-dealer outlets and on-farm application practices.

- **Training Evaluations:** Pre- and post-training assessments to measure knowledge uptake.
- **Environmental Sampling:** Soil and water quality testing near pesticide application sites.
- **Health Monitoring:** Coordination with MoHS for tracking pesticide-related illnesses.

9.4 Institutional Roles in M&E

Institution	M&E Roles
MAFS / CPU	Lead pest surveillance and training evaluations
EPA-SL	Conduct pesticide audits and environmental sampling
DAOs	Compile local monitoring data and report incidents
MoHS	Monitor and report health-related impacts of pesticide exposure
SLARI / Njala University	Support applied research and impact assessments
Project PIU / GRM Focal Points	Track grievances and ensure timely resolution. Environmental sampling

9.5 Reporting, Feedback, and Learning

- **Quarterly Reports** will be compiled by DAOs and submitted to MAFS/CPU and the PIU.
- **Annual Reviews** will consolidate field findings and recommend improvements.
- **Learning Workshops** will be held yearly with stakeholders to reflect on M&E results and update implementation approach.

10 Pest Management Implementation Budget

This chapter outlines the provisional budget required to implement the Pest Management Plan (PMP) under the Sierra Leone SAPZ Project. The budget reflects projected investments over the project lifecycle and is designed to be activity-based, allowing for adjustments as needed during implementation.

10.1 Overview

The pest management budget is structured around four major categories: capacity building and training, monitoring and research, equipment and materials, and field supervision and outreach. It supports the rollout of Integrated Pest Management (IPM) strategies, safe pesticide use, institutional strengthening, and community-level awareness.

10.2 Summary Budget Table

Budget Category	Description	Estimated Cost (US$)
A. Capacity Building and Awareness		**120,000**
IPMP Orientation Workshops	Orientation sessions within SAPZ beneficiary regions	15,000
Training of Trainers (ToT)	For MAFS staff, including Crop Protection and Extension Officers	10,000
Farmer Group Training	IPM and agrochemical safety awareness for beneficiary farmers	25,000
Training on Use and Storage of Pesticides	Demonstrations and sample provision	20,000
Training of Pesticide Distributors	Registration and awareness for resellers/distributors	10,000
Follow-up Field Visits	On-site verification of IPM adoption and challenges	5,000
IPMP Field Materials	Brochures, handbooks, and visual aids	10,000
Support to IPMP R&D	Sample analysis and validation of exposure levels	5,000
Pesticide Inventory	National/local stocktaking and database setup	20,000
B. Equipment and Materials		**7,000**
Procurement of Certified Spraying Equipment	Knapsack, backpack sprayers, and mist blowers	7,000
Total Estimated Budget		**127,000**

10.3 Budget Justification

The proposed budget prioritizes farmer training, frontline technical staff support, regulatory compliance, and practical equipment provision. Investment in orientation and farmer outreach ensures widespread adoption of IPM methods, while pesticide inventory and research support long-term sustainability. The procurement of certified spraying equipment reduces exposure risks and supports safe handling.

10.4 Flexibility and Revisions

The budget is indicative and not fixed. Adjustments may be made based on evolving implementation needs, field realities, and further guidance from the Ministry of Agriculture and Food Security (MAFS), EPA-SL, and the African Development Bank (AfDB).

Periodic budget reviews will be conducted alongside PMP progress evaluations to ensure continued relevance and cost-efficiency.

11 Grievance Redress Mechanism (GRM)

11.1 Purpose and Scope

This Grievance Redress Mechanism (GRM) outlines the procedures for addressing grievances related to pest and pesticide management under the Sierra Leone SAPZ Project. The GRM ensures that community members, farmers, workers, and other stakeholders can raise concerns about health, environmental, safety, or operational impacts from pesticide use, storage, or disposal in a safe, confidential, and effective manner.

11.2 Objectives

- Provide a transparent and accessible process for receiving and addressing grievances.
- Ensure timely and appropriate resolution of pesticide-related complaints.
- Strengthen accountability and promote trust between communities and implementing agencies.
- Improve environmental and health safeguards related to pest management practices.

11.3 Guiding Principles

- Accessibility: Open to all project stakeholders without discrimination.
- Confidentiality: Protection of complainant identity and sensitive information.
- Timeliness: Grievances addressed within established timeframes.
- Transparency: Decisions and actions documented and communicated.
- Non-retaliation: Complainants are protected from any form of retaliation.

11.4 Grievance Redress Process

Grievances may arise from:

- Inappropriate or unsafe use of pesticides.
- Environmental contamination or pollution incidents.
- Pesticide poisoning or health-related impacts.
- Inadequate training or safety provision by implementing partners.
- Disposal of pesticide containers or expired chemicals.

Step 1: Receipt of Grievance

Grievances can be submitted via:

- Verbal complaint to community-level GRM committee.
- Written letter or complaint form.

- Phone call, SMS and WhatsAPP (text and voice note) to the designated GRM contact, PIU, DOA, grievance committee members, extension officer, etc.
- Email to the Project Implementation Unit (PIU).
- Entry into a grievance box at designated locations (e.g., agro-dealer shops, extension offices).

Step 2: Acknowledgement

Grievances are acknowledged within 3 working days by the receiving officer or committee. Each complaint is logged in the GRM register.

Step 3: Assessment and Investigation

- The community-level committee conducts initial screening and resolution within 7–14 days.
- If unresolved, the grievance is escalated to the District GRM Committee, including EPA, MAFS, and District Agriculture Office representatives.
- Serious grievances (e.g. pesticide poisoning or environmental damage) are referred to the National GRM Committee.

Step 4: Resolution and Feedback

- Resolution strategies may include mediation, technical support, corrective actions, or compensation.
- Complainants are informed in writing of the decision and any follow-up actions.
- All resolutions must be documented in the GRM database.

Step 5: Appeal

- If dissatisfied, complainants may escalate to the National GRM Committee directly or via the PIU, Ministry of Agriculture and Food Security or the Environmental Protection Agency.

11.5 Roles and Responsibilities

Stakeholder	Role in GRM
Community-Level GRM Committee	Receive and resolve simple complaints; record grievances; conduct awareness.
District GRM Committee	Investigate and resolve more complex grievances; ensure compliance with safety norms.
PIU and MAFS/CPU	Maintain records; oversee implementation; support training and coordination.
National GRM Committee	Investigate and resolve the most complex grievances; ensure compliance with safety norms and refer for punitive action.
EPA-SL	Investigate environmental violations; issue sanctions for breaches.
Independent Mediator (as needed)	Facilitate impartial resolution of contested cases.

11.6 Monitoring and Reporting

- Quarterly summaries of grievances will be prepared and shared with the PIU and the AfDB.

- Indicators include number of grievances received, resolved, pending, and resolved within timeframe.
- The GRM system will be periodically reviewed and improved based on stakeholder feedback.

11.7 Awareness and Capacity Building

- GRM awareness sessions will be conducted as part of IPM training.
- Information on the GRM process will be included in brochures, posters, and public sensitization events.
- Agro-dealers and farmer groups will be trained on grievance recording and response.

11.8 Budget Consideration

GRM activities are integrated into the overall project budget under capacity building and operational support.

This GRM complements the broader safeguards and stakeholder engagement commitments of the SAPZ Project and shall be continuously updated to remain responsive and inclusive.

12 STAKEHOLDER ENGAGEMENT

12.1 PURPOSE OF STAKEHOLDER ENGAGEMENT

The development and implementation of the Pest Management Plan (PMP) for the Sierra Leone Rice Special Agro-Processing Zone (SAPZ) Project has been guided by inclusive and participatory stakeholder engagement. The objective was to gather local insights, build ownership, and align pest management strategies with the needs, priorities, and safety concerns of affected communities and relevant institutions.

12.2 STAKEHOLDERS CONSULTED

Stakeholders consulted during PMP preparation spanned across national, district, and local levels. They included:

- Ministry of Agriculture and Food Security (MAFS), including the Crop Protection Unit (CPU)
- Environment Protection Agency Sierra Leone (EPA-SL)
- Sierra Leone Standards Bureau (SLSB)
- District Agricultural Officers (DAOs) and agricultural extension services
- Farmer-Based Organizations (FBOs)
- Agro-dealers and licensed pesticide distributors
- Farmer Field School (FFS) facilitators and beneficiaries
- Local community leaders and authorities
- Women and youth representatives in the target chiefdoms

District	Location	Stakeholder Type	Method	Date(s)
Kambia	Mambolo, Kychum, Robanna	Farmers, landowners, tenant farmers, youth, women's leaders, town chiefs, FBOs	FGDs, community meetings, KIIs	Oct 2024, Feb–Apr 2025
Port Loko	Kathoma, Mange, Rothum, Mankara	Farmers, landowners, tenant farmers, youth, women's leaders, town chiefs, FBOs	FGDs, KIIs, meetings	Feb–Apr 2025
Both	District HQs and Chiefdoms	District Councils, DAOs, EPA-SL, MAFS, agro dealers.	Key informant interviews	Apr – May 2025
National	Freetown	MAFS, EPA-SL, MLCP, SLSB	Technical meetings	May 2025

12.3 METHODS OF ENGAGEMENT

The engagement process employed a variety of tools and platforms, including:

- Key informant interviews with technical and regulatory stakeholders
- Focus group discussions with farmers and agro-dealers in Kambia and Port Loko
- District-level consultation meetings
- Informal validation sessions with agricultural researchers from Njala University and SLARI

12.4 Key Issues Raised

Stakeholder inputs revealed several recurrent themes and challenges:

Theme	Stakeholder Feedback
Pesticide Access and Quality	Counterfeit, expired, and mislabelled pesticides are widespread. Stronger enforcement and certified supply chains are needed.
Training and Capacity	Most farmers and agro dealers lack adequate training in pesticide safety, calibration, and integrated methods. Expanded outreach and refresher sessions were requested.
Health and Environmental Risks	Improper pesticide disposal, lack of PPE, and unsafe storage practices pose risks to public health and water bodies. Women voiced concern over child exposure.
Alternative Pest Control	There is growing interest in neem, ash, pepper extracts, and biological control agents, particularly if these can be made more accessible.
Monitoring and Enforcement	District-level regulatory capacity is weak due to staffing and logistics limitations. Stronger coordination among EPA, MAFS, and customs is necessary.
Local Knowledge Integration	Farmers emphasized the importance of synchronized planting, trap cropping, and traditional deterrents. These are considered effective and affordable.

12.5 PMP Adjustments Based on Stakeholder Inputs

Stakeholder feedback directly influenced several aspects of the PMP:

- Emphasis on Integrated Pest Management (IPM) and reduced chemical reliance
- Selection of pesticides with lower toxicity and WHO Class II or III classification
- Inclusion of training modules for farmers and agro-dealers
- Development of a pesticide-related grievance redress mechanism (GRM)
- Focus on community sensitization, particularly among women and youth

12.6 Ongoing Engagement Commitments

The SAPZ Project commits to continuous engagement throughout PMP implementation. Planned activities include:

- Regular consultations through District Agricultural Offices and local councils
- Monitoring feedback via the GRM system
- Use of Farmer Field Schools for participatory learning and reporting
- Dissemination of simplified IPM guides and safety messages in local languages
- Inclusion of women, youth, and vulnerable groups in decision-making

Stakeholder engagement was integral to the design of the PMP. By involving a broad range of actors, the plan is grounded in practical experience, community awareness, and regulatory alignment. Continued stakeholder participation will remain a pillar of safe and sustainable pest management under the SAPZ Project.

Community and Institutional Engagements

13 REFERENCES

African Development Bank (AfDB). (2023). *Integrated Safeguards System (ISS) Policy Statement and Operational Safeguards*. Abidjan: AfDB.

African Development Bank (AfDB). (2021). *Environmental and Social Assessment Procedures (ESAP)*. Abidjan: AfDB.

African Union. (2021). *Continental Guidelines for Integrated Pest Management in Africa*. Addis Ababa: African Union Commission.

FAO. (2021). *International Code of Conduct on Pesticide Management*. Rome: Food and Agriculture Organization of the United Nations.

FAO. (2020). *Integrated Pest Management (IPM) Toolkit for Agricultural Development Projects*. Rome: FAO Plant Production and Protection Division.

FAO & WHO. (2018). *Guidelines on Highly Hazardous Pesticides*. Rome and Geneva: FAO and World Health Organization.

Government of Sierra Leone. (2022). *The Environment Protection Agency Act, 2022*. Freetown: Government Printing Department.

Government of Sierra Leone / Ministry of Agriculture and Food Security. (2023). *National Agricultural Transformation Programme (NAT 2023–2030)*. Freetown: MAFS.

International Fund for Agricultural Development (IFAD). (2010). *Good Practices for Integrated Pest Management in Smallholder Farming*. Rome: IFAD.

International Programme on Chemical Safety (IPCS). (2019). *Health and Environmental Risk Assessment of Pesticides*. Geneva: WHO/IPCS.

Ministry of Agriculture and Food Security (MAFS), Sierra Leone. (2024). *Crop Protection Strategy and Action Plan*. Freetown: MAFS.

Ministry of Agriculture and Forestry (MAF), Sierra Leone. (2018). *National Agricultural Policy Framework*. Freetown: MAF.

United Nations Environment Programme (UNEP). (2013). *Toolkit for Sustainable Pesticide and Chemical Management in Developing Countries*. Nairobi: UNEP Chemicals Branch.

USAID. (2014). *Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) Guidelines*. Washington D.C.: United States Agency for International Development.

World Bank. (2017). *Environmental and Social Framework (ESF): Environmental and Social Standard 3 – Resource Efficiency and Pollution Prevention and Management*. Washington, D.C.: World Bank.

World Bank. (2006). *Pest Management: OP 4.09*. Washington D.C.: World Bank Operational Policies.

ANNEX 1: PESTICIDES AVAILABLE IN SIERRA LEONE & THEIR HAZARD CLASSIFICATION

Name of Product	Active Ingredient (s)	Hazard Classification	Uses
Insecticides			
Deltamethrin25EC for rice	Deltamethrin 25g/L	II	It is an insecticide that belongs to the pyrethroid class, known for its effectiveness against a wide range of pests including rice pests like rice stem borers, rice leaf folders, and rice bugs. It's often applied as a foliar spray to control these pests and protect rice crops from damage.
Abamectin 1.8EC	Abamectin 18g/L	1b	Abamectin is a widely used insecticide and acaricide derived from the soil bacterium Streptomyces avermitilis. It is effective against a variety of pests including mites, leafhoppers, and certain types of caterpillars that commonly infest rice crops. Abamectin is typically applied as a foliar spray to target pests and protect rice plants from damage.
Dimethoate	Dimethoate 40% EC	II	Systemic organophosphate insecticide and acaricide with contact and stomach action are suitable for the control of a wide range of sucking and chewing pests including aphids, whiteflies and mites on rice,
Cypermethrin	Cypermethrin 10% EC	II	It belongs to the synthetic pyrethroid class of insecticides, which are known for their effectiveness against a broad spectrum of pests including insects such as rice stem borers, rice leaf folders, and rice bugs.

Karate 5EC	Lambadacyhalothrine (50 g/l)	II	Karate 5EC is used as a pesticide in various crops, including rice, to control pests such as rice leaf folders, stem borers, and leafhoppers.
Karate 2.5EC	Lambadacyhalothrine (25 g/l)	II	Karate 2.5EC is used as a pesticide in various crops, including rice, to control pests such as rice leaf folders, stem borers, and leafhoppers.
Cyhalone 10 EC	Cyhalonthrine (100g/l)	II	It belongs to the pyrethroid class of insecticides and is effective against a wide range of pests including rice stem borers, leaf folders, and other insects that commonly infest rice crops.
Dursban 450ULV	Chlorpyrifos-ethyl (450 g/l)	II	Dursban, also known as chlorpyrifos, is an insecticide that has been used in various agricultural settings, including rice cultivation, to control a variety of pests such as rice water weevil, stem borers, and leafhoppers.
Elsan 50 EC	Phenthoate 500g/l	II	Insecticide/ovicide to control insects of rice
Furadan	Carbofuran	II	It is a broad-spectrum insecticide that is effective against a variety of pests, including rice pests like stem borers and leaf folders
Dursban 4 EC	Chlorpyrifos-ethyl (480 g/l)	II	It is effective against a wide range of insect pests including rice stem borers, leafhoppers, and leaf folders

Durban 5% DP	Chlorpyrifos-ethyl (50 g/Kg)	III	It contains the active ingredient chlorpyrifos, which is effective against a variety of insect pests commonly found in rice fields, such as stem borers, leafhoppers, and leaf folders.
Dursban 240 EC	Chlorpyrifos-ethyl (480 g/l)	II	It is effective against a wide range of insect pests, including rice stem borers, leafhoppers, and leaf folders.
Dexban 48% EC	Chlorpyrifos 48%	II	It is commonly used to control a variety of insect pests in different crops, including rice. Deltamethrin is effective against a wide range of pests such as rice stem borers, leafhoppers, and leaf folders.
Chorsban 480 EC	Chlorpyrifos-ethyl	II	Chlorpyrifos" is the active ingredient in "Chorsban 480 EC," and it is indeed an insecticide commonly used in rice cultivation.
Decis 25 EC	Deltamethrin (25 g/l)	II	Decis 25 EC is an insecticide that contains the active ingredient deltamethrin. It is commonly used in rice cultivation to control a variety of insect pests, including rice leaf folder, rice stem borer, and rice bug.
Dimethoate	Dimethoate 40% EC	II	Dimethoate is an insecticide commonly used in rice cultivation. It is effective against a variety of pests that attack rice plants, including rice leaf folders, rice stem borers, and rice leafhoppers. Dimethoate works by inhibiting the activity of acetylcholinesterase, an enzyme necessary for the proper functioning of the nervous system in insects. This leads to paralysis and eventually death of the targeted pests.

Actellic 50 EC	Pirimiphosmethyl (50 g/l)	III	Actellic 50 EC is an insecticide commonly used in rice cultivation. It contains the active ingredient pirimiphos-methyl, which belongs to the organophosphate class of insecticides. Actellic 50 EC is effective against a variety of insect pests that infest rice crops, including rice weevils, rice bugs, and storage pests.
Actellic 300 CS	Pirimiphosmethyl (300 g/l)	III	Actellic 50 EC is an insecticide commonly used in rice cultivation. It contains the active ingredient pirimiphos-methyl, which belongs to the organophosphate class of insecticides. Actellic 50 EC is effective against a variety of insect pests that infest rice crops, including rice weevils, rice bugs, and storage pests.
Actellic Super Dust	Permethrine (3 g/kg) / Pirimiphosmethyl (50 g/l)	II	Actellic Super Dust is an insecticide used in rice cultivation. It contains the active ingredient pirimiphos-methyl, which is an organophosphate insecticide effective against a variety of pests commonly found in stored rice, such as weevils, beetles, and moths. Actellic Super Dust is often applied to rice grains during storage to protect them from insect infestation and damage.
Actellic Gold Dust	Pirimiphosmethyl (16 g/l) / Thiamethoxam (3.6g/kg)	III	It contains the active ingredient pirimiphos-methyl, which is an organophosphate insecticide effective against a variety of pests commonly found in stored rice, such as weevils, beetles, and moths. Actellic Super Dust is often applied to rice grains during storage to protect them from insect infestation and damage. in stored rice,.

Dimet 400 EC	Dimethoate	II	It belongs to the organophosphate class of insecticides and is effective against a wide range of pests that infest rice crops, including aphids, leafhoppers, planthoppers, and thrips. Dimethoate works by inhibiting the activity of acetylcholinesterase, an enzyme essential for the proper functioning of the nervous system in insects. This disruption leads to paralysis and eventual death of the pests.
Pacharr 25 EC	Acetamipride 1g/l + Lambdacyhalothrin 1g/l	II	Acetamiprid is a neonicotinoid insecticide effective against a broad spectrum of pests including aphids, leafhoppers, thrips, and whiteflies. It acts on the nervous system of insects, disrupting neurotransmission, and ultimately causing death. Lambda-cyhalothrin, on the other hand, is a pyrethroid insecticide that targets a wide range of insect pests such as rice stem borers, rice leaf rollers, and other chewing and sucking insects. It works by affecting the sodium channels in the nervous system of insects, leading to paralysis and death.
Tiger benzoate	Emamtectin	II	Emamectin benzoate is indeed an insecticide that is used in rice cultivation. It is effective against a variety of pests, including caterpillars, leafhoppers, and other chewing insects that can damage rice crops. Emamectin benzoate works by disrupting the nervous system of insects, leading to paralysis and eventual death. It is commonly applied to rice crops in various formulations such as liquid concentrates or granules.

Herbicides			
Yuperstar	Propanil 360g/L P	II	Propanil is used to control various kinds of weeds and grasses especially effective for cockspur grass, barnyard grass, broadleaves weeds on rice fields
Pendimethalin 33 EC	Pendimethalin 33%	II	It primarily targets annual grasses and certain broadleaf weeds by inhibiting their cell division and growth processes. Pendimethalin can effectively control a wide range of weeds in rice fields, including grassy weeds like barnyard grass, crabgrass, and broadleaf weeds like pigweeds and certain sedges. It's typically applied as a pre-emergent herbicide, meaning it's applied before weed seeds germinate or shortly after rice seedlings are transplanted to the field. This helps prevent weed competition and ensures better yields for the rice.
Londox 60 DF	Bensulfuran methyl 600g/l	III	Herbicide selective for irrigated rice to control Cyperus weeds and effective against Dicotyledons weeds.
Stomp 33 EC	Pendimethalin 33%	III	For the control of annual, perennial, and aquatic weeds on rice

Quizar super	Quizalofop-PEthyl 100g/L	II	Quizalofop-P-ethyl is indeed an herbicide that is commonly used in rice cultivation. It belongs to the aryloxyphenoxypropionate class of herbicides and is effective against grass weeds in rice fields. Quizalofop-P-ethyl works by inhibiting the enzyme acetyl-CoA carboxylase, which is essential for lipid synthesis in grass weeds. This inhibition disrupts the growth and development of grass weeds, ultimately leading to the death of the plant
Propanil	Primagold	II	Used as a selective post-emergence herbicide in the control of grasses and broad leaves in rice fields.
Rival 360 SL	Glyphosate (360 g/l)	III	It is particularly effective against grass weeds such as barnyard grass, watergrass, and signal grass, as well as some broadleaf weeds like smartweed. Rival 360 SL is typically applied post-emergence to control weeds in rice fields.
Roundup Biosec 68 SG	Glyphosate (680 g/kg)	III	It is a broad-spectrum herbicide effective against a wide range of weeds, including both grasses and broadleaf weeds. Glyphosate works by inhibiting the enzyme EPSP synthase, which is essential for the synthesis of certain amino acids in plants. This inhibition disrupts the growth and development of weeds, ultimately leading to their death.
Roundup 360 K	Glyphosate (360 g/kg)	III	It is a broad-spectrum herbicide effective against a wide range of weeds, including both grasses and broadleaf weeds. Glyphosate works by inhibiting the enzyme EPSP synthase, which is essential for the synthesis of certain amino

			acids in plants. This inhibition disrupts the growth and development of weeds, ultimately leading to their death.
Roundup 450 Turbo K	Glyphosate (450 g/kg)	III	It is a broad-spectrum herbicide effective against a wide range of weeds, including both grasses and broadleaf weeds. Glyphosate works by inhibiting the enzyme EPSP synthase, which is essential for the synthesis of certain amino acids in plants. This inhibition disrupts the growth and development of weeds, ultimately leading to their death.
Cotonet 500 EC	Metolachlore (333 g/l) / terbutryne (167 g/l)	III	Metolachlor, primarily targets grasses and some broadleaf weeds. Metolachlor inhibits weed seedling growth by affecting lipid synthesis in the plants. Terbutryne is a selective herbicide used for pre-emergence and early post-emergence control of grasses and some broadleaf weeds
Oxanet 250 EC	Oxadiazon (250 g/l)	III	Oxadiazon is an herbicide commonly used in rice cultivation. It belongs to the chemical class of oxadiazole herbicides. Oxadiazon primarily acts as a pre-emergent herbicide, meaning it is applied to soil before weed seeds germinate to prevent weed emergence.
Callistar 250 EC	Oxadiazon (250 g/l)	III	Oxadiazon works by inhibiting the growth of weed seedlings by interfering with the synthesis of carotenoid pigments, which are essential for photosynthesis. It effectively controls a wide range of annual grasses and broadleaf weeds.

Oxariz 250 EC	Oxadiazon (250 g/l)	II	Oxadiazon is a herbicide commonly used in rice cultivation. It belongs to the chemical class of oxadiazole herbicides. Oxadiazon primarily acts as a pre- emergent herbicide, meaning it is applied to soil before weed seeds germinate to prevent weed emergence.
Fungicides			
Prochlor super	Prochloraz 25% N	III	Prochloraz is effective against a wide range of rice diseases including blast (caused by the fungus Magnaporthe oryzae), sheath blight (caused by the fungus Rhizoctonia solani), and leaf smut (caused by the fungus Pyricularia grisea). Prochloraz works by inhibiting the growth of fungi and disrupting their ability to reproduce, ultimately leading to the control of fungal diseases. It's typically applied as a foliar spray or seed treatment to protect rice plants from fungal infections and to prevent yield losses.
Dithane M 45	Mancozeb (800 g/kg)	U	Dithane M-45 is a fungicide that is commonly used in rice cultivation. It contains the active ingredient mancozeb, which belongs to the group of dithiocarbamate fungicides. Mancozeb is effective against a wide range of fungal diseases that can affect rice crops, including blast (caused by the fungus Magnaporthe oryzae), sheath blight (caused by Rhizoctonia solani), and leaf spot diseases. It works by interfering with various enzymes and processes within the fungal cells, ultimately leading

			to their death.
Coga 80 WP	Mancozeb (800 g/kg)	U	Mancozeb is effective against a wide range of fungal diseases that can affect rice crops, including blast (caused by the fungus Magnaporthe oryzae), sheath blight (caused by Rhizoctonia solani), and leaf spot diseases. It works by interfering with various enzymes and processes within the fungal cells, ultimately leading to their death.
Dithane, R	Mancozeb	II	It contains the active ingredient mancozeb, which belongs to the group of dithiocarbamate fungicides. It works by interfering with various enzymes and processes within the fungal cells, ultimately leading to their death.
Yuhomil	Metalaxyl 8% + Mancozeb 64%	II	Metalaxyl is a systemic fungicide that belongs to the group of phenylamide fungicides. It is effective against diseases caused by oomycetes, such as damping- off, seedling blights, and root rots.
Seedox	Imidachlorpride 10% + metalaxyl 10% + carbendazine 10%	II	Seed treatment is effective in preventing and killing Nephotettix cincticeps, Delphacidae, Phytophthira, Drosophila, weevils, rice borer, Bemisia tabaci etc. in rice,
Calthio C 50 WS	Thirame (250 /kg) / chlorpyrifos ethyl (250 g/kg)	II	Thiram is a broad-spectrum fungicide and seed treatment agent. It is effective against a wide range of fungal diseases such as damping-off, seedling blights, and various soil-borne diseases. Thiram works by

			inhibiting fungal growth and preventing the establishment of fungal infections. Chlorpyrifos ethyl is an insecticide belonging to the organophosphate class. It is effective against a broad range of insect pests, including rice stem borers, leafhoppers, and other chewing and sucking insects
Calthio C 1350 FS	Imidacloprid (250 g/l) Thirame (100 g/l)	II	Imidacloprid is a systemic insecticide belonging to the neonicotinoid class. It is effective against a wide range of sucking insects, including aphids, leafhoppers, and whiteflies. It is effective against various fungal diseases such as damping-off, seedling blights, and soil-borne diseases. Thiram works by inhibiting fungal growth and preventing the establishment of fungal infections.

Hazard Classification (toxicity levels): 1a – Extremely Hazardous; 1b – Highly Hazardous; II – Moderately Hazardous; III – Slightly Hazardous; U – Unlikely to present acute hazard

ANNEX 2: MAFS-APPROVED PESTICIDE PRODUCTS

The following table lists pesticide products approved by the Ministry of Agriculture and Food Security (MAFS) for use in Sierra Leone, along with their chemical classification and WHO hazard class. These products are to be used in accordance with integrated pest management (IPM) principles and national safety guidelines.

Type	Active Ingredient	Subgroup / Classification	WHO Hazard Class
INSECTICIDES	Imidacloprid	Neonicotinoid	II (Moderately hazardous)
	Alpha-Cypermethrin (Alphamethrin)	Pyrethroid	II (Moderately hazardous)
	Cypermethrin	Pyrethroid	II (Moderately hazardous)
	Deltamethrin	Pyrethroid	II (Moderately hazardous)
	Chlorpyrifos	Organophosphate	II (Moderately hazardous)
	Diazinon	Organophosphate	II (Moderately hazardous)
FUNGICIDES	Captan	Phthalimide	U (Unlikely to present acute hazard)
	Mancozeb	Dithiocarbamate	U (Unlikely to present acute hazard)
	Propineb	Dithiocarbamate	U (Unlikely to present acute hazard)
	Difenoconazole	Triazole	II (Moderately hazardous)
	Tebuconazole	Triazole	II (Moderately hazardous)
	Cupric oxide (Copper II Oxide)	Inorganic Fungicide	II (Moderately hazardous)
HERBICIDES	Ethofumesate	Benzofuran	III (Slightly hazardous)
	Glyphosate	Phosphonoglycine	U (Unlikely to present acute hazard)
	Metamitron	Triazinone	III (Slightly hazardous)
	Propanil	Anilide	II (Moderately hazardous)
FUMIGANTS	*Zinc Phosphide	Inorganic compound / Acute rodenticide	Ia (Extremely hazardous)
	*Aluminium phosphide	Inorganic phosphide / Fumigant	Ia (Extremely hazardous)

**Restricted use only*

ANNEX 3: RISK ASSESSMENT MATRIX AND TOXICOLOGICAL PROFILES OF SELECTED PESTICIDES

This annex provides a detailed risk assessment matrix and toxicological profile of the key active pesticide ingredients recommended under the SAPZ Integrated Pest Management Plan. The information below aims to support safe and informed pesticide use by highlighting potential human health and environmental risks, WHO hazard classifications, and relevant safety measures.

A. RISK ASSESSMENT MATRIX

Active Ingredient	Pesticide Type	WHO Hazard Class	Toxicological Risks	Environmental Risks	Remarks / Controls
Imidacloprid	Insecticide	II (Moderately Hazardous)	Neurotoxic effects; low mammalian toxicity orally	Highly toxic to bees and aquatic invertebrates	Avoid application during flowering. Use IPM-compatible doses.
Alpha-Cypermethrin	Insecticide	II	Skin and eye irritant, neurotoxic at high doses	Toxic to fish, bees	Use PPE; restrict use near water bodies
Cypermethrin	Insecticide	II	Dermal toxicity, neurotoxic in large doses	Toxic to aquatic organisms and bees	Apply during low wind; store securely
Deltamethrin	Insecticide	II	Mild skin and eye irritant; neurotoxic in high exposure	Very toxic to fish and aquatic insects	Avoid drift to waterways; use protective gear
Chlorpyrifos	Insecticide	II	Cholinesterase inhibitor; serious neurotoxic risk	High persistence; toxic to birds, fish, bees	Use only with strict dosage control and environmental buffers
Diazinon	Insecticide	II	Systemic toxicity; inhibits cholinesterase	Highly toxic to birds, bees, and fish	Follow label restrictions; limit frequency of use
Captan	Fungicide	U (Unlikely Hazard)	Mild skin and eye irritation	Moderate persistence; low bioaccumulation	Wear gloves and avoid direct skin contact
Mancozeb	Fungicide	U	Thyroid effects; potential endocrine disruptor	Toxic to aquatic life	Use during dry conditions and with containment practices

Propineb	Fungicide	II	May affect liver function; long-term exposure risks	Persistent in environment	Rotate with non-dithiocarbamate fungicides
Difenoconazole	Fungicide	II	Possible carcinogenicity; eye irritation	Toxic to aquatic organisms	Avoid application near water sources
Tebuconazole	Fungicide	III (Slightly Hazardous)	Hepatotoxic and teratogenic in high doses	Moderate environmental persistence	Use PPE and observe pre-harvest intervals
Cupric Oxide	Fungicide	II	Skin/eye irritation; heavy metal accumulation risk	Persistent; bioaccumulative in aquatic systems	Use cautiously; avoid water contamination
Ethofumesate	Herbicide	III	Low acute toxicity; limited chronic data	Low mobility in soil	Safe if label directions are followed
Glyphosate	Herbicide	III	Eye and skin irritation; debated carcinogenicity	Low persistence; potential for aquatic weed resistance	Avoid overuse; follow strict label guidance
Metamitron	Herbicide	III	Low to moderate toxicity; photosensitive skin reactions	Low mobility, slight persistence	Use during early growth; limit re-application
Propanil	Herbicide	II	Hemolytic anemia, methemoglobinemia in large doses	Short persistence in water and soil	Use with caution in poorly drained areas
Zinc Phosphide	Fumigant	Ib (Highly Hazardous)	Severe acute toxicity; ingestion leads to respiratory failure	Highly toxic to all non-target fauna	Only for rodent control by trained personnel
Aluminium Phosphide	Fumigant	Ia (Extremely Hazardous)	Releases phosphine gas; fatal if inhaled	Very high acute environmental toxicity	Only trained users under supervision

B. Toxicological Classifications and Exposure Controls

Toxicity classification follows WHO recommendations:

- **Class Ia**: Extremely hazardous
- **Class Ib**: Highly hazardous
- **Class II**: Moderately hazardous
- **Class III**: Slightly hazardous
- **Class U**: Unlikely to pose acute hazard in normal use

General Recommendations

- Always follow label instructions and pre-harvest intervals.
- Use personal protective equipment (PPE) including gloves, goggles, masks, and boots.
- Ensure safe pesticide storage, away from children and food.
- Avoid pesticide application near water sources and pollinator habitats.
- Implement buffer zones and containment practices.

This annex is to be reviewed periodically as more data becomes available or as new pesticides are introduced or phased out under national regulatory guidance.

ANNEX 4: IMPLEMENTATION MATRIX

This annex summarizes the institutional roles and responsibilities for the implementation of the Pest Management Plan (PMP) under the Sierra Leone SAPZ Project.

Institution	Roles and Responsibilities
Project Implementation Unit (PIU)	• Provide overall coordination of PMP activities across all levels • Ensure alignment of PMP implementation with project objectives and AfDB safeguards - Facilitate timely resource allocation and procurement for PMP-related activities • Liaise with MAFS, EPA-SL, and other stakeholders on progress and challenges • Compile and submit periodic implementation and monitoring reports to the AfDB
Ministry of Agriculture and Food Security (MAFS) / Crop Protection Unit (CPU)	• Lead development and implementation of IPM strategies • Coordinate pest surveillance and training programs • Promote biological control and safe pesticide use • Support pesticide registration and awareness campaigns
Environment Protection Agency – Sierra Leone (EPA-SL)	• License pesticide imports, storage, and use • Review and approve agrochemical management plans • Conduct environmental compliance monitoring • Coordinate with other regulators and raise public awareness
Sierra Leone Standards Bureau (SLSB)	• Set and enforce national standards for pesticides • Certify pesticide quality and packaging • Train agro-dealers on proper product handling • Collaborate with EPA-SL on inspections and enforcement
District Agricultural Offices (DAOs)	• Deliver local IPM training and sensitization • Organize Farmer Field Schools • Monitor local pest outbreaks - Report pesticide use data to CPU
Agro-Dealers	• Sell only approved pesticide products • Adhere to national safety and labelling regulations • Provide guidance to farmers on proper pesticide use • Allow regulatory inspections and cooperate with enforcement
Farmers and Farmer-Based Organizations (FBOs)	• Participate in IPM training and safe pesticide use • Report incidents of misuse or poisoning • Dispose of pesticide containers properly • Engage in community-based pest surveillance systems
NGOs, SLARI, Njala University	• Conduct research on resistant varieties and biopesticides • Develop pest diagnostic tools and models • Support technical training for field extension agents • Translate research into policy and community practice
District Stakeholder Committees	• Convene coordination meetings at district level • Facilitate dialogue among DAOs, NGOs, agro-dealers, and farmers • Address implementation challenges and align local efforts with national goals

ANNEX 5: PEST MANAGEMENT PLAN IMPLEMENTATION MATRIX

Activity	Description	Timeline	Responsible Entity	Supporting Entities	Monitoring Indicators
PMP Orientation Workshops	Conduct awareness and orientation on IPMP in project districts	Year 1	PIU, MAFS	District Agricultural Offices, Extension Services	Number of workshops held; attendance records
Training of Trainers (ToT)	Build capacity of MAFS staff on IPM techniques and safe pesticide use	Year 1–2	MAFS, PIU	Crop Protection Directorate	Number of staff trained; training reports
Farmer Group Trainings	Capacity building for farmers on IPM, pesticide handling, and alternatives	Year 2–5	Extension Services, PIU	Farmer-Based Organizations (FBOs), NGOs	Number of farmers trained; training effectiveness feedback
Pesticide Inventory	National and regional inventory of pesticides in use	Year 1	PIU	MAFS, EPA-SL	Inventory database completed and updated
Registration and Training of Pesticide Distributors	Ensure that distributors are licensed and trained on safe practices	Year 1–3	EPA-SL	PIU, Ministry of Trade and Industry	Number of distributors registered and trained
IPMP Research Support	Monitor pesticide residues in soil, water, crops, and livestock	Year 2–5	MAFS, Research Institutes	PIU, Njala University	Number of samples analyzed; quarterly reports
Development of IPM Guidelines	Prepare and disseminate guidelines tailored to SAPZ rice systems	Year 1	PIU	MAFS, NGOs	Guidelines published and distributed
Public Awareness Campaigns	Promote non-chemical pest control, health & environmental risks	Year 1–3	PIU	EPA-SL, MoHS, Community Radio	Number of radio messages; awareness survey results
Monitoring & Evaluation	Routine field verification, compliance	Year 2–5	PIU	MAFS, EPA-SL	Quarterly M&E reports;

	tracking, impact analysis				corrective actions tracked
PMP Implementation Reporting	Annual reporting on progress of IPMP activities to AfDB and stakeholders	Annually	PIU	MAFS, EPA-SL	Reports submitted; feedback received and integrated