



PEST MANAGEMENT PLAN (PMP)

**THE KADUNA SPECIAL AGRO-INDUSTRIAL PROCESSING ZONES (SAPZ),
KADUNA STATE, NIGERIA**



OCTOBER 1, 2025



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FOR THE

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KADUNA STATE, NIGERIA**

FINAL REPORT

OCTOBER, 2025



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LIST OF ABBREVIATIONS AND ACRONYMS

ABU	– Ahmadu Bello University
ACs	– Aggregation Centers
ADPs	– Agricultural Development Projects
AfDB	– African Development Bank
AIH	– Agro-Industrial Hub
AIHs	– Agro-Industrial Hubs
APPEALS	– Agro-Processing, Productivity Enhancement and Livelihood Improvement Support Project (World Bank project in Nigeria)
BCAs	– Biological Control Agents
BCP	– Biological Control Practices
BoI	– Bank of Industry
Bt	– <i>Bacillus thuringiensis</i>
CADP	– Commercial Agriculture Development Project
CBOs	– Community-Based Organizations
CMV	– Cassava Mosaic Virus
CSOs	– Civil Society Organizations
CSR	– Corporate Social Responsibility
DDT	– Dichlorodiphenyltrichloroethane (synthetic pesticide)
ECOWAS	– Economic Community of West African States
EHS	– Environmental, Health and Safety
EIA	– Environmental Impact Assessment
ESA	– Environmental and Social Assessment
ESF	– Environmental and Social Framework (World Bank)
ESIA	– Environmental and Social Impact Assessment
ESMP	– Environmental and Social Management Plan
ESS	– Environmental and Social Standard (World Bank)
ESS3	– Environmental and Social Standard 3 (Resource Efficiency and Pollution Prevention)
ESS6	– Environmental and Social Standard 6 (Biodiversity Conservation)
ETL	– Economic Threshold Level
FADAMA	– Irrigable lowlands in Hausa language, used in World Bank-funded agricultural projects in Nigeria
FAO	– Food and Agriculture Organization of the United Nations
FCT	– Federal Capital Territory
FCTIU	– FCT Implementation Unit
FFS	– Farmer Field Schools
FGN	– Federal Government of Nigeria
FMARD	– Federal Ministry of Agriculture and Rural Development (now FMAFS)
FMAFS	– Federal Ministry of Agriculture and Food Security
FME_{env}	– Federal Ministry of Environment
GAAIZ	– Green Agro-Allied Industrial Zone
GAP	– Good Agricultural Practices
GIS	– Geographic Information System
GRM	– Grievance Redress Mechanism
G.A.P.	– Good Agricultural Practice (global certification scheme)
IAR	– Institute for Agricultural Research
ICT	– Information and Communication Technology
IFAD	– International Fund for Agricultural Development
IPCC	– Intergovernmental Panel on Climate Change
IPM	– Integrated Pest Management
IPMM	– Integrated Pest Management Measures
IPMP	– Integrated Pest Management Plan
IPPC	– International Plant Protection Convention



IsDB – Islamic Development Bank
ISS – Integrated Safeguards System (AfDB)
KAD-MA – Kaduna State Ministry of Agriculture
KAD-MoA – Kaduna State Ministry of Agriculture
KADP – Kaduna State Agricultural Development Program
KASU – Kaduna State University
KEPA – Kaduna State Environmental Protection Agency
KPI – Key Performance Indicator
LFN – Laws of the Federation of Nigeria
LGAs – Local Government Areas
LRP – Livelihood Restoration Plan
M&E – Monitoring and Evaluation
MDAs – Ministries, Departments, and Agencies
MRL – Maximum Residue Limit
MSMEs – Micro, Small, and Medium Enterprises
NAFDAC – National Agency for Food and Drug Administration and Control
NAERLS – National Agricultural Extension and Research Liaison Services
NAIDAN – National Agro-Input Dealers Association of Nigeria
NAPAMS – National Agency Product Administration and Monitoring System (NAFDAC)
NAQS – Nigerian Agricultural Quarantine Service
NESREA – National Environmental Standards and Regulations Enforcement Agency
NGOs – Non-Governmental Organizations
NPPON – National Plant Protection Organization of Nigeria
NSIA – Nigeria Sovereign Investment Authority
OHS – Occupational Health and Safety
OS – Operational Safeguard (AfDB)
OS1 – Operational Safeguard 1 (Assessment and Management of Environmental and Social Risks and Impacts)
OS3 – Operational Safeguard 3 (Pollution Prevention and Control, Hazardous Materials, and Resource Efficiency)
OS4 – Operational Safeguard 4 (Community Health, Safety and Security)
OS10 – Operational Safeguard 10 (Stakeholder Engagement and Information Disclosure)
PAPs – Project-Affected Persons
PCBs – Polychlorinated Biphenyls
PCM Committee / IPCMC – (Inter-Agency) Pest and Chemical Management Committee
PDO – Project Development Objective
PHPM – Post-Harvest Pest Management
PIC – Prior Informed Consent (Rotterdam Convention)
PICS – Purdue Improved Crop Storage
PIU – Project Implementation Unit
PME – Participatory Monitoring and Evaluation
PMP – Pest Management Plan
PPE – Personal Protective Equipment
PPPs – Public-Private Partnerships
PPSIS – Pesticide and Pest Surveillance Information System
PSIUs – Participating State Implementing Units
PSEWS – Pest Surveillance and Early Warning System
QA – Quality Assurance
RAP – Resettlement Action Plan
R&D – Research and Development
SAPZ – Special Agro-Industrial Processing Zone
SOPs – Standard Operating Procedures
TAAT – Technologies for African Agricultural Transformation



ToT – Training of Trainers

TRIMING – Transforming Irrigation Management in Nigeria (World Bank project)

TYLCV – Tomato Yellow Leaf Curl Virus

WAAPP – West Africa Agricultural Productivity Project

WHO – World Health Organization



EXECUTIVE SUMMARY

ES.1 Introduction

The Kaduna State Special Agro-Industrial Processing Zone (SAPZ) Project is a flagship agricultural transformation initiative jointly implemented by the African Development Bank (AfDB), the Federal Government of Nigeria (FGN), and the Kaduna State Government. The project aims to boost agricultural productivity, enhance agro-industrial value chains, and improve rural livelihoods through the establishment of an Agro-Industrial Hub (AIH) at Daki-Takwas (Chikun LGA) and an Agricultural Transformation Center (ATC) at Dutsen-Wai (Kubau LGA).

This Pest Management Plan (PMP) has been prepared in strict compliance with the AfDB's ****Integrated Safeguards System (ISS)**, particularly Operational Safeguard 3 (OS3) on Pollution Prevention and Control, Hazardous Materials, and Resource Efficiency, which explicitly requires a PMP for projects with significant pest risks. The plan also aligns with the World Bank's Environmental and Social Standards (ESS3 on Resource Efficiency and Pollution Prevention, and ESS6 on Biodiversity Conservation). The PMP provides a strategic framework to ensure that all pest and pesticide management under the SAPZ is environmentally sound, socially responsible, and sustainable.

ES.2 Environmental and Social Consequences of Current Pest Management Practices

Agricultural intensification under the SAPZ will increase pest pressure. A baseline assessment reveals that current practices in Kaduna State are predominantly chemical-based and characterized by:

- Excessive and inappropriate use of hazardous synthetic pesticides (e.g., Paraquat, Glyphosate);
- Poor storage and disposal practices, including unsafe reuse of containers and disposal near water sources;
- Minimal use of ecological or biological control options; and
- Limited awareness among farmers of safe handling procedures, leading to frequent health symptoms.

These practices have resulted in soil and water contamination, reduced biodiversity, emerging pest resistance, significant health risks to farm workers, and potential residue accumulation in food and export commodities. Addressing these challenges mandates a transition to Integrated Pest Management (IPM) approaches.

ES.3 Potential Impacts of Pest and Pesticide Management on Project Activities

The effectiveness of pest management is directly tied to the success and sustainability of SAPZ operations. Poorly managed pest control could lead to:

- Environmental Degradation: Pollution of soil and groundwater, harm to pollinators and beneficial organisms.
- Public Health Risks: Pesticide exposure, acute poisoning, and chronic illnesses among farmers and nearby communities.
- Economic Losses: Reduced yields, non-compliance with international residue limits (e.g., EU standards), and reduced export value.
- Reputational Damage: Social resistance and reputational risks for the SAPZ and its funding partners.

Conversely, adopting the IPM practices outlined in this PMP will:

- Enhance productivity, food safety, and market access
- Lower environmental footprints and protect ecosystem services; and



- Strengthen compliance with AfDB, national, and international sustainability standards.

ES.4 Overview of the SAPZ Project (AIH and ATC)

The Agro-Industrial Hub (AIH) and the Agricultural Transformation Center (ATC) are designed as integrated production and processing nodes. Key project components relevant to the PMP include:

- Agro-processing and Infrastructure Development: Construction of processing plants, cold storage, and logistics facilities.
- Farmer Support and Value Chain Services: Provision of quality inputs, training, and extension support.
- Institutional Strengthening: Development of policies, regulations, and capacity for sustainable agriculture.
- Project Coordination and Management: Through the SAPZ Project Implementation Unit (PIU) housed in the Kaduna State Ministry of Agriculture.

ES.5 Overview of Target Crops and Associated Pest Problems

The SAPZ program targets key value chains—maize, tomato, ginger, and soybean—which are vital to food security and export. These crops face significant pest pressures, causing annual yield losses of 25–40%. Key pests include:

Crop	Major Insect Pests	Principal Diseases	Key Weeds
Maize	Fall armyworm (<i>Spodoptera frugiperda</i>), stem borers	Maize streak virus, leaf blight, rust	<i>Striga hermonthica</i> , <i>Cyperus</i> spp.
Tomato	Tomato leaf miner (<i>Tuta absoluta</i>), fruit borers, whiteflies	Tomato yellow leaf curl virus, bacterial spot, late blight	<i>Amaranthus</i> spp., <i>Solanum nigrum</i>
Ginger	Ginger beetle, ginger lily borer	Bacterial wilt, leaf spot, rhizome rot	Broadleaf weeds, sedges
Soybean	Pod borers, aphids	Rust, bacterial pustule	<i>Commelina benghalensis</i> , <i>Euphorbia</i> spp.

ES.6 Current Approaches to Pest Management

Pest control in Kaduna State is overwhelmingly chemical-based, with cultural and biological methods used minimally and unsystematically. Current problematic approaches include:

- Widespread, often prophylactic, use of synthetic insecticides, herbicides, and fungicides;
- Limited farmer training on proper dosage, timing, and safety;
- Weak regulatory enforcement on pesticide registration and quality control; and
- Minimal research-extension linkages to promote non-chemical alternatives.

The PMP advocates a fundamental shift from this reactive pesticide dependence to a proactive Integrated Pest Management (IPM) approach based on prevention, monitoring, and environmentally responsible control methods.

ES.7 Current Issues in the Use and Management of Synthetic Chemical Pesticides

Systemic challenges within the pest control sector in Nigeria that impact the SAPZ include:

- Proliferation of counterfeit and substandard pesticides in informal markets.



- Weak enforcement of NAFDAC registration and importation procedures.
- Insufficient extension coverage for safe pesticide handling and IPM.
- Limited laboratory capacity for pesticide residue monitoring and quality assurance.
- Low awareness and access to biological control agents and bio-pesticides.
- Improper disposal of expired products and empty pesticide containers.

These issues highlight the urgent need for capacity development, regulatory harmonization, and stronger multi-stakeholder coordination.

ES.8 Policy, Legal, and Institutional Framework for IPM

The PMP is anchored on a robust assessment of Nigeria's environmental and agricultural policies, including:

- National Environmental (Hazardous Chemicals and Pesticides) Regulations.
- NAFDAC Act and Pesticide Registration Regulations.
- Environmental Impact Assessment Act.
- AfDB ISS (OS1, OS3, OS4, OS10) and World Bank ESS3 & ESS6.
- FAO/WHO International Code of Conduct on Pesticide Management.

Key implementing institutions include NAFDAC, NESREA, FMEnv, NAQS, NAERLS, IAR, and Kaduna State Ministry of Agriculture (KAD-MARD). The institutional capacity assessment revealed adequate legal frameworks but fragmented inter-agency coordination, limited laboratory capacity, weak extension coverage, and inadequate funding for surveillance.

ES.9 Project Integrated Pest Management Measures (IPMM)

The PMP outlines a comprehensive suite of ten integrated pest management strategies designed to reduce pesticide dependence and ensure compliance with AfDB safeguards. Key measures include:

- **Pest Surveillance and Monitoring:** Establishment of a Pest Surveillance and Early Warning System (PSEWS) using GIS and mobile applications for real-time reporting.
- **Capacity Building:** Formation of **Farmer Field Schools (FFS) and Training-of-Trainers (ToT) programs for extension officers, farmers, and agro-dealers.
- **Environmental, Health and Safety (EHS) Measures:** Mandatory provision and use of Personal Protective Equipment (PPE), establishment of pesticide container collection points, and occupational health monitoring.
- **Promotion of Biological Control Support** for the registration and commercialization of bio-pesticides and conservation of natural enemies.
- **Institutional Coordination:** Creation of an **Inter-Agency Pest and Chemical Management Committee (PCMC) to harmonize activities of NAFDAC, NESREA, NAQS, and KAD-MARD.
- **Grievance Redress Mechanism (GRM):** A structured, three-tier mechanism integrated into the SAPZ's broader GRM to handle complaints related to pesticide use.
- **Post-Harvest Pest Management:** Introduction of hermetic storage technologies and improved handling protocols.
- **Monitoring, Evaluation & Adaptive Management:** A results-based M&E system to track IPM performance indicators.
- **Digital Tools:** Deployment of a mobile-based pest information and management system.
- **Budget Framework:** The total estimated budget for PMP implementation is USD 247,000 over a five-year period.



ES.10 Conclusion

The Kaduna SAPZ Pest Management Plan provides a comprehensive, practical, and enforceable framework for sustainable pest management. Through its integrated approach—combining policy alignment, capacity building, environmental protection, and technological innovation—the PMP ensures:

- Reduced reliance on hazardous pesticides;
- Enhanced human and ecosystem health;
- Improved agricultural productivity, food safety, and market competitiveness; and
- Full compliance with AfDB safeguards and national environmental regulations.

Successful implementation will be key to safeguarding the project's investments, ensuring its long-term sustainability, and achieving its core objectives of economic growth and poverty reduction.



CHAPTER ONE: INTRODUCTION

1.0 Introduction

1.1 Background of the SAPZ Program

The Federal Government of Nigeria (FGN) requested for the support of the African Development Bank (AfDB)/ International Fund for Agricultural Development (IFAD) /Islamic Development Bank (IsDB) to finance the Special Agricultural Processing Zones (SAPZs) in Nigeria.

The Special Agro-Industrial Processing Zones (SAPZ) is a major investment program of the Federal Government of Nigeria (FGN), driven by the Federal Ministry of Agriculture and Food Security (FMAFS) in collaboration with the state governments, Development partners, relevant Federal Ministries, Departments and Agencies (MDAs) and private investors to develop agro-processing clusters in areas of high agricultural production across the country. It is a strategic move to rapidly develop modern agro-processing capacity to serve the vast and growing local market, create a sustainable market for farmers and reduce postharvest losses of local agricultural produce; thereby creating wealth for farmers, promoting import substitution and creating sustainable agriculture-related jobs for women and youths.

This clustering approach is to help address investment challenges in the development of agro-processing enclaves across Nigeria, including poor access to quality infrastructure, inadequate feedstock supplies and other challenges confronting agro-processing environment. SAPZs, therefore, will be developed with requisite infrastructure like roads, power, water for agro-processing environment which will help reduce cost absorptions and engender competitiveness in agro-industrial production that is critical to further unlocking the potential of Nigeria's Agriculture to create ready markets and wealth for farming communities and reduce rural poverty.

The SAPZ Program is aligned with the national policies and priorities. It seeks to sustainably contribute to poverty alleviation, zero hunger and inequality while providing opportunities for economic diversification, job creation, building climate resilience and improved livelihoods in Nigeria. It will also contribute to rural infrastructure development, improved access to agricultural markets, increased farm productivity, the adoption of agricultural technology, climate-smart agricultural production and processing practices, increased value addition and agro-processing, increased skills acquisition and job creation, for all actors along the value chain, including the smallholder farmers, women and youth, people with special needs and vulnerable groups.

The first Phase of Special Agro-Industrial Processing Zone (SAPZ) Program will be implemented in seven (7) states, namely: Cross River, Imo, Kaduna, Kano, Kwara, Ogun, and Oyo, and the Federal Capital Territory (FCT). The Program is valued for a total sum of USD\$538.05 million (net taxes), funded by the African Development Bank (AfDB), Islamic Development Bank (IsDB).

The Special Agro-Industrial Processing Zones are integrated development initiatives designed to concentrate agro-processing activities within areas of high agricultural potential to boost productivity, integrate production, processing and marketing of selected commodities. These zones will enable agricultural producers, processors, aggregators and distributors to operate in



the same vicinity to reduce transaction costs and share business development services for enhanced productivity and competitiveness. By bringing adequate infrastructure (energy, water, roads, ICT, etc.) to rural areas of high agricultural potential, SAPZs will attract investments from private agro-industrialists/entrepreneurs to contribute to the economic and social development of rural areas.

The establishment of SAPZs in Nigeria will boost the structural transformation of the economy by providing opportunities for public and private sector investment in agriculture, and when fully operational, the SAPZs will enhance national food and nutritional security, optimize the export of value-added agricultural commodities and improve the quality of livelihoods through wealth creation for rural farming communities.

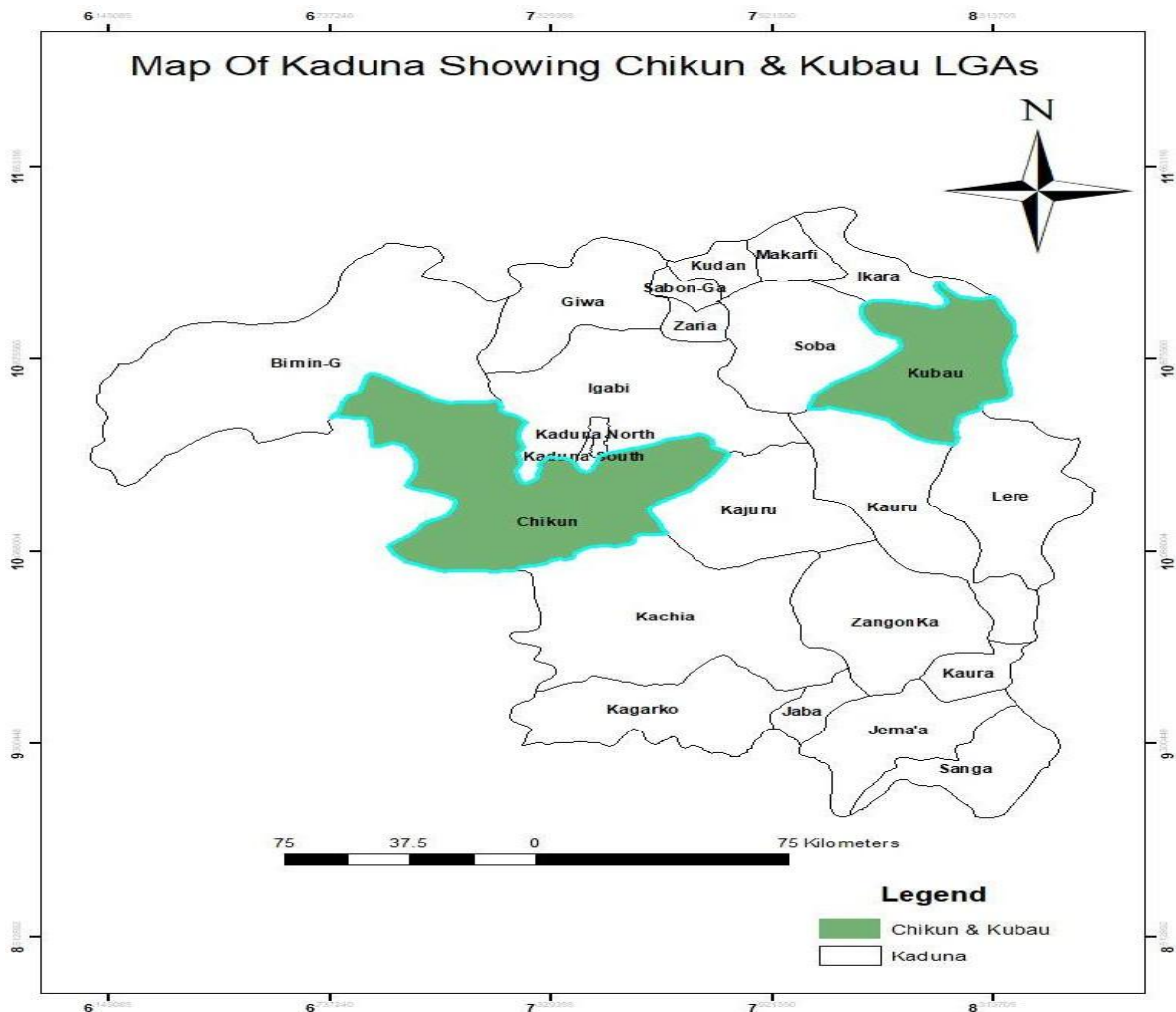


Figure 1.1: Map of Kaduna showing the project Locations



Project Development Objective (PDO)

The SAPZ Project Development goal is to increase household incomes, foster job creation in rural agricultural communities, especially for youth and women, and enhance food and nutritional security in Nigeria.

The development objectives of the Kaduna State Special Agro-Industrial Processing Zone (SAPZ) Project are to:

1. Promote inclusive and sustainable agro-industrial development
2. Enhance agricultural productivity and competitiveness
3. Increase rural household incomes and employment opportunities
4. Improve food and nutritional security.
5. Leverage private sector investment

Component 1: Support the development of climate-resilient enabling infrastructure and management of Agro-Industrial zones. The Special Agro-Industrial Processing Zones (SAPZ) Program, Kaduna State is set to benefit from significant infrastructure investments aimed at the development of the Green Agro-Allied Industrial Zone (GAAIZ). This initiative focuses on enhancing the enabling environment for agribusiness by targeting key value chains such as tomato, maize, and ginger. The component, which forms part of the broader program financed at USD 144.97 million, will support the construction and upgrading of essential infrastructure to facilitate private sector investment in agro-processing.

In Kaduna, the scope of infrastructure development will include office buildings, training centers, and general service layouts such as fencing, internal and access roads, parking areas, drainage, power supply, water systems, sewage and effluent management, and health and safety facilities. Additionally, specialized services will be established, including quarantine units, quality control laboratories, certification centers, and business support hubs for administrative, ICT, procurement, and employment-related services. The component also includes the implementation of Environmental and Social Management Plans (ESMPs) to ensure that development is both sustainable and socially inclusive.

The Nigeria Sovereign Investment Authority (NSIA), in collaboration with the Kaduna State Government, the Executing Agency, and the African Development Bank (AfDB), will play an advisory and monitoring role. This includes overseeing the engagement of Transaction Advisers, Design Consultants, and Contractors, as well as aligning the development of the Agricultural Transformation Center (ATC) under Component 2 with the broader program objectives. Kaduna's GAAIZ is one of eight priority Agro-Industrial Hubs identified in Phase I of the SAPZ Program, and it is poised to become a critical platform for agricultural transformation, job creation, and economic diversification in the state, the selected commodities were prioritized taking into consideration the potential for value addition.

Component 2. Agricultural Productivity and Production (of which Bank financing is USD 46.07 Million): This component of the SAPZ Program, focused on Agricultural Productivity and Production, will channel strategic investments into Kaduna State with the objective of



boosting the supply of raw materials to the Green Agro-Allied Industrial Zone (GAAIZ) located in Daki-Takwas, Chikun LGA. In particular, one Agricultural Transformation Center (ATC) will be established in Dutsen-Wai, Kubau LGA, to support key horticultural and grains value chains such as tomato, maize, soybeans, and ginger. This component, supported by USD 46.07 million in financing, will strengthen farm-level productivity through infrastructure development (such as land rehabilitation, irrigation schemes, feeder roads, and water supply), while supporting the development of Aggregation Centers (ACs) and Agricultural Transformation Centers (ATCs) strategically located within farming communities surrounding the AIH.

These ATCs and ACs will serve as critical hubs to facilitate farmers' access to quality inputs, including improved seeds, fertilizers, agro-chemicals, mechanization services, and digital technologies for modern farming. Ownership of the ATCs will rest with the Kaduna State Government, while operational management will be entrusted to qualified facility managers. To enhance productivity, training programs will be delivered to farmers on climate-smart agricultural practices, food safety, and quality standards. Furthermore, digital platforms will enable access to finance, input tracking, and extension services, including the deployment of an electronic wallet system for smart subsidies targeting fertilizers and seeds.

Kaduna's implementation will also feature an ICT platform registering all actors in the agricultural ecosystem—including producers, agro-dealers, input suppliers, and service providers—ensuring integrated and efficient service delivery. A robust agro-dealer network will be established to ensure last-mile delivery of inputs to farmers, especially in rural areas. Mechanization support, including agricultural equipment leasing through the ATCs, will also be promoted to reduce production costs and improve productivity across the farming cycle—from land preparation to post-harvest handling.

To further support farmer empowerment, the component will include advisory services delivered by extension agents and national and international research institutions, including the development of a productivity compact involving producer associations, government, off-takers, and R&D institutions. This collaboration will define clear targets for input demand, extension coverage, and production output, aiming to reach at least 40% of the producers in the state.

In addition to productivity, Component 2 will prioritize the inclusion of youth, women, and Micro, Small and Medium Enterprises (MSMEs). Through partnerships with institutions such as the Bank of Industry (BoI), it will provide business development services, entrepreneurship training, and access to finance for agro-entrepreneurs in Kaduna State, thereby stimulating job creation and economic empowerment across the agricultural value chain.

Component 3. Policy & Institutional Development (of which Banks is financing USD 6.75 Million): This Component of the SAPZ Program—Policy and Institutional Development—will focus on strengthening the policy, legal, and institutional frameworks that support the successful establishment and operation of Agro-Industrial Hubs (AIHs) and Agricultural Transformation Centers (ATCs) in Kaduna State. Backed by USD 6.75 million in financing, this component will provide targeted support to improve the enabling environment for private sector participation in agro-industrial development.

In Kaduna, Component 3 will support the review and reform of relevant state-level agricultural policies, legislation, and regulatory frameworks to align with national SAPZ objectives. It will



enhance the business environment within the Green Agro-Allied Industrial Zone (GAAIZ) by supporting the establishment of streamlined regulatory systems, including a One-Stop Shop for investors, digital infrastructure for business registration and licensing, and support mechanisms for customs, immigration, land access, and permitting.

To attract and retain investment in Kaduna's AIH and ATC, this component will finance investment promotion campaigns, branding, and marketing strategies targeted at local and international agribusinesses. These activities will raise awareness about the investment opportunities in the state's agro-industrial corridors, and position Kaduna as a competitive destination for agro-processing and value-added agricultural investments.

Furthermore, capacity building initiatives will be implemented for state-level institutions involved in managing and regulating the SAPZ. This includes training public officials on the use of IT-enabled systems, operational standards, and investor services to improve institutional efficiency and responsiveness. Technical assistance will also be provided to develop and implement standard operating procedures (SOPs) for the SAPZ initiative in Kaduna, ensuring consistency, transparency, and accountability in service delivery.

Additionally, a market sounding exercise will be conducted to assess private sector interest in the GAAIZ and determine investor expectations regarding infrastructure, incentives, and service delivery. Feedback from this exercise will guide future adjustments to the investment framework, ensuring it meets private sector needs while supporting inclusive agricultural transformation in the state.

Component 4. Program Coordination and Management (of which the Bank's financing is USD 12.22 Million) This component will support the establishment of a Special Delivery Team within FMARD and Participating State Implementing Units (PSIUs) at state-level and the FCT Implementation Unit (FCTIU). Other services to be supported include training of program officers, and necessary studies including the development of other SAPZ phases and financial/technical audits.

1.1.2 Key Component for Kaduna State SAPZ Program

The SAPZ program in Kaduna State includes:

- **Agro-processing infrastructure** (processing plants, storage facilities, cold chains)
- **Farmer support services** (extension services, input supply, training)
- **Market access facilitation** (aggregation centers, transportation systems)
- **Environmental safeguards implementation** (including pest management, waste management, and soil conservation)

Pest management is integral to each of these components, particularly for ensuring quality and safety in storage, processing, and market delivery.

1.2 Purpose and objectives of PMP for Kaduna State SAPZ

The primary objective of the Pest Management Plan (PMP) is to establish a comprehensive,



proactive, and sustainable framework for the effective control and prevention of pest infestations within a specific area or facility. This plan aims to protect human health, safeguard property, preserve environmental integrity, and ensure compliance with relevant legal and industry standards.

Purpose:

To promote the safe and sustainable use of pest control practices, reduce dependency on hazardous chemical pesticides, and support environmentally sound Integrated Pest Management (IPM) in line with SAPZ operations.

Objectives:

- Assess potential pest and disease risks in agricultural value chains supported by ATC and AIH.
- Reduce reliance on pesticides.
- Protect human health and the environment.
- Ensure cost-effective pest control.
- Improve safety and reduce pest related health issues.
- Develop IPM strategies that include biological control, crop rotation, and safe pesticide use.
- Build local capacity through training and access to eco-friendly pest management inputs.
- Establish monitoring systems to ensure compliance with environmental health and safety standards.
- Integrate pest control activities with broader livelihood restoration efforts (e.g., local input retailing or service provision).
- Ensure alignment with AfDB ISS, FMEnv pesticide regulations, and the WHO/FAO pesticide management framework.

1.2.1 Key Goals of the PMP

1. **Minimize Pest-Related Risks:** To reduce the risks posed by pests to human health, food safety, structural integrity, and operational efficiency through timely and effective intervention strategies.
2. **Integrated Pest Management (IPM) Approach:** To implement an Integrated Pest Management methodology that combines biological, physical, cultural, mechanical, and chemical tools in a manner that minimizes environmental impact and promotes long-term pest control solutions.



3. **Preventive Action:** To shift the focus from reactive pest control to preventive pest management by identifying potential pest breeding grounds, entry points, and conducive conditions, and taking proactive measures to eliminate or mitigate them.
4. **Education and Awareness:** To promote awareness among staff, residents, or facility users about best practices in pest prevention and control, encouraging responsible behavior that supports the overall goals of the PMP.
5. **Regulatory Compliance:** To ensure all pest management activities comply with local, national, and international regulations, including the safe and lawful use of pesticides, documentation, and record-keeping requirements.
6. **Continuous Monitoring and Evaluation:** To establish a consistent system for monitoring pest activity, evaluating the effectiveness of implemented control measures, and making data-driven decisions to improve future pest management practices.
7. **Cost-Effective Solutions:** To manage pest-related issues in a manner that is both financially efficient and environmentally responsible, avoiding unnecessary expenditures while maintaining high standards of hygiene and safety.

1.3 Scope of the PMP

The Pest Management Plan (PMP) for the Kaduna State Special Agro-Industrial Processing Zone (SAPZ) is designed to support the implementation of a sustainable and effective pest management strategy across all activities and infrastructure associated with the zone. The plan outlines the operational, environmental, and institutional frameworks necessary to prevent, monitor, and control pest infestations throughout the entire value chain—from agricultural production to agro-processing, storage, distribution, and waste management.

This scope reflects the complexity and scale of the SAPZ and its importance in enhancing food security, improving livelihoods, and contributing to economic development in Kaduna State and Nigeria as a whole.

1 Geographic and Operational Coverage

The PMP applies to all facilities, farms, and infrastructure under the Kaduna State SAPZ, including:

- Agricultural production areas
- Agro-processing plants and value-addition facilities
- Raw material storage sites (e.g., silos, warehouses, cold storage)
- Distribution hubs and transport corridors
- Administrative buildings and worker accommodation
- Waste handling, composting, and by-product recycling zones



2 Pest Categories Addressed

The plan covers a wide range of pests that could affect the operations and productivity of the SAPZ, including:

Agricultural Pests: Insects, rodents, fungi, and plant diseases that affect crop yields and livestock health.

Stored Product Pests:

Pests such as weevils, moths, beetles, and rodents that damage stored grains and processed goods.

Structural Pests: Termites, ants, and other organisms that damage infrastructure.

Public Health Pests: Mosquitoes, flies, and other vectors that pose health risks to workers and surrounding communities.

3 Integrated Pest Management (IPM) Implementation

The PMP emphasizes the use of Integrated Pest Management principles, combining:

- Cultural practices (crop rotation, sanitation, habitat manipulation)
- Biological control (natural predators, bio pesticides)
- Physical and mechanical methods (traps, barriers)
- Responsible chemical use (as a last resort, and in line with environmental and safety standards)

4 Environmental and Health Considerations

The PMP is aligned with national and international environmental standards and takes into account:

- Protection of non-target species, including pollinators and natural pest enemies
- Prevention of contamination of water bodies, soil, and air
- Health and safety of workers, farmers, and nearby communities
- Proper disposal of pesticide containers and expired chemicals

5 Capacity Building and Stakeholder Engagement

The PMP includes provisions for:

- Training and awareness programs for farmers, SAPZ personnel, and contractors on pest identification, safe pesticide use, and alternative control methods.
- Collaboration with local communities, research institutions, extension workers, and regulatory bodies.
- Promotion of traditional and indigenous knowledge systems relevant to pest management.



6 Monitoring, Evaluation, and Adaptive Management

To ensure effectiveness and continuous improvement, the PMP outlines:

- Pest surveillance and monitoring protocols
- Record-keeping and data analysis for pest trends and intervention outcomes
- Regular reviews and updates to the pest management strategy based on new information, technologies, or emerging threats

7 Legal and Institutional Framework

The PMP is guided by:

Nigeria's National Pesticide Regulation and EIA Act

1. **Environmental Impact Assessment Act (EIA Act No. 86 of 1992)** — sets the requirement for carrying out EIA and EIA-related procedures (screening, scoping, public consultation, approval, monitoring) for projects likely to have significant environmental impacts.
2. **NAFDAC pesticide laws & regulations** (NAFDAC Act and Pesticide Registration / Labeling / Guidelines — Pesticide Registration Regulations 2019/2021 and related guidelines; Bio-pesticide Regulations 2024) — regulate registration, importation, manufacture, labeling, quality control, sale/distribution and post-market surveillance of pesticide products.
3. **NESREA Act and Hazardous Chemicals & Pesticides Regulations** — NESREA enforces national environmental standards, including regulations that address handling, storage, transport, disposal, and codes of practice for hazardous chemicals and pesticides.
4. **NAFDAC press releases / operational guidance** — practical enforcement guidance, inspections and consumer safety notices that clarify how NAFDAC applies its mandate in the pesticides sector.

Specific provisions relevant to a PMP

A. Project-level EIA requirements (EIA Act)

- **EIA screening & determination:** If the PMP is part of a larger project/operation that is a scheduled activity, the project must be screened and, where required, a full EIA (or Environmental and Social Impact Assessment) prepared and submitted for approval before project decisions. The EIA Act establishes this “prior to decision” requirement.

PMP implication: include pesticide risks in the EIA (or as part of the ESIA), i.e., an independent pesticide risk assessment and mitigation measures must be in the environmental assessment documentation.



- **Public consultation & disclosure:** The EIA Act requires stakeholder/public participation for projects undergoing EIA.

PMP implication: plan public/stakeholder consultation about pesticide use, buffer zones, and perceived risks; document concerns and responses in the EIA/ESIA.

- **Monitoring & compliance reporting:** Approved EIAs must include environmental monitoring plans and periodic reporting; enforcement follows from the Act and related regulations.

PMP implication: embed monitoring indicators (e.g., residues in soil/water, non-target impacts, and incidents) and a reporting schedule into the PMP.

B. Pesticide registration, labeling and product controls (NAFDAC regulations & guidelines)

- **Only registered products:** NAFDAC regulations require that pesticides (including imported and domestically produced products) be registered before manufacture, import, sale or use in Nigeria; separate applications per product are required and documentation must be uploaded via NAPAMS. (Includes specific rules for bio-pesticides in 2024.)

PMP implication: use only products registered with NAFDAC — include a register of products in the PMP (product name, registration number, label instructions, MSDS).

- **Labeling & instructions for use:** Regulations set mandatory labeling content (active ingredient, concentration, usage instructions, precautions, PPE, storage, expiry, batch nos.).

PMP implication: the PMP must enforce strict adherence to label directions (dose, frequency, buffer zones) and include label checks during procurement.

- **Efficacy, quality and banned substances:** NAFDAC may reject or ban products that fail quality/efficacy or that contain prohibited active ingredients. The agency conducts inspections and quality control testing.

PMP implication: procurement specifications must include quality standards and a clause banning non-compliant products; include procedures for sampling and quality verification.

C. Handling, storage, transport, PPE, waste and codes of practice (NESREA+ NAFDAC guidance)

- **Safe storage & containment:** NESREA regulations and codes of practice set standards for pesticide storage facilities (labeled, secure, bonding where needed, away from water sources) and safe transport to prevent spills.

PMP implication: include store design, inventory control, secondary containment, signage, MSDS accessibility and transport protocols.

- **Applicator training & certification:** Regulations and codes require competent operators and prescribe protective measures for sprayers/operators. NAFDAC guidance and NESREA codes call for training and safe-use practices.

PMP implication: incorporate an operator training and certification plan, supervision and refresher trainings in the PMP.

- **Personal Protective Equipment (PPE):** Label and regulations specify PPE; PMP must require and monitor PPE use and maintenance.



- **Waste management & disposal:** Regulations address disposal of empty containers (triple rinse, puncture, burying or approved disposal route), residues and contaminated materials; NESREA enforces hazardous waste controls.
- **PMP implication:** include container management (collection, safe storage, disposal/return to supplier), spill response, and an approved hazardous waste disposal contractor or procedure.

D. Environmental protection controls & monitoring (NESREA / EIA)

- **Buffer zones & protection of sensitive receptors:** NESREA/EIA guidance expects identification of sensitive receptors (water bodies, schools, settlements, biodiversity hotspots) and the establishment of buffer zones or application restrictions.
- **PMP implication:** map receptors, set no-spray zones, wind-speed restrictions, and schedule applications to minimize drift and run-off.
- **Environmental monitoring and incident reporting:** Both NESREA and the EIA framework require monitoring of environmental impacts and reporting of significant incidents. NAFDAC also expects reporting of adverse events/poisonings.
- **PMP implication:** include baseline sampling, routine residue and water quality monitoring, and a clear incident reporting chain (who to notify e.g., NAFDAC, NESREA, local health authorities).

E. Enforcement, penalties and institutional roles

- **Multiple enforcement agencies:** NAFDAC (product registration, quality control), NESREA (environmental standards/enforcement), Federal Ministry of Environment (policy/EIA oversight), and sometimes FMARD or state environmental agencies have roles.
- **PMP implication:** identify the competent authorities for permits, inspections and reporting in the PMP and ensure contact details and responsibilities are listed.
- **Penalties & stop-work powers:** Non-compliance with registration, labeling, EIA conditions, or hazardous-waste rules attracts sanctions, product seizure, fines and criminal prosecution under the respective Acts/regulations. PMP must therefore include compliance auditing.

International guidelines such as those from FAO, WHO, AfDB's ISS (OS 1,3, & 4) and the World Bank's Environmental and Social Standards (particularly ESS3 and ESS6)

The Pest Management Plan (PMP) will be designed and implemented in line with internationally recognized best practice standards and guidelines. These international frameworks provide benchmarks for environmental protection, occupational safety, public health, and biodiversity conservation. They also ensure that the project complies with global commitments and the requirements of international development partners. The key international guidelines include:



- (i) **FAO Guidelines:** The Food and Agriculture Organization (FAO) provides comprehensive guidance on pesticide management, Integrated Pest Management (IPM), and sustainable agricultural practices. The FAO International Code of Conduct on Pesticide Management emphasizes safe distribution, use, and disposal of pesticides, while promoting alternatives such as biological control, cultural practices, and resistant crop varieties. The PMP will integrate these principles to minimize reliance on chemical pesticides, reduce risks to human health and the environment, and enhance sustainable pest control.
- (ii) **WHO Guidelines:** The World Health Organization (WHO) sets international standards for pesticide safety, particularly regarding public health. WHO's recommendations focus on toxicity classification, safe handling, labeling, and health risk assessments of pesticides. The PMP will adopt these provisions to ensure that only WHO-approved pesticides are procured and used, personal protective equipment (PPE) is provided to applicators, and that communities are sensitized on health and safety practices related to pest management.
- (iii) **African Development Bank (AfDB) Integrated Safeguards System (ISS)**
The AfDB's ISS establishes a framework for environmental and social sustainability in Bank-financed operations. The PMP will comply with the following Operational Safeguards (OS):
 - **OS1 – Environmental and Social Assessment:** Requires screening and assessment of environmental and social risks, including those linked to pesticide use, ensuring that appropriate mitigation measures are integrated into project design.
 - **OS3 – Biodiversity and Ecosystem Services:** Calls for protection of natural habitats and ecosystem services that may be affected by pesticide application. The PMP will ensure adoption of pest control measures that avoid or minimize harm to biodiversity.
 - **OS4 – Pollution Prevention and Control, Hazardous Materials, and Resource Efficiency:** Focuses on minimizing pollution, controlling hazardous chemicals, and promoting efficient resource use. The PMP will ensure proper storage, transport, application, and disposal of pesticides to prevent soil, water, and air contamination.
- (iv) **World Bank Environmental and Social Standards (ESS)**

The World Bank's Environmental and Social Framework (ESF) provides standards applicable to pest management under this project:

- **ESS3 – Resource Efficiency and Pollution Prevention and Management:** Emphasizes reduction of pollution and careful management of hazardous materials, including pesticides. The PMP will promote integrated pest management (IPM), minimize chemical inputs, and adopt measures to safely manage pesticide residues and packaging.
- **ESS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources:** Requires that project activities avoid significant harm to biodiversity. The



PMP will integrate measures to ensure that pest control practices do not negatively impact pollinators, beneficial insects, aquatic systems, or other critical natural habitats.

Institutional Structure of the Kaduna SAPZ

The successful implementation and sustainability of the Kaduna Special Agro-Industrial Processing Zone (SAPZ) require a clearly defined institutional arrangement with distinct roles and responsibilities among key actors. The institutional structure is designed to ensure coordination, accountability, and effective service delivery across the agricultural value chain, environmental safeguards, and local governance.

- 1. SAPZ Management Authority:** The SAPZ Management Authority will serve as the central coordinating body responsible for the day-to-day management of the Zone. Its core roles include:
 - Overseeing the overall planning, operation, and governance of the SAPZ.
 - Ensuring compliance with project objectives, financial management procedures, and safeguard requirements.
 - Facilitating partnerships with private sector investors, anchor firms, and service providers within the Zone.
 - Monitoring and evaluating project outcomes to ensure alignment with state and national development goals.

- 2. Ministry of Agriculture:** The Ministry of Agriculture provides technical leadership in agricultural development within the SAPZ. Its responsibilities include:
 - Providing policy direction on crop production, input supply, and extension services.
 - Supporting capacity building for farmers and agribusinesses on modern agricultural practices.
 - Ensuring alignment of SAPZ activities with state agricultural policies, food security objectives, and value chain priorities.
 - Collaborating with research institutes and development partners to promote innovation and technology transfer.

- 3. Ministry of Environment:** The Ministry of Environment is responsible for ensuring that SAPZ activities are environmentally sustainable and comply with national and international safeguard requirements. Its roles include:
 - Reviewing and approving Environmental and Social Impact Assessments (ESIAs) and monitoring implementation of Environmental and Social Management Plans (ESMPs).
 - Providing oversight on waste management, pollution control, and climate-smart agricultural practices.
 - Supporting awareness campaigns on sustainable land and water resource use.



- Ensuring biodiversity conservation and enforcement of environmental regulations within the SAPZ.
- 4. Local Government Councils|:** The local government councils serve as critical grassroots partners in the SAPZ framework. Their functions include:
- Facilitating community mobilization, sensitization, and participation in SAPZ programs.
 - Supporting land administration processes, including ensuring fair land acquisition and resettlement where applicable.
 - Providing oversight on local infrastructure (feeder roads, markets, water supply) that link communities to the SAPZ.
 - Serving as a liaison between the SAPZ Management Authority and host communities to ensure inclusiveness and social accountability.

1.4 Methodology Used in PMP Development for Kaduna State SAPZ|: The development of the Pest Management Plan (PMP) for the Kaduna State Special Agro-Industrial Processing Zone (SAPZ) followed a participatory, evidence-based, and consultative approach to ensure that the final plan is practical, context-specific, environmentally sound, and aligned with national and international standards. The methodology used for developing this PMP is outlined as follows:

1.4.1. Literature Review and Secondary Data Collection

A comprehensive review of existing literature, policies, regulatory documents, and previous studies on pest management in Nigeria and Kaduna State was conducted. Key documents reviewed included:

- National Environmental (Hazardous Chemicals and Pesticides) Regulations
- Federal Ministry of Environment (FMEnv) and National Agency for Food and Drug Administration and Control (NAFDAC) pesticide management guidelines
- Kaduna State Ministry of Agriculture reports
- African Development Bank AfDB ISS, OS1 and OS3 guidelines
- World Bank Environmental and Social Standards (ESS3 and ESS6)
- FAO and WHO pest and pesticide guidelines;

1. FAO International Code of Conduct on Pesticide Management (2014, updated jointly with WHO)

Purpose:

This is the core international framework governing all aspects of pesticide life-cycle management. It provides globally recognized standards for government regulators, industry, and users to ensure responsible, ethical, and sustainable pesticide management.



Key Principles:

- Pesticides should only be used when necessary and as part of Integrated Pest Management (IPM).
- Registration and regulation must ensure that only safe, effective, and quality-assured products enter the market.
- Protection of human health and the environment must be central to all pesticide use decisions.
- Training and capacity building for all stakeholders (farmers, distributors, applicators, extension agents).
- Safe storage, handling, transport, and disposal of pesticides and containers.
- Monitoring and enforcement of compliance across the supply chain.

Relevance to the PMP: The Kaduna SAPZ PMP must align with this Code in its pesticide registration, procurement, use, and disposal procedures.

2. FAO Guidelines on Good Labeling Practice for Pesticides (FAO/WHO, 2015)

Purpose:

Provides standardized guidance for labeling pesticide products to ensure users understand the hazards, directions for use, and safety precautions.

Key Requirements:

- Clear and legible labels in local languages.
- Use of pictograms for hazard communication.
- Mandatory information on dosage, crop/pest target, and re-entry periods.
- Information on first aid and emergency measures.

Relevance:

PMP implementation should require that all pesticides used in SAPZ are labeled according to these guidelines, particularly in Hausa and English.

3. FAO Guidelines for the Registration of Pesticides (FAO/WHO, 2010)

Purpose:

Provides governments with guidance on establishing or improving pesticide registration systems.

Key Components:

- Scientific evaluation of pesticide efficacy, safety, and environmental impact.
- Criteria for approving, restricting, or banning products.
- Procedures for post-registration monitoring and review.
- Data requirements and risk assessment protocols.



Relevance:

Supports Nigeria's NAFDAC registration system, ensuring all pesticides used in SAPZ are duly registered and quality-assured.

4. FAO Guidelines on Management Options for Empty Pesticide Containers (FAO, 2008)

Purpose:

Provides methods for safe collection, cleaning, recycling, or disposal of pesticide containers to prevent environmental pollution and human exposure.

Recommended Actions:

- Triple-rinsing containers before disposal.
- Establishing container return schemes.
- Avoiding reuse of containers for food or water.
- Centralized collection points for recycling or safe incineration.

Relevance:

Forms the basis for SAPZ's **container return and disposal system** under the EHS component of the PMP.

5. WHO Recommended Classification of Pesticides by Hazard (Most Recent Edition, WHO/IPCS)

Purpose:

Categorizes pesticides according to their acute toxicity to humans (Class Ia – Extremely hazardous; Class IV – Unlikely to present hazard). It provides the foundation for risk assessment, labeling, and worker safety measures.

Relevance:

- SAPZ PMP should prohibit or strictly control Class Ia and Ib pesticides.
- Promotes use of low-toxicity or biological alternatives consistent with WHO/FAO recommendations.

6. FAO Guidelines on Integrated Pest Management (IPM) in Crop Production (FAO, 2010 and 2021 updates)

Purpose:

Promotes environmentally friendly and economically viable pest management methods combining biological, cultural, and mechanical techniques.

Core Elements:

- Pest identification and life-cycle understanding.



- Economic threshold levels (ETL) for intervention.
- Emphasis on biological control, resistant varieties, and cultural practices.
- Reduction in pesticide reliance.

Relevance:

Forms the conceptual foundation for the **Kaduna SAPZ IPM framework** and Farmer Field School (FFS) training curriculum.

7. WHO Guidelines for Pesticide Poisoning Prevention and Management (WHO, 2020 update)

Purpose:

Provides health-based procedures for the diagnosis, treatment, and prevention of pesticide poisoning.

Key Areas:

- First aid and medical response protocols.
- Health monitoring of pesticide applicators.
- Poison information and reporting systems.
- Occupational health surveillance.

Relevance:

Guides the **Public Health Pest Control** and **EHS** measures in the SAPZ PMP, particularly mobile health clinic monitoring and emergency preparedness.

8. FAO Guidelines on Environmental Criteria for Pesticide Selection (FAO, 2015)

Purpose:

Advises on environmental impact assessment of pesticides — covering persistence, bioaccumulation, and non-target species impact.

Relevance:

Used by SAPZ PIU and NAFDAC to screen products before procurement, ensuring environmental sustainability.

This review provided the legal, institutional, and environmental baseline for the PMP.

Field visits were carried out in selected SAPZ clusters and surrounding agricultural communities to assess:

- The types and severity of pest infestations
- Local pest control methods and challenges



- Pesticide handling, storage, and application practices
- Agro-ecological and environmental conditions

These assessments were essential in identifying priority pest issues and the specific risks associated with SAPZ agricultural value chains.

1.4.3 Stakeholder Consultations

Consultations were conducted with a wide range of stakeholders to gather inputs and validate findings. These included:

- Smallholder and commercial farmers
- Extension officers and agronomists



- Pesticide dealers and input suppliers
- Kaduna State Ministry of Agriculture and Rural Development
- Federal Ministry of Environment (FMEnv)

Table 1.1: Summary of Stakeholder Consultations for the Pest Management Plan (PMP)

Stakeholder Group	Crops Discussed / Focus Areas	Key Issues & Concerns Raised	Key Recommendations / Inputs to PMP
Smallholder and Commercial Farmers	Maize, Rice, Ginger, Tomatoes, Soybean	- High pest pressure (stem borers, leaf miners, aphids, nematodes, and fungal diseases). - Heavy dependence on chemical pesticides due to lack of alternatives. - Limited access to quality, registered pesticides and biological control options. - Rising cost of agrochemicals and adulteration in the market.	- Strengthen access to extension support and practical IPM training. - Promote biological control and eco-friendly products through demonstration plots. - Improve farmer access to authentic agro-inputs via licensed dealers. - Introduce subsidies or group purchasing schemes for certified products.
Extension Officers and Agronomists	Maize, Rice, Tomatoes, Ginger	- Insufficient training in integrated pest management (IPM), pest diagnostics, and safe pesticide use. - Limited resources for field follow-up and monitoring. - Lack of updated technical materials and IPM guidelines.	- Build capacity of extension staff on IPM, safe pesticide handling, and ecological control. - Develop and distribute local IPM guides per crop. - Introduce mobile-based tools for pest reporting and farmer advisories.
Pesticide Dealers and Input Suppliers	All major crops	- Market dominated by counterfeit or substandard products. - Weak enforcement of dealer licensing and product registration. - Low farmer awareness on product labels and proper dosage.	- Enforce dealer registration and introduce a traceability system for inputs. - Conduct periodic training for agro-dealers on safe storage, labeling, and advisory roles. - Encourage stocking of approved bio-pesticides and IPM-compatible inputs.



Stakeholder Group	Crops Discussed / Focus Areas	Key Issues & Concerns Raised	Key Recommendations / Inputs to PMP
Kaduna State Ministry of Agriculture and Rural Development (KAD-MARD)	All major crops (State-wide coverage)	- Weak coordination between state agencies and federal regulatory institutions (NAFDAC, NESREA, NAERLS). - Limited budget and capacity for pesticide regulation and monitoring. - Need for data-driven pest surveillance at the state level.	- Establish a State-level Pest Surveillance and Control Unit under the SAPZ framework. - Strengthen coordination with NAFDAC and FMEnv for enforcement and information sharing. - Integrate pest management issues into state agricultural policy and SAPZ planning.
Federal Ministry of Environment (FMEnv)	Cross-cutting (Environmental impact of pesticide use)	- Concern over water and soil contamination from pesticide runoff. - Lack of systematic residue monitoring and reporting mechanisms. - Need for harmonized data sharing between FMEnv, NAFDAC, and FMAFS.	- Strengthen environmental monitoring of pesticide residues through accredited labs. - Promote awareness on environmentally safe disposal of pesticide containers and residues. - Mainstream environmental safeguards in SAPZ pest management implementation.
Research and Training Institutions (NAERLS, IAR, KASU)	Maize, Rice, Tomatoes, Soybean	- Ongoing research on pest dynamics and resistant crop varieties. - Need for stronger linkages between research outputs and field-level adoption. - Limited funding for adaptive IPM and bio-control trials.	- Develop locally adapted IPM packages for priority crops. - Conduct participatory field trials with farmers to validate eco-friendly technologies. - Establish demonstration and training hubs within the SAPZ clusters.
Agro-Processing / SAPZ Anchor Firms	Ginger, Tomatoes, Rice, Soybean	- Crop losses due to poor pest control in upstream supply chains. - Lack of quality standards on pesticide residues in raw materials.	- Introduce residue testing protocols and supplier compliance systems. - Encourage contract farmers to adopt IPM through incentives and certification support.



Table 1.2: Consultation Method and Timing

Stakeholder Group	Location / Cluster	Date	Number of Participants	Consultation Method	Main Discussion Points / Outcomes
Smallholder Farmers (Maize, Rice, Tomatoes, Ginger, Soybean)	Kubau, Igabi, Chikun and Kauru LGAs (Kaduna State)	20–30 July 2025	56 (44 men, 12 women)	Focus Group Discussions (FGDs) and field walk-throughs	Farmers identified key pest and disease challenges (e.g., fall armyworm, Tuta absoluta, rhizome rot, soybean rust). Strong demand for IPM training, access to genuine inputs, and practical field demonstrations.
Commercial Farmers / Out grower Associations	Kubau and Chikun LGAs	25 th June-21 July 2025	18 (all male)	Semi-structured Interviews	Shared experience with pesticide misuse, poor product quality, and absence of effective biological control options. Recommended creation of a certified agro-input supply network under SAPZ.
Extension Officers and Agronomists (State ADP / NAERLS)	Kaduna State ADP Headquarters, Barnawa	July 2025	22 (14 men, 8 women)	Key Informant Interviews (KIIs) and participatory workshop	Identified inadequate IPM capacity, logistics constraints, and outdated field materials. Proposed regular ToT programs, mobile advisory tools, and budgeted IPM extension positions under SAPZ.
Pesticide Dealers and Input Suppliers	Kaduna Central Market and Zaria	30 July - August 2025	15 (10 men, 5 women)	Structured Interviews and Rapid Market Appraisal	Revealed the prevalence of counterfeit and unregistered products; poor labeling and storage conditions. Requested standardized dealer licensing, enforcement, and awareness programs.



Stakeholder Group	Location / Cluster	Date	Number of Participants	Consultation Method	Main Discussion Points / Outcomes
Kaduna State Ministry of Agriculture and Rural Development (KAD-MARD)	State Secretariat, Kaduna	July 2025	8 officials	Formal Consultation Meeting	Confirmed the State's interest in supporting IPM mainstreaming under SAPZ. Highlighted coordination challenges with federal agencies and proposed establishment of a State Pest Management Committee.
Federal Ministry of Environment (FMEnv)	AIH and ATC site (Kubau and Chikun LGA's)	15-16 August 2025	2 refs. From the FMEnv., 1 ref. from KEPA, SAPZ ECCO, ESIA team and stakeholders from the communities visited	Formal Consultation Meeting	Emphasized environmental safeguards, waste handling, and residue monitoring. Recommended inclusion of pesticide disposal protocols and lab network strengthening.
Research and Training Institutions (IAR, NAERLS, KASU)	Virtual session	27 June 2025	10 (researchers and lecturers)	Virtual Meeting	Shared ongoing research on pest ecology and resistant crop varieties. Proposed integrating field trials and demonstration sites into SAPZ to showcase eco-friendly pest management.
Agro-processing / Anchor Firms (SAPZ Clusters)	Kubau Ikara and Soba LGA's	11 June 2025	ESIA team and stakeholders	Stakeholder Roundtable Discussion	Discussed quality standards and traceability requirements for suppliers. Supported adoption of residue testing protocols and certification incentives for IPM-compliant producers.

These consultations ensured the plan reflects the realities, needs, and capacities of key actors in the SAPZ



1.4.4 Institutional and Policy Analysis

An institutional mapping exercise was conducted to assess the roles, responsibilities, and capacities of federal, state, and local institutions involved in pest and pesticide management. This included:

- Regulatory agencies (NAFDAC, NESREA)
- Extension and research bodies National Agricultural Extension & Research Liaison Service (NAERLS), Institute for Agricultural Research (IAR), Agricultural development Projects (ADPs)
- SAPZ implementation structures

This analysis informed recommendations on institutional coordination, capacity building, and policy alignment.

1.4.5 Risk and Impact Assessment

Potential environmental and social risks associated with pest management interventions (especially pesticide use) were identified and analyzed.

The assessment focused on:

- Risks to human health, water bodies, and biodiversity
- Risks to vulnerable groups (e.g., women, youth, children)
- Potential for pest resistance and non-target effects

This guided the development of mitigation measures and safer alternatives.

1.4.6 Design of Pest Management Strategies

Based on the evidence gathered, Integrated Pest Management (IPM) strategies were designed. These strategies combined:

- Cultural and biological control methods
- Use of approved and safe chemical pesticides
- Training and awareness programs
- Monitoring and evaluation mechanisms

Strategies were tailored to the specific crop value chains, pest profiles, and capacity levels in Kaduna SAPZ.

1.4.7 Validation and Review

The draft Pest Management Plan (PMP) will be subjected to multi-stakeholder validation workshops to ensure its accuracy, technical relevance, and broad ownership. These sessions will provide a platform for dialogue, critique, and refinement of the PMP prior to its finalization. Feedback and recommendations generated during the workshops will be carefully reviewed and integrated into the revised version of the PMP.

Critical stakeholders expected to participate in the validation process include:



- **Government Ministries, Departments and Agencies (MDAs):**
 - Federal Ministry of Agriculture and Food Security (FMAFS)
 - Kaduna State Ministry of Agriculture
 - Kaduna State Ministry of Environment
 - National Environmental Standards and Regulations Enforcement Agency (NESREA)
 - National Agency for Food and Drug Administration and Control (NAFDAC)
 - Kaduna State Environmental Protection Authority (KEPA)
- **Research and Academia:**
 - Agricultural research institutes (e.g., Institute for Agricultural Research – IAR, Zaria)
 - Universities (e.g., Ahmadu Bello University, Faculty of Agriculture and Environmental Sciences)
- **Private Sector and Agribusiness Stakeholders:**
 - Agro-input suppliers and pesticide distributors
 - Commercial farmers and anchor firms operating within the SAPZ
 - Agro-processors and value chain actors
- **Civil Society and Community-Based Organizations (CBOs):**
 - Farmer associations and cooperatives
 - Women and youth groups involved in agriculture
 - NGOs focused on sustainable agriculture, environment, and public health
- **Development Partners and Donors:**
 - African Development Bank (AfDB)
 - World Bank
 - Food and Agriculture Organization (FAO)
 - Other technical and financial partners supporting the SAPZ
- **Local Government Councils and Traditional Institutions:**
 - Local Government Authorities hosting SAPZ activities
 - Traditional leaders and community representatives

1.4.8 Documentation and Dissemination

The final PMP will be documented in line with international standards and translated into user-friendly formats for various stakeholders. A dissemination plan will be developed to promote adoption and awareness.

This methodological approach ensures that the Kaduna State SAPZ Pest Management Plan is grounded in field realities, compliant with regulatory frameworks, and capable of fostering sustainable agricultural development.



CHAPTER TWO: PROJECT DESCRIPTION

2.1 Overview of the SAPZ Project in Nigeria

The Special Agro-Industrial Processing Zones (SAPZ) Project in Nigeria is a flagship initiative aimed at transforming the country's agricultural sector by promoting agribusiness, enhancing rural infrastructure, and boosting value addition through the development of agro-industrial hubs. The project is spearheaded by the Federal Government of Nigeria, with significant support from international development partners such as the African Development Bank (AfDB), International Fund for Agricultural Development (IFAD), and Islamic Development Bank (IsDB).

2.1.1 Objectives of the SAPZ Project

- 1. Boost Agricultural Productivity and Value Addition:** SAPZs are designed to concentrate agro-processing activities in zones with high agricultural potential. This approach aims to reduce post-harvest losses, increase value addition to raw agricultural products, and support agro-industrial development.
- 2. Create Jobs and Reduce Poverty:** By stimulating agribusiness and associated industries (e.g. Logistics, packaging, and storage), the project aims to create massive employment opportunities, particularly for youth and women in rural areas.
- 3. Promote Inclusive and Sustainable Development:** SAPZs aim to foster inclusive growth by integrating smallholder farmers into larger value chains and ensuring that rural community's benefit from industrial and infrastructural investments.
- 4. Enhance Infrastructure and Rural Transformation:** The project supports the development of key infrastructure, including roads, power, water supply, and storage facilities, to create an enabling environment for agro-industrial development.

2.1.2 Key Components of the SAPZ Projects

- 1. Agro-Industrial Hubs Development:** Creation of geographically defined zones where primary agricultural produce is processed into finished or semi-finished goods
- 2. Infrastructure Investment:** Development of roads, power, irrigation, water supply, and ICT to support agro-industrial activities.
- 3. Private Sector Involvement:** The SAPZ model encourages strong public-private partnerships (PPPs), with private investors playing a critical role in operating processing facilities within the zones.
- 4. Capacity Building and Technical Support:** Training programs for farmers, agro-dealers, and local stakeholders to enhance productivity and linkages to markets.

Pilot States and Scale

The SAPZ Project initially targets seven pilot states with high agricultural potential: Ogun, Oyo, Kaduna, Kano, Imo, Cross River, and Kwara The Federal Capital Territory (FCT) is also included as part of the initial phase. The long-term goal is to scale the project nationwide, aligning with Nigeria's broader agricultural transformation agenda.



2.1.3 Expected Outcomes:

- Increased private sector investment in agriculture and agro-processing.
- Improved incomes for farmers and rural households.
- Enhanced food security and reduced reliance on food imports.
- Job creation across agricultural and non-agricultural sectors.
- Sustainable rural development and reduced rural-to-urban migration.

2.2 Overview of the Project Influence Area

The project environment will encompass the specific sites of the Agricultural Transformation Center (ATC) and Agro-Industrial Hub (AIH), their direct zones of influence (within a 1–3 km radius), the indirectly or more broadly affected areas (including larger parts of Kubau and Chikun LGAs as well as adjoining regions of Kaduna State), and associated facilities such as access roads, solar energy installations, water treatment systems, and waste management infrastructure. The ATC will be established at Dutsen-Wai-Kuzuntu, while the AIH will be situated at Daki-Takwas, both strategically positioned to take advantage of Kubau’s fertile agricultural land and Chikun’s access to the Kaduna-Abuja Expressway to facilitate market connectivity. The project environment will be shaped by and will, in turn, influence the activities of the SAPZ program, including infrastructure development, agricultural intensification, and agro-processing operations.

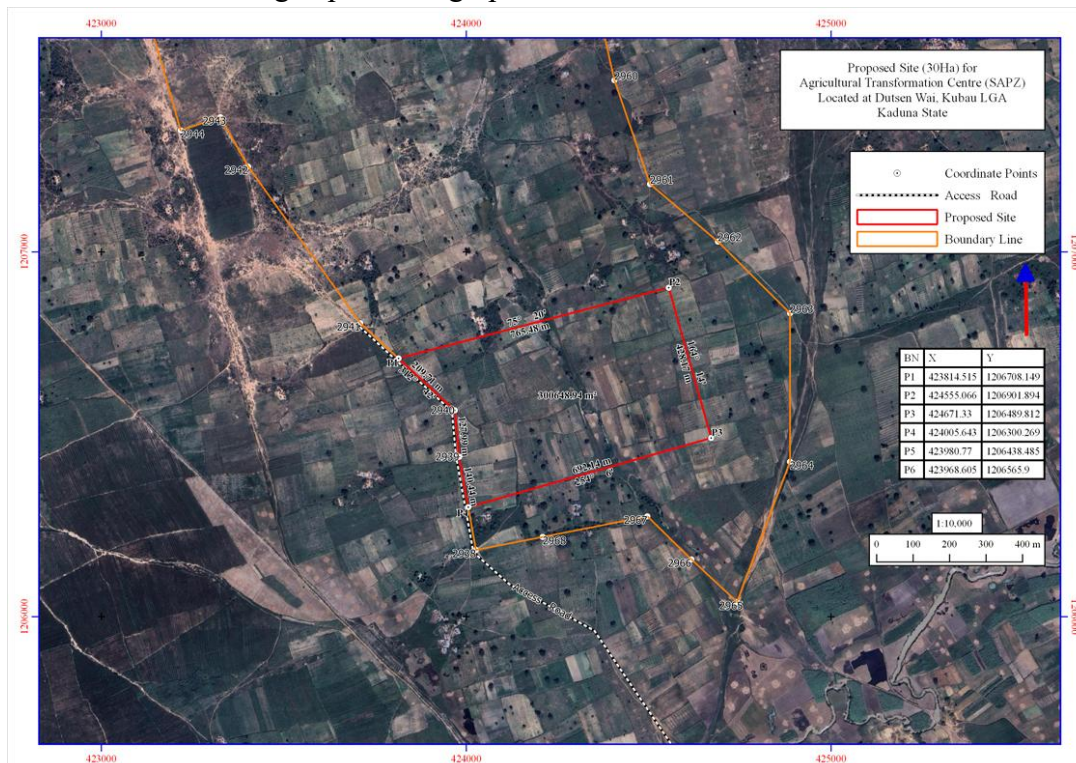


Figure 3.1: Map of ATC project site at Dutsen-wai-Kuzuntu

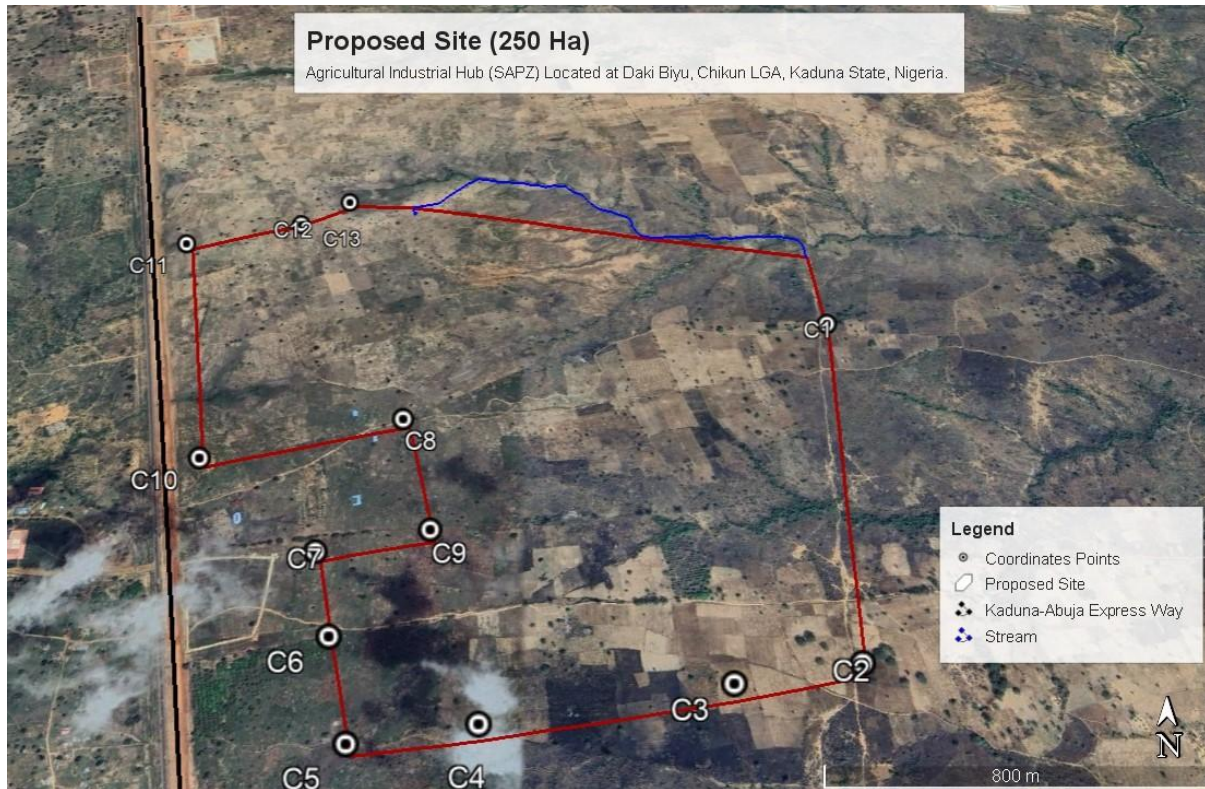


Figure 3.2: Map of AIH at Daki Takwas communities

2.3 Size of Project Area

The project site comprises two primary locations within Kaduna State: one at Dutsen-Wai-Kuzuntu in Kubau LGA and the other at Daki-Takwas in Chikun LGA, with a combined area of approximately 280 hectares. Specifically, the Agricultural Transformation Center (ATC) is planned to occupy 30 hectares at Dutsen-Wai-Kuzuntu—a rural, agriculturally productive area known for the cultivation of crops such as maize, soybeans, ginger, and tomatoes. The Agro-Industrial Hub (AIH) will be established on a larger parcel of 250 hectares at Daki-Takwas, approximately 75 kilometers from Kaduna city, and adjacent to the Olam Farms corridor along the Abuja-Kaduna-Zaria Expressway.

Both sites are currently under active agricultural use, although the lands are officially owned by the Kaduna State Government. Despite the statutory ownership, local community members have long utilized these lands for farming, and they recognize government ownership. To ensure equitable transition and minimize adverse impacts, a census and inventory of project-affected persons (PAPs) will be undertaken to inform the Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) in line with AfDB and FMEnv requirements.





CHAPTER THREE: RATIONALE FOR THE PEST MANAGEMENT PLAN

3.1 Rationale for the Pest Management Plan

The purpose of this Pest Management Plan is to establish a sustainable, effective, and environmentally responsible approach to controlling pest populations while minimizing risks to human health, non-target organisms, and the surrounding ecosystem. The Pest Management Plan is designed to provide a comprehensive framework for managing pests and diseases in the Kaduna State Special Agro-Industrial Processing Zones (SAPZ) which includes;

1. **Protection of Health and Safety:** Pests such as rodents, insects, and birds can transmit diseases, contaminate food, and cause allergic reactions. Implementing a pest management plan helps reduce these public health risks and promotes a safe environment for occupants, workers, and the general public
2. **Preservation of Property and Infrastructure:** Pests can cause significant damage to buildings, wiring, insulation, crops, and other structures. A proactive plan helps prevent costly repairs and prolongs the life of physical assets.
3. **Compliance with Regulations:** Many jurisdictions require pest management plans in settings such as schools, food production facilities, and healthcare institutions. This plan ensures compliance with local, state, and federal regulations and aligns with best practices such as Integrated Pest Management (IPM)
4. **Environmental Responsibility:** Traditional pest control methods often rely heavily on chemical pesticides, which can lead to resistance, harm beneficial organisms, and contaminate soil and water. This plan adopts IPM principles to reduce reliance on chemicals, emphasizing prevention, monitoring, and targeted control measures.
5. **Economic Efficiency:** Pest outbreaks can lead to significant economic losses due to damaged goods, downtime, and treatment costs. A well-structured plan provides a cost-effective framework for long-term pest control, reducing the likelihood and severity of infestations through early detection and targeted intervention.
6. **Sustainability and Prevention:** By addressing the root causes of pest infestations—such as poor sanitation, structural vulnerabilities, or improper waste management—the plan fosters sustainable practices that prevent future problems rather than relying solely on reactive solutions.
7. **Promote sustainable agriculture:** The plan encourages sustainable agricultural practices that are economically viable, environmentally friendly, and socially responsible.

3.2 Potential Impacts of Pest and Pesticide Management on Project Activities

The adoption of modern agricultural technologies in the Kaduna SAPZ is expected to enhance productivity and strengthen food security. However, if pest management is not properly handled, it could result in negative environmental impacts and public health risks. To address this, the Pest Management Plan (PMP) emphasizes sustainable and safe approaches to pest control. By promoting Integrated Pest Management (IPM), reducing excessive reliance on chemical pesticides, and encouraging environmentally friendly alternatives, the PMP seeks to maximize agricultural benefits while minimizing potential risks.



Table 3.1: Potential negative impacts of poor PM and mitigation measures under good PMP

Potential Negative Impacts (if poorly managed)	Mitigation / Good Practices under PMP
Environmental contamination – pollution of soil, surface water, and groundwater from excessive or improper pesticide use	Promote Integrated Pest Management (IPM); ensure proper pesticide handling, storage, and disposal practices
Loss of biodiversity – harm to beneficial insects, pollinators, aquatic life, and non-target organisms	Encourage use of biological controls, selective pesticides, and habitat protection measures
Human health risks – exposure of farmers, workers, and nearby communities to toxic chemicals	Training on safe pesticide application, provision and use of Personal Protective Equipment (PPE), and strict adherence to WHO/FAO standards
Pest resistance – over-reliance on chemical pesticides leading to resistant pest populations	Rotate pesticides with different modes of action; adopt cultural and biological control methods
Improper waste management – unsafe disposal of empty containers and chemical residues	Establish collection systems for containers; promote triple-rinsing, recycling, or safe disposal methods

3.2.1 Environmental and Social Consequences of Poor Pest Management Practices

In Kaduna State, poorly managed pest control such as excessive or inappropriate use of pesticides can cause serious negative impacts, including threats to agricultural sustainability, ecological balance, and human health. Recognizing these risks, the Pest Management Plan (PMP) promotes an integrated and sustainable approach to pest management. This approach prioritizes alternative methods such as biological control and cultural practices, while ensuring that chemical pesticides are used responsibly and only when necessary.

The PMP also emphasizes capacity building through farmer awareness programs and technical training, enabling safe, efficient, and environmentally friendly pest control. By adopting these measures, the Kaduna SAPZ can achieve a balance between higher agricultural productivity and environmental preservation. Ultimately, sustainable pest management will help protect natural resources, safeguard public health, and strengthen food security while building a resilient agricultural system capable of addressing pest challenges without compromising social and environmental well-being.



Table 3.2: Poor Pest Management and PMP Approach Benefits

Poor Pest Management → Risks	PMP Approach → Benefits
Excessive or inappropriate pesticide use leading to soil, water, and air pollution	Promotes Integrated Pest Management (IPM) and responsible use of pesticides only when necessary
Threats to biodiversity, including pollinators, aquatic life, and other beneficial species	Encourages biological control, cultural practices, and conservation of natural habitats
Increased human health risks from exposure to toxic chemicals	Provides training, awareness, and use of Personal Protective Equipment (PPE) to ensure safety
Long-term decline in agricultural sustainability due to pest resistance and ecosystem imbalance	Builds farmer capacity to adopt sustainable techniques, reducing reliance on chemicals
Reduced food safety and insecurity over time	Ensures balanced productivity, food security, and environmental preservation



CHAPTER FOUR: POLICY, LEGAL, AND INSTITUTIONAL FRAMEWORK

4.0 Policy, Legal, And Institutional Framework

An effective Pest Management Plan (PMP) for the Kaduna State Special Agro-Industrial Processing Zone (SAPZ) must operate within a well-defined and robust legal, regulatory, and institutional environment. This section outlines the relevant national policies and regulations, applicable international standards, and the roles and responsibilities of key institutions at the federal, state, and local levels, including the SAPZ project management and private sector actors.

A robust and harmonized policy, legal, and institutional framework is central to the success of the Pest Management Plan for Kaduna SAPZ. Compliance with national and international standards, combined with coordinated institutional action and stakeholder engagement, will ensure that pest control activities are effective, sustainable, and socially responsible. This foundation supports the broader goals of productivity, food safety, and environmental protection in the SAPZ.

4.1 National Pest and Pesticide Management Policies and Regulations

Nigeria has developed a set of legal instruments and policy frameworks to guide the use, management, and regulation of pesticides and pest control activities. These include:

1. Federal Ministry of Environment (FMEnv)

- FMEnv is the lead agency responsible for environmental protection and natural resource management in Nigeria.
- It sets national standards for pesticide use and environmental safeguards and oversees Environmental Impact Assessments (EIAs) for agro-industrial projects like SAPZ.
- FMEnv enforces the Environmental Impact Assessment Act Cap E12 LFN 2004, which requires that agricultural and industrial developments assess and mitigate environmental risks, including those related to pest and pesticide management.

2. National Agency for Food and Drug Administration and Control (NAFDAC)

- NAFDAC is the primary regulatory body for the registration, control, manufacture, importation, exportation, distribution, sale, and use of pesticides and agrochemicals in Nigeria.
- It maintains a list of approved, restricted, and banned pesticides, in accordance with WHO and FAO guidelines.
- NAFDAC ensures that pesticide products meet safety standards, and it conducts periodic monitoring of pesticide residues in food products.



3. National Environmental Standards and Regulations Enforcement Agency (NESREA)

NESREA is charged with enforcing environmental laws and standards, including those related to hazardous substances and chemical waste. It implements specific environmental regulations such as:

- National Environmental (Hazardous Chemicals and Pesticides) Regulations, 2014
- National Environmental (Agricultural Sector) Regulations, 2018

These regulations address pesticide storage, application, transportation, and waste disposal, including penalties for non-compliance.

4. Federal Ministry of Agriculture and Food Security (FMAFS)

- FMAFS provides extension services, pest surveillance, and pest control campaigns (e.g., locust control, armyworm response).
- It promotes Integrated Pest Management (IPM) and coordinates national agricultural policy with environmental and health safety goals.

5. Other Relevant Instruments

- Factory Act Cap F1 LFN 2004 – Regulates worker safety in pesticide use.
- Customs and Excise Management Act – Governs the import and export of pesticides and related chemicals.
- National Biosafety Management Agency Act, 2015 – Oversees genetically modified organisms, including pest-resistant crop varieties.

4.2 International Standards and Conventions

Nigeria is a signatory to many conventions on the protection of the environment, which lay credence to the IPMP under study. Some of these conventions pertinent to this study include:

- Montreal Protocol
- Bamako Convention on Hazardous Wastes
- Basel Convention on Trans-boundary Movements of Hazardous Wastes and their Disposal
- Stockholm Convention on Persistent Organic Pollutants (POPs)
- International Code of Conduct for the Distribution and Use of Pesticides
- Rotterdam Convention

Among the aforementioned conventions, a certain number of them have a direct importance with pesticides and the fight against pollution, particularly the Stockholm Convention on persistent organic pollutants. This convention, in accordance with Principle 15 of the Rio Declaration on Environmental and Development, aims at protecting human health and the environment from persistent organic pollutants such as aldrin, dieldrin, chlordane, endrin, heptacholic, hexachlorobenzene, mirex, toxaphene, DDT and PCBs. It is a global treaty to protect human health and the environment from highly dangerous, long-lasting chemicals by restricting and ultimately eliminating their production, use, trade, release and storage. The Convention was adopted in Stockholm, Sweden on May 22, 2001. It calls for outright banning and destruction of 12 Persistent Organic Pollutants, 9 of which are pesticides.



These are: Pesticides

POPs: Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene, Mirex, Toxaphene. The Industrial POPs: Dioxins, Furans, Polychlorinated biphenyls (PCBs).

Given the involvement of international funding agencies (AfDB, IsDB, IFAD), the PMP will comply with the following international standards:

1. **African Development Bank (AfDB) Integrated Safeguards System (ISS), 2023:** The AfDB's Integrated Safeguards System (ISS) 2023 establishes a comprehensive framework to ensure that Bank-financed operations are environmentally and socially sustainable. The updated ISS aims to enhance development effectiveness by systematically identifying and managing risks, preventing and mitigating adverse impacts, and strengthening the resilience of communities and ecosystems. It places a strong emphasis on inclusive growth, climate change adaptation and mitigation, and meaningful stakeholder engagement.

Relevant AfDB Operational Safeguards for the Kaduna SAPZ Pest Management Plan include:

- **OS 1: Assessment and Management of Environmental and Social Risks and Impacts:** As the overarching safeguard, OS 1 provides the foundational process for identifying pest management as a key risk through the Environmental and Social Assessment (ESA). It mandates the development of an Environmental and Social Management Plan (ESMP), under which the Pest Management Plan (PMP) is developed, integrated, and implemented.
- **OS 2: Labour and Working Conditions:** The PMP must incorporate provisions to protect the health and safety of workers (e.g., farmers, applicators) who handle, store, or apply pesticides. This includes providing appropriate training, personal protective equipment (PPE), and procedures to prevent occupational exposure, in line with Occupational Health and Safety (OHS) requirements.
- **OS 3: Resource Efficiency and Pollution Prevention and Management:** This is the primary safeguard governing the PMP's technical content. It explicitly requires the preparation of a PMP for significant pest issues and mandates the use of Integrated Pest Management (IPM) to minimize pollution. It sets strict standards for the selection, procurement, storage, handling, application, and disposal of pesticides to prevent contamination of air, water, and soil.
- **OS 4: Community Health, Safety and Security:** The PMP must address risks to nearby communities from pesticide drift, runoff, or accidental exposure. It requires measures to ensure community safety, such as establishing buffer zones, providing community awareness programs on pesticide risks, and incorporating safe application practices to protect public health.
- **OS 10: Stakeholder Engagement and Information Disclosure:** The development and implementation of the PMP require meaningful consultation with affected communities and workers. This includes disclosing information about the pesticides to be used, associated risks, and safety measures, and establishing a grievance mechanism for community members to raise concerns related to pest management activities.

2. **FAO International Code of Conduct on Pesticide Management**



This Code serves as the primary voluntary international standard for responsible pesticide management. It will inform the Kaduna SAPZ PMP by providing the operational framework for key activities, including:

- **Capacity Building & Training:** Establishing protocols for training pesticide handlers and applicators.
- **Safe Handling & Application:** Defining procedures for the transport, storage, and application of pesticides to minimize human exposure and environmental contamination.
- **Integrated Pest Management (IPM):** Promoting the reduction of pesticide reliance through the Code's emphasis on alternative, sustainable approaches.

3. World Health Organization (WHO) Guidelines

The WHO's work complements the FAO Code and provides critical, science-based inputs for the PMP, specifically:

- **Hazard Classification:** The WHO's pesticide classification system will be used to screen and select pesticides, prioritizing those in the less hazardous classes (e.g., U, III) and justifying the use of any in more hazardous categories (e.g., Ib, Ia).
- **Health Risk Assessment:** WHO guidelines on health surveillance and exposure thresholds will be used to assess and mitigate risks to farm workers and nearby communities, ensuring the project meets its occupational and community health and safety obligations under AfDB safeguards.

4. World Bank Environmental and Social Framework (ESF)

The World Bank's ESF provides internationally recognized best practices that will be used to inform and strengthen the Kaduna SAPZ Pest Management Plan. The following standards offer critical guidance:

- **ESS3: Resource Efficiency and Pollution Prevention and Management:** This standard directly governs pesticide use. It will guide the PMP by: Formally establishing Integrated Pest Management (IPM) as the primary strategy, making chemical pesticides a measure of last resort. Requiring practices that prevent pollution from pesticide residues, protecting water and soil quality. Encouraging the selection of the least hazardous pesticides when chemical controls are necessary.
- **ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources:** This standard ensures that pest management activities do not harm local ecosystems. The PMP will adhere to ESS6 by: Implementing measures to protect non-target species, including pollinators and aquatic life, from pesticide exposure. Addressing the threat of invasive alien species through strict hygiene and quarantine measures within the project area to prevent their introduction and spread.

5. Basel, Rotterdam, and Stockholm Conventions

Rotterdam Convention: The Rotterdam Convention on the Prior Informed Consent on Procedure for Certain Hazardous Chemicals and Pesticides in International Trade is a global treaty that came into force in February 2004. It is designed to protect public health and the environment by promoting informed decision-making by importing countries in relation to



products that have been banned or severely restricted by at least two other Parties to the Convention. It formalizes the voluntary principles established in the International Code of Conduct.

The *Rotterdam Convention on Prior Informed Consent (PIC)* aims to help participating countries make informed decisions about the potentially hazardous chemicals that might be shipped to them, and to facilitate communication of these decisions to other countries. The Convention requires exporting Parties to honor the decisions of importing Parties.

The key principles of PIC are:

- International shipment of a pesticide included in the PIC list should not occur against the wishes of the importing country.
- In the absence of a decision from an importing country, the export may proceed if the pesticide is registered in the country, or if it has previously been used or imported into the country.
- If an importing country decides not to consent to further imports, the decision must be applied to imports from all sources, and domestic manufacturing and use must cease.;
- Recommendations for inclusion of banned and severely restricted chemicals in the PIC procedure must be supported by risk evaluations reflecting prevailing conditions at the national level.

Basel Convention: The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal was concluded in Basel, Switzerland on March 22, 1989, and entered into force in May 1992. The Basel Convention contains specific provisions for the monitoring of implementation and compliance. A number of articles in the Convention oblige Parties (national governments which have acceded to the Convention) to take appropriate measures to implement and enforce its provisions, including measures to prevent and punish conduct in contravention of the Convention.

The key principles/outcomes of the Basel convention are:

- In order to minimize the threat, hazardous wastes should be dealt with as close to where they are produced as possible.
- Trans-boundary movements of hazardous wastes or other wastes can take place only upon prior written notification by the State of export to the competent authorities of the States of import and transit (if appropriate).
- Each shipment of hazardous waste or other waste must be accompanied by a movement document from the point at which a trans-boundary movement begins to the point of disposal. Hazardous waste shipments made without such documents are illegal.
- Outright bans on the export of these wastes to certain countries; however, Trans-boundary movements can take place, if the state of export does not have the capability of managing or disposing of the hazardous waste in an environmentally sound manner.

Stockholm Convention: Bans or restricts the use of persistent organic pollutants (POPs), including certain pesticides.



Basel Convention: Regulates trans-boundary movement and disposal of hazardous waste, including pesticide containers and expired chemicals.

International Plant Protection Convention (IPPC)

Aims to prevent the spread of pests across borders and promotes phyto-sanitary standards in trade.

4.2 Institutional Roles and Responsibilities

To ensure the effective implementation of the PMP within the Kaduna SAPZ, a multi-level governance structure must be established. The roles are distributed across the following entities:

1. Federal Government Institutions

The development and implementation of the Pest Management Plan (PMP) for the Kaduna State SAPZ Project will be coordinated with relevant national regulatory institutions to ensure full compliance with Nigerian laws, policies, and international best practices. The specific mandates and roles of these agencies are outlined below:

Pesticide Regulation and Quality Control

- **National Agency for Food and Drug Administration and Control (NAFDAC):** Responsible for the registration, regulation, and quality control of all pesticide products to be procured and used under the project. NAFDAC ensures that only certified, approved, and safe pesticide formulations are imported, distributed, and applied in accordance with the NAFDAC Act (Cap N1 LFN 2004) and relevant guidelines.

Environmental Protection and Compliance

- **Federal Ministry of Environment (FMEnv):** Provides overall regulatory oversight for environmental compliance. The Ministry reviews and approves the project's Environmental Impact Assessment (EIA) and associated safeguard instruments such as the ESMP and PMP, ensuring that pesticide-related risks are identified, mitigated, and monitored throughout the project lifecycle.
- **National Environmental Standards and Regulations Enforcement Agency (NESREA):** Ensures enforcement of national environmental standards related to pesticide use, handling, and disposal. NESREA monitors compliance with chemical and waste management regulations, ensuring that pollution of air, soil, and water resources is prevented through adherence to the National Environmental (Chemicals, Pharmaceuticals, Soaps and Detergents) Regulations, 2009 and other applicable instruments.

Agricultural Implementation and Extension Services

- **Federal Ministry of Agriculture and Food Security (FMAFS):** Provides technical guidance and extension support for the implementation of Integrated Pest Management (IPM) approaches. The Ministry coordinates pest surveillance, field demonstrations, and farmer training to ensure environmentally sound and economically viable pest



control practices in collaboration with State and Local Government extension structures.

State-Level Coordination

- **Kaduna State Ministry of Agriculture and Natural Resources (KAD-MoA):** Serves as the State-level implementing agency, ensuring alignment of pest management activities with Kaduna State agricultural policies and regulations. The Ministry will supervise field implementation, coordinate with LGAs, and ensure safe pesticide handling, distribution, and use within the SAPZ and surrounding agricultural communities.

2. Kaduna State Government

- **Kaduna State Environmental Protection Agency (KEPA) Law, 2018:** KEPA oversees environmental management in Kaduna State, including waste management, pollution control, and environmental impact assessments for state-level projects. The PMP will coordinate with KEPA to obtain necessary permits and ensure compliance with state-specific environmental standards.
- **Kaduna State Climate Change Policy (2024):** This policy provides a strategic framework to build resilience, reduce emissions, and integrate climate action into development planning. It aligns with national and global climate goals, emphasizing inclusive, low-carbon growth. The policy targets sectors like agriculture, energy, and health while prioritizing vulnerable populations.
- **State Ministry of Agriculture:** Coordinates extension services, farmer training, and pest control programs in alignment with the PMP.
- **State Ministry of Environment and Natural Resources:** Supports enforcement of state-level environmental laws, including those relating to pesticide use and disposal.

3. SAPZ Kaduna State Implementation Unit

- Oversees implementation of the PMP across all SAPZ facilities.
- Coordinates environmental and social compliance as required by donors (AfDB).
- Maintains pest surveillance records, facilitates audits, and enforces compliance among tenants and contractors.

4. Local Government Councils

- Mobilize local farmers and stakeholders.
- Monitor grassroots implementation of pest control activities.
- Provide support for awareness campaigns and community sensitization.

5. Private Sector Actors (Farmers, Processors, Suppliers)

- Adhere to PMP guidelines and national regulations.
- Maintain proper records of pesticide usage and training.
- Report pest outbreaks and pesticide accidents promptly.
- Collaborate in training, awareness, and waste management programs.



6. Civil Society and Development Partners

- Support advocacy, monitoring, and public education.
- Provide technical assistance and financing for IPM projects.
- Act as watchdogs to ensure community health and environmental standards are upheld.



CHAPTER FIVE: BASELINE ASSESSMENT ON PEST AND DISEASE IN KADUNA STATE

5.1 Assessment of Capacity of Nigeria on Integrated Pest Management

Many cultural practices and physical control measures to pest control are currently in use in Nigeria and have been for several farming generations; however, some of them have not provided sufficient and environmentally friendly options for pest management. For instance, bush burning as a way of controlling pest causes deforestation and loss of biodiversity and therefore should be discouraged. In addition, the flooding problems experienced in Nigeria and the accompanying widespread pest management concerns will require that the issues of pest be given adequate attention.

The conventional chemical control has been the means generally used to control crop invasions by pests in large agricultural programs in Nigeria. This approach has led to numerous cases of recorded intoxications each year, the resistance of numerous pests to many chemicals (case of *Helicoverpa armigera* to pyrethroids), the destruction of useful species, the perturbation of the ecological balance, the dependence towards synthetic chemical pesticides and the growing debt of farmers compelled to use increasingly expensive products, the deviances in the use of cotton pesticides on some food crops such as cowpea, etc.

In order to reduce the incidences of pest in Nigeria a number of project-based interventions have been carried out on IPM. Some of these are:

- IPM for pest control in the Commercial Agriculture Development Project (CADP)
- Farmer's training on IPM under the Transforming Irrigation Management in Nigeria (TRIMING) project.
- Cocoa farmers training on the use of IPM to pest control and the IPM for pest control in the National FADAMA Agricultural Development in Nigeria

5.1.1 Assessment of Collaboration on IPM

As it has been established SAPZ will enjoy IPMP collaborative benefit and lessons learned from other existing world-bank/donor funded projects, currently being implemented in Nigeria. This is quite beneficial and possible, considering the fact that a lot of experience and success has been gained in Nigeria under APPEALS, CADP, FADAMA II and III projects, and WAAPP (West Africa Agricultural Productivity Project) including application of IPM operations.

In addition, this collaboration will take into account the experiences that can be shared by the National Plant Protection Organization of Nigeria (NPPON) & Nigerian Agricultural Quarantine Service (NAQS). Consequently, the project stands to gain from shared experience and capacity with these existing bodies in terms of challenges and success drivers of IPM operations, which will, for instance, take into consideration international standards for phyto-sanitary measures, phyto-sanitary treatment and diagnostic protocols and other similar areas. As such, SAPZ project beneficiaries will enjoy knowledge transfer on IPM implementation.

5.1.2 Pest Management in Kaduna State

Kaduna is a leading agricultural state in Nigeria. Major crops include maize, sorghum, rice,



ginger, beans, soybeans, groundnut and tomatoes. The SAPZ zones span across all the 23 LGAs of the state with more emphasis on ATC at Dutsen-wai, Kuzuntu Kubau LGA and AIH at Daki-Takwas, Chikun LGA and their respective neighboring LGAs.

Pest management plays a crucial role in strengthening agricultural production in Kaduna State, the predominant use of chemical pesticides, lack of technical capacity, limitations in infrastructure, and the absence of a systematic adoption of integrated and sustainable pest control practices.

5.2 Current Pest Management Practices in Kaduna State:

The pest management landscape in Kaduna State presents several challenges that could undermine the success and sustainability of the SAPZ project if not properly addressed. These include:

- **Heavy Reliance on Chemical Pesticides:** Farmers and agribusinesses in the region continue to rely predominantly on synthetic chemical pesticides for pest control. While effective in the short term, this approach raises multiple concerns:
- **Health and Environmental Risks:** Prolonged exposure to chemical residues poses risks to farm workers, consumers, and surrounding ecosystems.
- **Pest Resistance:** Overuse or misuse of certain chemical classes has led to the development of pest resistance, diminishing the efficacy of available products.
- **Contamination:** Runoff and improper disposal contribute to soil and water pollution, impacting biodiversity and downstream agricultural productivity.
- **Poor Storage Practices:** Post-harvest pest management is often compromised due to inadequate storage infrastructure and handling:
- **Infestation:** Grains and other stored products are frequently subject to infestation by weevils, rodents, and fungal pathogens.
- **Loss of Value:** Poor storage conditions lead to significant quantitative and qualitative losses, affecting market value and food safety.
- **Use of Hazardous Fumigants:** In attempts to manage storage pests, some actors resort to unsafe chemical fumigation techniques without proper training or equipment.

5.3. Limited Knowledge of Integrated Pest Management (IPM) Techniques

There is a notable gap in awareness and adoption of IPM principles among smallholder farmers and agro-processors:

- **Training Gaps:** Many farmers lack access to training on ecological pest management, crop rotation, resistant varieties, and pest monitoring.
- **Cultural Practices Ignored:** Non-chemical techniques such as timely planting, field sanitation, and biological barriers are underutilized.
- **Low Extension Support:** Agricultural extension services are limited in capacity to provide consistent and practical IPM advice across the SAPZ.
- **Low Use of Biological Controls:** Biological pest control options are underexploited within the state, despite their potential for sustainable agriculture:



- **Limited Access:** Beneficial organisms like parasitoids, predators, and microbial pesticides are rarely available in local agro-input markets.
- **Lack of Awareness:** Farmers and agribusinesses often lack knowledge of how biological control agents work and how to integrate them with other practices.
- **No Incentives:** Policy or financial incentives to encourage adoption of environmentally-friendly solutions are minimal or nonexistent.

5.4 Inadequate Pesticide Regulation Enforcement

Despite existing national and state-level regulations, enforcement remains weak:

Unregulated Market: Counterfeit, expired or banned pesticides are commonly sold in informal markets.

Non-Standardized Use Guidelines: Many farmers do not follow prescribed application rates or safety protocols due to illiteracy or lack of training.

Weak Institutional Capacity: Regulatory bodies often lack the resources and manpower needed for regular inspections, monitoring, and penalties for violations.

5.5 Other Challenges related to the use of Pesticides in Kaduna State

1. **Dependence on Chemical Pesticides:** The intensive use of chemical pesticides is a common practice in Kaduna State, often without adequate technical support, resulting in serious problems such as pest resistance, contamination of soil and water resources, and adverse impacts on human health.
2. **Limited Access to Alternative Inputs:** Many farmers in Kaduna State have restricted access to alternative inputs, such as biological control methods and cultural practices, which can help reduce dependence on chemical pesticides.
3. **Institutional Limitations:** Agricultural extension services in Kaduna State face significant limitations in their technical and operational capacity, making it difficult to support farmers in integrated pest management.
4. **Environmental and Health Risks:** The misuse of pesticides poses significant environmental and health risks, including contamination of soil, water, and air, as well as adverse impacts on human health.

5.6 Pest and Pesticide Management

1. **Concerns on the Use of Pesticides:** Pesticides are toxic substances released most times intentionally into our environment. This includes substances that kill weeds (herbicides), insects (insecticides), fungus (fungicides), rodents (rodenticides), and others. Though they could be very useful in managing pest problems, they are also a great environmental and health risk.
2. **Persistent Organic Pollutant (POPs):** Nigeria became a signatory to the Stockholm Convention on Persistent Organic Pollutants, In May 2001 and the commitment was ratified in 2004. Under Annex A (listed for Elimination) of the convention, Parties must take measures to eliminate the production and use of obsolete chemicals



These obsolete pesticides are characterized by a high persistence in the environment (e.g. half-life for DDT in soil ranges from 22 to 30 years, Toxaphene -14 years, Mirex -12 years, Dieldrin- 7 years, Chlordecone up to 30 years), low water solubility and thus potential to accumulate in fatty tissue of living organisms including humans and toxicity to both human and wildlife. Due to intensive releases to the environment in past several decades, and tendency to long-range trans-boundary atmospheric transport, they are now widely distributed and are found around a globe. Most agricultural pesticides could constitute any of the POPs chemicals, which if are in use pose adverse environmental, animal and human health risks.

Considering that Nigeria is a Signatory, the country is compelled to stop the use of POPs pesticides if still in use. For other pesticides, which are not POPs, the issues of toxicity still remain and the consequence of application on agricultural farmland and resultant wider environmental and social impacts.

3. **Pesticides and Human Heal:** According to the 2022 wet Season Agricultural Performance survey in Nigeria reported by the National Agricultural Extension & Research Liaison (NAERLS) have revealed that pests and diseases have caused crop loss up to eighty percent in some farms in Nigeria ad an estimation of 1.5 to 200,000ha of land in 2022. This shows that pests are destructive, and these yield gaps depend on use of pesticides to close them. Pesticides have been linked to a wide range of human health hazards, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, reproductive abnormalities, and endocrine disruption. Unfortunately, chronic health effects may occur years after even minimal exposure to pesticides in the environment, or result from the pesticide residues, which we ingest through our food and water. Pesticides can cause many types of cancer in humans. Some of the most prevalent forms include leukemia, non-Hodgkin's lymphoma, brain, bone, breast, ovarian, prostate, testicular and liver cancers.
4. **Environmental Risks:** Potential adverse environmental and health risks of pesticides applications that are of concern to the proposed For Women project may include:

The risks associated with the use or applications of pesticides are:

- A. **Air Pollution:** The vaporized form of sprayed pesticides will be released into the air, and if the chemical compound is very stable, the vapor can travel beyond the project intervention sites. Whether pesticides are applied by spraying or by surface application, air is the usual medium through which the chemicals move to their intended and unintended targets. While some of the active ingredients in pesticides stay in the atmosphere for only a short while, others may last longer and may have the potential to contaminate the air, affecting humans and animals. Reliable data on how pesticides behave in air, such as distance travelled, are lacking, because adequate monitoring tools are unavailable.
- B. **Soil contamination:** Pesticides which are still used in agricultural land in and around the proposed sites could enter soil during spraying resulting in wash-off or run-off into soil. Some pesticides such as soil fumigants and nematicides which are applied directly into soil to control pests and plant diseases are often retained in the soil. Long-term excessive use of pesticides will cause higher pesticide residues in the soil, which will cause soil contamination within the area.



- C. Surface and Groundwater Contamination:** Generally, there are four major routes through which pesticides reach the water: they may drift outside of the intended area when sprayed, may percolate, or leach through soil, may be carried to the water as runoff, or may be spilled. Pesticides typically enter surface water when rainfall or irrigation water exceeds the infiltration capacity of soil and resulting runoff then transports pesticides to streams, rivers, and other surface-water bodies. Groundwater contamination may occur when pesticide residue in surface water such as drainages, streams, and municipal wastewater is leached downward into groundwater. Also, if pesticide applications are adopted by the project as the most preferred measure for pest management Groundwater contamination may also occur from pesticide residue in surface water, such as drainages, streams, and municipal wastewater.
- D. Harm to Non-target Species:** The environmental impact of pesticides consists of the effects of pesticides on non-target species. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, because they are sprayed or spread across entire agricultural fields. Runoff can carry pesticides into aquatic environments while wind can carry them to other fields, grazing areas, human settlements and undeveloped areas, potentially affecting other species. Other problems emerge from poor production, transport and storage practices. Over time, repeated application increases pest resistance, while its effects on other species can facilitate the pest's resurgence.

5. Health Risks

The health risks could result from:

A. Direct inhalation Concerns: Pesticides can enter the body through inhalation of aerosols, dust and vapour that contain pesticides; through oral exposure by consuming food and water; and through skin exposure by direct contact. The effects of pesticides on human health depend on the toxicity of the chemical and the length and magnitude of exposure. Farmer, farm workers and their families experience the greatest exposure to agricultural pesticides through direct contact. Bioaccumulation of pesticides in the body over time and toxicity increases as a consequence of this cumulative impact.

B. Potential Site-related Health Concerns

The concerns are:

- Consumption of crops and plants grown under chemical pest control could cause health hazards to humans and animals within and around the project site.
- Certain kinds of chemical intoxication especially after drinking pesticide contaminated water are a medium to high likelihood. This is a crucial potential impact considering that most of the locals get drinking water from surface and groundwater sources.
- Skin, eye, and nose irritation
- Possibility of cancers, neurologic, endocrine and reproductive problems from direct and indirect exposure to pesticides.
- Occupational health and safety risks. Long term inhalation of toxic pesticides sprayed, could eventually result in respiratory illnesses or disease conditions.



6. Implications for the Kaduna SAPZ Project

The Kaduna SAPZ aims to boost agro-processing and value chain development. However, without significant improvement in pest management practices:

- Food safety concerns may limit access to premium markets, especially for export.
- Environmental degradation could undermine long-term agricultural productivity.
- Economic losses from pest damage and post-harvest spoilage may deter investor confidence.
- Social risks such as health issues and community resistance could emerge due to continued pesticide misuse.

5.7 Description of Target Crops and Associated Pest Problems

The Kaduna State Special Agro-Industrial Processing Zones (SAPZ) project focuses on maize, ginger, and tomatoes as target crops. These crops play a vital role in food security, income generation, and economic development in the region.

1. **Pest Problems:** The target crops within the Kaduna SAPZ are exposed to a range of pest-related challenges that can significantly impact productivity and quality. Maize is particularly susceptible to insect pests such as stem borers, fall armyworms, and grasshoppers, while ginger is attacked by the ginger lily borer and ginger beetle. Tomatoes also face considerable pressure from pests like the tomato fruit borer and whiteflies. In addition to insect damage, these crops are prone to several plant diseases. Maize commonly suffers from maize streak virus, rust, and leaf blight; ginger is vulnerable to bacterial wilt and leaf spot; and tomatoes are frequently affected by tomato yellow leaf curl virus and bacterial spot. Furthermore, weed infestation poses a major threat across all target crops, as weeds compete with plants for essential resources such as nutrients, water, and sunlight, ultimately leading to reduced crop yields and diminished quality.
2. **Pest Management Challenges:** The use of chemical pesticides is a common practice in Kaduna State, but it poses significant risks to human health and the environment. The indiscriminate use of pesticides can lead to pest resistance, contamination of soil and water resources, and loss of biodiversity.
3. **Farmers Categories:** Farmers in Kaduna State can broadly be categorized into three main groups based on the scale of their operations and farming practices. Smallholder farmers constitute the majority and typically depend on traditional agricultural methods, often constrained by limited access to finance, modern inputs, and technical support. Medium-scale farmers operate at a more commercial level, utilizing greater quantities of agrochemicals—such as fertilizers and pesticides—to enhance productivity and improve crop yields. In contrast, large-scale farmers adopt highly mechanized and intensive farming systems, characterized by greater efficiency but also higher reliance on chemical inputs, which may have implications for environmental sustainability and soil health.



5.8 Stakeholder Knowledge, Attitudes, and Usage of Pesticides in Kaduna State

- 1. Knowledge of Pesticides:** Farmers in Kaduna State display differing levels of knowledge, awareness, and attitudes toward pesticide use. Commonly used pesticides in the region include paraquat, glyphosate, and lambda-cyhalothrin—chemicals that, although effective in pest control, are classified by the World Health Organization (WHO) as moderately hazardous. In terms of pesticide safety knowledge, many farmers possess limited understanding of safe handling and application procedures, with only about 87.9% indicating that they read product safety data sheets prior to use. Despite this gap in knowledge, most farmers demonstrate awareness of the health risks associated with pesticide exposure, commonly reporting symptoms such as headaches, dizziness, skin irritation, and itchy eyes following application.
- 2. Attitudes towards Pesticide Use:** Farmers in Kaduna State generally acknowledge the crucial role of pesticides in agricultural productivity and the importance of safety measures during their use. About 35.4% of farmers strongly agree that pesticides are indispensable for achieving high crop yields, reflecting their reliance on chemical pest control to sustain production. Regarding safety, 62.7% of farmers strongly believe that the use of personal protective equipment (PPE) is vital in preventing pesticide poisoning and minimizing health hazards. In addition, many farmers demonstrate an awareness of the risks associated with pesticide use, recognizing the dangers of engaging in unsafe behaviors such as eating, drinking, or smoking while handling or applying pesticides.
- 3. Usage of Pesticides:** Pesticide use practices among farmers in Kaduna State reveal both intensive application patterns and significant gaps in safety compliance. Approximately 30.3% of farmers apply pesticides more than three times within a single cropping season, indicating frequent reliance on chemical control measures. However, despite a general awareness of safe handling procedures, many farmers still engage in unsafe practices—for instance, 30.6% reuse empty pesticide containers for domestic purposes, while 32% use their mouths to unblock sprayer nozzles, actions that pose serious health risks. In terms of pesticide storage and disposal, the situation is equally concerning: 86.6% of farmers store pesticides in their homes, often without proper containment, and 10.1% fail to dispose of empty containers in accordance with manufacturer guidelines, thereby increasing the potential for environmental contamination and household exposure.
- 4. Factors Influencing Safety Behavior:** Several socio-demographic factors influence farmers' pesticide use behavior and safety practices in Kaduna State. Education level plays a significant role, as farmers with higher levels of education tend to demonstrate greater awareness and adherence to pesticide safety guidelines. In contrast, age appears to be a contributing factor to unsafe behaviors, with older farmers often more likely to engage in risky practices, possibly due to habitual methods or resistance to adopting newer safety approaches. Additionally, years of farming experience positively affect safety behavior—farmers with longer experience generally develop better handling habits and a deeper understanding of the health and environmental risks associated with pesticide use.



5. Opportunities for Improvement in Relation to the Current Pest Management Practices:

The current pest management practices within the Kaduna State SAPZ present several areas ripe for enhancement. Optimizing pest control is crucial for improving agricultural productivity, reducing losses, enhancing food security, and protecting both human health and the environment. Below are the key opportunities for improvement:

7. Integrated Pest Management (IPM) Adoption and Scale-Up:

One of the major gaps is the limited adoption of Integrated Pest Management (IPM) techniques, which combine biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. There is a significant opportunity to:

- Train farmers and extension agents on IPM principles and practices.
- Promote the use of bio-pesticides and natural predators rather than reliance on synthetic chemicals.
- Develop demonstration plots to showcase IPM effectiveness in SAPZ clusters.

8. Capacity Building and Farmer Education:

Many smallholder farmers lack sufficient knowledge of pest biology, early detection, and appropriate control measures. Addressing this could involve:

- Establishing regular training and capacity-building programs tailored to local pest challenges.
- Enhancing collaboration with agricultural research institutes (e.g. KASU, IAR, ABU Zaria) to localize best practices.
- Creating farmer field schools (FFS) to disseminate knowledge through peer learning.

9. Monitoring, Early Warning, and Surveillance Systems:

The absence or inefficiency of structured pest surveillance and early warning systems limits timely response to outbreaks. Opportunities include:

- Developing a digital pest alert system using mobile technology and GIS tools.
- Establishing community-based monitoring networks to report pest infestations.
- Integrating weather and pest modeling data to forecast outbreaks.

1. Regulation and Quality Control of Pesticides:

Unregulated pesticide sales, use of banned or substandard products, and improper application methods are common. Improvements can be made through:

- Stricter enforcement of existing agrochemical regulations and policies.
- Certification and licensing for agrochemical retailers and applicators.
- Public awareness campaigns about the dangers of unsafe pesticide use.

2. Sustainable and Climate-Smart Pest Control Strategies:

Given the increasing impact of climate change on pest dynamics, there is a need to integrate sustainability into pest management by:

- Promoting climate-resilient crop varieties with pest resistance traits.
- Encouraging crop rotation and diversified farming systems to break pest life cycles.



- Leveraging agro-ecological approaches to enhance natural pest suppression.

3. Private Sector and PPP Engagement: Public-Private Partnerships (PPPs) can help scale innovative solutions by:

- Encouraging agribusinesses and input providers within the SAPZ to support farmer training and IPM product supply.
- Supporting innovation hubs and agro-tech startups focused on pest detection tools and eco-friendly products.
- Developing inclusive business models that make pest control services affordable for smallholders.

4. Data Collection, Research, and Policy Integration: Limited local data hinders informed decision-making. Areas for development include:

- Establishing a central pest data management system in collaboration with research institutions.
- Conducting localized studies on pest prevalence, resistance trends, and control effectiveness.
- Ensuring pest management strategies are embedded into broader SAPZ policy and investment plans.

To address these challenges, there is a need for an Integrated Pest Management Plan (PMP) that prioritizes the responsible and rational use of pesticides, strengthens institutional capacities, and promotes control alternatives based on biological, cultural, and physical methods. The effective implementation of the PMP will require the active participation of all stakeholders, including government agencies, farmers' associations, phyto-sanitary services, research institutions, and strategic partners.



CHAPTER SIX: KEY PEST PROBLEMS IN KADUNA STATE

6.0 Key Pest Problems for Kaduna SAPZ

The agricultural landscape of Kaduna State presents a diverse array of agro-ecological conditions, supporting the production of staple and cash crops such as maize, rice, soybean, cassava, tomato, ginger, sorghum, and groundnut—all of which are integral to the Kaduna State Special Agro-Industrial Processing Zone (SAPZ). However, the productivity and sustainability of these crops are severely threatened by a wide range of pests, including insect pests, weeds, and pathogens (fungi, bacteria, viruses, and nematodes). These pest pressures, if unmanaged, can result in significant yield losses, increased production costs, environmental degradation, and food insecurity.

Below is a presentation of detailed key pest problems within Kaduna State, based on field assessments, expert consultations, and secondary data from agricultural research institutions and extension services.

6.1 Major Insect Pests

Insect pests are a primary constraint to crop production in Kaduna SAPZ. These pests damage crops at different growth stages—vegetative, flowering, and post-harvest—resulting in yield and quality reduction.

A. Maize (*Zea mays*)

- **Fall Armyworm (*Spodoptera frugiperda*):** A devastating pest that feeds on leaves, whorls, and cobs, leading to yield losses of up to 50% if uncontrolled.
- **Stem Borers (*Busseola fusca* and *Sesamia calamistis*):** Larvae tunnel into stems, weakening the plant and reducing grain production.
- **African Bollworm (*Helicoverpa armigera*):** A generalist pest that damages maize and legumes by feeding on reproductive structures.

B. Rice (*Oryza sativa*)

- **Rice Stem Borers *Chilo* species (e.g., *Chilo partellus* (Swinhoe), commonly known as the spotted stem borer) and *Scirpophaga* species (e.g., *Scirpophaga incertulas* (Walker), commonly known as the yellow stem borer):** Cause dead hearts and whiteheads, leading to significant grain loss.
- **Rice Hispa (*Dicladispa armigera*):** Adult and larvae feed on leaf tissue, reducing photosynthetic capacity.
- **Planthoppers (*Nilaparvata lugens*):** Suck sap from rice plants and transmit rice ragged stunt and grassy stunt viruses.

C. Tomato (*Solanum lycopersicum*)

- **Tuta absoluta (Tomato Leaf Miner):** A highly destructive invasive pest that bores into leaves, stems, and fruits, often leading to total crop failure.
- **Whiteflies (*Bemisia tabaci*):** Suck sap and transmit tomato yellow leaf curl virus.
- **Fruit Borers (*Helicoverpa armigera*):** Bore into developing fruits, reducing market value.

D. Soybean and Groundnut



- **Pod Borers (*Maruca vitrata*):** Attack flower buds and pods, leading to reduced seed formation.
- **Aphids (*Aphis glycines*):** Transmit viral diseases and weaken plants through sap feeding.

E. Ginger and Root Crops

- **Nematodes (*Meloidogyne spp.*):** Cause root galling, stunted growth, and secondary infections.
- **Rhizome Borers (Shoot flies and root grubs):** Damage ginger rhizomes, leading to rotting and poor yields.

6.2 Major Weeds

Weeds compete with crops for light, nutrients, and water, while also serving as alternate hosts for insect pests and pathogens. In Kaduna state, weed infestation is a persistent challenge, especially in rain fed and smallholder systems.

A. Broadleaf Weeds

- ***Chromolaena odorata* (Siam Weed):** An aggressive invader that suppresses native vegetation and crop growth.
- ***Ageratum conyzoides*:** Common in fallow fields; hosts several viruses and insects.
- ***Amaranthus spp.*:** Fast-growing, nutrient-exhausting weeds common in grain fields.

B. Grassy Weeds

- ***Imperata cylindrica* (Speargrass):** Highly persistent, regenerates quickly from rhizomes, and inhibits crop establishment.
- ***Echinochloa spp.* (Barnyard Grass):** Major weed in rice fields; mimics crop morphology, making control difficult.
- ***Rottboellia cochinchinensis* (Itch Grass):** Outcompetes maize and sorghum; hard to control manually.

C. Sedges

- ***Cyperus esculentus* and *C. rotundus* (Nut sedge, purple sedge):** Difficult to eradicate due to underground tubers; common in irrigated fields.

D. Parasitic Weeds

- ***Striga hermonthica* (Witchweed):** Attacks cereal crops like maize, sorghum, and millet by attaching to roots and extracting nutrients, leading to severe yield loss.

6.3 Major Pathogens (Fungi, Bacteria, Viruses, and Nematodes)

Pathogenic microorganisms are responsible for a wide range of crop diseases in the Kaduna state, affecting all stages from seedling to post-harvest.



6.3.1 Fungal Diseases

A. Maize:

- Northern Leaf Blight (*Exserohilum turcicum*)
- Maize Rust (*Puccinia polysora*)

B. Rice:

- Rice Blast (*Magnaporthe oryzae*) – affects leaves and panicles.
- Sheath Blight (*Rhizoctonia solani*)

B. Tomato:

- Early Blight (*Alternaria solani*)
- Late Blight (*Phytophthora infestans*) – especially destructive during rainy seasons.

Soybean and Groundnut:

- Leaf Spot (*Cercospora spp.*)
- Anthracnose (*Colletotrichum spp.*)

6.3.2 Bacterial Diseases

- Bacterial Leaf Blight (*Xanthomonas oryzae*) in rice
- Bacterial Wilt (*Ralstonia solanacearum*) in tomato and solanaceous crops
- Bacterial Pustule and Bacterial Blight in soybean

6.3.3 Viral Diseases

- Maize Streak Virus (MSV) – transmitted by leafhoppers
- Tomato Yellow Leaf Curl Virus (TYLCV) – transmitted by whiteflies
- Groundnut Rosette Virus – aphid-transmitted, causing stunting and chlorosis
- Cowpea Mosaic Virus – affects legumes and is spread by aphids

6.3.4 Nematodes

- Root-knot Nematodes (*Meloidogyne spp.*): Affect almost all crops, particularly vegetables and legumes
- Cyst Nematodes: Affect soybean and are difficult to detect until severe

6.4 Post-Harvest Pests in Kaduna State

Post-harvest pests represent a significant threat to agricultural productivity and food security in the Kaduna State Special Agro-Industrial Processing Zone (SAPZ). Despite the considerable efforts invested in production, poor post-harvest handling and pest infestation often lead to massive losses in both quantity and quality of agricultural commodities. These losses undermine farmers' incomes, reduce market competitiveness, increase food prices, and pose serious health risks to consumers due to contamination and spoilage.

Post-harvest losses in Nigeria are estimated at 30–50% for some food commodities. In Kaduna SAPZ, where the focus crops include grains (maize, rice, and sorghum), legumes (soybean, groundnut, cowpea), vegetables (tomato, pepper), and spices (ginger), these losses are exacerbated by a combination of:



- Inadequate drying
- Poor storage facilities and infrastructure
- High ambient humidity
- Use of non-hermetic bags and unprotected containers
- Limited knowledge of post-harvest pest control
- Weak regulatory enforcement and pesticide misuse

Storage Challenges

Poor storage practices such as use of untreated bags, high humidity, and lack of aeration contribute to mold growth and aflatoxin contamination (especially by *Aspergillus flavus*).

The pest challenges in Kaduna state are multi-faceted, involving a complex interaction of insects, weeds, and pathogens. These pests, if not effectively managed, threaten the viability of the SAPZ initiative and its goal of agricultural industrialization and food security. Understanding the local pest ecology is therefore critical to developing sustainable, integrated pest management (IPM) strategies that balance productivity with environmental and public health safety.

These conditions provide a conducive environment for pest infestation and secondary microbial contamination, particularly in rural and semi-urban areas where modern storage systems are lacking.

6.4.1 Major Post-Harvest Pests by Commodity

Grains (Maize, Sorghum, Rice)

A. Maize Weevil (*Sitophilus zeamais*)

- One of the most destructive storage pests of maize.
- Adults bore into the grain to lay eggs; larvae feed within, leaving hollowed kernels.
- Causes weight loss, reduced nutritional value, and contamination with frass and exuviae.

B. Larger Grain Borer (*Prostephanus truncatus*)

- Highly invasive and aggressive pest; attacks maize and dried cassava.
- Can cause total destruction of stored maize in less than three months.
- Difficult to control once established.

C. Rice Weevil (*Sitophilus oryzae*)

- Similar behavior to maize weevil but prefers rice and wheat.
- Infestation can begin in the field and intensify in storage.
- Reduces grain viability and market quality.

D. Angoumois Grain Moth (*Sitotroga cerealella*)

- A serious pest of rice and maize in storage.
- Larvae develop inside the grain, causing internal damage.
- Often goes unnoticed until grain is milled or consumed.

Legumes (Cowpea, Soybean, Groundnut)

A. Cowpea Bruchid (*Callosobruchus maculatus*)



- Lays eggs on dry cowpea seeds; larvae bore into seeds, causing extensive internal damage.
- Rapid multiplication can lead to complete loss within 3–4 months if untreated.
- Infested grains show holes, dust, and poor market appeal.

B. Groundnut Storage Beetles (*Tribolium castaneum*, *Caryedon serratus*)

- Attack shelled groundnuts during storage.
- Cause rancidity, weight loss, and contamination with body parts and frass.
- Can trigger aflatoxin contamination when combined with fungal infection.

Tubers and Root Crops (Cassava, Yam)

- Cassava Chips and Dried Roots are susceptible to *Prostephanus truncatus* and fungal rot.
- Yams stored in traditional barns are vulnerable to:
- Soft rot caused by *Rhizopus* spp.
- Nematode infection leading to dry rot
- Rodent damage during dry-season storage

Vegetables (Tomato, Pepper, Onion)

Perishable vegetables are highly prone to microbial decay and mechanical damage, especially when not handled properly.

A. Fruit Rot Pathogens

- *Alternaria*, *Rhizopus*, *Fusarium*, and *Botrytis* species attack tomatoes and peppers during post-harvest.
- Infections begin from minor bruises or cuts during harvest and transportation.
- Spoilage occurs rapidly in humid environments.

B. Fruit Flies (*Tephritidae* spp.)

- Lay eggs in ripening fruits; larvae feed on pulp.
- Infested fruits collapse quickly and cannot be marketed or processed.

Ginger

After harvest, rhizomes are prone to:

- Fungal rots (e.g., *Fusarium*, *Pythium*, *Penicillium* species)
- Rhizome borers and mites in dried ginger
- Infestation increases under high humidity and poor ventilation during drying and storage.

6.4.2 Secondary Pests and Contamination

Rodents and Birds

- Feed on stored grains and legumes.
- Cause direct loss and contamination through droppings and urine.
- Contribute to the spread of zoonotic diseases.



Mould and Mycotoxin-Producing Fungi

- Common in maize, groundnut, and millet stored under humid conditions.
- *Aspergillus flavus* and *A. parasiticus* produce aflatoxins—potent carcinogens and liver toxins.
- Aflatoxin contamination results in rejection of export-quality crops and serious public health risks.

6.4.3 Economic and Health Implications

Economic Losses: Smallholder farmers, who constitute the majority of producers in Kaduna, suffer income losses due to reduced saleable volumes, lower quality grades, and rejection in formal markets.

Health Hazards: Infestation by pests and fungi leads to contamination with aflatoxins, molds, and allergens, contributing to malnutrition, immunosuppression, liver diseases, and stunted growth in children.

Food Insecurity: When harvests are lost post-production, food availability decreases, pushing up prices and deepening poverty and hunger in rural communities.

6.4.4 Contributing Factors to Post-Harvest Pest Problems

- Lack of hermetic storage technologies (e.g., PICS bags, metal silos)
- Poor post-harvest handling and hygiene
- Inadequate drying methods (sun drying on bare ground)
- Use of inappropriate storage materials (e.g., jute sacks, open bins)
- Limited knowledge and access to safe storage chemicals and bio-preservatives
- Weak extension services and farmer training on best post-harvest practices.

6.4.5 Recommended Post-Harvest Pest Management Strategies

To address these challenges, the following strategies are recommended for Kaduna SAPZ:

A. Improved Storage Systems

- Adoption of hermetic storage (e.g., Purdue Improved Crop Storage [PICS] bags, metal bins, solar dryers)
- Use of raised, ventilated structures to minimize moisture and heat buildup

B. Post-Harvest Hygiene

- Clean storage areas regularly
- Remove old grain residues and damaged produce before storing new harvest

C. Controlled Drying and Handling

- Use of tarpaulins or concrete floors for hygienic drying
- Solar dryers or mechanical dryers to reduce moisture content uniformly

D. Biological and Botanical Protectants

- Neem seed powder, ash, and diatomaceous earth as alternatives to synthetic chemicals

E. Judicious Use of Pesticides and Fumigants



- Use only approved pesticides and fumigants (e.g., aluminum phosphide under professional supervision)
- Avoid overuse and contamination of food products

F. Capacity Building

- Farmer training on post-harvest loss prevention
- Strengthening of extension services and agro-processing cooperatives

6.5 Emerging and Invasive Pests in Kaduna State SAPZ

Emerging and invasive pests represent a growing threat to agriculture in Kaduna State and, by extension, the success of the Special Agro-Industrial Processing Zone (SAPZ) initiative. Unlike endemic pests that have long been part of the local agro-ecosystem, emerging pests are either new to the region or are existing pests that have become more destructive due to changes in climate, land use, cropping patterns, or pesticide resistance. Invasive pests, on the other hand, are non-native species that have entered and established in the region, often with no natural enemies, allowing them to spread rapidly and cause severe economic and ecological damage. These pests pose a serious risk to food security, livelihoods, public health, and biodiversity, particularly when surveillance systems are weak and response mechanisms are slow. This section explores the major emerging and invasive pest threats affecting the Kaduna SAPZ region, their characteristics, pathways of introduction, and the challenges they pose to pest management.

6.5.1 Drivers of Emerging and Invasive Pest Incidences

Several factors are contributing to the emergence and spread of new pest species in Kaduna SAPZ:

- Climate change (altered rainfall, humidity, and temperature patterns)
- Global trade and cross-border movement of agricultural goods
- Mono-cropping and continuous cultivation without crop rotation
- Reduced biodiversity and natural enemies due to deforestation
- Weak phytosanitary controls at borders and markets
- Pesticide misuse, leading to resistance and pest resurgence

6.5.2 Key Emerging and Invasive Pests in Kaduna SAPZ

A. Fall Armyworm (*Spodoptera frugiperda*) – Invasive

Origin: Native to the Americas; first detected in West Africa in 2016.

Host Range: Primarily attacks maize but also affects sorghum, millet, rice, and over 80 plant species.

Damage and Impact:

- Larvae feed voraciously on leaves, tassels, and maize cobs, leading to 20–50% yield loss if unmanaged.
- Rapid reproduction and high mobility make it difficult to contain.
- Resistance to several chemical insecticides has already been observed.



- Severe outbreaks have led to increased pesticide usage, escalating costs and health risks.

Current Status in Kaduna: Widespread and persistent across maize-producing areas; now considered endemic but still a major threat during cropping seasons.

B. Tomato Leaf Miner (*Tuta absoluta*) – Invasive

Origin: South America; introduced into Africa in 2006, and into Nigeria by 2015.

Host Range: Primarily affects tomato, but can also attack potato, eggplant, and other solanaceous crops.

Damage and Impact:

- Larvae burrow into leaves, stems, and fruits, causing tissue collapse and early fruit rot.
- Can cause up to 100% yield loss in open-field tomato production.
- Difficult to control with conventional insecticides due to its endophytic (internal) feeding behavior.
- Drives up the cost of tomato production and affects tomato processors within the SAPZ.

Current Status in Kaduna: Present in major tomato-growing areas like Kubau, Ikara, Makarfi, Soba, Giwa, and Kudan LGAs.

C. Parthenium Weed (*Parthenium hysterophorus*) – Invasive

Origin: Native to the Americas; invasive in many parts of Africa.

Characteristics:

- Aggressive, fast-growing annual weed that outcompetes crops and native species.
- Releases allelopathic chemicals that inhibit crop germination.
- Host to various crop pests and diseases.

Impact:

- Reduces crop productivity and land value.
- Causes dermatitis, respiratory allergies, and livestock toxicity.
- Affects livestock pastures, causing indirect losses to mixed farming systems.

Current Status in Kaduna: Spreading rapidly in disturbed lands, along roadsides, and in under-managed farmlands.

D. Maize Lethal Necrosis Disease (MLND) – Emerging

Cause: Co-infection by Maize chlorotic mottle virus (MCMV) and other viruses like Sugarcane mosaic virus (SCMV).

Symptoms:

- Chlorotic mottling, leaf drying, premature death of plants.
- Stunted growth and sterile ears in maize.

Impact:

- First reported in East Africa but poses an emerging risk in West Africa due to trade and seed movement.
- Devastating impact in countries where it has been established, causing over 50% yield loss.
- Spread mainly through infected seeds and insect vectors (thrips, beetles, aphids).

Status in Kaduna: Not yet confirmed, but vigilance is required due to increasing maize



production and seed imports.

E. Desert Locust (*Schistocerca gregaria*) – Invasive Migratory Pest

Origin: Native to dry areas of Africa and the Middle East.

Threat Level: Swarms can migrate long distances and devastate entire fields within hours.

Impact:

- Massive feeding damage to cereals, vegetables, and pasture lands.
- Causes food shortages and pasture depletion for livestock.
- Difficult to control due to migratory nature and scale of infestation.

Current Status: No outbreak in Kaduna currently, but climate change and regional invasions from Sahel regions present a significant risk.

F. Whitefly (*Bemisia tabaci* - B biotype) -- Invasive

Role: Vector for numerous plant viruses, including Tomato Yellow Leaf Curl Virus (TYLCV) and Cassava Mosaic Virus (CMV).

Impact:

- Sap-feeding causes leaf curling, chlorosis, and stunting.
- Rapid virus transmission among crops.
- Resistant to many chemical insecticides, requiring integrated control.

Current Status: Established in Kaduna; spreading in vegetable and cassava fields.

6.5.3 Impacts of Emerging and Invasive Pests on SAPZ Goals

The increasing frequency and severity of emerging and invasive pest outbreaks pose a critical threat to the Kaduna State SAPZ's long-term success. A proactive, science-based, and collaborative pest management approach is essential to mitigate these risks, protect investments, and ensure sustainable agricultural transformation. With early detection, strong regulatory frameworks, and integrated control strategies, the SAPZ can build resilience against these biological threats and safeguard food and economic security in the region.

Emerging and invasive pests directly threaten the economic and social objectives of the SAPZ by:

- Reducing yield and quality of key crops targeted for processing
- Increasing input costs (especially pesticides and labor)
- Lowering profitability for farmers and processors
- Triggering food price inflation due to supply shortages
- Undermining investment in the value chains and agro-industrial infrastructure
- Hindering export potential due to phytosanitary concerns

6.5.4 Gaps and Challenges in Management

- Weak pest surveillance and early warning systems
- Low farmer awareness and misdiagnosis of new pests
- Inadequate quarantine and border control protocols
- Limited access to biological control agents
- Heavy dependence on chemical pesticides, leading to resistance



6.5.5 Recommendations for Management

To manage emerging and invasive pests effectively within the Kaduna SAPZ, the following actions are recommended:

A. Strengthen Pest Surveillance and Early Warning

- Establish regional pest surveillance units within the SAPZ.
- Train extension officers on pest identification and monitoring.
- Leverage ICT tools (e.g., mobile apps, GIS) for real-time reporting.

B. Enforce Quarantine and Phyto sanitary Measures

- Improve inspection of seeds and planting materials.
- Monitor and regulate trans-boundary movement of agricultural commodities.
- Collaborate with neighboring states and ECOWAS member countries on pest control.

B. Promote Integrated Pest Management (IPM)

- Encourage use of resistant crop varieties.
- Promote biological control agents (e.g., parasitoids for *Tuta absoluta*).
- Introduce cultural practices (e.g., crop rotation, sanitation).

C. Capacity Building

- Conduct targeted training for farmers and agro-dealers on invasive pest control.
- Develop pest identification guides and multilingual awareness campaigns.

D. Research and Innovation

- Support research institutions (e.g., IAR and NAERLS) to develop local solutions.
- Pilot pest forecasting systems based on weather data and crop phenology.



CHAPTER SEVEN: ASSESSMENT OF CURRENT PEST MANAGEMENT PRACTICES IN KADUNA STATE

7.0 Assessment of Current Pest Management Practices in Kaduna State SAPZ

7.1 Chemical Control Usage

Chemical control, specifically the use of synthetic pesticides, herbicides, and fungicides, remains a dominant method of pest management within agricultural systems in Kaduna State and across much of Nigeria. An assessment of its current application reveals both its widespread dependence and several associated challenges that highlight the need for improvement. The assessment is based on the following reasons:

7.1.1 Widespread Dependence on Chemical Pesticides

Farmers in Kaduna State predominantly rely on chemical pesticides as the primary and often sole method of managing pests, diseases, and weeds. This is especially true in high-value and commercial crop production systems supported under the SAPZ initiative.

Reason for Usage:

- Quick actions, ease of access, and perceived effectiveness.

Common Chemicals Used:

- Organophosphates (e.g., chlorpyrifos), pyrethroids, glyphosate-based herbicides, carbamates, and synthetic fungicides.

Target Pests:

- Insect pests (e.g., stem borers, aphids, whiteflies), fungal pathogens (e.g., blights, rusts), and problematic weeds (e.g., Striga, Cyperus spp.).

7.1.2 Challenges with Current Chemical Control Practices

A. Misuse and Overuse of Chemicals

Inappropriate Dosages:

- Many farmers either over-apply or under-apply pesticides due to lack of training or misunderstanding of label instructions.

Incorrect Timing:

- Spraying is often done without monitoring pest thresholds, leading to unnecessary applications.

Pesticide Cocktails:

- Farmers often mix multiple pesticides (sometimes incompatible ones), leading to chemical antagonism or phytotoxicity.

B. Limited Knowledge and Awareness

Many smallholder farmers lack adequate knowledge of:

- Pest life cycles
- Appropriate chemical selection
- Safe handling and protective measures
- Extension services are often under-resourced and insufficient to provide ongoing training and guidance.



- C. **Health and Environmental Hazard: Human Health Risks:** Farmers and farm workers are frequently exposed to toxic chemicals due to lack of personal protective equipment (PPE) and poor safety practices. **Environmental Contamination:** Over-application and improper disposal practices contribute to
- Water body pollution
 - Soil degradation
 - Decline in beneficial insect populations (e.g., pollinators and natural enemies)
- E. **Development of Pest Resistance:** Prolonged use of the same active ingredients has led to resistance in several pest populations, reducing chemical effectiveness and increasing production costs.

4.1.3 Regulatory and Supply Chain Issues

- A. **Weak Enforcement of Pesticide Regulations:** While NAFDAC and FMEnv provide regulatory frameworks, enforcement is inconsistent. Unregistered, substandard, or banned pesticides are often found in local markets.
- B. **Inadequate Quality Control:** There is a proliferation of counterfeit or adulterated pesticides due to poor monitoring of the supply chain. Farmers are often unaware of how to verify product authenticity.
- C. **Poor Record Keeping and Traceability:** Most farmers do not keep pesticide use records, making monitoring and assessment difficult. Lack of traceability also impairs efforts to establish safe residue levels for agro-processing and export markets.

7.1.4 Summary of the Key Observations and Issues on Chemical Control Usage

Observations:

- High dependence on synthetic chemical pesticides among smallholder and commercial farmers.
- Common use of broad-spectrum insecticides, herbicides, and fungicides, often without technical guidance.
- Frequent use of Class II and III WHO-hazard pesticides, including restricted or banned substances.
- Over application and misuse due to lack of calibrated equipment or understanding of dosage instructions.

Issues:

- Pesticide resistance is emerging due to repeated use of similar active ingredients.
- Environmental contamination (soil, water) from runoff and improper disposal of pesticide containers.
- Human health risks, including reported cases of poisoning, skin irritation, and respiratory issues among applicators and farm workers.
- Weak enforcement of pesticide regulations and poor monitoring by regulatory bodies (NAFDAC, FMEnv).



7.1.5 Opportunities for Improvement

To improve chemical control practices within the SAPZ framework, several strategic interventions are needed:

- A. Strengthen Extension Services: Train farmers on safe and effective pesticide use, pest identification, and IPM principles.
- B. Enhance Regulation and Monitoring: Improve the enforcement of existing pesticide regulations and remove unregistered products from markets.
- C. Promote Safe Use and Storage: Introduce farmer field schools and demonstrations on PPE use, safe mixing, spraying techniques, and storage practices.
- D. Encourage Alternatives: Gradually reduce chemical dependency by integrating biological and cultural control methods, supporting a transition to Integrated Pest Management (IPM).
- E. Support Research: Encourage localized studies to assess resistance development and pesticide efficacy for region-specific pests.
- F. Promote Private Sector Partnerships: Engage agro-dealers and suppliers in safe pesticide marketing, training, and stewardship programs.

Chemical control remains a cornerstone of pest management in Kaduna State, but its current usage presents significant risks and inefficiencies. A shift toward more sustainable, knowledge-based, and regulated use is essential for enhancing productivity, protecting human and environmental health, and ensuring the long-term success of the SAPZ initiative.

7.2 Biological Control Adoption

Biological control—the use of natural enemies such as predators, parasitoids, and pathogens to manage pest populations—is a vital component of sustainable Integrated Pest Management (IPM) strategies. However, in the context of current pest management practices in Kaduna State, the adoption of biological control remains very limited. This assessment explores the status, challenges, and opportunities for improving the use of biological control within the Special Agro-Industrial Processing Zone (SAPZ) initiative.

7.2.1 Current Status of Biological Control Adoption

A. Low Awareness and Understanding

- Most smallholder and even medium-scale farmers have limited or no knowledge of biological control options.
- There is confusion between organic farming and biological control, leading to underutilization of biological agents.

B. Minimal Use of Natural Enemies

- Indigenous natural enemies such as lady beetles, lacewings, spiders, and parasitic wasps exist in the environment but are not purposefully conserved or augmented. -
- There is no systematic release or commercialization of bio-agents like *Trichogramma*, *Metarhizium anisopliae*, or *Bacillus thuringiensis* (Bt) in Kaduna State.



C. Poor Ecosystem Management

- The frequent and indiscriminate use of chemical pesticides harms beneficial organisms, reducing the potential for natural pest regulation.
- Habitat destruction due to land clearing and mono-cropping limits the proliferation of natural enemies.

7.2.2 Institutional and Technical Challenges

A. Lack of Research and Extension Linkages

- Agricultural research institutions in Nigeria (e.g., IAR Zaria) have developed bio-pesticide options, but these innovations are not widely disseminated or adopted.
- Weak extension systems do not adequately promote or educate farmers about biological control.

B. Limited Commercial Supply Chains

- There is an absence of commercial producers and distributors of bio-control agents in Kaduna and neighboring areas.
- Farmers have limited access to approved and tested bio-pesticides such as fungal pathogens, parasitoids, or bio-nematicides.

C. Weak Policy and Regulatory Support

- National pest management policies and pesticide regulations are more focused on chemical pesticide registration and control.
- Bio-control products face unclear or lengthy registration processes, discouraging private sector investment.

7.2.3 Farmer Attitudes and Perceptions

Farmers tend to prefer "quick fix" chemical options due to:

- Visible, immediate results
- Lack of patience for the slower, longer-term effects of biological control

There is a general perception that bio-control agents are ineffective or unreliable, often due to lack of exposure or inconsistent field results.

7.2.4 Summary of Key Observations and Issues on Biological Control Adoption

Observations:

- Minimal or negligible use of biological control agents (BCAs) such as predators, parasitoids, or microbial agents.
- Very limited availability of locally adapted bio-pesticides or bio-agents in local agro-input markets.
- Some awareness of neem-based formulations, but usage remains low and inconsistent.



Issues:

- Lack of institutional support for bio-agent production, distribution, or quality assurance.
- No structured training on integration of biological controls within broader IPM frameworks.
- Farmers generally distrust or underestimate the effectiveness of biological alternatives.

7.2.5 Missed Opportunities in the SAPZ Context

Given the Kaduna SAPZ's focus on improving agricultural productivity, value chain development, and environmental sustainability, biological control presents numerous untapped opportunities:

- Cotton, Tomato, and Maize Value Chains: These are high-potential crops under the SAPZ initiative that are susceptible to pests like bollworms, whiteflies, and stem borers—all of which can be managed using biological agents.
- Post-Harvest Pest Management: Bio-fumigants and biological grain protectants (e.g., *Pseudomonas* spp., neem-based products) could reduce post-harvest losses without compromising food safety.
- Agro-Ecology Alignment: Biological control aligns with climate-smart agriculture and ecological farming practices being promoted in other components of the SAPZ.

7.2.6 Recommendations for Improved Adoption

To scale biological control adoption and integrate it effectively into pest management practices in Kaduna SAPZ, the following actions are needed:

A. Capacity Building and Farmer Training

- Introduce farmers to biological control concepts through Farmer Field Schools (FFS), demonstration plots, and media campaigns.
- Train extension agents and lead farmers on identification and conservation of natural enemies.

B. Strengthen Research and Development

Support local research institutions to:

- Develop and test indigenous biological control agents.
- Validate bio-pesticide efficacy under Kaduna agro-ecological conditions.
- Investigate mass-rearing and field application protocols.

C. Policy and Regulatory Reform

- Simplify and clarify the registration process for bio-pesticides and biological control agents.
- Provide incentives (e.g., subsidies, tax breaks) for private sector engagement in bio-control production and distribution.

D. Encourage Public-Private Partnerships (PPPs)



- Partner with bio-pesticide companies and NGOs to promote commercial availability and adoption.
- Support agro-dealers with training and stocking of registered, quality-assured biological products.

E. Promote Agro-Ecological Farming Practices

- Encourage habitat conservation practices like intercropping, flower strips, and cover cropping that support beneficial organisms.
- Reduce the use of broad-spectrum insecticides to allow biological control agents to thrive.

Biological control remains an underutilized but highly promising approach in current pest management systems in Kaduna State. Its low adoption is primarily due to limited awareness, weak support systems, and an overreliance on chemical pesticides. By strengthening research, training, policy frameworks, and private sector involvement, the SAPZ initiative can effectively integrate biological control into its broader pest management strategy—enhancing productivity while ensuring environmental and human health.

7.3 Cultural Control Adoption

Cultural control refers to the use of agronomic practices that reduce pest establishment, reproduction, dispersal, and survival. These practices are among the oldest and most accessible forms of pest management. However, in Kaduna State, particularly within the SAPZ target zones, the adoption of cultural control measures remains inconsistent and often suboptimal. This assessment explores the current status, gaps, and opportunities related to the adoption of cultural control practices.

7.3.1 Current Adoption Status of Cultural Control

Cultural control practices are used to varying degrees by farmers, especially smallholders, but often not in a systematic or scientifically-informed way. Adoption depends heavily on traditional knowledge and resource availability, with limited integration into structured pest management plans.

A. Commonly Practiced Cultural Controls

Crop rotation:

- Practiced in some areas to break pest and disease cycles, particularly among maize, legumes, and sorghum.

Early planting: Occasionally used to avoid peak pest pressure but not consistently timed or informed by pest surveillance.

Field sanitation: Residue removal and burning of infested crop materials are practiced in some communities but not universally.

Intercropping and mixed cropping: Common among smallholders for subsistence, providing some pest suppression benefits.

Tillage practices: Traditional plowing sometimes helps to expose soil-borne pests and disrupt



their life cycles.

B. Less Common or Poorly Implemented Cultural Measures

Use of resistant/tolerant crop varieties: Limited awareness and access to pest-resistant crop cultivars developed by national research institutions.

Trap cropping: Rarely practiced due to lack of technical knowledge and unavailability of appropriate trap crops.

Adjusting planting dates and spacing: Infrequently used as a pest control strategy—spacing is often determined by tradition or seed availability rather than pest avoidance.

7.3.2 Key Constraints to Effective Cultural Control Adoption

- A. Limited Technical Knowledge:** Most farmers are not trained in how or why cultural practices can reduce pest pressure. There's little understanding of pest life cycles, thresholds, or timing necessary for effective use of cultural methods.
- B. Poor Access to Extension Services:** Agricultural extension workers are few, poorly resourced, and often lack up-to-date training on IPM practices, including cultural control. There is limited outreach to systematically promote cultural control practices alongside other IPM components.
- C. Land and Resource Constraints:** Small landholdings discourage crop rotation or fallowing, as farmers prefer continuous cropping for subsistence. Access to inputs like cover crop seeds, resistant varieties, or mechanized equipment is low.
- D. Lack of Research-Extension-Farmer Linkages:** Innovations and findings from research institutes (e.g., on optimal crop rotations or resistant varieties) are not effectively disseminated to farmers in the SAPZ.

7.3.3 Environmental and Agronomic Impacts

Where cultural control practices are applied effectively, they offer several advantages:

Reduction in pest incidence and population buildup

Improved soil health and fertility through diversified rotations and reduced chemical input reliance

Cost savings on synthetic pesticides and associated risks However, the inconsistent and unscientific application often limits these benefits.

7.3.4 Summary of Key Observations and Issues on Cultural Control Adoption

Observations:

- Some indigenous knowledge exists around traditional pest avoidance (e.g., early planting, intercropping, burning infested residues).
- Cultural practices like crop rotation and fallowing are practiced but not primarily for pest control.
- Weed management is mostly mechanical or chemical; limited use of cover crops or mulching.

Issues:



- Inconsistent adoption of cultural practices due to labor shortages and lack of awareness of pest benefits.
- Poor understanding of land preparation timing, sanitation, and habitat manipulation as pest prevention tools.
- Limited integration of cultural methods into organized IPM training or SAPZ extension packages.

7.3.5 Opportunities for Enhancing Cultural Control in SAPZ Pest Management

Given the SAPZ's emphasis on sustainable, scalable, and climate-smart agriculture, cultural control methods offer multiple opportunities for improvement and mainstreaming:

- A. Strengthening Farmer Training and Awareness:** Integrate cultural control practices into Farmer Field Schools (FFS), demonstration plots, and SAPZ-supported agribusiness trainings. Develop community-level training manuals and visual aids illustrating cultural methods for specific pest problems (e.g., maize stem borers, tomato fruit worms, root rot in legumes).
- B. Promote Agro ecological Practices:** Encourage the use of intercropping, border cropping, and crop diversification to disrupt pest cycles. Introduce push-pull strategies (e.g., maize with Desmodium and Napier grass) adapted to Kaduna's agro-ecological zones.
- C. Facilitate Access to Improved Varieties:** Work with research institutions (e.g., IAR Zaria, NAERLS) and seed companies to scale up the dissemination of pest-resistant crop varieties. Ensure seed system improvements that promote access to certified seeds with known resistance traits.
- D. Incorporate Cultural Control into SAPZ Guidelines and Standards:** Develop IPM protocols that explicitly include cultural control options as a first line of defense. Promote cultural controls as Good Agricultural Practices (GAP) to be adopted by agro-processing contractors and suppliers within the SAPZ framework.
- E. Link Cultural Control with Other IPM Strategies:** Position cultural practices as foundational within a larger IPM strategy that includes biological and chemical controls. Demonstrate cost-benefit advantages of cultural practices through data collected in SAPZ-supported pilot sites or clusters.

7.3.6 Monitoring and Documentation

- Introduce farm-level recordkeeping to monitor the use and effectiveness of cultural practices.
- Support participatory action research where farmers test and adapt cultural methods under local conditions, encouraging farmer-to-farmer dissemination.

While some cultural control methods are already in use in Kaduna State, their adoption is largely informal, inconsistent, and unsupported by scientific pest management principles. Within the SAPZ context, there is significant potential to mainstream these practices through structured training, better extension services, supportive policies, and integration with other IPM components. Cultural control stands out as a cost-effective, sustainable, and environmentally friendly approach that, if properly scaled, can significantly reduce pest



pressure and dependency on chemical pesticides.

7.4 Knowledge and Capacity Gaps

A critical review of the current pest management practices in Kaduna State, particularly within the Special Agro-Industrial Processing Zone (SAPZ), reveals that knowledge and capacity gaps are among the most fundamental barriers to the effective implementation of sustainable, safe, and integrated pest management strategies. These gaps exist at multiple levels—among farmers, extension workers, agro-dealers, and even some institutional stakeholders—and significantly influence the reliance on ineffective or hazardous pest control methods.

7.4.1. Farmers' Knowledge and Skills Gaps

a. Limited Awareness of Integrated Pest Management (IPM)

- Most farmers are unfamiliar with the concept of IPM, which combines chemical, biological, cultural, and mechanical control methods.
- There is little understanding of pest ecology, thresholds, or the environmental and health risks of over-relying on chemical pesticides.

b. Inadequate Pest Identification Skills

- Farmers often misidentify pest species or fail to distinguish between pests and beneficial insects, leading to unnecessary or inappropriate pesticide use.
- There is a general lack of diagnostic skills to identify pest-related symptoms versus nutrient deficiencies or abiotic stress.

c. Poor Decision-Making on Control Methods

- Without proper training, farmers rely heavily on visual damage or neighboring practices to decide on pest control measures.
- Decisions are often reactive rather than preventive or integrated, leading to increased costs and reduced effectiveness.

d. Low Knowledge of Safe Pesticide Use

Many farmers do not understand pesticide label instructions, leading to:

- Incorrect mixing ratios
- Inadequate use of personal protective equipment (PPE)
- Unsafe storage and disposal practices

7.4.2 Gaps in Capacity among Agricultural Extension Agents

a. Insufficient Numbers and Coverage

- The ratio of extension workers to farmers in Kaduna is critically low, limiting their ability to provide hands-on guidance on pest management.

b. Outdated Technical Knowledge:

- Many extension officers lack updated training on emerging pests, IPM techniques, and safe pesticide handling.
- There is limited use of decision-support tools such as pest calendars, scouting protocols, or monitoring data.



c. Weak Linkages with Research Institutions:

- Extension services are poorly integrated with research outputs from institutions like the Institute for Agricultural Research (IAR), Ahmadu Bello University, or National Agricultural Extension and Research Liaison Services (NAERLS), which have developed locally adapted pest control technologies.

7.4.3 Agro-Dealer Knowledge and Role in Pest Management

a. Poorly Trained Agro-Input Vendors

- Many agro-dealers are not adequately trained in advising farmers on pest diagnosis, pesticide selection, or application techniques.
- Some promote pesticide sales based on profit rather than suitability, leading to misuse or overuse.

b. Weak Product Stewardship

- Little attention is paid to pesticide resistance management, pesticide shelf life, or the promotion of alternative (biological or cultural) pest control products.

7.4.4 Institutional and Structural Capacity Limitations

a. Lack of Localized Pest Surveillance and Data Systems

- There is no coordinated pest monitoring or early warning system in Kaduna State, making it difficult to respond proactively to outbreaks or emerging pest threats.
- Pest management programs often operate in isolation without real-time data or feedback loops.

b. Limited Research Translation and Scaling

- Although Nigerian research institutions have developed various pest control technologies (e.g., bio-pesticides, resistant varieties), these are not widely promoted or scaled up due to weak extension–research–private sector collaboration.

c. Weak Policy and Programmatic Support

Current agricultural support programs under the SAPZ do not adequately prioritize knowledge-building components on pest management.

There is a lack of institutional frameworks that require IPM training, pesticide safety education, or monitoring of pest control practices.

7.4.5 Gender and Youth Knowledge Gaps

a. Gender-Based Disparities

- Women farmers, who are often deeply involved in food production and post-harvest activities, have less access to pest management information and training compared to men.
- Cultural norms and limited mobility restrict their participation in training or extension programs.

b. Youth Involvement

- Young people are underrepresented in pest management training programs, despite their potential to adopt and scale digital tools and innovative approaches.



7.4.6 Digital and ICT-Related Gaps

a. Low Use of Digital Pest Advisory Tools

Despite the growing availability of digital agriculture platforms (e.g., mobile apps, SMS advisories), their usage among rural farmers remains low due to:

- Poor digital literacy
- Limited smartphone access
- Inadequate local language content

7.4.7 Summary on the Key Observations and Issues on Knowledge and Capacity Gaps

Observations:

- Many farmers are unaware of IPM principles, and see pest control as synonymous with pesticide use.
- Extension services are under-resourced, with poor staff-to-farmer ratios and limited IPM technical expertise.
- Agro-dealers are often the main source of pest control advice, though many lack formal training in IPM.

Issues:

- Poor record-keeping among farmers makes it difficult to track pest patterns or evaluate control effectiveness.
- Lack of access to real-time pest monitoring tools, decision support systems, or mobile advisory platforms.
- Insufficient curriculum integration of IPM in vocational agricultural institutions and colleges.

7.4.8 Opportunities to Address Knowledge and Capacity Gaps

To improve pest management outcomes in the Kaduna SAPZ, targeted interventions are needed to close these knowledge and capacity gaps:

a. Expand Farmer Education and Field Schools

- Establish and scale Farmer Field Schools (FFS) focused on IPM and ecological pest management.
- Develop simplified guides, posters, and videos in Hausa and English on pest identification and safe pesticide use.

b. Strengthen and Retrain Extension Workforce

- Continuous professional development for extension agents on IPM, biological control, and emerging pest threats.
- Equip extension workers with pest scouting kits and mobile-based decision-support tools.

c. Train Agro-Dealers as Trusted Advisors

- Provide accredited IPM and pesticide safety training to agro-dealers and retailers.
- Create a certification scheme for agro-input suppliers to ensure accountability and quality advice.



d. Establish Pest Surveillance and Early Warning Systems

- Promote community-based pest monitoring systems integrated with state-level pest data platforms.
- Collaborate with research institutions for pest mapping, forecasting, and advisory dissemination.

e. Mainstream Gender and Youth Inclusion

- Design pest management training programs that deliberately include women and youth, with flexible delivery formats.
- Support youth-led agro-tech innovations (e.g., drone scouting, mobile pest diagnosis tools).

The knowledge and capacity gaps at all levels—farmers, extension agents, agro-dealers, and institutions—are a major constraint to effective, sustainable pest management in Kaduna State. Bridging these gaps is essential to reducing pesticide misuse, improving crop health, protecting human and environmental safety, and achieving the goals of the SAPZ. A coordinated, inclusive, and well-resourced knowledge development strategy will lay the foundation for more resilient, productive, and ecologically sound pest management systems.

7.5 SWOT ANALYSIS ON THE CURRENT PEST MANAGEMENT PRACTICES

Summary Table Showing Strength, Weaknesses, Opportunities and Threats for the Current
Table 7.1: SWOT ANALYSIS on current Pest Management Practices

ASPECT	STRENGTH	WEAKNESSES	OPPORTUNITIES	THREATS
Chemical Control	Readily available inputs	Overuse, misuse, toxicity	Promote safer and IPM-compliant products	Resistance, pollution, health risks
Biological Control	Some awareness (neem use)	Lack of access, poor trust	Promote bio-agent production, training	Market rejection, limited supply
Cultural Control	Traditional practices exist	Not targeted for pest control	Integrate into SAPZ extension materials	Decline in indigenous knowledge
Knowledge and Capacity	Informal knowledge channels	Weak extension and poor training	Build farmer field schools, ICT tools	Persistent knowledge gap, misinformation



CHAPTER EIGHT: ASSESSMENT OF PHYTOPHARMACEUTICALS REGULATION & AGRICULTURAL EXTENSION CAPACITY FOR SAFE CHEMICAL MANAGEMENT IN KADUNA SAPZ

8.1 Introduction

Phytopharmaceuticals (pesticides and bio pesticides) are essential tools for crop protection but carry risks to human health, non-target organisms and the environment when they are misused, mislabeled, substandard or illegally traded. A robust regulatory system is therefore critical to ensure that only safe, effective and properly labeled products are available and that their lifecycle (import → distribution → use → disposal) is managed. This section summarizes the Nigerian regulatory framework, institutional responsibilities, operational procedures, key weaknesses, and the regulatory compliance measures to be required under the Kaduna SAPZ PMP.

8.1.1 Purpose and scope

This chapter provides a comprehensive assessment of the existing institutional, technical, and regulatory capacity in Nigeria — with emphasis on Kaduna State and the Special Agro-Processing Zone (SAPZ) — to safely manage phytopharmaceuticals (chemical and biological pest control products) required for the crops and value chains supported under the project.

The safe management of phytopharmaceuticals is essential to achieving agricultural productivity goals without compromising human health, food safety, or environmental integrity. Therefore, this assessment serves as both a diagnostic tool and a strategic roadmap for improving pest management governance and capacity within the SAPZ framework.

The assessment is designed to identify institutional strengths, weaknesses, gaps, and opportunities in the phytopharmaceuticals management system, and to recommend actionable interventions that align with national regulations and international safeguard standards (World Bank ESS3 & ESS6; AfDB ISS—OS3). It aims to guide the development of a practical, risk-informed, and locally adaptable Pest Management Plan (PMP) for Kaduna SAPZ.

8.1.2 Scope of the Assessment

The chapter systematically examines five interlinked pillars of phytopharmaceuticals management:

(a) Registration and Regulation of Products

This component reviews the legal and institutional framework governing the registration, importation, distribution, and quality control of pesticides, herbicides, fungicides, and bio-pesticides in Nigeria.

It assesses:

- The roles of NAFDAC, NESREA, NAQS, and State-level agricultural and environmental authorities in pesticide governance.
- The procedures for product registration, labelling, licensing, and monitoring.
- The adequacy of phytopharmaceuticals legislation, enforcement mechanisms, and coordination among federal and state institutions.



- The extent to which Nigeria's system meets international best practices on pesticide lifecycle management, including provisions for banned and restricted substances, biological control agents, and chemical waste disposal.
- This analysis identifies regulatory gaps, challenges of counterfeit products, and opportunities to promote bio-rational and eco-friendly alternatives.

(b) Agricultural Extension Services

This section evaluates the capacity and reaches of agricultural extension systems at both federal and state levels to promote Integrated Pest Management (IPM) and safe pesticide use.

It covers:

- Institutional arrangements and mandates of NAERLS, State ADPs, and local extension networks.
- The adequacy of training, manpower, logistics, and resource support for extension workers.
- Existing mechanisms for farmer education, demonstration plots, and knowledge transfer on safe chemical handling, protective equipment (PPE), and alternative pest management strategies.
- Gaps in coverage, training curricula, gender inclusion, and linkage between research, extension, and farmer practice.
- The section provides an evidence-based appraisal of how extension systems can be strengthened to support the implementation and sustainability of the PMP.

(c) Supply chain and Market Regulation

The assessment reviews the phytopharmaceuticals supply chain, including importation, storage, distribution, and retail sale within Kaduna State.

It examines:

- The structure and organization of the input supply network (manufacturers, importers, distributors, and agro-dealers).
- Dealer registration and licensing procedures, including NAFDAC's oversight of importers and retailers.
- Issues of product adulteration, counterfeit pesticides, informal markets, and inadequate storage conditions.
- Access to bio-pesticides and eco-friendly products, availability of protective gear, **and** label translation for local farmers.
- Recommendations focus on promoting a traceable, quality-assured, and environmentally responsible input market through certification, capacity building, and market surveillance.

(d) Monitoring, Enforcement and Feedback Systems

This section assesses the systems for monitoring pesticide use, environmental residues, and compliance with national standards and safeguard requirements.

Key focus areas include:

- **Inspection and enforcement** mechanisms led by NAFDAC, NESREA, and State Ministries.
- The existence and capacity **of** diagnostic and residue-testing **laboratories** for monitoring pesticide residues in produce, water, and soil.



- The use of data and digital tools for tracking pesticide use, reporting adverse effects, and feeding back into policy and extension systems.
- The level of stakeholder coordination among research institutions, government agencies, and farmers.
- The assessment highlights both achievements (e.g., laboratory establishment, policy frameworks) and constraints (e.g., limited testing capacity, fragmented data flow).

(e) Capacity gaps and constraints

The final analytical component consolidates findings from the previous sections to identify cross-cutting institutional, human, and technical capacity gaps affecting safe pest management.

These include:

- Weak institutional coordination and data sharing among regulatory bodies.
- Limited human resources and logistical capacity for field inspection, residue analysis, and enforcement.
- Poor farmer awareness of pesticide safety standards and disposal practices.
- Inadequate research-extension-farmer linkages and low adoption of biological control and IPM technologies.
- The analysis provides a foundation for prioritizing interventions under the PMP.

8.2 Institutional Framework, Norms, and Track Record (High-Level Overview)

Nigeria's system for managing phytopharmaceuticals and promoting Integrated Pest Management (IPM) is anchored on several federal institutions, supporting research and extension agencies, and private-sector actors. Each plays a defined role in ensuring that pesticide use and pest management practices align with national laws, international obligations, and sustainable agricultural development goals.

Despite notable progress, challenges remain in coordination, enforcement, and capacity, especially at the sub-national level. The following provides an overview of key institutions, their mandates, regulatory norms, and track records:

1. National Agency for Food and Drug Administration and Control (NAFDAC)

NAFDAC serves as the principal national authority for the registration, regulation, and technical oversight of pesticides and other phytopharmaceuticals products in Nigeria.

Mandate and Functions:

- NAFDAC is responsible for evaluating, registering, and licensing all agrochemicals (pesticides, herbicides, fungicides, and bio-pesticides) imported, manufactured, or distributed within the country.
- The agency ensures that products meet safety, efficacy, and environmental standards before market authorization.
- Through its National Agency Product Administration and Monitoring System (NAPAMS), NAFDAC operates an electronic registration platform that facilitates product applications, renewals, and regulatory monitoring.
- It conducts post-market surveillance, inspection of dealers, and quality control testing to detect counterfeit or substandard products.



- NAFDAC also collaborates with NESREA, NAQS, and the Federal Ministry of Agriculture and Food Security (FMAFS) to harmonize pesticide control standards and promote best practices
- Track Record and Challenges: NAFDAC has established a structured registration framework aligned with FAO and WHO guidelines and has improved transparency through the NAPAMS digital system. However, challenges persist, including limited field inspection capacity, circulation of unregistered and counterfeit pesticides, and weak enforcement at state and local levels.

2. National Environmental Standards and Regulations Enforcement Agency (NESREA)

NESREA, under the Federal Ministry of Environment, provides complementary oversight focusing on environmental protection and pollution prevention.

Mandate and Functions:

- NESREA enforces environmental regulations relating to the production, storage, transport, use, and disposal of hazardous substances, including pesticides.
- It implements the National Environmental (Chemicals, Pesticides, and Hazardous Waste) Regulations, ensuring that pesticide use does not compromise environmental quality or biodiversity.
- The agency monitors pesticide residues in soils, water, and agricultural produce and promotes environmentally sound management (ESM) of chemicals.
- NESREA also supports awareness campaigns and compliance monitoring to reduce pollution and contamination risks from pesticide misuse.

Track Record and Challenges: NESREA has strengthened environmental compliance through national guidelines and coordinated enforcement drives. However, overlaps in mandates with NAFDAC and limited inter-agency data sharing sometimes result in fragmented oversight, especially regarding pesticide waste management and pollution monitoring.

3. Federal Ministry of Agriculture and Food Security (FMAFS), NAERLS, and IAR

The Federal Ministry of Agriculture and Food Security (FMAFS) leads Nigeria's agricultural policy framework and coordinates pest management, crop protection, and IPM initiatives at the national level.

Mandate and Functions:

- FMAFS formulates and supervises policies on crop protection, pesticide use, and sustainable pest management.
- It oversees specialized institutions such as the National Agricultural Extension and Research Liaison Services (NAERLS) and the Institute for Agricultural Research (IAR), which provide technical backstopping, training, and technology dissemination for IPM and eco-friendly pest control options.
- These agencies conduct adaptive research, demonstration projects, and capacity-building programs for extension workers and farmers.
- They also generate and validate technologies on biological control, pest-resistant crop varieties, and safe pesticide handling.

Track Record and Challenges: FMAFS and its research arms have developed strong technical expertise and field presence through the Agricultural Development Programs (ADPs). However, resource limitations, insufficient coordination with regulatory agencies, and reduced funding for extension services constrain their ability to fully support nationwide IPM



adoption.

4. Nigeria Agricultural Quarantine Service (NAQS)

The Nigeria Agricultural Quarantine Service (NAQS) is mandated to prevent the introduction and spread of pests, diseases, and contaminants that may threaten agricultural production and biodiversity.

Mandate and Functions:

- NAQS regulates the import, export, and transit of plants, animals, and related products through inspection, certification, and quarantine measures at ports, borders, and airports.
- It ensures that phytosanitary standards comply with international conventions such as the International Plant Protection Convention (IPPC).
- The agency works closely with NAFDAC and FMAFS to monitor imported agrochemicals and to control entry of prohibited or hazardous pesticides.

Track Record and Challenges: NAQS has strengthened Nigeria's phytosanitary system and international compliance. However, it faces operational constraints such as limited laboratory infrastructure, shortage of inspectors, and porous borders that enable illegal pesticide importation.

5. Private Sector and Dealer Associations

The private sector, including manufacturers, importers, distributors, and retailers of agro-inputs, plays a central role in the pesticide supply chain.

Mandate and Role:

- Private agro-input dealers ensure last-mile delivery of phytopharmaceuticals to farmers across rural areas.
- Regulatory initiatives such as the Agro-Dealer Listing and Permitting System have been introduced by FMAFS and NAFDAC to formalize distribution networks and improve accountability.
- Dealer associations (e.g., National Agro-Input Dealers Association of Nigeria – NAIDAN) participate in awareness campaigns and collaborate with extension services on **safe-use training** and **IPM adoption**.

Track Record and Challenges: While the private sector has enhanced product availability and farmer access, compliance with registration and safety standards varies widely. Informal and unregulated pesticide markets persist, leading to issues of product adulteration, inadequate labeling, and unsafe disposal. Strengthening private sector regulation and incentives for compliance remains a national priority.

8.3 Registration and Regulation of Phytopharmaceuticals

Current Situation

Nigeria's pesticide regulation system is anchored in the mandate of the National Agency for Food and Drug Administration and Control (NAFDAC), which **oversees** the registration, importation, formulation, distribution, and marketing of phytopharmaceuticals.



Registration and labeling requirements are formalized through NAFDAC's Pesticide Registration Guidelines, consistent with FAO/WHO International Code of Conduct on Pesticide Management. The process involves:

- Submission of a comprehensive technical dossier including toxicological, efficacy, and environmental data.
- Product evaluation and field trials under Nigerian agro ecological conditions.
- Issuance of a Certificate of Registration through the electronic National Agency Product Administration and Monitoring System (NAPAMS).
- Specification of product labeling, safety data sheets, and permitted use patterns.

Recent reforms have seen NAFDAC tighten controls on pesticide trade, introducing bulk import permits, dealer listing systems, and risk-based inspections. A central database now enables regulators to track product approvals and registration validity.

Strengths

- A formal, transparent registration **process** guided by published procedures and criteria.
- The NAPAMS electronic platform improves traceability and data management.
- Alignment with international standards (FAO/WHO, ECOWAS harmonization) enhances credibility and regional consistency.
- Establishment of technical directorates and expert review panels ensures scientific oversight.

Weaknesses / Risks

- Institutional overlaps between NAFDAC, NESREA, NAQS, and State Ministries of Agriculture complicate enforcement and create jurisdictional ambiguities.
- Unregistered and counterfeit products persist in informal markets, undermining safe pesticide use.
- Limited surveillance capacity and resource constraints weaken field-level enforcement and post-market monitoring.
- Slow response times for product evaluation due to high administrative load and limited technical assessors.

Implications for the PMP

A robust regulatory system is critical for the safe use of phytopharmaceuticals within the Kaduna SAPZ. Strengthening enforcement coordination, improving public **access to registered product lists**, and expanding **inspection coverage** will be essential to ensuring chemical safety and promoting confidence in agricultural input markets.



8.4 Agricultural Extension Services: Norms, Arrangement, and Track Record

Institutional Context and Mandate

Agricultural extension in Nigeria is a shared responsibility between the Federal Ministry of Agriculture and Food Security (FMAFS), the National Agricultural Extension and Research Liaison Services (NAERLS), the Institute for Agricultural Research (IAR), and State Agricultural Development Programs (ADPs).

These institutions are mandated to:

- Translate research findings into farmer-friendly technologies.
- Deliver training and advisory services on pest management, soil fertility, and climate-smart practices.
- Support the adoption of Integrated Pest Management (IPM) and Biological Control Practices (BCP) through field demonstrations and training modules.

NAERLS leads national extension coordination and has pioneered digital extension tools, radio and TV outreach, **and** farmer field school approaches.

Track Record and Constraints

- Although extension services are institutionally established, they remain under-funded and understaffed, with a low ratio of agents to farmers (often 1:2000 or worse).
- Extension workers lack up-to-date IPM and ecological pest management training, limiting their capacity to provide accurate pest diagnosis or pesticide safety guidance.
- Many ADPs rely on donor-funded **projects** to sustain operations, resulting in inconsistent coverage.
- Weak monitoring systems and poor feedback loops limit learning and adaptive management.

Operational Implications for SAPZ

To achieve the desired behavioral change in pesticide management, the Kaduna SAPZ must:

- Invest in IPM specialization training for extension personnel.
- Deploy digital advisory tools (SMS alerts, mobile apps, voice messages).
- Establish Incentive systems for extension agents promoting BCP adoption.
- Integrate IPM/BCP modules into farm cluster training curricula for SAPZ anchor firms and smallholders.

8.5 Supply Chain and Market Regulation

Current Features

The agro-input supply chain in Nigeria has undergone gradual formalization. Dealer registration, listing permits, and inventory monitoring are used to enhance traceability and accountability. Despite progress, a large proportion of agro-input retailers still operate in informal or semi-regulated markets, especially in peri-urban and rural areas.



Key Risks

- Poor product storage (exposure to heat, sunlight, moisture) compromises pesticide quality.
- Repackaging, adulteration, and sale of unlabeled/expired products are widespread.
- Counterfeit and banned chemicals circulate freely in informal markets due to weak border controls.
- Limited market access to biological control agents and bio-pesticides constrains IPM implementation.

Priority Regulatory Gaps

- Infrequent inspection and surveillance at retail level.
- Limited traceability systems for supply chains and product batches.
- Weak enforcement mechanisms for illegal importation and unsafe repackaging.
- Lack of incentives and policy support for bio-pesticide production, registration, and distribution.

Strategic Implication

To safeguard SAPZ productivity, market integrity must be strengthened through:

- Mandatory dealer licensing and labeling standards.
- Periodic market sweeps and residue testing.
- Subsidies and procurement incentives for certified biological control products.

8.6 Monitoring, Enforcement, and Feedback Systems

Current State

Monitoring of pesticide residues, environmental contamination, and pest outbreaks remains fragmented and inconsistent.

- Laboratory infrastructure is limited to a few regional centers, often lacking advanced analytical capacity.
- Environmental and residue testing programs are not yet institutionalized as part of national agricultural policy.
- There is no centralized pesticide incident database or geo-referenced monitoring system for SAPZ or national use.

Enforcement Mechanisms

- NAFDAC and NESREA share responsibility for enforcement but operate under distinct legal frameworks. Coordination between field units and state agencies is often ad hoc.
- Prosecution of violators is rare due to lengthy legal processes and limited field logistics.
- Community-level enforcement (via ADPs or local councils) remains weak due to lack of mandate and resources.



Feedback Loops

- Existing farmer reporting systems for pesticide misuse, pest outbreaks, or health incidents are minimal.
- There is limited use of ICT-based tools (SMS, web dashboards) for real-time monitoring.
- Absence of sentinel plots and feedback frameworks limits data collection and early warning capabilities.

8.7 Capacity Gaps and Constraints in the Phytopharmaceuticals Regulation and Agricultural Extension Services

A review of the institutional framework and operational arrangements for pesticide (phytopharmaceuticals) regulation and agricultural extension in Kaduna State reveals several capacity gaps and systemic weaknesses that may limit the effective and safe implementation of pest management activities under the SAPZ. These constraints affect both regulatory oversight **and** field-level adoption of safe pesticide practices.

1. Regulatory and Institutional Coordination Gaps

While NAFDAC, NESREA, NAQS, and the Federal Ministry of Agriculture and Food Security (FMAFS) all play roles in pesticide registration, monitoring, and enforcement, coordination between these agencies remains weak. At the state level, the Kaduna State Ministry of Agriculture and the Kaduna Environmental Protection Authority (KEPA) lack structured mechanisms to share regulatory data or enforce compliance. As a result:

- Oversight of pesticide distribution and usage is fragmented;
- Field inspections are irregular; and
- Communication on counterfeit or banned products is delayed.

Implication: This weakens enforcement of safe pesticide use standards within the SAPZ and increases the risk of environmental contamination and exposure to unregistered chemicals.

2. Limited Laboratory and Diagnostic Capacity

Kaduna State does not currently have a dedicated pesticide residue and phytosanitary laboratory with the capacity for routine analysis of agrochemicals, soil, and water samples. Testing is mostly centralized in Abuja or Zaria, causing logistical delays and increased costs. Diagnostic services for pest identification and resistance monitoring are also limited.

Implication:

Without accessible and accredited testing facilities, it is difficult to:

- Verify pesticide quality or contamination levels;
- Conduct residue monitoring for compliance with AfDB and WHO/FAO standards;
- Support evidence-based decision-making in pest management.



3. Inadequate Agricultural Extension Capacity

The Kaduna State Agricultural Development Program (KADP) and related extension systems remain under-resourced and understaffed. Most field agents lack specialized training in Integrated Pest Management (IPM), biological control, or safe pesticide stewardship. Training materials are outdated, and mobility constraints (transport and logistics) limit field coverage.

Implication:

Farmers receive limited or inconsistent guidance on pesticide handling, correct dosage, use of protective equipment, and alternatives such as botanical or biological controls.

4. Informal Agrochemical Supply Chain

Although NAFDAC has established the National Agro-Input Dealer Listing and issues import and distribution permits, enforcement at state and local levels remains weak. Many unregistered agro-dealers and itinerant vendors sell pesticides of uncertain quality. Improper repackaging, poor storage conditions, and sale of expired or counterfeit products remain common.

Implication:

Farmers risk purchasing and using unsafe or ineffective products, increasing potential for crop damage, pest resistance, and environmental pollution.

5. Weak Monitoring, Enforcement, and Data Systems

Routine market surveillance, field inspection, and pesticide-use reporting are minimal. There is no state-level digital database tracking pesticide imports, dealer licenses, or adverse pesticide incidents. Monitoring relies heavily on sporadic inspections or complaint-based responses.

Implication:

The absence of a feedback and traceability system hinders rapid detection of chemical misuse, poisoning cases or pest outbreaks related to pesticide resistance.

6. Low Awareness and Limited Adoption of Safe Practices

Most smallholder farmers are unaware of:

- The WHO pesticide hazard classification system,
- Proper personal protective equipment (PPE) use, or
- Correct pesticide storage and disposal procedures.

Training on biological control agents, neem-based formulations, and nature-based pest solutions is limited to isolated pilot projects.

Implication:

Unsafe handling and disposal practices persist, with risks to workers, consumers, and surrounding ecosystems.



7. Financial and Resource Constraints

Budgetary allocations for pest management, extension services, and laboratory operations are limited and irregular. Existing institutions depend heavily on donor or project funding for training, mobility, and inspection activities.

Implication:

Sustainability of IPM training, monitoring, and enforcement post-project remains a key challenge.

Table 8.1: Capacity Gaps and Constraints (Summary)

Domain	Key Capacity Constraints
Regulatory coordination	Overlapping mandates between NAFDAC, NESREA, NAQS, and FMAFS; weak joint SOPs and data-sharing mechanisms.
Laboratory & diagnostics	Insufficient regional labs for residue analysis and pest identification; lack of QA systems.
Extension services	Inadequate funding, low IPM specialization, and limited training infrastructure.
Market integrity	Informal markets dominate; low compliance among dealers; poor storage and traceability; minimal bio-pesticide access.
Data & surveillance	No centralized pest/chemical monitoring database; poor integration of research, extension, and regulatory data.

Table 8.2 Summary of Implications for the SAPZ PMP

Capacity Gap Area	Impact on SAPZ PMP Implementation	PMP Strategic Response
Regulatory coordination	Fragmented enforcement; weak oversight	Establish an Inter-Agency Pest and Chemical Management Committee (IPCMC) to harmonize roles (NAFDAC, NESREA, KEPA, KAD-MARD, SAPZ-PIU).
Laboratory capacity	No state-level pesticide residue testing	Support upgrade/equipment of Zonal labs (Zaria/Kaduna) for pesticide residue and diagnostic testing.
Extension services	Poor farmer awareness, unsafe practices	Establish IPM Field Schools and strengthen extension ToT for ecological pest management.
Input supply chain	Circulation of counterfeit/unregistered products	Enforce dealer licensing and traceability systems with KEPA and NAFDAC oversight.
Monitoring and data	Lack of pest/pesticide reporting and traceability	Develop a digital surveillance and reporting platform linked to SAPZ MIS.



Capacity Gap Area	Impact on SAPZ PMP Implementation	PMP Strategic Response
Awareness and training	Unsafe handling and limited IPM adoption	Continuous farmer education, PPE distribution, and awareness on FAO/WHO standards.
Funding limitations	Weak institutional sustainability	Incorporate PMP budget lines into SAPZ operational budget and leverage private-sector co-financing.

8.8 Priority Recommendations for the PMP

To address the above challenges and strengthen the Kaduna SAPZ’s phytopharmaceuticals governance, the PMP should implement an Integrated Capacity Strengthening and Risk Management Framework built around seven priority actions:

1. Harmonize Regulatory Mandates and Coordination

- Establish an Inter-Agency Pest and Chemical Management Committee (PCM Committee) involving NAFDAC, NESREA, FMAFS/NAERLS, NAQS, and the Kaduna State Ministry of Agriculture.
- Develop joint Standard Operating Procedures (SOPs) for registration, import permits, dealer licensing, inspections, and sanctions.
- Introduce a shared digital database for registered products and compliance tracking.

2. Strengthen NAFDAC Registration and Market Surveillance

- Clean and publish the national pesticide register for public access.
- Conduct bi-annual market audits to remove unregistered or counterfeit products.
- Support risk-based surveillance using geo-referenced data and sentinel sampling.

3. Upgrade Laboratory and Diagnostic Capacity

- Establish or strengthen regional pesticide residue testing laboratories (e.g., at NAERLS/IAR and KASU).
- Introduce routine sampling protocols for soil, water, and produce.
- Link laboratories to a centralized data repository managed under SAPZ’s Environmental Unit.

4. Reform and Fund Extension Services for IPM and BCP

- Create IPM specialist units within ADPs.
- Develop digital advisory tools and farmer field school programs focused on nature-based pest management.
- Provide incentive structures for extension officers demonstrating measurable IPM adoption outcomes.

5. Formalize and Regulate the Input Supply Chain

- Implement mandatory dealer certification and product traceability systems.
- Enforce storage and handling standards for all agrochemical outlets.
- Provide financial or tax incentives for stocking certified biological products.



6. **Establish a Centralized Pesticide and Pest Surveillance Information System (PPSIS)**
 - Develop an interactive dashboard integrating pest outbreak reports, lab data, and satellite-based surveillance.
 - Enable mobile reporting from extension agents and farmers.
 - Use data analytics to trigger early warning alerts and guide policy response.
7. **Introduce Market and Policy Incentives for Sustainable Pest Management**
 - Promote eco-friendly products through subsidies, preferential procurement, and green certification schemes.
 - Encourage SAPZ anchor firms to adopt IPM-based certification (e.g., Global G.A.P., Eco Cert).
 - Support local production of bio-pesticides and microbial agents through public-private partnerships.

Expected Outcomes

- Enhanced regulatory efficiency and inter-agency coordination.
- Stronger enforcement against illegal or unsafe pesticide use.
- Expanded laboratory and diagnostic infrastructure for monitoring.
- Improved farmer knowledge and adoption of IPM/BCP.
- Cleaner markets and safer agricultural produce.
- A transparent, data-driven pest and pesticide management ecosystem for Kaduna SAPZ.



Table 8.3 Sample Implementation Matrix for Phytopharmaceuticals Regulation and Agricultural Extension Services for Kaduna SAPZ

S/N	Key Issue / Gap	Proposed Action / Measure	Responsible Institutions	Timeline	Expected Output / KPI	Estimated Cost (USD)
1	Weak coordination among regulatory agencies (NAFDAC, NESREA, KEPA, KAD-MARD)	<ul style="list-style-type: none"> Establish an Inter-Agency Pest and Chemical Management Committee (IPCMC) to coordinate regulation, monitoring, and data sharing. Develop harmonized Standard Operating Procedures (SOPs) for registration, import permits, and inspections. 	SAPZ-PIU, NAFDAC, NESREA, KEPA, KAD-MARD	Year 1	<ul style="list-style-type: none"> Functional IPCMC established. SOPs jointly endorsed by all agencies. 	10,000
2	Limited laboratory and diagnostic capacity for pesticide residue and quality testing	<ul style="list-style-type: none"> Upgrade and equip regional laboratory (Zaria/Kaduna) for pesticide residue and phytosanitary testing. Train lab personnel in FAO/WHO analytical protocols. 	NAFDAC, FMAFS, KAD-MARD, IAR, KASU	Year 1–2	<ul style="list-style-type: none"> Laboratory accredited for pesticide analysis. 5 trained analysts in residue testing. 	35,000
3	Inadequate extension worker training on IPM and safe pesticide use	<ul style="list-style-type: none"> Develop and implement Training of Trainers (ToT) on IPM, safe pesticide handling, 	NAERLS, ADP, SAPZ-PIU	Year 1–3	<ul style="list-style-type: none"> 100 extension officers trained. 	18,000



S/N	Key Issue / Gap	Proposed Action / Measure	Responsible Institutions	Timeline	Expected Output / KPI	Estimated Cost (USD)
		<p>and phytopharmaceuticals regulation.</p> <ul style="list-style-type: none"> Integrate FAO/WHO guidelines into extension manuals. 			<ul style="list-style-type: none"> Revised IPM training manual produced. 	
4	Proliferation of unregistered/counterfeit agrochemicals	<ul style="list-style-type: none"> Conduct periodic market surveillance and dealer licensing audits. Introduce traceability (lot/batch coding) and certification stickers for registered dealers. 	NAFDAC, KEPA, KAD-MARD, SAPZ Legal Unit	Year 1–3 (Annual)	<ul style="list-style-type: none"> 100% of SAPZ-area dealers registered and licensed. Quarterly market inspection reports produced. 	15,000
5	Weak enforcement and reporting mechanisms	<ul style="list-style-type: none"> Deploy joint inspection teams (NAFDAC–KEPA–SAPZ). Establish real-time SMS/online reporting system for pesticide misuse and incidents. 	SAPZ-M&E Unit, NAFDAC, KEPA	Year 2	<ul style="list-style-type: none"> Joint inspection system operational. 80% of incidents 	12,000



S/N	Key Issue / Gap	Proposed Action / Measure	Responsible Institutions	Timeline	Expected Output / KPI	Estimated Cost (USD)
					logged digitally.	
6	Low farmer awareness of safe pesticide management	<ul style="list-style-type: none"> Conduct farmer field sensitization on pesticide safety, PPE use, and container disposal. Translate safety posters and FAO pictograms into Hausa and distribute widely. 	SAPZ-PIU, ADP Extension, NGOs, CSOs	Year 1–3	<ul style="list-style-type: none"> 10,000 farmers sensitized. 5,000 posters distributed. 	14,000
7	Poor management of empty pesticide containers and waste	<ul style="list-style-type: none"> Establish container return and collection points at SAPZ aggregation centers. Partner with recyclers for safe disposal. 	SAPZ-HSE Unit, KEPA, Agro-dealers	Year 2–3	<ul style="list-style-type: none"> 70% return rate achieved. Two recycling partnerships signed. 	10,000
8	Limited access to biological control and eco-friendly products	<ul style="list-style-type: none"> Facilitate approval and registration of bio-pesticides and microbial agents through NAFDAC. Support private suppliers to stock certified products. 	NAFDAC, FMAFS, SAPZ-PIU	Year 2	<ul style="list-style-type: none"> 3 bio-pesticide products approved. 5 dealers certified to distribute. 	8,000



S/N	Key Issue / Gap	Proposed Action / Measure	Responsible Institutions	Timeline	Expected Output / KPI	Estimated Cost (USD)
9	Lack of centralized pest and pesticide use data	<ul style="list-style-type: none"> Integrate a Digital Pest and Pesticide Management Dashboard into SAPZ MIS. Link with lab results and extension reports. 	SAPZ-ICT Unit, FMARD, NAFDAC	Year 2–3	<ul style="list-style-type: none"> Real-time data dashboard functional. Annual pesticide use reports published. 	20,000
10	Sustainability and funding constraints	<ul style="list-style-type: none"> Integrate PMP budget lines into SAPZ annual operational plans. Leverage private-sector CSR and AfDB technical assistance funds for continuity. 	SAPZ-PIU, AfDB, KAD-MARD	Continuous	<ul style="list-style-type: none"> PMP funding secured in annual SAPZ budgets. At least two co-financing agreements signed. 	0*

Estimated Total Cost: USD 142,000

(Excludes ongoing budgetary allocations within SAPZ operational financing)

Explanatory Notes:

- Purpose:**

This matrix operationalizes key actions to strengthen phytopharmaceuticals regulation, improve extension service delivery, and ensure safe pesticide management **across** SAPZ clusters.



- **Implementation Oversight:** The SAPZ Project Implementation Unit (PIU) will coordinate with NAFDAC, KEPA, NESREA, and KAD-MARD, reporting progress through quarterly environmental and social monitoring reports to the AfDB.
- **Monitoring Indicators:** Measurable outputs (e.g., number of licensed dealers, trained officers, lab tests conducted) will feed into the PMP's overall Monitoring & Evaluation (M&E) framework.
- **Costing Basis:** Estimates are derived from comparable AfDB agricultural projects in Nigeria (ATASP, TAAT, ENABLE-Youth) and include allowances for logistics, materials, and training.

Table 8.4 Sample Implementation Matrix

Action	Lead	Support	Timeline (yrs)	Resource level	Indicator
Inter-agency Pest & Chemical Management Committee; joint SOPs	FMAFS / NAFDAC	NESREA, NAQS, Kaduna MoA	0-1	Low	SOPs signed; monthly coordination meetings
Clean national register + dealer licensing enforcement sweep	NAFDAC	State MoA, Police	0-2	Medium	% of markets compliant; seizures reported
Upgrade 2 regional residue labs + QA link to NAPAMS	NAFDAC / NESREA	Donors, IAR	0-3	High	samples tested/month; MRL compliance %
IPM/BCP ToT & 50 FFS in SAPZ	NAERLS / ADP	SAPZ Secretariat, NGOs	0-2	Medium	farmers trained; % adoption of IPM practices
Mobile reporting & dashboard (PSEWS pilot)	SAPZ Secretariat	NAERLS, IT vendor	0-1	Medium	Time-to-alert; reports/month
Bio pesticide market development (incubation, incentives)	State MoA	Private sector, IAR	0-3	Medium	registered bio pesticides; market availability



8.9 Monitoring & evaluation and feedback loops

- Establish KPIs (market compliance rate, residue exceedance rate, extension contacts per farmer, IPM adoption rate).
- Quarterly joint reports from NAFDAC/NESREA/NAERLS, annual public dashboards, and community feedback channels (hotline/SMS).
- Use sentinel monitoring plots and periodic random market sampling to validate vendor compliance and product integrity.

8.10 Conclusion

Nigeria possesses the statutory framework and institutions to manage phytopharmaceuticals and extension services, but critical capacity gaps (coordination, labs, enforcement and extension funding and input-market integrity) must be closed to safely manage chemicals needed by Kaduna SAPZ value chains. The PMP should therefore combine regulatory harmonization, laboratory upgrades, extension reform, market regulation and digital surveillance to deliver safe, environmentally sound pest management and to accelerate adoption of biological and nature-based solutions.

To ensure effective and safe management of phytopharmaceuticals in the Kaduna SAPZ, the PMP prioritizes institutional strengthening, capacity building, and digital innovation. By addressing these gaps through targeted training, inter-agency coordination, and infrastructure investment, the SAPZ will progressively achieve compliance with FAO/WHO guidelines, AfDB's Operational Safeguard 3 (Pollution Prevention & Control), and Nigeria's National Pesticide Regulations, ensuring long-term sustainability and environmental safety.



CHAPTER NINE: OPPORTUNITIES FOR IMPROVEMENT ON IPM STRATEGIES

9.0 Opportunities for Improvement on IPM Strategies

There are several opportunities for improvement in Integrated Pest Management (IPM) strategies for the Kaduna State Special Agro-Industrial Processing Zone (SAPZ). Enhancing these strategies will not only improve agricultural productivity but also promote environmental sustainability and reduce human health risks. Some of the key areas that require improvement include;

- Strengthening Farmer Awareness and Capacity Building
- Enhancing Research and Pest Surveillance Systems
- Promoting Biological Control and Ecological Approaches
- Improving Access to and Regulation of Safer Inputs
- Institutional Coordination and Policy Support
- Strengthening Post-Harvest Pest Management
- Monitoring, Evaluation, and Adaptive Management
- Encouraging Public-Private Partnerships

9.1 Strengthening Farmers' Awareness and Capacity Building

Farmers in Kaduna State, especially those within the SAPZ catchment areas, largely rely on conventional pesticide-based practices due to:

- Limited awareness of safer and more sustainable alternatives,
- Poor access to technical advisory services,
- Inadequate training in pest diagnosis, decision-making, and IPM integration.

Improving farmer knowledge and practical capacity is fundamental to reducing pest-related crop losses, environmental degradation, and health risks. This aligns with the SAPZ's objective of sustainable, climate-smart agro-industrial development.

9.1.1 Key Capacity Challenges Identified:

- Limited understanding of pest life cycles and thresholds.
- Poor diagnostic skills to distinguish between pest damage and abiotic symptoms.
- Reliance on pesticide retailers for advice, many of whom lack formal training
- Lack of structured training platforms on IPM at local or state level.
- Low literacy among some smallholder farmers, limiting access to written materials.

9.1.2 Opportunities for Improvement

- Establish Farmer Field Schools (FFS) Focused on IPM
- Facilitate practical, season-long training on IPM through FFS in major commodity-producing clusters within the SAPZ.

Include modules on:

- Pest and beneficial insect identification,



- Economic thresholds and decision-making,
- Safe pesticide handling and use,
- Biological and cultural control methods.
- Develop and Distribute IPM Training Materials
- Create locally adapted IPM manuals, brochures, and visual guides for major crops (maize rice, tomatoes, ginger, etc.).
- Use info graphics, posters, and videos in Hausa and English to increase reach and comprehension.

Disseminate through:

- Farmer cooperatives,
- Extension agents,
- Agro-dealer networks,
- Local radio and social media.

Strengthen Extension Services

This can be achieved by;

- Build the capacity of extension agents on IPM through Training of Trainers (ToT) workshops.
- Equip them with diagnostic kits, pest ID cards, tablets/mobile tools, and safety demonstration gear.
- Introduce performance-based incentives for extension workers who promote IPM adoption.

Leverage ICT and Digital Platforms

Develop or support mobile apps or SMS-based advisory services (e.g., pest alerts, spraying schedules, bio-agent availability).

Partner with digital agriculture startups or telecoms to provide interactive voice-based IPM tips for low-literacy farmers.

Establish an online IPM resource portal linked to the SAPZ knowledge hub.

Encourage Farmer-to-Farmer Learning

Identify and train IPM Champions within farmer groups to serve as peer educators.

Organize community field days and exchange visits between villages practicing IPM and those using conventional practices.

Recognize outstanding farmers or groups through awards and certifications for IPM compliance.

Collaborate with Schools and Vocational Institutions

Mainstream IPM into the curriculum of:

- Kaduna State University Faculty of Agriculture,
- Agricultural training centers,
- Vocational secondary schools.
- Encourage youth involvement in sustainable pest control entrepreneurship, such as bio-pesticide production and scouting services.

Promote Gender-Inclusive Training

Design IPM training activities that are accessible to women and youth, who are often left out of conventional agricultural training.



Use convenient training schedules, local languages, and involve female extension agents.

9.1.3 Expected Outcomes:

- Improved farmer decision-making in pest control, leading to fewer but more effective pesticide applications.
- Greater adoption of ecological practices such as trap cropping, intercropping, and use of botanicals.
- Reduced pest resistance, environmental pollution, and post-harvest losses.
- Empowered rural communities equipped to implement self-reliant, sustainable pest management systems.
- Integration into SAPZ PMP (Pest Management Plan):

This component should be integrated as a major strategic intervention in the Pest Management Plan, with:

- Defined targets (e.g., 1,000 farmers trained per year),
- Key Performance Indicators (KPIs) like number of FFS established, % IPM adoption rate, pesticide use reduction rates),
- Institutional roles (e.g., Ministry of Agriculture, ADPs, SAPZ Project Implementation Unit),
- Timeline and budget allocation for outreach and training.

9.2 Enhancing Research and Pest Surveillance Systems

Effective IPM relies on accurate, timely, and location-specific information on pest populations, crop vulnerabilities, climatic influences, and control measures. In Kaduna State SAPZ, there is currently a lack of structured pest surveillance and weak linkages between research institutions, farmers, and policymakers. This leads to:

- Late or inappropriate responses to pest outbreaks,
- Poor adoption of IPM innovations,
- Continued use of outdated or ineffective pesticides.

Enhancing research and surveillance systems can generate the evidence base and early warning capacity necessary to support data-driven, proactive IPM decisions across the SAPZ.

9.2.1 Current Gaps in Kaduna SAPZ

The study identifies the following Gaps;

- No centralized pest database or forecasting system for the zone.
- Weak or non-functional pest diagnostic labs at the local level.
- Poor integration of local research findings into extension and farmer outreach.
- Lack of routine monitoring of pest dynamics, pesticide resistance, or natural enemy populations.
- Absence of a structured framework for emerging and invasive pest detection.



9.2.2 Opportunities for Improvement

1. Establish a Centralized Pest Surveillance and Early Warning System (PSEWS)

- Create a zonal Pest Surveillance and Forecasting Unit under the SAPZ implementation team.
- Deploy field scouts or surveillance officers trained to monitor and report pest presence, intensity, and movement.
- Use climate data, historical pest trends, and cropping calendars to generate early warnings for key pests.

2. Partner with Research Institutions

Collaborate with institutions such as:

- Institute for Agricultural Research (IAR), Zaria
- National Agricultural Extension and Research Liaison Services (NAERLS)
- Kaduna State University (KASU) and agricultural colleges.

Conduct joint research on:

- Pest identification and life cycles,
- Efficacy of biological control agents and botanicals,
- Development of IPM packages for strategic crops (e.g., maize, tomatoes, ginger, rice).

3. Develop a Pest Monitoring and Reporting System

- Establish fixed pest monitoring plots and traps across SAPZ production clusters.
- Standardize data collection on:
 - Pest populations (insects, weeds, diseases),
 - Crop phenology and infestation levels,
 - Environmental factors (temperature, rainfall).
- Train local extension workers and farmer leaders to serve as community-based pest monitors.

4. Integrate ICT Tools and Digital Innovation

Develop or adapt mobile-based apps and SMS platforms to:

- Report pest outbreaks in real-time,
- Send alerts and recommendations to farmers,
- Collect geo-referenced pest surveillance data.
- Use drones or remote sensing to monitor large-scale infestations in high-value crop areas.

5. Strengthen Diagnostic and Research Laboratories

- - Upgrade or support the establishment of regional diagnostic laboratories with tools for pest and pathogen identification.

- Provide access to soil and plant health testing services to identify pest predisposition factors (e.g., nutrient deficiency, soilborne pathogens).

- Ensure routine testing of pesticide residues in produce and water to guide safe use policies.

6. Build a Pest Knowledge Repository



Compile and digitize research findings, pest profiles, and recommended IPM solutions into a Kaduna SAPZ Pest Information Portal.

Include:

- Visual pest ID guides,
- Crop-pest calendars,
- Treatment thresholds and IPM tactics.

7. Promote Farmer Participation in Research (Participatory IPM)

- Involve farmers directly in field testing of IPM options through on-farm trials and adaptive research plots.
- Encourage documentation of indigenous pest control practices and their scientific evaluation.
- Facilitate feedback loops between researchers and farmers to improve technology uptake.

9.2.3 Expected Outcomes

- Early detection and control of pest outbreaks before they cause significant damage.
- Data-driven decisions on timing and selection of pest control strategies.
- Increased adoption of locally validated IPM packages.
- Strengthened institutional linkages and synergy between research, extension, and SAPZ stakeholders.
- Reduction in crop losses, pesticide misuse, and economic costs of pest management.

9.2.4 Integration into SAPZ PMP

This strategic area should be integrated into the Pest Management Plan (PMP) with dedicated interventions such as:

- Setting up of Zonal Pest Surveillance Centers,
- Annual IPM research agenda and budget allocation,
- KPIs such as number of pest reports analyzed, pest outbreaks detected, IPM technologies developed and adopted.

Table 9.1: Recommended Actions Summary

Activity	Stakeholders	Tools/Resources	Outcome
Establish Pest surveillance Unit	KD SAPZ PIU, KADA, FMA&FS	Trained staff, traps, ICT tools	Early warning capability
Collaborate with research bodies	IAR, NAERLS, KASU	Joint research, funding	IPM Packages for local crops
Create farmer-linked data system	Extension agents, ICT providers	Mobile apps, SMS alerts	Farmer empowerment on pest control
Develop diagnostics Labs	KDMOA, Private labs	Lab equipment, staff	Accurate pest, pathogen ID
Lunch digital Pest portal	KD SAPZ PIU, NGOs	Online repository	Knowledge accessibility



9.3 Promoting Biological Control and Ecological Approaches

Biological control and ecological approaches are central pillars of IPM that focus on leveraging natural enemies, microbial agents, and ecological balance to manage pest populations below damaging levels. However, in Kaduna State—and by extension, within the SAPZ area of coverage—the use of bio-control and ecological methods remains low due to limited awareness, availability, and institutional support.

Strengthening this area is essential to reduce dependence on hazardous chemical pesticides, combat resistance development; lower production costs, and aligns the SAPZ with global sustainability and food safety standards (e.g., EU MRL compliance, organic certification, and SDGs).

9.3.1 Current Gaps on Biological Control and Ecological Approaches

- Lack of access to bio-control products (e.g., Trichogramma, Metarhizium, Bacillus thuringiensis).
- Weak institutional support for bio-agent production, research, and distribution.
- Low farmer confidence in the effectiveness of non-chemical alternatives.
- Inadequate training and demonstration on the ecological management of pests.
- Absence of ecological habitat designs (e.g., hedgerows, trap crops, flowering borders) in most farming systems.

9.3.2 Opportunities for Improvement

1. Local Production and Distribution of Biological Control Agents

- Support the establishment of small-scale bio-agent production units through public-private partnerships with agro biotech firms, research institutes (e.g., IAR Zaria), and universities.
- Encourage investment in entomopathogenic fungi, parasitoid rearing, and microbial bio-pesticides.
- Ensure regulatory oversight and quality control through NAFDAC and FMARD-approved protocols.

2. Promote Use of Botanicals and Bio-pesticides

- Encourage use of plant-based pest control products such as neem (*Azadirachta indica*), garlic, ginger extracts, and chili formulations.
- Provide support for standardizing and commercializing local herbal formulations.
- Work with agro-dealers to stock and promote safe, approved bio-pesticide products.

3. Introduce Ecological Farming Practices

Promote conservation agriculture practices that improve biodiversity and pest resilience, such as:

- Crop rotation,
- Intercropping (e.g., maize with legumes),
- Use of cover crops,
- Mulching and reduced tillage.



- Design and demonstrate habitat management techniques like:
- Planting flowering strips to attract pollinators and predators,
- Installing insectary plants and natural vegetation buffers.

4. Demonstration and Training on Bio-control Use

- Establish bio-control demonstration plots within the SAPZ for key crops like tomato, rice, maize, and ginger.

Train farmers on:

- Identification and conservation of natural enemies (lady beetles, lacewings, parasitoid wasps),
- Timing and application of microbial bio-pesticides,
- Combining bio-control with monitoring tools like pheromone traps.

5. Integrate Bio-control into Certification and Market Access: Promote bio-control use as a requirement or incentive in Good Agricultural Practices (GAP), organic farming, and export-oriented production.

Support producer cooperatives to access eco-certification programs that demand reduced chemical inputs and promote traceability.

6. Develop Policy and Institutional Support Framework: Incorporate bio-control promotion into Kaduna State agricultural policy and SAPZ operational manuals.

Provide financial incentives such as tax waivers, grants, or input subsidies for bio-based products.

Strengthen collaboration between SAPZ, Ministry of Agriculture, research institutions, NGOs, and the private sector.

9.3.3 Expected Outcomes

- Reduction in use and cost of chemical pesticides.
- Increase in population of natural enemies and pollinators.
- Improved soil health and ecosystem services.
- Lower pest resistance and pesticide residues in food products.
- Enhanced compliance with food safety standards, attracting premium markets.
- Integration into SAPZ PMP (Pest Management Plan)

This opportunity should be integrated as a strategic intervention pillar in the PMP, with defined activities, timelines, budget lines, and monitoring indicators.

9.3.4 Suggested Implementation Actions

Promoting biological control and ecological approaches in the Kaduna SAPZ is a transformational opportunity to shift from pesticide-heavy farming to a resilient, productive, and sustainable agro-ecosystem. This aligns with national and international best practices in food production and enhances the competitiveness of SAPZ commodities in both domestic and export markets.



9.4 Improving access to and regulation of safer inputs

Improving access to and regulation of safer inputs is a critical opportunity for enhancing Integrated Pest Management (IPM) strategies, particularly within the context of Kaduna State's Special Agro-Industrial Processing Zone (SAPZ). This intervention area aims to reduce the environmental and health risks associated with synthetic pesticide use, while ensuring farmers have reliable access to alternatives that support sustainable pest management.

9.4.1 Opportunities for Strengthening IPM Strategies in Kaduna State SAPZ

a. Promotion and Availability of Safer Alternatives: One of the major limitations in current pest management practices is the limited availability of safer, eco-friendly pest control inputs. To improve this:

- Introduce and subsidize safer alternatives such as bio-pesticides, botanical extracts (e.g., neem-based products), insect growth regulators (IGRs), and other low-toxicity options.
- Support local production and distribution of bio-based inputs to reduce costs and improve availability.
- Establish agro-dealer support programs to ensure that retail outlets within and around SAPZ host communities are well-stocked with approved IPM-compatible products.

b. Strengthening Input Supply Chains: A resilient supply chain is necessary for consistent access to safer inputs:

- Partner with private sector input manufacturers and distributors to improve last-mile delivery.
- Set up community-based input access points, particularly in remote production clusters within the SAPZ.
- Facilitate bulk procurement arrangements through cooperatives or farmer clusters to reduce prices and improve timely delivery.

3. Input Quality Control and Regulatory Oversight: Input quality control and regulatory oversight is a major gap identified and can be improved by;

- Ineffective regulation leads to the proliferation of counterfeit, adulterated, or banned products.
- Enhance collaboration with NAFDAC, NESREA, and State Ministries of Agriculture and Environment to strengthen monitoring and enforcement of input standards.
- Establish a pest control input certification and labeling system to help farmers identify genuine, approved products.
- Conduct regular market surveillance and quality audits of agrochemical vendors, especially in SAPZ-linked markets.

4. Training and Sensitization on Safer Input Use: Many farmers lack awareness of the existence or benefits of safer alternatives. Capacity building is essential:

- Organize regular farmer field schools and demonstration plots showcasing efficacy of safer inputs under real field conditions.
- Develop and distribute easy-to-understand manuals and IEC materials on identification, usage, and storage of IPM-compatible inputs.



- Train agro-dealers and extension officers to provide accurate information and advisory services to farmers.
 - **Incentivizing Adoption of Safer Inputs:** Behavioral change among farmers can be promoted through incentives and enabling policies:
 - Offer input vouchers or subsidies for first-time users of safer inputs to stimulate demand.
 - Link IPM-compliant farmers to premium markets or certifications (e.g., organic, Global G.A.P.), offering those better returns for safe production practices.
 - Integrate IPM requirements into financial or insurance products, making access to safer inputs a condition for participation.
- 5. Policy and Institutional Support;** Supportive policies at state and national levels are vital to institutionalizing safer input use:
- Review and update pesticide registration and approval frameworks to fast-track low-risk bio-pesticide approvals.
 - Establish a Kaduna State IPM Advisory Council or Input Oversight Committee to oversee input standards, registration, and farmer feedback loops.
 - Harmonize with international conventions such as the FAO Code of Conduct on Pesticide Management and Rotterdam Convention to eliminate highly hazardous pesticides (HHPs).

9.5 Institutional coordination and policy support

Institutional coordination and policy support are foundational pillars for the successful implementation and sustainability of Integrated Pest Management (IPM) strategies. In the context of Kaduna State's Special Agro-Industrial Processing Zone (SAPZ), enhancing these elements creates the enabling environment required for widespread IPM adoption, enforcement of standards, resource mobilization, and multi-stakeholder engagement.

9.5.1 Opportunities for Improvement in IPM Strategies for Kaduna State SAPZ

- 1. Strengthening Inter-Institutional Coordination:** Currently, pest management activities often suffer from fragmented responsibilities, overlapping mandates, and poor communication between institutions at different levels. Improved coordination would ensure synergy, efficiency, and better outcomes:
 - Establish an IPM Coordination Task Force or Technical Working Group within the SAPZ governance structure that includes representatives from:
 - Federal Ministry of Agriculture and Food Security (FMAFS)
 - Kaduna State Ministry of Agriculture
 - FMEnv, NAFDAC, NESREA
 - Research institutes (e.g., NAERLS, IAR)
 - Agrochemical industry players, CSOs, and farmer cooperatives
 - Assign clear roles and responsibilities to each institution involved in pest surveillance, input regulation, farmer education, and enforcement of standards.



- Develop an institutional coordination framework or Memorandum of Understanding (MoU) that facilitates information sharing, joint planning, and resource mobilization among stakeholders.

2. Enhancing Policy and Regulatory Support for IPM: Policy gaps and weak enforcement frameworks limit the effectiveness of sustainable pest control.

Improvements should include:

- Review and align state-level agricultural and environmental policies to explicitly promote IPM principles and practices.
- Institutionalize IPM in Kaduna State Agricultural Policy, making it a core requirement in SAPZ-supported value chains.

Enforce stricter compliance with international agreements such as:

- FAO International Code of Conduct on Pesticide Management
- Rotterdam and Stockholm Conventions
- World Bank ESS3 (Resource Efficiency and Pollution Prevention), AfDB ISS OS3 (Biodiversity, Renewable Resources, and Ecosystem Services) and ESS6 (Biodiversity Conservation)
- Ban or phase out highly hazardous pesticides (HHPs) and promote the fast-track registration of bio-pesticides and other low-risk alternatives.
- Establish a Kaduna State Pest and Pesticide Control Board to coordinate regulation, awareness campaigns, and oversight of all pest control activities within the SAPZ.

3. Institutional Capacity Building

Many state-level institutions and extension services lack the technical know-how or tools to deliver effective IPM interventions. Opportunities for capacity development include:

- Train regulatory officers, extension agents, and local government officials on IPM protocols, pest diagnostics, safe pesticide use, and monitoring systems.
- Provide funding and infrastructure support to key institutions such as Kaduna State Agricultural Development Agency (KADA) and Kaduna Environmental Protection Authority (KEPA) to enable them deliver on their mandates.
- Strengthen linkages between research, policy, and practice by encouraging collaboration between academic institutions and state actors in the development and validation of IPM technologies.

4. Mainstreaming IPM into National and State-Level Planning Instruments: IPM should not be a standalone activity but embedded in broader planning and budgeting frameworks:

- Include IPM indicators in Kaduna State's agricultural performance monitoring system.
- Integrate IPM strategies into State Annual Operational Plans, SAPZ investment plans, and extension packages.
- Ensure that pest and pesticide management is a key component in environmental and social impact assessments (ESIAs) for all SAPZ-supported projects.



5. Improving Stakeholder Engagement and Policy Feedback Mechanisms: Effective IPM implementation requires the voices of all actors in the value chain:

- Institutionalize multi-stakeholder platforms (e.g., IPM stakeholder forums, agro-ecology platforms) where farmers, agro-dealers, researchers, and policymakers can co-design solutions and give feedback.
- Facilitate regular policy dialogues, joint reviews, and learning events, particularly focusing on pest outbreaks, invasive species, and pesticide-related health/environmental incidents.
- Promote civil society participation in pest management oversight, especially in advocating for safe farming environments and protecting vulnerable groups.

6. Leveraging Development Partnerships and Funding: Stronger institutional coordination makes it easier to attract donor and private sector investment into IPM:

- Coordinate donor support for IPM under a unified strategy, aligning the efforts of projects funded by the World Bank, AfDB, IFAD, etc.
- Encourage private sector investment in research, bio-pesticide development, and pest control services, supported by clear policy incentives.
- Leverage public-private partnerships (PPPs) to scale up pest surveillance systems, training, and safe input supply within SAPZ clusters.

9.6 Post-harvest Pest Management (PHPM)

Post-harvest Pest Management (PHPM) is a critical, yet often underemphasized component of Integrated Pest Management (IPM), particularly within agricultural development frameworks like the Kaduna State Special Agro-Industrial Processing Zone (SAPZ). Strengthening post-harvest pest management offers a high-impact opportunity to reduce losses, improve food quality and safety, enhance marketability, and support food security goals.

9.6.1 Opportunities for Improvement in IPM Strategies for Kaduna State SAPZ

1. Recognizing the Magnitude of Post-Harvest Losses: In Kaduna State and across Nigeria, 30–40% of harvested crops are lost due to inadequate post-harvest pest control—especially for cereals, legumes, tubers, and horticultural products. These losses are often due to:

- Infestation by pests like weevils, borers, bruchids, moths, and rodents
- Fungal and microbial contamination, including aflatoxins and molds
- Poor storage infrastructure and unhygienic handling practices

Strengthening PHPM within IPM strategies can drastically improve both product quantity and quality, especially for SAPZ-targeted value chains such as maize, rice, soybeans, ginger, tomatoes, and onions.

2. Promoting Appropriate Storage Technologies and Infrastructure: Improved storage reduces the need for chemical treatments and minimizes pest infestation risks:



- Scale up use of hermetic storage technologies, such as PICS (Purdue Improved Crop Storage) bags, airtight silos, and metal bins—especially at farm and aggregation levels.
- Upgrade warehouse and storage centers within SAPZ clusters with ventilation, temperature and humidity controls, and pest-proof structures.
- Encourage use of clean harvesting and drying practices, such as solar dryers and moisture meters, to ensure crops are stored at safe moisture levels (e.g., <13% for grains).
- Introduce community-level grain banks and cold chain systems, managed by farmer cooperatives or agribusinesses.

3. Integrated Monitoring and Control of Post-Harvest Pests: IPM does not end at harvest—it must include proactive pest surveillance and control post-harvest:

- Implement pest monitoring protocols (e.g., pheromone traps, temperature/moisture sensors) in warehouses and aggregation centers to detect and respond to infestations early. Promote non-chemical control options, such as:
 - Use of botanicals and inert dusts (e.g., neem seed powder, diatomaceous earth)
 - Biological control agents for storage pests
 - Use of modified atmospheres (e.g., oxygen depletion using CO₂ or nitrogen)
 - Discourage routine use of synthetic insecticides in storage due to risks of residues, resistance, and environmental contamination.

4. Strengthening Regulatory and Quality Assurance Mechanisms

Effective post-harvest pest control must be backed by enforcement of standards:

- Introduce and enforce standards for storage facilities and pest management practices in collaboration with;
 - National Agency for Food and Drug Administration and Control (NAFDAC)
 - Nigerian Stored Products Research Institute (NSPRI)
 - Standards Organization of Nigeria (SON)
- Facilitate testing and certifications of stored produce for contaminants like aflatoxins, pesticide residues, and microbial pathogens.
- Establish a quality assurance framework that supports traceability and IPM-compliant labeling for SAPZ market-bound produce.

5. Building Farmer and Stakeholder Capacity in PHPM: Poor knowledge of post-harvest IPM options is a major constraint to adoption:

- Train farmers, warehouse managers, and processors on post-harvest handling, hygiene, storage pest identification, and safe treatment options.
- Develop and disseminate easy-to-use guides on post-harvest pest risks and IPM practices for different commodities.
- Engage agro-dealers and processors in extension campaigns to promote IPM-aligned post-harvest solutions.



6. Leveraging Innovation and Research in Post-Harvest IPM; Innovation can play a key role in minimizing post-harvest losses:

- Support R&D collaborations with NSPRI, IAR, and universities to test and scale innovations in storage, drying, and pest control.
- Use digital tools for remote monitoring of storage conditions, alerts for pest infestations, and tracking movement of produce along the supply chain.
- Pilot insurance schemes that incentivize adoption of improved post-harvest practices, rewarding producers who demonstrate low-loss, IPM-compliant systems.

7. Enhancing Institutional Support and Market Linkages; To make PHPM sustainable, it must be embedded within larger SAPZ systems:

- Ensure post-harvest IPM is integrated into SAPZ infrastructure planning—from farm gate aggregation points to processing centers.
- Facilitate market access for producers using improved storage, such as linking them with premium buyers, export markets, or food processors requiring high-quality raw materials.
- Support farmer groups and cooperatives to invest jointly in post-harvest IPM infrastructure and services.

Strengthening post-harvest pest management is essential for improving the effectiveness of IPM strategies in Kaduna State SAPZ. By reducing storage losses, enhancing food safety, and supporting premium market access, post-harvest IPM closes the loop on sustainable agricultural production. The integration of appropriate technologies, regulatory frameworks, training, and private sector participation will ensure that gains made in field pest management are not lost after harvest.

9.7 Monitoring, Evaluation, and Adaptive Management

Monitoring, Evaluation, and Adaptive Management (MEAM) are critical components of a robust and responsive Integrated Pest Management (IPM) strategy. In the context of the Kaduna State Special Agro-Industrial Processing Zone (SAPZ), these functions provide the evidence, accountability, and learning required to continuously refine pest management interventions, respond to emerging threats, and ensure efficient resource use.

9.7.1 Opportunities for Improvement in IPM Strategies for Kaduna State SAPZ

1. Establishing a Robust IPM Monitoring System: Effective pest management requires timely, accurate, and continuous monitoring of pest dynamics, pesticide usage, and ecosystem impacts.

Opportunities:

Develop a State-wide Pest Surveillance System:

- Deploy pheromone traps, light traps, and other field tools across SAPZ production zones to monitor pest incidence and outbreak risks.



- Leverage geospatial tools (GPS, drones) and digital apps to record and map pest hotspots in real-time.

Create an IPM Data Management and Analysis Platform:

- Integrate data collected by extension workers, research institutions, and farmer cooperatives.
- Centralize this information for use by policy makers, SAPZ administrators, and private sector actors.

Track Pesticide Use Patterns and Resistance Trends:

- Monitor types, frequency, and volume of pesticide applications by farmers.
- Establish early warning systems for pesticide resistance or environmental contamination.

2. Embedding IPM in M&E Frameworks: To ensure accountability and learning, IPM must be integrated into broader Monitoring & Evaluation frameworks used by the SAPZ program.

Opportunities:

Define clear, measurable IPM indicators such as:

- Percentage of farmers adopting IPM-compatible practices.
- Reduction in chemical pesticide use.
- Number of pest outbreaks managed through non-chemical methods.
- Quantity of produce stored without post-harvest losses due to pests.
- Adoption of bio-pesticides or hermetic storage systems.

Develop M&E tools for IPM tracking, including:

- Field checklists for extension agents.
- Pest risk maps and seasonal calendars.
- Mobile surveys or farmer scorecards on IPM adoption and impact.
- Ensure IPM is part of project reporting and evaluations, including mid-term reviews, impact assessments, and donor reporting for SAPZ activities.

3. Promoting Adaptive Management and Evidence-Based Decision-Making: The complexity and variability of pest challenges require a flexible, adaptive approach rather than fixed prescriptions.

Opportunities:

Institutionalize regular learning and reflection cycles:

- Convene quarterly or seasonal IPM review meetings at LGA and state levels involving farmers, extension agents, researchers, and policymakers.
- Use these platforms to analyze trends, share lessons, and adapt strategies.

Establish Rapid Response Protocols for Emerging Threats:

- Develop contingency plans and quick-response teams for new pest invasions (e.g., fall armyworm, tomato leaf miner).
- Coordinate with national bodies like FMARD and NAQS for emergency response and cross-border pest surveillance.

Support on-farm experimentation and participatory action research (PAR):



- Encourage farmers to trial different pest control options and contribute to local knowledge development.
- Feed results into extension materials and training programs.

4. Capacity Building for MEAM in IPM: Improved monitoring and evaluation require skilled personnel and institutional systems.

Opportunities:

- Train extension agents, local NGOs, and private sector partners on M&E tools, pest surveillance, data collection, and analysis.
- Equip Kaduna Agricultural Development Agency (KADA) and SAPZ technical teams with digital devices and M&E software.
- Engage local institutions like Kaduna State University, NAERLS, or IAR to provide technical backstopping and support research-based adaptation.

5. Feedback Loops for Farmers and Stakeholders: An inclusive and responsive IPM system should provide timely feedback to end-users and allow for community-based decision-making.

Opportunities:

- Create farmer feedback mechanisms (e.g., WhatsApp groups, hotlines, community radio programs) to report pest observations and receive timely advice.
- Develop dashboards or bulletins to communicate pest forecasts, outbreak alerts, and recommended control strategies.
- Use participatory monitoring tools that involve farmers in tracking pest pressures and evaluating the outcomes of different interventions.

6. Leveraging Technology and Partnerships: Modern MEAM systems can benefit from collaboration and innovation:

Opportunities:

- Partner with AgTech firms, research institutions, and NGOs to pilot digital IPM monitoring tools.
- Link to national and regional pest surveillance networks (e.g., ECOWAS Early Warning System, Nigerian Pest Risk Analysis programs).
- Use satellite imagery and AI for landscape-level pest prediction and ecosystem health monitoring.

Monitoring, Evaluation, and Adaptive Management (MEAM) is not merely a support function—it is the engine of innovation and accountability within a sustainable IPM framework. For Kaduna State SAPZ, strengthening MEAM will ensure that pest management remains responsive to local realities, backed by data, and able to evolve with new challenges. It will also increase the efficiency of investments, foster continuous learning, and ultimately contribute to a more resilient and productive agro-industrial system.

9.8 Encouraging Public-Private Partnerships

Encouraging Public-Private Partnerships (PPPs) presents a powerful opportunity to strengthen



and scale Integrated Pest Management (IPM) strategies in Kaduna State's Special Agro-Industrial Processing Zone (SAPZ). Leveraging the strengths of both sectors—public oversight and private innovation—can address critical gaps in financing, technology dissemination, infrastructure, and service delivery in pest management systems.

9.8.1 Opportunities for Improvement in IPM Strategies for Kaduna State SAPZ

- 1. Mobilizing Private Sector Investment in IPM Inputs and Services:** The private sector is well-positioned to drive the production, distribution, and commercialization of IPM-compatible inputs and services.

Opportunities:

Support local production and commercialization of safer inputs, such as:

- Bio-pesticides, botanicals (e.g., neem formulations), and microbial products.
- Hermetic storage bags and non-chemical post-harvest technologies.
- Pest-resistant seeds and bio-fortified crop varieties.

Incentivize agro-dealers and distributors to stock and promote IPM-compliant products through:

- Tax breaks, subsidies, or startup grants.
- Business development services and digital inventory platforms.
- Encourage pest management companies to offer private extension and scouting services to commercial farmers and cooperatives under contract farming schemes.

- 2. PPPs for Pest Surveillance and Data Systems:** Timely and accurate pest surveillance requires investment in technology, logistics, and human resources—areas where PPPs can be instrumental.

Opportunities:

- Partner with AgTech and ICT firms to develop and manage pest monitoring platforms and early warning systems (e.g., mobile apps, digital maps and dashboards).
- Engage drone service providers and AI companies to offer real-time pest detection and remote sensing of field conditions.
- Involve telecommunications companies in disseminating pest alerts and IPM advice through SMS, USSD, or IVR services to smallholder farmers.

- 3. Co-Investment in IPM Research, Demonstration, and Capacity Building:** Collaboration between public research institutes and private agribusinesses can accelerate innovation and farmer adoption.

Opportunities:

- Develop joint demonstration farms or IPM learning hubs, where private sector inputs are tested and validated in partnership with institutions like IAR, NAERLS, or KADA.
- Establish innovation grants or challenge funds to support startups and SMEs developing IPM solutions (e.g., pheromone traps, bio-control agents, pest prediction models).
- Facilitate training-of-trainers programs, where private sector agronomists are capacitated alongside public extension agents to disseminate IPM knowledge.



- 4. Strengthening Post-Harvest IPM Infrastructure through PPPs:** The private sector can play a key role in reducing post-harvest pest losses by investing in modern storage and processing infrastructure.

Opportunities:

- PPP arrangements to develop and operate aggregation centers, cold chains, and grain banks, incorporating IPM-compatible storage and handling systems.
- Engage food processors and exporters to co-invest in quality assurance systems that require IPM compliance from producers.
- Develop warehouse receipt systems tied to pest-safe storage standards, giving farmers access to credit and better markets while reducing losses.

- 5. Financing and Risk-Sharing for IPM Adoption:** Access to financing is often a barrier to IPM uptake among smallholders. PPPs can help bridge this gap.

Opportunities:

- Work with microfinance institutions and agribusiness lenders to offer tailored credit products for IPM input acquisition.
- Introduce blended finance mechanisms, where public funds de-risk private investment in pest management ventures (e.g., input guarantees, interest subsidies).
- Partner with agricultural insurers to offer index-based or bundled insurance packages tied to adoption of IPM practices (e.g., IPM-compliant farmers get premium discounts).

- 6. Enhancing Policy Support and Incentives for PPP Engagement:** The government has a key role in enabling a favorable environment for private sector participation in IPM.

Opportunities:

- Develop a Kaduna State IPM-PPP Framework or Policy, providing clarity on roles, procedures, and incentives for collaboration.
- Establish an IPM Innovation and Investment Platform within SAPZ governance structures, bringing together private actors, donors, public agencies, and research bodies.
- Offer regulatory fast-tracking for bio-pesticide companies, and provide recognition or certifications for IPM-compliant private enterprises.

- 7. Promoting Inclusive Partnerships:** PPPs should also be designed to benefit youth, women, and vulnerable groups across the value chain.

Opportunities:

- Support youth-led agribusinesses offering pest control, crop monitoring, or post-harvest services.
- Facilitate women's cooperatives to partner with private firms for aggregation, processing, or retailing of IPM-treated produce.
- Include smallholder farmers in out-grower schemes, contract farming models, or IPM certification programs supported by private processors and exporters.

Encouraging public-private partnerships is a strategic pathway to unlock innovation,



investment, and scalability for IPM in Kaduna State SAPZ. By aligning public interest with private efficiency, PPPs can deliver sustainable, cost-effective, and inclusive pest management solutions. Such partnerships will also enhance value chain competitiveness, reduce pest-related losses, and position Kaduna as a leader in eco-friendly agricultural production.



CHAPTER TEN: PEST MANAGEMENT STRATEGIES

Pest management strategies are essential for controlling pests that can damage crops, livestock, and human health.

10.1 Types of Pest Management Strategies

1. **Mechanical and Physical Pest Control:** Using traps, barriers, and other physical methods to control pests. Examples include sticky traps for flying insects, snap traps for rodents, and row covers to protect plants from insects.
2. **Biological Pest Control:** Utilizing natural enemies, such as predators, parasites, and pathogens, to control pests. Examples include introducing ladybugs to control aphids and using nematodes to control insect larvae.
3. **Chemical Pest Control:** Using pesticides to control pests. This method should be used judiciously and in combination with other approaches for effective, long-term control.
4. **Cultural Pest Control:** Modifying agricultural practices to prevent pest establishment, reproduction, dispersal, and survival. Examples include crop rotation, sanitation, and pruning infested plants.
5. **Integrated Pest Management (IPM):** A holistic approach that combines multiple pest management strategies to manage pests effectively while minimizing harm to people, the environment, and beneficial organisms.

10.2 Integrated Pest Management (IPM)

In the pursuit of ensuring global food security, protecting the environment, and promoting sustainable agricultural practices, Integrated Pest Management (IPM) has emerged as a vital strategy. IPM is a comprehensive approach that seeks to manage pests in a way that minimizes harm to people, the environment, and beneficial organisms. By combining different management tools and techniques, IPM provides a long-term solution to pest problems, reducing the reliance on chemical pesticides and maintaining ecosystem balance.

At its core, IPM is a decision-making process that involves identifying the pest, monitoring its population, and determining the most effective management strategy. This approach recognizes that pests are toxic to humans, animals, or the environment and that their management requires a multifaceted approach. By understanding the complex interactions between pests, their natural enemies, and the environment, IPM seeks to develop sustainable and effective management strategies that minimize the risks associated with pest control.

The importance of IPM cannot be overstated. With the increasing pressure to produce food sustainably and reduce the environmental impact of agricultural practices, IPM offers a promising solution. By adopting IPM strategies, farmers can reduce their reliance on chemical pesticides, minimize the development of pesticide-resistant pest populations, and promote ecosystem services that benefit both agriculture and the environment.

In this context, IPM is not just a pest management strategy; it is a critical component of sustainable agriculture. By integrating IPM into agricultural practices, farmers can contribute to a more sustainable food system that prioritizes environmental stewardship, human health, and economic viability.

As the global population continues to grow, the need for sustainable agricultural practices will



only increase. IPM offers a valuable framework for addressing the complex challenges facing agriculture today, from managing pests and diseases to promoting ecosystem services and reducing environmental degradation. By embracing IPM, we can work towards a more sustainable future for agriculture and ensure that food production meets the needs of both present and future generations.

10.2.1 Key Components of IPM

1. **Pest Identification:** Correct identification of the pest is the foundational step in effective pest management. Accurate diagnosis ensures that the most appropriate, targeted, and cost-effective control measures are applied, preventing unnecessary or ineffective pesticide use.
2. **Monitoring and Assessing Pest Numbers and Damage:** Regular monitoring of pest populations and the extent of crop damage helps farmers make informed decisions about when and how to intervene. Continuous assessment allows for early detection of infestations and helps in evaluating the effectiveness of control strategies.
3. **Guidelines for When Management Action is Needed:** Establishing clear **action thresholds**—specific pest population or damage levels that trigger control measures—is essential. This approach prevents premature or excessive pesticide applications and promotes economically and environmentally sound pest management.
4. **Preventing Pest Problems:** Implementing preventive strategies such as crop rotation, proper field sanitation, use of resistant crop varieties, and timely planting can significantly reduce pest outbreaks. These **cultural control measures** create unfavorable conditions for pest survival and reproduction.
5. **Using a Combination of Management Tools:** Effective pest management requires an **integrated approach** that combines biological, cultural, physical, and chemical methods. Employing multiple complementary strategies enhances control effectiveness, reduces pest resistance, minimizes environmental impact, and promotes sustainable agricultural production.

10.2.2 Benefits of IPM

1. **Reduced Chemical Use:** Integrated Pest Management (IPM) significantly reduces dependence on chemical pesticides by emphasizing preventive and non-chemical control methods. This approach minimizes the risk of environmental contamination, preserves beneficial organisms, and safeguards human health from pesticide exposure.
2. **Increased Crop Yields:** By effectively controlling pest populations through timely and appropriate interventions, IPM helps enhance crop productivity and quality. Healthier crops and reduced pest-related losses contribute to improved food security and higher economic returns for farmers.
3. **Sustainable Agriculture:** IPM supports long-term agricultural sustainability by promoting ecological balance and soil health. Through the integration of biological, cultural, and mechanical control methods, IPM reduces reliance on chemical inputs, conserves biodiversity, and ensures that farming systems remain productive and environmentally friendly over time.



10.2.3 IPM Approach

The SAPZ PMP adopts a four-tier IPM strategy:

1. Preventive Measures (*First Line of Defense*)

- Crop rotation and intercropping to break pest life cycles.
- Use of pest-resistant and early-maturing crop varieties.
- Field sanitation: removal of crop residues and volunteer plants.
- Proper spacing and planting dates to reduce pest harboring conditions.

2. Biological Control (*Environmentally Friendly Methods*)

- Release of natural predators and parasitoids (e.g., *Trichogramma* wasps, ladybird beetles).
- Use of microbial bio-pesticides (e.g., *Bacillus thuringiensis*, neem-based products).
- Habitat management to encourage beneficial organisms.

3. Mechanical and Physical Control (*Non-Chemical Direct Actions*)

- Installation of pheromone traps, light traps, and sticky traps.
- Use of rodent-proof storage structures.
- Handpicking and destruction of heavily infested plant parts.
- Solarization of stored grains to kill insect pests.

4. Chemical Control (*Last Resort – Strictly Controlled*)

- Only apply pesticides when pest infestation exceeds the **Economic Threshold Level (ETL)**.
- Selection of pesticides based on **WHO Class III (slightly hazardous)** and Class U (unlikely to present acute hazard).
- Prohibit the use of WHO Class Ia (extremely hazardous) and Class Ib (highly hazardous) pesticides.
- Follow label instructions strictly for dosage, application interval, and pre-harvest intervals.

10.2.4 Safe Pesticides Handling and Storage Protocols

- All pesticides must be stored in designated, ventilated facilities away from food and water sources.
- Personal protective equipment (PPE) must be worn during mixing and application.
- Empty pesticide containers must be triple-rinsed, punctured, and disposed of through approved hazardous waste channels.
- Prohibit re-use of pesticide containers for food or water storage.



10.2.5 Integration with ESIA Safeguards

- Pest control measures must not compromise air, soil, or water quality standards outlined in the ESIA.
- Buffer zones will be maintained near water bodies to prevent pesticide drift or runoff.
- All pest control activities will be logged and reported quarterly as part of ESIA monitoring.

10.3 IPM Plan for Kaduna SAPZ

The following strategic interventions together form a holistic pest management system that is scalable across the Kaduna SAPZ's diverse agro-industrial activities. By combining proactive surveillance, ecosystem-based control, structural integrity, community involvement, and institutional capacity, the PMP ensures that pest risks are mitigated at every point of the agricultural value chain—while enhancing food safety, protecting biodiversity, supporting farmers, and aligning with global environmental and health standards. The strategy involves the utilization of the following:

1. Integrated Pest Management (IPM) Strategy

Goal: Transition from chemical-dependent pest control to integrated, eco-friendly methods that are sustainable and cost-effective.

Key Actions:

- **Promote Good Agricultural Practices (GAPs):** Encourage farmers to adopt timely planting, appropriate crop spacing, intercropping, and proper field management techniques to minimize pest incidence and enhance crop vigor. These practices improve plant health and resilience, reducing the need for chemical intervention.
- **Encourage Resistant Varieties:** Collaborate with national and international research institutes such as the Institute for Agricultural Research (IAR) and the International Institute of Tropical Agriculture (IITA) to promote and disseminate pest-resistant and climate-resilient crop varieties suited to local conditions.
- **Cultural Control Measures:** Implement field sanitation, effective weed management, crop rotation, fallowing, and general field hygiene to disrupt pest life cycles and reduce their breeding sites. These non-chemical strategies form the foundation of sustainable pest management.
- **Biological Controls:** Utilize natural enemies such as parasitoids, predators (e.g., *Trichogramma spp.*), and microbial agents like *Bacillus thuringiensis* (Bt) to suppress pest populations. These biological solutions are environmentally friendly and help maintain ecological balance.
- **Mechanical and Physical Controls:** Employ devices and barriers such as pheromone traps, sticky traps, light traps, rodent traps, and physical barriers to monitor and directly control pest populations, reducing reliance on chemical pesticides.
- **Judicious Chemical Use:** When pesticide application becomes necessary, ensure it is targeted and based on economic thresholds. Only pesticides classified as WHO Class II or lower should be used, accompanied by farmer training on proper handling, dosage,



and safe disposal to minimize risks to health and the environment.

- **Promote Indigenous Knowledge:** Integrate and promote traditional pest control methods such as the use of neem-based extracts, ash application, intercropping, and other locally proven practices. Leveraging indigenous knowledge enhances community ownership, sustainability, and cultural acceptance of pest management interventions.

2. Farm-to-Factory Biosecurity Protocols

Goal: Prevent pest entry and spread along the value chain—from field to processing units.

Key Actions:

- **Field-Level Biosecurity:** Establish strict quarantine zones for infested fields to prevent the spread of pests and diseases to unaffected areas. Ensure regular decontamination of tools, machinery, and equipment before and after use to minimize cross-contamination between fields.
- **Transport Hygiene:** Maintain high standards of hygiene in all transport operations by cleaning and fumigating vehicles used for moving agricultural produce. Raw materials should be properly sealed and covered during transit to prevent pest infestation and contamination en route to processing facilities.
- **Agro-Processing Biosecurity:** Implement insect-proofing measures in storage and processing areas, including the use of screens, sealed doors, and controlled ventilation. Conduct monthly inspections and pest monitoring to detect and manage stored-product pests promptly, ensuring food safety and product quality.
- **Waste and By-Product Handling:** Enforce proper segregation of organic and inorganic waste at all processing sites. Organic waste should be safely composted, treated, or disposed of in designated facilities to prevent the creation of pest breeding grounds and reduce environmental pollution.

3. Structural and Environmental Management

Goal: Eliminate conditions that favor pest infestation in SAPZ infrastructure.

Key Actions:

- **Design Infrastructure to Be Pest-Resistant:** Incorporate pest-resistant features into all agricultural and processing infrastructure. This includes installing mesh screens on windows and vents, ensuring proper drainage systems to prevent stagnant water, and constructing rodent-proof storage facilities with sealed vents and tight-fitting doors. Such designs help minimize pest entry and harboring within buildings and storage areas.
- **Periodic Structural Inspection:** Conduct routine inspections of buildings and storage facilities to detect signs of pest activity, including termites, ants, and rodents. Apply appropriate preventive treatments and promptly seal cracks, crevices, and structural gaps to eliminate potential nesting or entry points for pests.
- **Environmental Sanitation:** Maintain high standards of cleanliness in and around all facilities. Clear vegetation and debris near buildings, regularly clean surroundings, and drain or manage standing water to reduce mosquito breeding and other pest habitats. Continuous environmental sanitation supports overall facility hygiene and complements other biosecurity measures.



4. Public Health Pest Management

Goal: Minimize pest-related health risks to SAPZ workers and host communities.

Key Actions:

- **Community Vector Control Campaigns:** Partner with local health departments and environmental agencies to organize regular vector control programs, including mosquito fogging, larval source reduction, and community sanitation drives. Complement these efforts with public awareness campaigns that educate residents and farm workers on vector prevention, proper waste management, and hygiene practices to reduce disease transmission.
- **Install Sanitation Facilities:** Provide and maintain adequate sanitation infrastructure, ensuring access to clean water, functional toilets, and proper waste disposal systems for all staff and workers. These facilities help maintain hygiene, prevent contamination, and minimize breeding sites for disease vectors.
- **Periodic Medical Surveillance:** Establish a system for routine health screening and monitoring of workers to detect early signs of pesticide exposure and vector-borne diseases such as malaria and dengue. Implement prompt medical response and maintain health records to support occupational safety and public health management.

5. Capacity Building, Farmer Training, and Extension Services

Goal: Empower stakeholders with skills, knowledge, and tools for sustainable pest management.

Key Actions:

- **Train-the-Trainer Model:** Implement a capacity-building framework that develops a pool of skilled local IPM facilitators through intensive Master Training Programs. These trainers will, in turn, cascade knowledge and skills to farmers and community groups, ensuring sustainability and local ownership of pest management initiatives.
- **Farmer Field Schools (FFS):** Establish seasonal Farmer Field Schools across the SAPZ clusters to provide hands-on demonstrations of Integrated Pest Management (IPM) techniques. Through participatory learning, farmers will gain practical experience in pest identification, monitoring, and the application of eco-friendly control methods.
- **Workshops for Agro-Processors and Logistics Teams:** Organize targeted training workshops for agro-processors, warehouse managers, and logistics operators focused on pest detection, prevention, and control in storage, packaging, and transport systems. These trainings will emphasize food safety, hygiene, and post-harvest loss reduction.
- **Training for Agro-Input Dealers:** Strengthen the capacity of agro-input suppliers and dealers to ensure responsible pesticide sales and advisory services. Training will cover safe handling, correct labeling, proper storage, and dissemination of accurate usage information to farmers in compliance with national and international pesticide management standards.

6. Community Engagement and Stakeholder Collaboration



Goal: Promote inclusive pest management by leveraging partnerships.

Key Actions:

- **Engage Traditional Leaders and Farmer Cooperatives:** Collaborate closely with traditional leaders, community-based organizations, and farmer cooperatives to enhance mobilization, awareness creation, and local participation in pest management initiatives. Leverage indigenous knowledge systems and community structures to promote culturally appropriate, sustainable pest control practices that align with local realities.
- **Partner with Research Institutions:** Strengthen partnerships with reputable research bodies such as the International Institute of Tropical Agriculture (IITA), National Agricultural Extension and Research Liaison Services (NAERLS), National Agricultural Research Institutes (NARIs), and Ahmadu Bello University (ABU) Zaria to advance research, innovation, and dissemination of pest management technologies. Collaboration will support adaptive research on pest dynamics, biological control agents, and resilient crop varieties.
- **Public-Private Partnerships (PPP):** Foster strategic public-private collaborations with agro-chemical companies and agritech firms to support field trials, product demonstrations, and farmer capacity-building programs on Integrated Pest Management (IPM) solutions. These partnerships will facilitate access to safe, effective, and environmentally sound pest control technologies while promoting responsible input use.

7. Environmental and Occupational Health Safeguards

Goal: Protect biodiversity and minimize health and environmental risks.

Key Actions:

- **Pesticide Risk Assessments:** Conduct comprehensive risk assessments for all pesticides prior to approval and use, evaluating both human health and environmental toxicity. This process should include reviewing active ingredients, exposure pathways, and potential long-term effects on soil, water, and biodiversity to ensure only safe and approved products are used within the SAPZ.
- **Personal Protective Equipment (PPE):** Ensure that all pesticide applicators are equipped with complete PPE kits, including gloves, masks, goggles, and protective clothing. Enforce mandatory use of PPE during handling, mixing, and spraying operations, coupled with continuous training on safe pesticide application and first-aid procedures to minimize exposure risks.
- **Safe Storage and Disposal:** Establish community pesticide banks and container return schemes to manage pesticide storage and disposal responsibly. Expired or unused pesticides, along with empty containers, should be collected, documented, and incinerated or treated in compliance with environmental safety standards to prevent contamination of soil and water resources.
- **Pollinator Protection:** Promote bee-friendly pest management practices by avoiding pesticide application during flowering periods and restricting spraying to early morning or late evening hours when pollinator activity is minimal. Encourage the adoption of integrated pest management (IPM) approaches and habitat conservation to protect



pollinator populations essential for crop productivity and ecosystem health.

8. Digital Surveillance, Monitoring, and Data Analytics

Goal: Detect pest outbreaks early and improve decision-making through digital tools.

Key Actions:

- **Deploy Pest Surveillance Systems:** Implement robust pest surveillance and early warning systems using mobile applications, remote sensing, and GIS-based tools to monitor and track pest infestations in real time. This data-driven approach enables rapid detection, timely response, and effective coordination among farmers, extension officers, and relevant institutions to prevent large-scale outbreaks.
- **Develop Farmer Feedback Loops:** Establish interactive communication channels such as SMS alerts, WhatsApp groups, and digital dashboards to facilitate two-way information exchange between farmers and agricultural extension agents. These platforms will provide real-time pest alerts, advisory messages, and management recommendations, enhancing community preparedness and adaptive response.
- **Maintain Pest and Pesticide Database:** Create and regularly update a centralized digital database containing detailed records of pest occurrences, pesticide usage, control measures, and outcomes. This system will support evidence-based decision-making, help identify emerging pest trends, and guide future interventions for improved pest management across the SAPZ.

9. Legal Compliance and Policy Enforcement

Goal: Align all pest control activities with national and international regulations.

Key Actions:

- **Compliance Audits:** Conduct annual compliance audits of all SAPZ pest management operations to ensure adherence to national and international standards, including those set by NAFDAC, NESREA, and the FAO. These audits should evaluate pesticide registration, storage, handling, and disposal practices, as well as the implementation of Integrated Pest Management (IPM) and biosecurity protocols across project sites. Findings should inform continuous improvement measures and corrective actions.
- **Harmonize with Kaduna State Laws:** Align all pest management and environmental protection activities with relevant Kaduna State environmental, agricultural, and public health regulations. This harmonization ensures policy coherence, avoids regulatory overlaps, and strengthens institutional collaboration among state agencies responsible for pest and pesticide control.
- **Develop Local By-laws (If Needed):** Support the formulation of community-level by-laws to regulate activities related to vector control, waste management, and chemical disposal. Such localized regulations will empower communities to enforce environmental and public health standards, promote accountability, and sustain good biosecurity and pest control practices within and around the SAPZ.

10. Adaptive Management and Continual Improvement

Goal: Build a flexible PMP that evolves with new knowledge, technologies, and emerging



threats.

Key Actions:

- **Annual PMP Review Workshops:** Organize annual review and learning workshops to assess the performance of the Pest Management Plan (PMP) and integrate lessons learned from field implementation. These workshops should draw on monitoring and evaluation reports, stakeholder feedback, and emerging pest trends to update strategies, refine action plans, and strengthen institutional coordination for continuous improvement.
- **Pilot Innovations:** Promote the testing and adoption of innovative pest management technologies, such as drones for pest scouting, AI-powered pest identification tools, and botanical pesticide formulations. Field pilots should be conducted in collaboration with research institutions and private sector partners to evaluate effectiveness, scalability, and cost efficiency before wider deployment across SAPZ clusters.
- **Knowledge Sharing Platform:** Establish a dynamic online knowledge-sharing platform that serves as a centralized hub for training materials, pest alerts, best practices, and farmer success **stories**. The platform will foster peer learning, enhance information dissemination, and encourage collaboration among farmers, extension agents, researchers, and policymakers engaged in sustainable pest management.

10.4 Pest Management Strategy Implementation Plan

The implementation of pest management strategies for Kaduna state SAPZ must be strategic, inclusive, and sustainable tailored to local agro ecological and socio-economic contexts. The goal is to reduce the dependency on harmful pesticides, promote Integrated Pest Management and enhance productivity through safe, cost-effective and environmentally friendly practices.

1 Strategic Objectives of the implementation plan

The following are the strategic objectives of the implementation plan:

- Promote the adoption of IPM practices across the state
- Improve awareness, knowledge and technical capacity of farmers and stakeholders
- Ensure proper regulation and safe use of pesticides
- Encourage the use of biological and cultural pest control methods
- Strengthen surveillance, monitoring and early warning systems.



Table 10.1: PMP Implementation Matrix (excluding cost implications which are presented on the next chapter Table 11.1)

S/N	STRATEGY	KEY ACTIVITIES	TIMELINE	KEY PERFORMANCE INDICATORS(KPI)	RESPONSIBLE INSTITUTIONS	EXPECTED OUTCOMES
1	Integrated Pest Management (IPM)	Field demonstration of IPM Distribution of IPM Kits (traps, neem-based bio pesticides) Promotion of crop rotation and resisters varieties.	Year 1-3	70% of SAPZ farmers adopting IPM 40% reduction in synthetic pesticide use	KADMOA, SAPZ-PIU and Extension Services	Safer, more sustainable Pest control at farm level
2	Farm-to-Factory Biosecurity	Sanitation protocols at farms and transport hubs. Install pest-proof infrastructure in storage/processing zones. Fumigation of transport containers.	Year 1-2	100% of SAPZ warehouses sanitized quarterly 90% pest-free transport compliance	SAPZ Logistics Unit, Agro-processors and KEPA	Reduced pest spread along the value chain



Pest Management Plan (PMP) for the Proposed Kaduna SAPZ Project (AIH and ATC)

3	Structural and Environmental Management	Build rodent and termite proof storage units Routine infrastructure inspections Landscaping and environmental hygiene	Year 1-3	100% c compliance in new infrastructure 60% decline in structural pest incidents	KADMOA, SAPZ Infrastructure/Facility Engineers and KEPA	Increased structural resilience and pest management
4	Public Health Pest Control	Routine fogging and vector control Public awareness on sanitation and waste disposal Set up mobile clinics for staff health monitoring	Year 1-3	80% reduction in mosquito breeding hotspots Zero pesticide – related poisoning	SAPZ Health Unit, KEPA, Kaduna MoH and LG Councils	Healthy workforce and reduced vector-borne diseases
5	Capacity Building and Farmer Training	Establish farmer Field Schools (FFS) Trained agro-dealers and pesticides users Extension officers trained as IPM facilitators	Year 1-3 (Quarterly Trainings)	1000 farmers trained annually 80 trained IPM facilitators by Year 2	KADMOA, NAERLS, SAPZ-PIU and NGOs	Informed stakeholders and better field level decisions



Pest Management Plan (PMP) for the Proposed Kaduna SAPZ Project (AIH and ATC)

6	Community Engagement and Partnerships	<p>Mobilized traditional leaders for pest education</p> <p>Partner with KASU, ABU and IAR for IPM R&D</p> <p>Co-create pest alert systems with local youth groups</p>	Year 1-2	<p>50% of SAPZ communities reached by outreach</p> <p>Institutional MOUs signed</p>	SAPZ-PIU, CSOs, Community leaders and Youth groups	Stronger local ownership and innovation
7	Environmental and Occupational Health	<p>Distribute PPEs to pesticide handlers</p> <p>Train on pesticide storage and spill response</p> <p>Setup pesticide container return centers</p>	Year 1-2	<p>100% pesticide applicators equipped with PPEs</p> <p>70% safe container return rate</p>	NAFDAC, KEPA, SAPZ-HSE Team and Agro-Dealers	Safer pesticide use and reduced environmental risk
8	Digital Surveillance and Monitoring	<p>Launch mobile app for pest reporting</p> <p>Deploy GIS mapping for pest hotspots</p> <p>Create digital pesticide</p>	Year 2-3	<p>80% of clusters reporting via app</p> <p>Digital pest maps report created annually</p>	SAPZ-ICT/MIS Unit, FMARD and AgTech Startups	Real-time pest data and responsive interventions



Pest Management Plan (PMP) for the Proposed Kaduna SAPZ Project (AIH and ATC)

		usage log				
9	Legal Compliance and Policy Enforcement	Regular compliance audits Register all agro-chemical dealers Harmonize SAPZ activities with national policies	Year 1-3 (Annual Audits)	100% licensed pesticide dealers Annual compliance scorecard published	NAFDAC, KEPA, NESREA, KADMOA and SAPZ Legal Team	Strong regulatory adherence and enforcement
10	Adaptive Management	Annual PMP review and update Incorporate emerging technologies Pilot new bio-control agent or AI tools	Year 2-3 (Yearly review)	PMP Updated annually 3 pest innovation pilot completed	SAPZ-PIU, R&D Institutions and Innovation Hubs	Dynamic, responsive pest management strategy



CHAPTER ELEVEN: COMPREHENSIVE INTEGRATED PEST MANAGEMENT (IPM) IMPLEMENTATION PLAN FOR KADUNA SAPZ

11.1 Introduction and Purpose

This chapter presents the Comprehensive Integrated Pest Management (IPM) Implementation Plan for the Kaduna Special Agro-Processing Zone (SAPZ). It provides a framework for translating the strategies and principles outlined in preceding chapters into an action-oriented and results-based program. The Plan ensures that pest and disease management practices under the SAPZ are environmentally sound, socially responsible, and aligned with international best practice and the African Development Bank (AfDB) Integrated Safeguards System (ISS), particularly Operational Safeguard 3 (OS3), as well as World Bank ESS3 (Resource Efficiency and Pollution Prevention) and ESS6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources).

The overall objectives of the Plan are to:

- Institutionalize IPM as the standard approach for pest management within the SAPZ.
- Reduce the dependence on synthetic pesticides by promoting biological and ecological alternatives.
- Protect human health, food safety, and the environment.
- Build institutional and technical capacity for pest surveillance, regulation, and management.
- Ensure compliance with AfDB environmental and social safeguard requirements.

11.2 Implementation Strategy

Implementation of the IPM Plan will adopt a phased and integrated approach combining surveillance, training, regulation, coordination, and monitoring activities. The strategy is structured around ten inter-related components, summarized in *Annex 9.1 (IPM Implementation Matrix)*. Each component outlines key activities, expected outputs, responsible institutions, performance indicators, indicative costs, and timelines.

11.3 Key Components and Activities

1. Pest Identification, Monitoring, and Surveillance

A foundational activity of the PMP is the establishment of a **Pest Surveillance and Early Warning System (PSEWS)** for key SAPZ crops; maize, rice, tomatoes, ginger, and soybeans. The system will integrate field scouting, pheromone/light traps, GIS-based mapping, and digital reporting to detect pest incidence in real time. Research and regulatory institutions (NAERLS, IAR, NAQS) will develop pest profiles, describing life cycles, economic threshold levels (ETL), and seasonal occurrence calendars. Quarterly surveillance bulletins will guide farmers and SAPZ managers on preventive and corrective measures.

2 Worker Training and Capacity Development



Human capacity is central to IPM sustainability. The Plan will establish Farmer Field Schools (FFS) and IPM Training Centers across SAPZ clusters. Quarterly Training-of-Trainers (ToT) sessions will target extension agents, agro-dealers, and lead farmers. Gender-sensitive and youth-inclusive training will be prioritized to ensure equitable participation. Partner institutions; NAERLS, KASU, and the State ADP (KADA) will provide technical backstopping and maintain training curricula.

3 Environmental, Health, and Safety (EHS) Measures

To safeguard people and ecosystems, EHS measures will be mainstreamed into SAPZ operations.

This includes:

- Distribution and enforcement of Personal Protective Equipment (PPE);
- Establishment of pesticide container collection and disposal centers;
- Development of spill response and waste management protocols; and
- Regular occupational health and safety audits.
- Implementation will be coordinated by the SAPZ Health, Safety, and Environment (HSE) Unit, with oversight from NAFDAC, NESREA, and KEPA.

4 Record-Keeping and Documentation

- **Accurate Record-Keeping:** Maintaining precise and consistent records is vital for ensuring traceability, accountability, and compliance with the African Development Bank (AfDB) environmental and social safeguard reporting requirements.
- **Standardized Documentation: Uniform pesticide** use logs and pest monitoring forms will be adopted and implemented at both the farm and cluster levels. These tools will capture detailed information on pesticide type, quantity applied, application date, pest species, and control outcomes.

Decision Support and Reporting: The integrated database will enhance data-driven decision-making, improve regulatory compliance, and provide a reliable foundation for periodic progress reporting to AfDB and other stakeholders.

4. Evaluation, Feedback, and Adaptive Learning

To ensure continuous improvement and adaptive management, the Pest Management Plan (PMP) will implement a Participatory Monitoring and Evaluation (PME) framework that actively involves all key stakeholders in performance tracking and decision-making.

- **Participatory Monitoring and Evaluation (PME):** A structured PME mechanism will be established to facilitate inclusive assessment of pest management activities. This approach will empower farmers, extension agents, regulators, and SAPZ management to jointly evaluate progress, identify challenges, and recommend corrective actions.
- **Bi-Annual Review Workshops: Bi-annual multi-stakeholder review workshops** will be convened to review implementation outcomes, analyze monitoring data, and capture lessons learned. These sessions will serve as learning platforms for experience sharing and collaborative problem-solving.





- **Feedback and Learning Tools:** Farmer scorecards, stakeholder feedback loops, and performance tracking indicators will be integrated into the annual PMP review process. The insights generated will guide the annual revision of the PMP, ensuring it remains responsive, evidence-based, and aligned with evolving pest dynamics and environmental safeguards.

6 Contingency Measures for Pest Outbreaks

Given the potential for sudden and large-scale pest infestations, a comprehensive Pest Outbreak Contingency Plan will be established to ensure rapid and coordinated response across all SAPZ sites.

- **Pest Outbreak Contingency Plan:** The plan will outline clear strategies for early detection, rapid intervention, and containment of pest outbreaks to minimize crop losses and protect environmental health.
- **Rapid Response Units (RRUs):** Dedicated Rapid Response Units will be established and strategically deployed within SAPZ clusters. These units will be equipped with diagnostic kits, surveillance tools, and emergency stocks of low-toxicity or biological pesticides to enable immediate and effective field action during pest emergencies.
- **Response Protocols:** Standardized response protocols will define specific reporting lines, communication procedures, and action thresholds to ensure prompt coordination and efficient response among implementing agencies and field teams.
- **Institutional Coordination:** The implementation and oversight of the contingency plan will be carried out in close collaboration with the Federal Ministry of Agriculture and Food Security (FMAF&S)—particularly through its Plant Protection Department—alongside the Nigeria Agricultural Quarantine Service (NAQS) and the SAPZ Emergency Response Structure. This coordinated framework will strengthen national preparedness and ensure a timely, science-based response to pest outbreaks.

7 Promotion of Biological and Eco-Friendly Controls

To reduce reliance on chemical pesticides and promote environmentally friendly pest control, the Pest Management Plan (PMP) will prioritize the use and mainstreaming of biological control agents, botanicals, and bio-pesticides across SAPZ operations.

- **Promotion of Eco-Friendly Alternatives:** The PMP will actively encourage the adoption of biological control agents, plant-based formulations, and bio-pesticides as sustainable alternatives to synthetic chemicals. These approaches will help maintain ecological balance, protect pollinators, and safeguard human and environmental health.
- **On-Farm Multiplication Units:** Support will be provided for the establishment of on-farm multiplication and rearing units for beneficial organisms such as *Trichogramma spp.*, *Beauveria bassiana*, and other effective biological control agents. These local production units will ensure a steady supply of bio-inputs that are affordable and adapted to local pest dynamics.
- **Incentives for Adoption:** To encourage uptake among smallholder farmers and anchor firms, the PMP will introduce incentive mechanisms such as input subsidies, demonstration plots showcasing efficacy, and preferential procurement arrangements for bio-based pest control products.



- **Research and Technical Support:** Strategic partnerships will be strengthened with research and extension institutions—including the Institute for Agricultural Research (IAR), the National Agricultural Extension and Research Liaison Services (NAERLS), and the Nigerian Stored Products Research Institute (NSPRI)—to validate product efficacy, develop locally adapted bio-pesticide formulations, and provide continuous technical guidance and capacity-building for farmers and extension workers.

8 Post-Harvest Pest Management

Pest management interventions will extend beyond on-farm activities to encompass post-harvest handling, storage, and processing systems, ensuring comprehensive protection of agricultural produce across the entire value chain.

- **Post-Harvest and Storage Management:** The PMP will prioritize training programs for warehouse operators and agro-processors on pest identification, early detection, and hygiene management to prevent storage losses. Emphasis will be placed on proper handling, ventilation, and environmental control within storage facilities.
- **Adoption of Improved Technologies:** Modern hermetic storage solutions, cold-chain systems, and pest-proof storage infrastructure will be promoted to minimize pest infestations and maintain product quality. Regular fumigation and sanitation protocols will be enforced to eliminate stored-product pests and prevent contamination.
- **Institutional Collaboration:** Implementation of post-harvest pest management measures will be carried out in partnership with the Nigerian Stored Products Research Institute (NSPRI) and the Standards Organisation of Nigeria (SON). These institutions will provide technical support, quality assurance, and monitoring to ensure compliance with national food safety and storage standards.

9 Regulatory Coordination and Market Enforcement

An Inter-Agency Integrated Pest Management (IPM) Coordination Task Force will be established to strengthen institutional collaboration, regulatory oversight, and information sharing among key stakeholders involved in pest and pesticide management within the SAPZ.

- **Task Force Composition:** The Task Force will include representatives from the National Agency for Food and Drug Administration and Control (NAFDAC), the National Environmental Standards and Regulations Enforcement Agency (NESREA), the Federal Ministry of Agriculture and Food Security (FMAFS), the Nigeria Agricultural Quarantine Service (NAQS), and the Kaduna State Ministry of Agriculture and Rural Development (KAD-MARD).
- **Roles and Responsibilities:** The Task Force will be responsible for harmonizing inspection schedules, coordinating pest management oversight across agencies, sharing compliance and monitoring data, and jointly enforcing licensing regulations for pesticide dealers and distributors. This collaborative mechanism will improve efficiency, reduce duplication, and strengthen regulatory enforcement.
- **Transparency and Public Access:** To enhance public awareness and accountability, the Task Force will maintain and annually update a public registry of approved pesticides, indicating their active ingredients, toxicity classifications, and authorized distributors. This transparent system will deter the importation and use of unregistered or counterfeit pesticides, ensuring that only safe and approved products are used within the SAPZ.



10 Digital Monitoring and Farmer Advisory Tools

The SAPZ will harness digital innovation to enhance pest monitoring, reporting, and advisory services through the deployment of a mobile-based pest information and management system.

- **Mobile Pest Reporting and Advisory System:** A user-friendly digital platform will be developed to enable real-time pest reporting, rapid response, and continuous farmer support. The system will feature SMS-based pest alerts, enabling farmers to receive timely notifications about emerging pest threats and recommended control measures.
- **GIS-Based Pest Hotspot Mapping:** The platform will incorporate GIS technology to map pest hotspots across SAPZ clusters, providing spatial insights for targeted interventions, resource allocation, and trend analysis. This real-time mapping will enhance coordination among field teams, extension officers, and regulatory agencies.
- **Farmer Helpdesk and Support Services:** A dedicated farmer helpdesk will be integrated into the system to provide personalized guidance, troubleshooting, and expert advice on pest identification, safe pesticide use, and Integrated Pest Management (IPM) practices.
- **Integration with SAPZ M&E Dashboard:** The digital pest management system will be fully linked to the SAPZ Monitoring and Evaluation (M&E) dashboard, enabling evidence-based decision-making, data-driven planning, and rapid dissemination of early-warning information to all relevant stakeholders.

11.4 Institutional Coordination Mechanism

Implementation of this Plan will be led by the SAPZ Project Implementation Unit (PIU) under the Kaduna State Ministry of Agriculture. The PIU will coordinate with:

- **Federal Agencies:** NAFDAC, NESREA, FMARD/FMAFS, NAQS, and FMEnv for regulatory and technical oversight.
- **Research & Training Bodies:** NAERLS, IAR, KASU, and NSPRI for adaptive research, training, and validation.
- **Private Sector:** SAPZ anchor firms, processors, and agro-dealers for field implementation and compliance monitoring.
- **Local Governments and Community Associations:** For grassroots awareness and farmer mobilization.

A Pest and Chemical Management Committee (PCMC) will be constituted to guide inter-agency collaboration, review progress quarterly, and recommend corrective measures.

11.5 Monitoring, Evaluation, and Reporting

Monitoring and evaluation of pest management activities will be anchored on a Results-Based Management (RBM) framework aligned with the African Development Bank (AfDB) environmental and social safeguard reporting requirements. This approach will ensure that monitoring focuses on measurable outcomes, accountability, and continual improvement in Integrated Pest Management (IPM) performance.



- **Integration into the ESMS:** The SAPZ Monitoring and Evaluation (M&E) Unit will embed IPM-specific indicators into the broader Environmental and Social Management System (ESMS) to enable systematic tracking of environmental performance and compliance with AfDB standards.
- **Key Performance Indicators:** Progress will be measured using a set of core indicators, including:
 - Number of farmers and extension officers trained in IPM practices;
 - Percentage reduction in synthetic pesticide use across SAPZ clusters;
 - Number of pest surveillance and pesticide residue monitoring reports produced;
 - Number and type of bio-pesticide products registered and adopted;
 - Frequency, timeliness, and effectiveness of pest outbreak response actions.
- **Reporting Schedule:** Quarterly monitoring reports will be prepared by the SAPZ Project Implementation Unit (PIU) and submitted to the AfDB and the Federal Ministry of Environment (FMEnv). These reports will highlight implementation progress, compliance levels, and lessons learned.
- **Evaluation Framework:** Mid-term and final evaluations will be conducted to assess the overall effectiveness, institutional performance, and sustainability of the IPM system. The evaluations will also generate recommendations to strengthen pest management strategies and guide future interventions within the SAPZ program.

11.6 Budget Framework

The estimated total cost of implementing the Comprehensive IPM Plan is USD 2.63 million over a five-year period. Budget allocations will cover surveillance infrastructure, training, laboratory upgrades, digital systems, coordination, and contingency reserves. Funding sources will include:

- SAPZ project operational funds;
- AfDB safeguard implementation budget;
- Kaduna State and Federal agricultural development allocations; and
- Private-sector partnerships and donor contributions.

Annual budget planning will align with SAPZ work plans and undergo financial audit under the project's fiduciary framework.

11.7 Expected Outcomes

Successful implementation of the IPM Plan will deliver the following outcomes:

- **Enhanced Pest Surveillance and Early Warning Systems:** Strengthened capacity for real-time pest detection, monitoring, and early warning across all SAPZ clusters, enabling rapid response and minimizing crop losses.
- **Reduced Dependence on Chemical Pesticides:** Significant decline in synthetic pesticide use through the adoption of biological control agents, botanicals, and other eco-friendly pest management alternatives, promoting safer and more sustainable production systems.
- **Strengthened Regulatory Coordination and Compliance:** Improved institutional collaboration and enforcement among regulatory bodies, ensuring full compliance with



national regulations and AfDB safeguard standards for pest and pesticide management.

- **Improved Farmer Safety, Food Quality, and Environmental Health:** Enhanced occupational safety for farmers, better food quality assurance, and greater environmental protection through safer pesticide handling, storage, and disposal practices.
- **Institutionalized IPM Capacity:** Embedded and sustained Integrated Pest Management (IPM) capacity across research institutions, extension services, and private-sector partners, ensuring continuous innovation and knowledge transfer.

Collectively, these outcomes will drive sustainable agricultural intensification, enhance ecosystem resilience, and strengthen food security and livelihoods in Kaduna State and across Nigeria's agricultural transformation zones.



Table 11.1: Comprehensive Integrated Pest Management (IPM) Implementation Matrix

S/N	Strategy / Focus Area	Key Activities	Timeline	Key Performance Indicators (KPI)	Responsible Institutions	Expected Outcomes	Estimated Cost (USD)	Equivalent in NGN (₦1 = \$1,550)
1	Integrated Pest Management (IPM)	<ul style="list-style-type: none"> Establish IPM learning plots and conduct field demonstrations across SAPZ clusters. Distribute IPM kits (pheromone traps, neem-based biopesticides, PPE). Promote resistant crop varieties, crop rotation, and intercropping to minimize pest pressure. 	Year 1–3	<ul style="list-style-type: none"> 70% of SAPZ farmers adopting IPM by Year 3. 40% reduction in synthetic pesticide use. 	KAD-MANR, SAPZ-PIU, Kaduna ADP Extension Services, FMAF&S	Sustainable pest control practices and reduced chemical dependency at farm level.	\$23,000	₦35,650,000
2	Farm-to-Factory Biosecurity	<ul style="list-style-type: none"> Enforce sanitation and biosecurity protocols at farms, aggregation points, and processing centers. Install pest-proof barriers, screens, and traps in storage and transport facilities. 	Year 1–2	<ul style="list-style-type: none"> 100% of SAPZ warehouses sanitized quarterly. ≥90% pest-free certification in transport and logistics systems. 	SAPZ Logistics Unit, Agro-Processors, KEPA	Minimized pest spread and contamination along the entire value chain.	\$20,000	₦31,000,000



S/N	Strategy / Focus Area	Key Activities	Timeline	Key Performance Indicators (KPI)	Responsible Institutions	Expected Outcomes	Estimated Cost (USD)	Equivalent in NGN (₦1 = \$1,550)
		<ul style="list-style-type: none"> Conduct periodic fumigation, disinfection, and hygiene inspections. 						
3	Structural and Environmental Management	<ul style="list-style-type: none"> Construct rodent- and termite-proof warehouses and silos. Conduct periodic structural inspections of farm and processing infrastructure. Implement landscaping, drainage, and environmental sanitation standards. 	Year 1–3	<ul style="list-style-type: none"> 100% compliance in all new SAPZ facilities. 60% reduction in pest-related structural damage. 	KAD-MANR, SAPZ Infrastructure Unit, KEPA	Improved facility durability and environmental hygiene; reduced pest incidence.	\$26,000	₦40,300,000
4	Public Health Pest and Vector Control	<ul style="list-style-type: none"> Implement regular mosquito fogging and vector management programs. Conduct sanitation and hygiene awareness campaigns. 	Year 1–3	<ul style="list-style-type: none"> 80% reduction in vector breeding hotspots. Zero reported pesticide poisoning incidents. 	SAPZ Health, Safety & Environment (HSE) Unit, KEPA, Kaduna State Ministry of Health, LGAs	Improved public health and worker safety within SAPZ communities.	\$25,000	₦38,750,000



S/N	Strategy / Focus Area	Key Activities	Timeline	Key Performance Indicators (KPI)	Responsible Institutions	Expected Outcomes	Estimated Cost (USD)	Equivalent in NGN (₦1 = \$1,550)
		<ul style="list-style-type: none"> Operate mobile clinics for pesticide exposure and vector-borne disease surveillance. 						
5	Capacity Building and Farmer Training	<ul style="list-style-type: none"> Establish Farmer Field Schools (FFS) and IPM training centers. Conduct quarterly “Training of Trainers” (ToT) for extension agents and agro-dealers. Integrate gender and youth modules on safe pest management. 	Year 1–3 (Quarterly)	<ul style="list-style-type: none"> 1,000 farmers trained annually. 80 certified IPM facilitators by Year 2. 	KAD-MANR, NAERLS, SAPZ-PIU, NGOs	Strengthened farmer capacity and enhanced knowledge transfer in pest management.	\$33,000	₦51,150,000
6	Community Engagement and Partnerships	<ul style="list-style-type: none"> Engage traditional leaders and local councils in pest management awareness. Partner with research institutions (KASU, ABU Zaria, IAR) for innovation and adaptive research. 	Year 1–2	<ul style="list-style-type: none"> 50% of SAPZ host communities engaged in IPM outreach. 3 institutional MoUs signed for research and 	SAPZ-PIU, CSOs, Community Leaders, Youth Associations	Strengthened local ownership, innovation uptake, and social inclusion.	\$11,000	₦17,050,000



S/N	Strategy / Focus Area	Key Activities	Timeline	Key Performance Indicators (KPI)	Responsible Institutions	Expected Outcomes	Estimated Cost (USD)	Equivalent in NGN (₦1 = \$1,550)
		<ul style="list-style-type: none"> Develop pest alert systems through youth and CSO collaboration. 		<ul style="list-style-type: none"> innovation collaboration. 				
7	Environmental and Occupational Health (EHS)	<ul style="list-style-type: none"> Distribute PPE kits to pesticide handlers and applicators. Conduct training on pesticide storage, spill response, and emergency procedures. Establish pesticide container collection, return, and recycling systems. 	Year 1–2	<ul style="list-style-type: none"> 100% of pesticide users equipped with PPE. 70% of containers returned or safely recycled. 	NAFDAC, KEPA, SAPZ HSE Unit, Agro-Input Dealers	Reduced exposure risks, improved workplace safety, and sound waste management.	\$36,000	₦55,800,000
8	Digital Surveillance and Monitoring	<ul style="list-style-type: none"> Deploy mobile pest reporting and advisory platforms. Use GIS-based mapping for pest hotspot identification. Maintain digital pesticide usage and 	Year 2–3	<ul style="list-style-type: none"> 80% of clusters reporting via digital platform. Annual pest hotspot maps published. 	SAPZ ICT/MIS Unit, FMAF&S, AgriTech Partners	Data-driven pest management and enhanced decision-making capacity.	\$30,000	₦46,500,000



S/N	Strategy / Focus Area	Key Activities	Timeline	Key Performance Indicators (KPI)	Responsible Institutions	Expected Outcomes	Estimated Cost (USD)	Equivalent in NGN (₦1 = \$1,550)
		residue monitoring database.						
9	Legal Compliance and Policy Enforcement	<ul style="list-style-type: none"> Conduct annual compliance and regulatory audits. Register and license all agrochemical dealers within SAPZ Align SAPZ PMP practices with national pest management policy and AfDB ISS (2023). 	Year 1–3 (Annual)	<ul style="list-style-type: none"> 100% licensed agrochemical dealers. Annual compliance and performance scorecard published. 	NAFDAC, NESREA, KEPA, KAD-MANR, SAPZ Legal Compliance Team	Strengthened governance, transparency, and environmental compliance.	\$20,000	₦31,000,000
10	Adaptive Management and Innovation	<ul style="list-style-type: none"> Conduct annual reviews of the Pest Management Plan (PMP). Pilot innovations such as AI-based pest detection, drones for scouting, and new bio-pesticides. Document, evaluate, and scale successful approaches. 	Year 2–3 (Annual Review)	<ul style="list-style-type: none"> PMP updated annually. 3 innovation pilots successfully implemented. 	SAPZ-PIU, Research & Innovation Hubs, IAR, NAERLS	Adaptive, learning-based PMP integrated with innovation and continuous improvement.	\$23,000	₦35,650,000



Total Estimated Cost

- **In USD:** \$247,000
- **In NGN:** ₦382,850,000



CHAPTER TWELVE: IPMP IMPLEMENTATION AND MANAGEMENT

12.0 Introduction

The fundamental areas essential to the successful implementation of this IPMP are:

- Measures that ensure that banned pesticides are not procured for the project.
- Training & Capacity Development - Measures that will ensure capacity building among stakeholders that will implement the IPMP
- Institutional Arrangements
- Monitoring Measures to ensure that POPs pesticides and WHO class I and II pesticides considered to be extremely/highly and moderately hazardous respectively are not procured and/or used;
- Stakeholder Participation measures that will ensure that farmers get the relevant technical aids and education on the implementation of safe and alternative pest control measures rather than the use of chemicals.

12.1 IPM Recommendations for Implementation

The following recommendations shall guide the implementation of the IPM:

1. Capacity development and training for key project personnel such as environmental & Social Framework specialist, monitoring team & also 'for SAPZ project beneficiaries that will be involved in agricultural activities in the following key areas:
 - Environmental Assessment & basic concept of Environment
 - Environmental Regulations and Statutory requirements with focus on Government and AfDB
 - Introduction to Environmental & Social Environmental & Social Framework
 - Occupational Health and Safety (OHS) and importance of Personal Protective Equipment
 - Train on the biological and cultural pest control options and prohibition of use of Bank funds to procure unacceptable pesticides and why.
 - Developing Safe Practices in the Management & Handling of Chemical Pesticides (Transportation, storage, handling, storage of empty pesticide containers
 - Patterns of functional pest surveillance & early warning systems
 - IPM Implementation and Monitoring (with field exercises) to enable the beneficiaries have a proper hands-on knowledge of best practice pest control methods that do not involve use of chemicals.

It is also vital that this training communicates measures to ensure that unacceptable pesticides are not procured with the Bank's funds, which will be verified by the environmental safeguard's specialist at the State level.

2. Ensure provision of PPE by purchase of special protective clothing for pesticide use & handling - hand gloves, gas mask, safety boot and coverall.
3. The SAPZ-PIU shall ensure proper Compliance Monitoring of IPMP requirements according to the IPMP monitoring plan.

Carry out the disclosure of Copies of this IPMP, like other Environmental & Social Framework



instruments to enable stakeholders review and make inputs, where necessary.

12.2 Measures for Ensuring harmful pesticides are not procured

For this IPM to be effective, measures to ensure that unacceptable pesticides are not procured with Bank's fund will be verified by the environmental safeguard's specialist at the State level. The environmental specialists at the SAPZ-PIU will screen the pesticides procurement list prior to procurement and ensure that only pesticides that are acceptable and approved by the Bank/WHO/NAFDAC are procured. The outcome of the screening will be sent to the AfDB for concurrence.

Other measures for the overall success of IPM are:

- SAPZ-PIU will consider subsidizing IPM products to the target beneficiaries in order to discourage the use of chemical and harmful pesticides. If the alternative to chemical control to pest is available and cost effective the tendency to use chemicals will be minimized, and that way, the proliferation of WHO Class 1 and Class 11 pesticides would have been avoided.
- There will be adequate an awareness program to educate farmers and stakeholders including sellers, users and farm workers on the adverse impact/risk associated with the use of certain chemicals. Names and chemical classes of banned chemicals will be brought to the attention of project beneficiaries through various awareness programs. Also, farmers will be educated on the types and classes of pesticides that are approved for use. Annexes 1-3 presents a list of pesticides based on their classification by World Health Organization (WHO).
- The SAPZ-PIU will ensure that the IPM options (materials, species, equipment, etc.) are distributed to beneficiaries early enough for timely implementation, There will be engagement of advisors (extension workers, etc.) to assist farmers with technical know-how of the IPM in the formative years of operation;

12.3 Institutional arrangements and framework for implementation

The successful implementation of this Pest Management Plan (PMP) depends on the effective collaboration and coordination among multiple institutions operating at federal, state, and project levels. As the PMP forms an integral component of the overall Environmental and Social Management Framework (ESMF) for the Kaduna SAPZ, it requires shared responsibility, technical input, and oversight from the following key actors:

1. **SAPZ Project Implementation Unit (SAPZ-PIU)**
 - **Lead implementing entity** for the PMP.
 - Coordinates all pest management, monitoring, reporting, and capacity-building activities within the SAPZ.
 - Ensures that pest management practices at the Anchor Investment Hub (AIH) and Agri-Transformation Centers (ATCs) comply with **AfDB Operational Safeguard 3, FAO/WHO guidelines**, and national pesticide regulations.
 - Integrates PMP activities into annual work plans and budgets.



- Submits progress and compliance reports to the African Development Bank and Kaduna State Government.
- 2. **Kaduna State Ministry of Agriculture and Rural Development (KAD-MARD)**
 - Provides **technical oversight** on crop protection, phytosanitary issues, and pest control operations.
 - Coordinates with the State Agricultural Development Program (ADP) to deploy extension officers for IPM training, farmer sensitization, and field-level monitoring.
 - Facilitates alignment with state agricultural policy and ensures linkages with local government agricultural departments.
- 3. **Kaduna Environmental Protection Authority (KEPA)**
 - Ensures environmental compliance of pest management activities, especially in waste disposal, water quality, and pesticide storage.
 - Participates in inspection, environmental monitoring, and enforcement of pollution control standards.
 - Works with SAPZ-HSE teams to verify safe pesticide handling, disposal, and container management.
- 4. **National Agency for Food and Drug Administration and Control (NAFDAC)**
 - **Regulatory authority for phytopharmaceuticals** in Nigeria.
 - Responsible for pesticide registration, labeling, quality assurance, and control of imports and distribution.
 - Supports the SAPZ through training, product verification, and periodic market surveillance to prevent the circulation of counterfeit or banned products.
 - Provides guidance on compliance with the **FAO/WHO International Code of Conduct on Pesticide Management**.
- 5. **National Environmental Standards and Regulations Enforcement Agency (NESREA)**
 - Monitors compliance with national environmental regulations and standards for hazardous chemicals and waste management.
 - Collaborates with KEPA and SAPZ-PIU in conducting joint inspections and enforcing environmental provisions under the ESMF.
 - Provides technical guidance on pollution prevention and residue management.
- 6. **Nigeria Agricultural Quarantine Service (NAQS)**
 - Oversees **phytosanitary control**, pest surveillance, and prevention of trans boundary pest movement through import/export inspection.
 - Supports early detection and containment of pest outbreaks within SAPZ clusters.
- 7. **National Agricultural Extension and Research Liaison Services (NAERLS) and Institute for Agricultural Research (IAR), Zaria**
 - Serve as **technical and research backstopping institutions** for Integrated Pest Management (IPM) and biological control research.
 - Support development of IPM packages, conduct field demonstrations, and train extension officers and farmers.



- Collaborate with SAPZ-PIU in pest identification, life-cycle studies, and IPM curriculum design.
- 8. Kaduna State Agricultural Development Program (ADP)**
 - Deploys **extension officers** to train farmers and monitor adoption of IPM practices across SAPZ clusters.
 - Serves as the link between the project and farming communities, ensuring timely delivery of technical messages and data feedback.
- 9. Local Government Councils**
 - Facilitate community mobilization and farmer sensitization at grassroots level.
 - Support monitoring of pesticide use and field sanitation in local SAPZ clusters.
 - Liaise with traditional leaders, community-based organizations, and cooperatives to promote IPM adoption.
- 10. Private Sector and Agro-Input Dealers**
 - Responsible for the **safe distribution, storage, and sale** of registered pesticides and bio-control agents.
 - Expected to comply with NAFDAC and SAPZ-approved product lists.
 - Participate in dealer training, record keeping, and container return programs under the PMP.
- 11. Farmers' Cooperatives and Producer Associations**
 - Primary beneficiaries and frontline implementers of IPM practices.
 - Participate in **farmer field schools**, pest monitoring, and feedback mechanisms.
 - Maintain farm-level records on pesticide use, storage, and disposal.
- 12. Academic and Research Institutions (KASU, ABU, KADA, etc.)**
 - Provide technical research support for testing and validating bio-pesticides and nature-based solutions.
 - Contribute to environmental impact studies, laboratory testing, and pest management innovation.
- 13. Non-Governmental Organizations (NGOs) and Civil Society Organizations (CSOs)**
 - Support public awareness campaigns on pesticide safety, environmental protection, and health education.
 - Facilitate inclusion of women and youth in IPM capacity-building programs.
- 14. African Development Bank (AfDB)**
 - Provides technical oversight and ensures compliance with its **Integrated Safeguard System (ISS)**, particularly **Operational Safeguards 1, 3, and 4**.
 - Reviews implementation progress and disbursements related to environmental and social management, including PMP activities.

12.4 Monitoring and Evaluation

The objectives of monitoring and evaluation for the IPMP are as follows:

- Providing timely information about the compliance with or otherwise, of the SAPZ IPM operation process outlined in this report. This will ensure continuous improvement in the project areas



- To make a final evaluation in order to determine whether the mitigation measures incorporated in the IPMP have been successful.

The monitoring requirements for the environmental and health impacts of the pesticide's management activities are articulated under this management component. Monitoring and evaluation of the agricultural support IPMP will be mainstreamed into the overall monitoring and evaluation system for the project's ESMF. The key issues to be considered in the monitoring process are whether a pesticides procurement checklist is available and used during procurement and screening to:

- Ensure that POPs pesticides and WHO class (1a) and (1b) pesticides are not procured or used.

12.5 Participation/Consultation

The SAPZ-PIU will be largely responsible for ensuring participation of the relevant stakeholders/community at sub-project level. Involvement of the stakeholders/community should not be limited to interactions with the community but also disclosing relevant information pertaining to the project tasks.



CHAPTER THIRTEEN: ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

13.0 Environmental and Social Considerations in PMP Implementation

The implementation of the Pest Management Plan (PMP) for the Kaduna State SAPZ recognizes the complex interconnections between pest management activities, environmental health, human wellbeing, and socio-economic dynamics. While Integrated Pest Management (IPM) offers environmentally-friendly and sustainable pest control alternatives, if poorly implemented, pest control activities can pose serious environmental, social, and public health risks.

This section of the report outlines key considerations, potential environmental and social risks, and appropriate mitigation measures to ensure the PMP contributes to safe, inclusive, and sustainable agro-industrial development in Kaduna State.

13.1 Environmental Considerations

Environmental protection is a critical pillar of the Pest Management Plan (PMP) for the Kaduna SAPZ. Pest control activities—particularly those involving synthetic chemical inputs—can have far-reaching and often unintended consequences on ecosystems, biodiversity, soil and water quality, and climate resilience. Thus, environmental considerations must be integrated into all stages of PMP implementation, from planning and procurement to field application, monitoring, and evaluation.

1 Key Environmental Risks and Challenges

a. Pollution of Soil and Water Resources

- Leaching and Runoff: Inappropriate pesticide application, overuse, or heavy rainfall shortly after spraying may cause chemicals to enter groundwater or surface water bodies.
- Storage and Disposal Issues: Poor handling and disposal of pesticide containers and expired products can contaminate the environment.

b. Loss of Biodiversity

Pesticides, especially non-selective ones, can harm non-target species including:

- Pollinators (e.g., bees, butterflies)
- Natural predators (e.g., lady beetles, parasitoid wasps)
- Aquatic organisms (e.g., fish, amphibians)
- Declines in these beneficial species can disrupt ecological balance and increase dependence on chemical controls.

c. Soil Health Degradation

Continuous chemical pesticide use may:

- Reduce soil microbial diversity
- Alter soil nutrient cycles
- Increase pest resistance and pesticide residues in the soil



d. Air Quality and Climate Risks

- Improper aerial spraying or open burning of packaging materials may contribute to air pollution and greenhouse gas emissions.

e. Pest Resistance and Ecological Imbalance

Repeated and unregulated pesticide use can lead to:

- Resistance development in pest populations
- Outbreaks of secondary pests due to suppression of natural enemies

2 Mitigation Measures

a. Promotion of Integrated Pest Management (IPM)

- Use a combination of biological, cultural, mechanical, and chemical methods.
- Prioritize preventive approaches such as resistant varieties, crop rotation, and sanitation.

b. Preference for Low-Risk Inputs

Promote the use of:

- Bio-pesticides and botanical extracts (e.g., neem, pyrethrins)
- Bio-control agents (e.g., Trichogramma, Bacillus thuringiensis)
- Pheromone and light traps to reduce reliance on chemicals
- Restrict procurement to pesticides approved by NAFDAC, WHO Class II or lower.

c. Safe Pesticide Application and Handling

Train farmers and applicators on:

- Correct dosage, timing, and methods
- Use of Personal Protective Equipment (PPE)
- Spray buffer zones around water bodies and sensitive habitats
- Avoid spraying during high wind speeds or near bee-foraging times.

d. Environmental Risk Assessments and Site Planning

- Conduct Environmental Impact Assessments (EIA) for SAPZ infrastructure and storage sites.
- Identify and protect environmentally sensitive areas (e.g., rivers, wetlands, forests).

e. Waste Management and Pollution Control

- Promote recycling or safe collection of empty pesticide containers
- Prohibit open burning or burial of hazardous chemical containers.
- Facilitate community-level pesticide disposal programs in collaboration with NAFDAC and NESREA.

f. Promotion of Agro-ecological Practices



Encourage:

- Intercropping and trap cropping
- Cover crops and mulching
- Use of compost and organic fertilizers to improve soil health
- Protect beneficial organisms through non-chemical conservation strategies.

g. Environmental Monitoring and Reporting

Indicators will be tracked under the PMP's Monitoring and Evaluation framework including:

- Water and soil quality (pesticide residue testing)
- Biodiversity observations (pollinator counts, natural enemy activity)
- Volume and type of pesticides used
- Percentage of area under IPM or bio-control practices

Monitoring Tools and Methods:

- Farmer Field Diaries
- Environmental checklists and audits
- Satellite imagery or drone assessments (for large-scale SAPZ plots)

h. Alignment with Environmental Regulations and Policies

The PMP implementation shall conform to the following:

National Guidelines:

- FMEV Environmental Impact Assessment Act (Cap E12 LFN 2004)
- NAFDAC Pesticide Registration and Control Regulations
- NESREA Environmental Quality Standards

International Environmental Standards:

- World Bank ESS3 & ESS6 (Resource Efficiency & Biodiversity Conservation)
- FAO Code of Conduct on Pesticide Management
- IFAD Social, Environmental and Climate Assessment Procedures (SECAP)

i. Capacity Building for Environmental Compliance

To ensure the integration of environmental safeguards:

- Provide targeted training for SAPZ PMU staff, extension agents, agro-dealers, and farmers.
- Develop environmental risk management manuals and SOPs for all actors.
- Engage local environmental officers and NGOs in community awareness and monitoring.

j. Sustainability Measures

- Mainstream environmental indicators into the PMP Annual Work Plan and Budget.
- Encourage public-private partnerships for innovation in ecological pest management.
- Institutionalize Environmental and Social Compliance Units within SAPZ management structures.



13.2 Social Considerations

Effective pest management does not only involve technical and environmental concerns; it must also address the social dynamics and human dimensions of agricultural production. The PMP for the Kaduna SAPZ recognizes that interventions related to pest control — especially those involving chemicals — can have direct and indirect impacts on farmers, laborers, women, youth, vulnerable groups, and local communities.

Social considerations aim to ensure that pest management activities are equitable, inclusive, culturally appropriate, and protective of human health and rights, while also fostering local participation, knowledge transfer, and community resilience.

13.2.1 Key Social Risks and Issues

a. Occupational Health and Safety Risks

- Direct exposure to pesticides can cause acute or chronic health problems (skin irritation, respiratory issues, and reproductive health risks).
- Many smallholder farmers lack protective equipment (PPE) and proper training on safe handling.
- Children and women often help in spraying, weeding, or harvesting, increasing exposure risks.

b. Public Health Concerns

- Improper pesticide use and disposal can lead to chemical contamination of food and water consumed by rural communities.
- Weak enforcement of maximum residue limits (MRLs) may expose the public to long-term health risks.
- Communities living near SAPZ clusters may be affected by airborne or waterborne pesticide drift.

c. Inequity and Exclusion

Small-scale, female-headed, and resource-poor farmers often lack access to:

- Training on IPM
- Safer alternatives to chemical pesticides
- Inputs like bio-control agents or PPE
- Language, literacy, and cultural barriers can limit participation in extension services.

d. Loss of Traditional Knowledge

- Over-reliance on synthetic pesticides may displace indigenous knowledge of natural pest control, such as use of ash, herbs, or intercropping.
- Generational gaps and top-down interventions may weaken local pest surveillance traditions.

e. Social Resistance and Acceptance

- Communities may resist certain pest control approaches (e.g., GMOs, synthetic pesticides, or aerial spraying) due to fears, misinformation, or religious/cultural beliefs.
- Inadequate community engagement and transparency may cause distrust.



13.2.2 Mitigation and Social Inclusion Strategies

a. Promote Safe Pesticide Handling and Occupational Health

- Provide extensive training on safe pesticide use targeting farmers, youth, and laborers.
- Distribute or subsidize PPE kits (gloves, masks, boots, overalls).
- Monitor and track health records and incidents of pesticide-related illnesses in collaboration with health institutions.
- Support mobile health outreach in SAPZ communities.

b. Community Health and Environmental Safety

- Establish buffer zones between agricultural fields and residential areas.
- Regularly test water and food for pesticide residues and make results publicly available.
- Promote non-chemical and low-toxicity alternatives especially in areas near schools, markets, or homes.

c. Gender Equity and Empowerment

- Ensure gender-inclusive training sessions, with flexible schedules and women-friendly venues.
- Recruit female extension agents to promote peer learning and trust.
- Support women's cooperatives to access bio-control products, IPM technologies, and markets.
- Address the invisible labor of women in pest control and encourage shared decision-making.

d. Inclusion of Youth and Vulnerable Groups

- Design youth-focused agribusiness programs in eco-friendly pest management (e.g., bio-pesticide production, trap fabrication).
- Provide affordable IPM kits and inputs to low-income farmers through credit, grants, or input-voucher schemes.
- Tailor communication materials to non-literate audiences using visuals, radio jingles, and local languages.

e. Strengthen Community Engagement and Participation

- Use participatory rural appraisal (PRA) tools to identify community pest management needs and perceptions.
- Involve traditional leaders, farmer groups, women's associations, and youth clubs in pest surveillance committees.
- Establish community feedback and grievance mechanisms to handle concerns related to pest control practices.

f. Protect and Integrate Local Knowledge

- Document and validate indigenous pest control methods (e.g., use of neem, pepper, ash, or medicinal plants).
- Promote blending of local knowledge with modern IPM strategies through demonstration plots.
- Encourage community-led research and trials.

g. Social Impact Monitoring and Indicators



- The following indicators will be tracked as part of the PMP’s monitoring and evaluation (M&E) framework:

Table 13.1: Social Impact Monitoring Indicators

Indicator	Frequency	Responsible Entity
% of farmers trained on safe pesticide handling	Quarterly	SAPZ PIU, Extension Services
% of female and youth participation in PMP activities	Quarterly	SAPZ PIU, NGOs
Reported cases of pesticide-related illness or accidents	Monthly	Health Services, SAPZ M&E
% of smallholder farmers accessing bio-pesticides or PPE	Bi-annually	SAPZ PIU, Agro-dealers
Number of community complaints on pest control issues	Quarterly	SAPZ PIU
Number of indigenous practices integrated into IPM training	Annually	Research institute, SAPZ PIU

h. Alignment with National and International Social Safeguards

The PMP aligns with:

- World Bank Environmental and Social Standard 4 (ESS4): Community Health and Safety
- AfDB Integrated Safeguards (OS1 and OS5)
- FAO’s Guidelines on Pesticide Management and Labor Conditions
- Nigeria’s Occupational Safety and Health (OSH) Standards
- National Gender Policy and Agricultural Sector Gender Policy

i. Sustainability Measures

- Institutionalize social inclusion and health protection units within the SAPZ PMU.
- Develop a Social Safeguards Implementation Plan (SSIP) with timelines, targets, and responsibilities.
- Leverage public-private partnerships to improve social infrastructure (e.g., rural clinics, safe storage centers).

Support long-term investments in education, farmer cooperatives, and community resilience.

13.3 Impacts on Non-target Species and Ecosystems

1 Key Risks

- Impact on Pollinators:** Systemic and contact insecticides can adversely affect key pollinators such as bees, butterflies, and other nectar-feeding insects, leading to reduced



pollination efficiency and lower crop yields.

- **Harm to Beneficial Insects:** Predatory and parasitic insects—including lady beetles, lacewings, and Trichogramma species—that naturally regulate pest populations may be unintentionally harmed, disrupting the ecological balance.
- **Aquatic and Amphibian Toxicity:** Runoff and leaching of pesticides into nearby water bodies can cause acute and chronic toxicity to fish, amphibians, and aquatic invertebrates, compromising freshwater ecosystem health.
- **Soil Biodiversity Decline:** Repeated pesticide applications can negatively alter soil microbial diversity and beneficial fauna such as earthworms, reducing soil fertility, nutrient cycling, and overall ecosystem resilience.

2 Mitigation Strategies

- **Adopt Selective and Targeted Pesticide Use:** Prioritize the use of selective, low-toxicity, and target-specific pesticides instead of broad-spectrum chemicals to minimize harm to non-target organisms and beneficial species.
- **Promote Habitat Conservation:** Establish and maintain flowering strips, hedgerows, and refuge zones within and around farms to provide forage, nesting sites, and shelter for pollinators and natural enemies.
- **Monitor Beneficial Species:** Implement regular ecological monitoring in IPM demonstration fields to track populations of pollinators, predators, and parasitoids, ensuring that pest management interventions remain ecologically balanced.
- **Plan Pesticide Use Seasonally:** Develop and enforce seasonal pesticide application schedules to avoid spraying during peak pollination periods and to safeguard pollinator activity and ecosystem services.

13.4 Gender and Vulnerable Groups Considerations

1 Issues Identified

- **Gender-Specific Exposure Risks:** Women are frequently exposed to pesticides during routine agricultural activities such as weeding, harvesting, and post-harvest storage. However, they often lack access to adequate training, protective equipment (PPE), and decision-making opportunities in pest management programs.
- **Youth and Vulnerable Farmer Constraints:** Young and marginalized farmers commonly face limited access to safe agricultural inputs, IPM technologies, and financial support, constraining their ability to adopt environmentally sound pest control practices.
- **Socio-Cultural and Literacy Barriers:** Cultural norms, language differences, and low literacy levels can prevent effective participation of women, youth, and vulnerable groups in extension and capacity-building initiatives, thereby limiting inclusivity and knowledge transfer within the farming community.

2 Proposed Actions

- **Develop Gender-Responsive IPM Training Programs:** Design and implement



inclusive IPM training modules that address the unique roles and exposure risks of women in agriculture. Where culturally appropriate, organize women-only learning groups to foster confidence, participation, and peer learning.

- **Empower Female Extension Agents:** Recruit and train female extension officers to lead community outreach and capacity-building initiatives, ensuring better engagement with women farmers and promoting gender-sensitive communication.
- **Enhance Access to Affordable IPM Tools:** Facilitate the provision of low-cost, eco-friendly pest management tools—such as pheromone traps, neem-based bio-pesticides, and protective gear—to women, youth, and other vulnerable farmers to encourage safe and sustainable adoption.
- **Promote Inclusive Communication Strategies:** Develop illustrated, audio-visual, and non-text-based information, education, and communication (IEC) materials tailored for farmers with limited literacy, ensuring accessibility and comprehension across all social groups.
- **Strengthen Participatory Decision-Making:** Ensure active inclusion of women, youth, and marginalized groups in pest surveillance committees, farmers' associations, and IPM planning platforms to promote shared ownership, transparency, and equitable decision-making.



CHAPTER FOURTEEN: MONITORING AND EVALUATION (M&E) PLAN

14.0 Monitoring and Evaluation (M&E) Plan

A well-structured Monitoring and Evaluation (M&E) plan is essential for tracking the progress, effectiveness, and sustainability of Integrated Pest Management (IPM) strategies within the Kaduna State Special Agro-Industrial Processing Zone (SAPZ). The performance indicators will help stakeholders—including government agencies, donor institutions, farmers, and private sector actors—assess the impact of IPM implementation, identify gaps, and inform decision-making for continuous improvement.

14.1 Key Performance Indicator Categories

This section outlines the key performance indicators across input, output, outcome, and impact levels to track progress, effectiveness, and sustainability of IPM implementation

1 Input Indicators

These measures the resources, efforts, and fundamental activities committed to the implementation of IPM strategies. These indicators answer the question “what are we putting into the system”

Purpose for setting out the input indicators is mainly to assess whether the necessary prerequisites (funding, training, personnel, infrastructure, and policy support) are being mobilized effectively.



Table 14.1: IPM Monitoring and Performance Indicators

Indicator	Definition / Description	Target	Frequency	Responsible Institutions
1. Number of IPM Training Sessions Conducted	Total number of IPM training sessions delivered to farmers, extension agents, and agro-dealers across SAPZ clusters.	≥10 sessions per year	Quarterly	SAPZ-PIU, KAD-MANR, NGOs
2. Number of Trained IPM Facilitators	Number of extension agents, lead farmers, and agro-dealers trained and certified to deliver IPM practices.	≥50 facilitators per year	Annually	FMAF&S, KAD-MANR, NGOs
3. Farmers Trained in IPM Practices	Total number of farmers (disaggregated by gender and age) trained on IPM techniques and safe pesticide use.	≥1,000 farmers per year	Quarterly	SAPZ-PIU, KAD-MANR, FMAF&S
4. Percentage of Farmers Adopting IPM Practices	Proportion of trained farmers who adopt at least one IPM technique (biological, cultural, or mechanical control).	≥60% by Year 3	Annually	SAPZ-PIU, ADP Extension Services
5. Reduction in Synthetic Pesticide Use	Percentage decrease in the volume or frequency of synthetic pesticide use among SAPZ farmers.	≥40% reduction by Year 3	Annually	SAPZ-PIU, KEPA, NAFDAC
6. Budget Allocated for IPM Interventions	Share of the total pest management budget dedicated specifically to IPM programs, training, and research.	≥30% of total PMP budget	Annually	SAPZ-PIU, AfDB, Kaduna State Government
7. Number of Bio-Pesticide Products Registered and Used	Number of registered and approved bio-pesticide products promoted and used within SAPZ clusters.	≥5 products by Year 3	Annually	NAFDAC, FMAF&S, Research Institutes
8. Number of Pest Surveillance Reports Produced	Total number of pest surveillance and monitoring reports generated using digital or field-based tools.	≥4 per year	Quarterly	SAPZ ICT/MIS Unit, FMAF&S
9. Pesticide Residue Monitoring	Frequency and results of pesticide residue	≥2 residue tests per	Bi-	KEPA, NAFDAC,



Indicator	Definition / Description	Target	Frequency	Responsible Institutions
Results	monitoring in crops and water bodies around SAPZ clusters.	year	annually	SAPZ HSE Unit
10. Number of PPE Kits Distributed to Farmers	Quantity of Personal Protective Equipment (PPE) distributed to farmers, spray operators, and agro-dealers.	≥500 PPE kits distributed annually	Annually	SAPZ-PIU, Agro-Input Dealers
11. Participation of Women and Youth in IPM Programs	Percentage of total participants in IPM activities who are women or youth.	≥40% women, ≥30% youth	Annually	SAPZ Gender Desk, KAD-MANR, NGOs
12. Number of Awareness and Outreach Campaigns Conducted	Community sensitization and outreach events on pest management, pollinator protection, and safe pesticide use.	≥6 campaigns per year	Quarterly	SAPZ-PIU, CSOs, Community Leaders
13. Incidence of Pest Outbreaks in SAPZ Clusters	Number and frequency of significant pest outbreaks recorded and managed within SAPZ operational zones.	≤2 outbreaks per year	Quarterly	FMAF&S, SAPZ-PIU, NAQS
14. Number of IPM Research Collaborations Established	Number of formal collaborations (MoUs) with research institutions (IAR, NAERLS, ABU, KASU) for IPM innovation.	≥3 MoUs by Year 3	Annually	SAPZ-PIU, R&D Institutions
15. Farmer Satisfaction Level with IPM Support	Level of farmer satisfaction with IPM training, support, and results (measured via survey).	≥80% satisfaction rate	Annually	SAPZ M&E Unit, NGOs
16. Compliance with AfDB Safeguard and National EHS Standards	Level of adherence to AfDB OSS, NAFDAC, NESREA, and KEPA standards in pest management practices.	100% compliance annually	Annually	SAPZ-PIU, AfDB, KEPA, NESREA

Notes: All indicators should be sex- and age-disaggregated where applicable



- Monitoring data should feed into the SAPZ Environmental and Social Management System (ESMS) and quarterly AfDB progress reports.
- Annual evaluations should assess effectiveness, sustainability, and gender equity outcomes.

2 Output Indicators

These measure the immediate results of inputs and activities. These indicators answer the question “what have we delivered”

Purpose for setting out the output indicators is mainly to assess whether the activities (training, sensitization, supply chain adjustments, trials) are achieving their intended short-term deliverables.

Table 14.2 IPM Adoption and Input Availability Indicators

Indicator	Definition / Description	Target	Frequency	Responsible Institutions
Number of Farmers Adopting at Least One IPM Technique	Percentage of beneficiary farmers applying at least one IPM practice such as trap cropping, biological control, or use of pest-resistant varieties.	≥60% of total beneficiary farmers	Bi-annually	SAPZ M&E Unit, ADP Extension Services
Number of IPM Demonstration Plots Established	Demonstration fields established across Local Government Areas (LGAs) to showcase and promote IPM best practices.	≥15 demonstration plots across SAPZ LGAs	Bi-annually	KAD-MANR, SAPZ-PIU
Availability of Bio-Pesticides and Safer Chemical Alternatives	Proportion of agro-dealer outlets within SAPZ clusters stocking approved bio-pesticides and low-toxicity chemical alternatives.	≥75% of agro-dealer outlets stocked	Quarterly	NAFDAC, NAQS, Private Sector Partners

3 Outcome Indicators



These indicators evaluate behavioral and systemic changes resulting from the outputs. They answer the question “what change is occurring as a result of the outputs”

Purpose of these indicators is to assess whether stakeholders are adopting safer and more sustainable pest management practices and whether the environment is improving as a result.

Table 14.3 IPM Adoption and Input Availability Indicators

Indicator	Definition / Description	Target	Frequency	Responsible Institutions
Number of Farmers Adopting at Least One IPM Technique	Proportion of beneficiary farmers implementing at least one Integrated Pest Management (IPM) practice, such as trap cropping, biological control, or use of resistant crop varieties.	≥60% of total beneficiary farmers	Bi-annually	Extension Services, SAPZ M&E Unit
Number of IPM Demonstration Plots Established	Number of demonstration fields established across Local Government Areas (LGAs) to showcase and promote IPM technologies and best practices.	≥15 demonstration plots across SAPZ LGAs	Bi-annually	KAD-MANR, SAPZ-PIU
Availability of Bio-Pesticides and Safer Chemical Alternatives	Proportion of agro-dealer outlets within SAPZ clusters that stock approved bio-pesticides and low-toxicity chemical alternatives for pest management.	≥75% of agro-dealer outlets adequately stocked	Quarterly	NAFDAC, NAQS, Private Sector Partners

4 Impact Indicators

These indicators measure long-term and high-level changes in social, economic, and environmental conditions. They answer the question “what is the overall effect of our IPM efforts?”

The purpose is to determine whether IPM implementation is contributing to sustainable development goals such as food security, environmental health, and improved livelihoods.

Impact indicators are also essential for reporting to funders, government bodies, and international partners on the strategic success of the IPM intervention.



Table 14.4: Socioeconomic and Environmental Impact Indicators

Indicator	Definition / Description	Target	Frequency	Responsible Institutions
Improvement in Farmer Income	Percentage increase in farmers' net income attributable to improved pest management practices and reduced crop losses.	≥25% increase in average farmer income	Every 2 years	SAPZ M&E Unit, NGOs, Farmer Associations
Reduction in Pesticide-Related Health Incidents	Percentage reduction in reported human or animal health cases linked to pesticide exposure within SAPZ communities.	≥50% reduction in pesticide-related incidents	Every 2 years	Kaduna State Ministry of Health, NAFDAC
Biodiversity Index in Agro-Ecosystems	Measured diversity and abundance of beneficial organisms (e.g., pollinators, predators, decomposers) in IPM-managed fields compared to baseline.	Demonstrated improvement over baseline values	Every 2 years	Research Institutes, SAPZ Environmental & Social Safeguards Unit

14.2 Monitoring Tools and Methods

Monitoring tools and methods are essential to ensure timely, accurate, and evidence-based tracking of IPM implementation progress. The following tools and methods will be used to generate both quantitative and qualitative data from the field and institutional levels.

Table 14.5: Monitoring and Evaluation Tools for PMP Implementation

Tool	Purpose	Methodology
Farmer Field Surveys	To collect field-level data on IPM adoption, pest infestation levels, pesticide use patterns, and farmer practices.	Structured questionnaires administered through mobile data collection tools (e.g., KoboToolbox, ODK).
Field Observation Checklists	To monitor demonstration plots, crop conditions, pest population levels, and the effectiveness of control measures.	Regular field inspections using standardized checklists and visual scoring methods.
Pest Surveillance Reports	To track pest outbreak trends, identify hotspots, and inform early-warning systems.	Use of pheromone and light traps, remote sensing data, and farmer alert systems.
Agro-Dealer	To assess the availability and	Retail outlet surveys, inventory



Tool	Purpose	Methodology
Stock Audits	distribution of bio-rational and low-toxicity pest control products in local markets.	reviews, and supply chain audits.
Health Clinic Data	To monitor and document pesticide exposure and poisoning cases among farmers and agricultural workers.	Review and analysis of hospital and clinic records on pesticide-related health incidents.
GIS and Remote Sensing	To spatially map IPM adoption areas, pest dynamics, and ecological changes within SAPZ clusters.	Use of geospatial tools such as satellite imagery, UAV (drone) mapping, and GIS analytics.

14.3 Reporting Structure and Frequency

A structured reporting system ensures timely communication of results, progress, gaps, and corrective actions to all stakeholders. The reporting structure for the IPM strategies in Kaduna SAPZ is organized as follows:

Table 14.6: Reporting Framework for PMP Implementation

Report Type	Content / Description	Frequency	Submitted To
Monthly Progress Reports	Summarize key input and output indicators, implementation progress, field activities, and emerging issues related to pest management.	Monthly	SAPZ Project Steering Committee, AfDB
Annual Evaluation Report	Present outcome-level results, early impacts, lessons learned, and financial summaries of IPM implementation.	Annually	FMAF&S, AfDB, Kaduna State Ministry of Agriculture and Natural Resources (KAD-MANR)
Mid-Term Review Report	Assess overall IPM strategy performance, identify implementation challenges, and recommend corrective actions for the remaining project period.	Year 3	Independent Evaluators, SAPZ-PIU
Final Impact Assessment Report	Provide a comprehensive evaluation of the IPM Plan's performance, sustainability, institutional effectiveness, and long-term impacts.	End of Project	All Key Stakeholders (AfDB, FMAF&S, KAD-MANR, KEPA, NAFDAC, NESREA)



14.4 Feedback and Adaptive Management

Adaptive management is a core element of the IPM M&E system. It allows implementers to adjust interventions in real-time based on evidence, field realities, and stakeholder feedback. The following mechanisms will support a responsive and flexible implementation environment:

1 Real-Time Feedback Loops

- Establish SMS-based reporting platforms and WhatsApp extension groups where farmers and extension agents can report pest outbreaks or input shortages.
- Regular feedback sessions with farmer groups to assess satisfaction, adoption barriers, and unintended consequences.
- Develop digital dashboards to visualize real-time M&E data (hosted by SAPZ PMU or M&E consultants) for quicker decision-making.

2 Learning and Reflection Workshops

- Annual IPM review and learning workshops at the state level, involving stakeholders from FMARD, KADP, ADP, farmer groups, agro-dealers, and NGOs.
- Share and discuss field data, identify bottlenecks, and co-create updated action plans for the next year.
- Promote peer-to-peer learning platforms among farmers practicing IPM.

3 Mid-Season Technical Reviews

- Conduct reviews during peak pest seasons (e.g., rainy season months) to monitor pest trends and assess the effectiveness of control measures.
- Adjust pesticide procurement, surveillance intensity, or farmer sensitization campaigns accordingly.

4 Stakeholder Engagement Forums

Quarterly forums for key actors (government, donors, private sector, civil society) to discuss policy, financing, product registration, and extension alignment with IPM goals.

5 Risk and Scenario Planning

- Use pest trend data to conduct scenario-based planning (e.g., for invasive species, climate-related pest outbreaks).
- Develop contingency plans and rapid response mechanisms for major pest emergencies.



CHAPTER FIFTEEN: BUDGET AND FINANCING

15.0 Introduction to Budget and Financing of PMP Implementation

The successful implementation of the Pest Management Plan (PMP) for Kaduna State SAPZ requires adequate and sustained financing. Budgetary planning ensures the alignment of resources with the PMP's strategic objectives, including integrated pest control, farmer training, environmental safeguards, and monitoring. The financing mechanism must be inclusive, multi-stakeholder driven and sustainable over the medium to long term.

15.1 Budgetary Framework

A moderate, realistic, and scalable budget has been developed, covering the full scope of PMP implementation over a 3-year period. The budget is structured around 10 major components, ensuring coverage of operational, technical, institutional, and environmental aspects of pest management.\



Table 15.1: Estimated Budget for Implementation of the IPM Implementation Matrix

S/N	Strategy / Focus Area	Estimated Cost (USD)	Equivalent Cost (₦)	% of Total Budget	Remarks / Key Cost Components
1	Integrated Pest Management (IPM)	\$23,000	₦35,650,000	9.3%	Establishment of IPM demonstration plots, distribution of IPM kits (pheromone traps, neem-based bio-pesticides, PPE), promotion of resistant crop varieties, crop rotation, and intercropping.
2	Farm-to-Factory Biosecurity	\$20,000	₦31,000,000	8.1%	Enforcement of hygiene and biosecurity measures at farms and processing units, pest-proofing of facilities, routine fumigation, inspection, and logistics container monitoring.
3	Structural and Environmental Management	\$26,000	₦40,300,000	10.5%	Construction and rehabilitation of pest-resistant storage facilities, regular environmental sanitation, landscaping, and structural inspection for pest-proofing.
4	Public Health Pest and Vector Control	\$25,000	₦38,750,000	10.1%	Implementation of mosquito and vector control programs, fogging campaigns, sanitation drives, and health surveillance for pesticide exposure in SAPZ communities.
5	Capacity Building and Farmer Training	\$33,000	₦51,150,000	13.4%	Establishment of Farmer Field Schools (FFS), Training of Trainers (ToT) programs, IPM resource centers, and gender/youth-responsive modules on safe pesticide handling.
6	Community Engagement and Partnerships	\$11,000	₦17,050,000	4.5%	Awareness creation, community mobilization, collaboration with academia and CSOs, pest alert system development, and youth engagement initiatives.
7	Environmental and Occupational Health (EHS)	\$36,000	₦55,800,000	14.6%	Procurement of PPE, training on safe pesticide use and spill response, establishment of pesticide container return/recycling systems, and EHS compliance monitoring.
8	Digital Surveillance and	\$30,000	₦46,500,000	12.1%	Development of ICT-based pest monitoring tools, GIS mapping of



Pest Management Plan (PMP) for the Proposed Kaduna SAPZ Project (AIH and ATC)

S/N	Strategy / Focus Area	Estimated Cost (USD)	Equivalent Cost (₦)	% of Total Budget	Remarks / Key Cost Components
	Monitoring				pest hotspots, digital pesticide-use logs, and mobile advisory platforms.
9	Legal Compliance and Policy Enforcement	\$20,000	₦31,000,000	8.1%	Annual regulatory audits, licensing of agrochemical dealers, and harmonization of SAPZ pest management practices with AfDB safeguards and national policies.
10	Adaptive Management, Research, and Innovation	\$23,000	₦35,650,000	9.3%	Annual PMP reviews, pilot testing of bio-control and AI-based pest monitoring tools, knowledge sharing, and scaling of innovative best practices.
	TOTAL ESTIMATED COST	\$247,000	₦382,850,000	100%	Total estimated budget for a five-year PMP implementation period , inclusive of capacity development, monitoring, and adaptive innovation components.

Table: 15.2: Pest Management Plan (PMP) – Consolidated Budget Summary (Aligned with AfDB OSS 2023)

Category	Activities Covered	Estimated Cost (USD)	Equivalent Cost (₦)	Remarks / Alignment with AfDB OSS
1. Technical IPM Interventions	Integrated pest management (IPM) field demonstrations, biological control pilots, farm biosecurity measures, structural pest management, and resistant variety promotion.	\$69,000	₦106,950,000	Supports OSS 1 (Environmental & Social Assessment) and OSS 3 (Biodiversity & Renewable Resource Management) by promoting ecosystem-based pest control and reduced chemical dependency.
2. Health, Safety & Environmental Safeguards	Public health pest and vector control, sanitation drives, occupational health and safety measures, PPE procurement, and	\$61,000	₦94,550,000	Ensures compliance with OSS 5 (Labor, Working Conditions, and Health & Safety) and mitigates health risks from pesticide



Category	Activities Covered	Estimated Cost (USD)	Equivalent Cost (₦)	Remarks / Alignment with AfDB OSS
	pesticide waste management.			exposure.
3. Capacity Building & Community Awareness	Farmer Field Schools (FFS), Training of Trainers (ToT) programs, gender-responsive IPM training, community outreach, and partnerships with research institutions and CSOs.	\$44,000	₦68,200,000	Advances OSS 1 and OSS 10 (Stakeholder Engagement) by building institutional capacity and ensuring inclusive participation.
4. Regulatory & Institutional Strengthening	Policy harmonization, inter-agency coordination (NAFDAC, KEPA, NESREA, FMAF&S), agro-dealer licensing, and compliance audits.	\$20,000	₦31,000,000	Strengthens governance and regulatory oversight under OSS 1 and OSS 5 , ensuring sound pest and pesticide management.
5. Digital & Monitoring Systems	Development of ICT platforms, GIS-based pest hotspot mapping, digital data collection tools, mobile advisory applications, and early-warning systems.	\$30,000	₦46,500,000	Promotes data-driven decision-making and aligns with AfDB's Digital Agriculture Strategy (2022–2031) for precision monitoring.
6. Adaptive Learning & Innovation	PMP reviews, R&D trials, AI-based pest detection, technology integration, and scaling of innovative IPM practices.	\$23,000	₦35,650,000	Supports continuous improvement and innovation consistent with AfDB's emphasis on adaptive management and sustainability.
7. Contingency (5%)	Provision for inflationary adjustments, logistics, or unforeseen implementation needs.	≈\$12,000	≈₦18,600,000	Provides financial flexibility and risk mitigation for unforeseen implementation gaps.
—	TOTAL ESTIMATED COST – Five-Year PMP Implementation Plan	≈\$247,000	≈₦382,850,000	Comprehensive budget for implementation of IPM, capacity building, EHS compliance, and adaptive innovation across SAPZ clusters.



15.1.1 Notes and Budget Rationale

1. **Implementation Period:** The budget covers a three-year intensive rollout and two-year consolidation period, totaling five years.
2. **Funding Sources:**
 - **Primary:** SAPZ Project Implementation Unit (PIU) operational and environmental management budgets.
 - **Co-financing:** AfDB Environmental Safeguard allocations, Kaduna State Government (KAD-MARD), and private sector anchor firms under CSR and compliance contributions.
 - **Supplementary:** Partnerships with national research institutes (NAERLS, IAR, KASU) and potential donor support (FAO, IFAD, or GEF) for biological control and ICT monitoring systems.
3. **Cost Basis:** The estimates are drawn from comparable AfDB-supported agricultural safeguard programs (e.g., TAAT, ENABLE-Youth, FADAMA III+, and ATASP-1). They include:
 - Equipment procurement (PPEs, traps, training kits, ICT tools);
 - Capacity building (trainings, workshops, ToTs);
 - Surveillance and monitoring infrastructure; and
 - Public health and EHS measures.
4. **Inflation Adjustment:** A 5% contingency has been incorporated to cover currency fluctuation and inflationary trends during the project's life cycle.
5. **Monitoring and Financial Control:** Budget execution will be monitored through the SAPZ M&E Unit and reported quarterly to AfDB, FMEnv, and KAD-MARD, ensuring transparency and accountability in disbursement and outcomes.

Implementation Summary

The total estimated budget of USD 247,000 (₦382,850,000) will support the implementation of the Pest Management Plan (PMP) through targeted investments in capacity building, awareness creation, digital surveillance systems, regulatory strengthening, and environmental safeguards.

This strategic investment is designed to:

- Minimize pesticide misuse and environmental contamination through the promotion of integrated pest management (IPM) techniques and safe pesticide handling;
- Enhance farmer health, safety, and productivity by building technical capacity and ensuring access to personal protective equipment (PPE) and safer pest control options;
- Institutionalize IPM practices within the SAPZ ecosystem, embedding sustainability, innovation, and continuous learning across all agricultural value chains; and
- Ensure full compliance with the African Development Bank's Operational Safeguard 3 (Biodiversity and Renewable Resource Management) and Nigeria's environmental and pesticide control regulations, promoting long-term ecological resilience and food security.



15.2 Financing Sources

The implementation of the Pest Management Plan (PMP) will adopt a blended financing approach, drawing on contributions from government institutions, development partners, private sector actors, farmers, and civil society organizations. This approach ensures financial sustainability, local ownership, and alignment with broader SAPZ objectives.

a. Government Contributions

- **Federal Government (FMAF&S and FME_{env}):** Funding will be provided through national agricultural, pest control, and environmental programs coordinated by the Federal Ministry of Agriculture and Food Security (FMAF&S) and the Federal Ministry of Environment (FME_{env}), focusing on IPM promotion, pesticide regulation, and capacity development.
- **Kaduna State Government:** Financial and logistical support will be channeled through the Kaduna State Ministry of Agriculture and Natural Resources (KAD-MANR), Kaduna State Environmental Protection Authority (KEPA), and relevant SAPZ state structures for agricultural extension, infrastructure, and environmental compliance.

b. Development Partners

- **African Development Bank (AfDB):** Will provide the core financing for PMP implementation under the SAPZ framework, covering capacity building, biosecurity infrastructure, digital surveillance systems, and environmental safeguards.
- **Other Development Partners (IFAD, IsDB, World Bank, FAO):** May provide complementary technical and financial support targeting sustainable agriculture, IPM adoption, farmer training, and biological control enhancement through parallel or co-financed initiatives.

c. Private Sector Contributions

- **Agro-Input Suppliers and Processors:** Will co-finance the deployment of bio-control agents, distribution of pest-resistant seeds, and organization of training programs on safe pesticide use and IPM best practices.
- **Agribusinesses and Anchor Firms:** Will invest in post-harvest pest management, storage and warehouse pest-proofing, and logistics sanitation, contributing to improved supply chain biosecurity.

d. Farmer Contributions

- **In-kind and Cost-Sharing Mechanisms:** Farmers will contribute labor, local materials, and partial co-financing, particularly for the procurement of PPEs, bio-pesticides, and field sanitation materials. This will promote ownership and strengthen sustainability at the community level.

e. NGOs and Civil Society Organizations

- **Technical and Financial Support:** Non-Governmental Organizations (NGOs) and Civil Society Organizations (CSOs) will provide advocacy, awareness creation, and community-level engagement support. Their contributions will focus on environmental education, IPM awareness campaigns, and capacity building for women and youth groups.



15.3 Financial Management and Disbursement

To ensure transparency, accountability, and efficiency, financial management for the PMP will follow AfDB and IFAD financial control procedures and the Government of Nigeria's public finance management standards.

- A dedicated PMP Implementation Account will be established under the SAPZ Project Management Unit (PMU) for managing all project-related funds, ensuring traceability of disbursements.
- Quarterly budgets and annual work plans will guide expenditure priorities, ensuring alignment with project milestones and AfDB-approved cost categories.
- All procurement and disbursement processes will adhere to AfDB/IFAD procurement and financial management guidelines, including documentation, verification, and approval workflows.
- Independent financial and compliance audits will be conducted annually by accredited auditors to ensure transparency, proper utilization of funds, and conformity with AfDB fiduciary standards.
- Periodic financial performance reviews will be integrated into SAPZ's Monitoring and Evaluation (M&E) framework to assess cost efficiency and identify opportunities. Expenditures will be guided by quarterly budgets and annual work plans.
- Disbursements will comply with approved procurement and financial management procedures, consistent with AfDB and IFAD guidelines.
- Independent audits will be conducted annually to ensure transparency and accountability.

15.4 Sustainability Measures

- Progressive integration of pest management activities into State Ministry of Agriculture budgets to ensure long-term continuity.
- Development of cost-recovery mechanisms for pesticide distribution, biological agents, and post-harvest equipment.
- Investment in capacity-building to reduce reliance on external technical support.

15.5 Budget Review and Adaptation

- The PMP budget will undergo a mid-term review at the end of Year 1.5 to account for:
 - Emerging pest threats and invasive species.
 - Inflation or fluctuations in input costs.
 - Lessons learned from monitoring and evaluation (M&E) activities.
- All budget adjustments will be formally documented and approved by the SAPZ Steering Committee and financing partners.
- Capacity-building investments to reduce long-term reliance on external technical support.



ANNEXES AND REFERENCES

Annex 1 – Approved Pesticide List (WHO Hazard Classification)

Active Ingredient	Common Name	WHO Class	Approved Use
Lambda-cyhalothrin	Karate	III (Slightly hazardous)	Foliar insect control
Imidacloprid	Confidor	III	Sucking insect control
Spinosad	Tracer	U (Unlikely hazard)	Caterpillars & thrips
Neem extract	Neem-based products	U	Multiple crop pests
Bacillus thuringiensis (Bt)	Various	U	Caterpillars

Annex 2 – Pest Monitoring Form

Farmer/Cluster Name: -----

Date: -----

Crop Type: -----

Pest Identified: -----

Estimated Infestation Level (%): -----

Control Method Used: -----

Follow-up Date: -----

Annex 3 – PPE Checklist for Pesticide Application

- **Gloves**
- **Goggles or face shield**
- **Respirator/mask**
- **Overalls or long-sleeve clothing**
- **Rubber boots**



Annex 4 – ESIA Safeguard Compliance Checklist

Safeguard Measure	Compliant? (Y/N)	Notes
Buffer zones maintained		
PPE used during application		
Pesticide storage meets safety standards		
No children/pregnant women involved in handling		
Empty containers disposed of safely		

Annex 5 – Grievance Reporting Form

Complainant Name: _____ (optional)

Contact Information: _____ (optional)

Nature of Complaint: _____

Date Received: _____

Resolution Proposed: _____

Date Resolved: _____

Annex 6 – Stakeholder Consultation Summary

- **List of meetings held, locations, and key participants.**
- **Summary of stakeholder inputs relevant to pest management.**



Table 1. Extremely hazardous (Class Ia) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Aldicarb [ISO]	116-06-3	2757	C	S	I-S	1	0.93	See note 3; EHC 121; HSG 64; ICSC 94; JMPR 1992, 1995
Brodifacoum [ISO]	56073-10-0	3027	CO	S	R	1	0.3	EHC 175; HSG 93
Bromadiolone [ISO]	28772-56-7	3027	CO	S	R	1	1.12	EHC 175; HSG 94
Bromethalin [ISO]	63333-35-7	2588		S	R	1	2	
Calcium cyanide [C]	592-01-8	1575		S	FM	2	39	Adjusted classification; see note 1; ICSC 407
Captafol [ISO]	2425-06-1			S	F	5	5000	Adjusted classification; see notes 2 and 3; HSG 49; IARC 53 (Group 2A); ICSC 119; JMPR 1977, 1985
Chlorethoxyfos [ISO]	54593-83-8	3018	OP	L	I	1	1.8	Extremely hazardous by skin contact (LD ₅₀ = 12.5 mg/kg); ICSC 1681
Chlormephos [ISO]	24934-91-6	3018	OP	L	I	2	D27	ICSC 1682
Chlorophacinone [ISO]	3691-35-8	2588		S	R	1	3.1	EHC 175; ICSC 1756
Difencoum [ISO]	56073-07-5	3027	CO	S	R	1	1.8	EHC 175; HSG 95
Difethialone [ISO]	104653-34-1	2588		S	R	1	0.56	EHC 175
Diphacinone [ISO]	82-66-6	2588		S	R	1	2.3	EHC 175; ICSC 1757
Disulfoton [ISO]	298-04-4	3018	OP	L	I	1	2.6	ICSC 1408; JMPR 1992, 1996
EPN	2104-64-5	2783	OP	S	I	2	14	See note 4; ICSC 753
Ethoprophos [ISO]	13194-48-4	3018	OP	L	I-S	2	D26	ICSC 1660; JMPR 1999; [Oral LD ₅₀ = 33 mg/kg]
Flocoumafen	90035-08-8	3027		S	R	1	0.25	EHC 175; ICSC 1267
Hexachlorobenzene [ISO]	118-74-1	2729	OC	S	FST	5	D10000	Adjusted classification (notes 3 and 5); EHC 195; IARC 79 (Group 2B); ICSC 895
Mercuric chloride [ISO]	7487-94-7	1624	HG	S	F-S	1	1	See note 3; ICSC 979
Mevinphos [ISO]	7786-34-7	3018	OP	L	I	1	D4	ICSC 924; JMPR 1996; [Oral LD ₅₀ = 3.7 mg/kg]
Oxamyl [ISO]	23135-22-0	2757	C	S	I	1	2.5	JMPR 2017

Table 1. Extremely hazardous (Class Ia) technical grade active ingredients in pesticides 21

Table 1. Extremely hazardous (Class Ia) technical grade active ingredients in pesticides (cont.)

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Parathion [ISO]	56-38-2	3018	OP	L	I	2	13	See note 3; HSG 74; IARC 112 (Group 2B); ICSC 6; JMPR 1995; High case fatality reported – see note 6
Parathion-methyl [ISO]	298-00-0	3018	OP	L	I	2	14	See note 3; EHC 145; HSG 75; ICSC 626; JMPR 1984, 1995
Phenylmercury acetate [ISO]	62-38-4	1674	HG	S	FST	2	24	Adjusted classification; see notes 3 and 7; ICSC 540
Phorate [ISO]	298-02-2	3018	OP	L	I	1	2	See note 3; JMPR 1996, 2004; ICSC 1060
Phosphamidon	13171-21-6	3018	OP	L	I	2	7	See note 3; ICSC 189; JMPR 1986
Sodium fluoroacetate [C]	62-74-8	2629		S	R	1	0.2	ICSC 484
Sulfotep [ISO]	3689-24-5	1704	OP	L	I	1	5	ICSC 985
Tebupirifos [ISO]	96182-53-5	3018	OP	L	I	1	1.3	Extremely hazardous by skin contact (LD ₅₀ 9.4 mg/kg in rats); ICSC 1767
Terbufos [ISO]	13071-79-9	3018	OP	L	I-S	1	c2	ICSC 1768; JMPR 1990, 2003

EHC = Environmental Health Criteria Monograph; HSG = Health and Safety Guide; IARC = IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; ICSC = International Chemical Safety Card; JMPR = Evaluation by the Joint FAO/WHO Meeting on Pesticide Residues.

Notes to Class Ia

1. Calcium cyanide is in Class Ia as it reacts with moisture to produce hydrogen cyanide gas. Hydrogen cyanide is fatal if swallowed, in contact with skin or if inhaled (ICSC 492).
2. Captafol is carcinogenic in both rats and mice.

Table 2. Highly hazardous (Class Ib) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Abamectin [ISO]	71751-41-2	2588		S	AC, LN	2	8.7	JMPR 2015
Acrolein [C]	107-02-8	1092		L	H	2	29	EHC 127; HSG 67; ICSC 90
Allyl alcohol [C]	107-18-6	1098		L	H	3	64	Highly irritant to skin and eyes; ICSC 95; Adjusted classification (see note 3)
Azinphos-ethyl [ISO]	2642-71-9	2783	OP	S	I	2	12	JMPR 1973
Azinphos-methyl [ISO]	86-50-0	2783	OP	S	I	2	16	See note 2; ICSC 826; JMPR 1992, 2007
Blastidion-S	2079-00-7	2588		S	F	2	16	ICSC 1758
Bromophos-ethyl [ISO]	4824-78-6		OP	L	I	3	71	Adjusted classification (see note 3)
Butocarboxim [ISO]	34681-10-2	2992	C	L	I	3	158	JMPR 1985; Adjusted classification (see note 3)
Butoxy-carboxim [ISO]	34681-23-7	2992	C	L	I	3	D288	Adjusted classification (see note 3)
Cadusafos [ISO]	95465-99-9	3018	OP	L	N, I	2	30	JMPR 2009
Calcium arsenate [C]	7778-44-1	1573	AS	S	I	2	20	EHC 18, 224; IARC 84 (see note 5); ICSC 765; JMPR 1969
Carbofuran [ISO]	1563-66-2	2757	C	S	I	2	8	See note 2; ICSC 122; JMPR 1996, 2002, 2008
Chlorfenvinphos [ISO]	470-90-6	3018	OP	L	I	2	31	ICSC 1305; JMPR 1994
3-Chloro-1,2-propanediol [C]	96-24-2	2689		L	R	3	112	IARC 101 (Group 2B); ICSC 1664; Adjusted classification (see notes 1 and 3)
Coumaphos [ISO]	56-72-4	2783	OP	S	AC, MT	2	7.1	ICSC 422; JMPR 1990
Coumatetralyl [ISO]	5836-29-3	3027	CO	S	R	2	16	
Cyfluthrin [ISO]	68359-37-5		PY	S	I	2	c15	ICSC 1764; JMPR 2006; See note 4
Beta-cyfluthrin [ISO]	1820573-27-0		PY	S	I	2	c11	JMPR 2006; See note 4

Table 2. Highly hazardous (Class Ib) technical grade active ingredients in pesticides 22

Annex 7: Class 1a Pesticides as described by World Health Organization (WHO)



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Table 2. Highly hazardous (Class Ib) technical grade active ingredients in pesticides (cont.)

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Demeton-S-methyl [ISO]	919-86-8	3018	OP	L	I	2	40	EHC 197; ICSC 705; JMPR 1989
Dichlorvos [ISO]	62-73-7	3018	OP	L	I	3	57-108	Volatile; EHC 79; HSG 18; IARC 53 (Group 2B); ICSC 690; JMPR 1993, 2011; Adjusted classification (see note 3)
Dicrotophos [ISO]	141-66-2	3018	OP	L	I	2	22	ICSC 872
Dinoterb [ISO]	1420-07-1	2779	NP	S	H	2	25	
DNOC [ISO]	534-52-1	1598	NP	S	I-S,H	2	25	JMPR 1965a; EHC 220; ICSC 462. See note 2.
Edifenphos [ISO]	17109-49-8	3018	OP	L	F	3	150	JMPR 1981. Adjusted classification (see note 3)
Ethiofencarb [ISO]	29973-13-5	2992	C	L	I	3	200	ICSC 1754; JMPR 1982. Adjusted classification (see note 3)
Famphur	52-85-7	2783	OP	S	I	2	48	
Fenamiphos [ISO]	22224-92-6	2783	OP	S	N	2	15	ICSC 483; JMPR 1997, 2002
Flucythrinate [ISO]	70124-77-5	3352	PY	L	I	3	c67	JMPR 1985; see note 4; Adjusted classification (see note 3)
Fluoroacetamide [C]	640-19-7	2588		S	R	2	13	ICSC 1434. See note 2
Formetanate [ISO]	22259-30-9	2757	C	S	AC	2	21	
Furathiocarb	65907-30-4	2992	C	L	I-S	2	42	
Heptenophos [ISO]	23560-59-0	3018	OP	L	I	3	96	Adjusted classification (see note 3)
Isoxathion [ISO]	18854-01-8	3018	OP	L	I	3	112	Adjusted classification (see note 3)
Lead arsenate [C]	7784-40-9	1617	AS	S	L	2	c10	EHC 18, 224; ICSC 911; JMPR 1969
Mecarbam [ISO]	2595-54-2	3018	OP	Oil	I	2	36	ICSC 1755; JMPR 1986
Mercuric oxide [ISO]	21908-53-2	1641	HG	S	O	2	18	ICSC 981; CICAD 50. See note 2
Methamidophos [ISO]	10265-92-6	2783	OP	S	I	2	30	HSG 79; ICSC 176; JMPR 1990, 2002; See note 2
Methidathion [ISO]	950-37-8	3018	OP	L	I	2	25	ICSC 1659; JMPR 1997

Table 2. Highly hazardous (Class Ib) technical grade active ingredients in pesticides (cont.)

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Methiocarb [ISO]	2032-65-7	2757	C	S	I	2	20	ICSC 1766; JMPR 1998
Methomyl [ISO]	16752-77-5	2757	C	S	I	2	17	EHC 178; HSG 97; ICSC 177; JMPR 1989, 2001
Monocrotophos [ISO]	6923-22-4	2783	OP	S	I	2	14	See note 2; HSG 80; ICSC 181; JMPR 1995; High case fatality reported – see note 6.
Nicotine [ISO]	54-11-5	1654		L		1	D50	ICSC 519
Omethoate [ISO]	1113-02-6	3018	OP	L	I	2	50	JMPR 1985; 1996
Oxydemeton-methyl [ISO]	301-12-2	3018	OP	L	I	3	65	JMPR 1989, 2002; Adjusted classification (see note 3)
Paris green [C]	12002-03-8	1585	AS	S	L	2	22	Copper-arsenic complex
Pentachlorophenol [ISO]	87-86-5	3155		S	I,F,H	2	D80	See note 2; Irritant to skin; EHC 71; HSG 19; IARC 117 (Group 1); ICSC 69
Propetamphos [ISO]	31218-83-4	3018	OP	L	I	3	106	Adjusted classification (see note 3)
Sodium arsenite [C]	7784-46-5	2027	AS	S	R	2	10	EHC 224; IARC 84 (see note 5); ICSC 1603
Sodium cyanide [C]	143-33-9	1689		S	R	2	6	ICSC 1118; CICAD 61
Strychnine [C]	57-24-9	1692		S	R	2	16	ICSC 197
Tefluthrin	79538-32-2	3349	PY	S	I-S	2	c22	See note 4
Thallium sulfate [C]	7446-18-6	1707		S	R	2	11	EHC 182; ICSC 336
Thiofanox [ISO]	39196-18-4	2757	C	S	I-S	2	8	
Thiometon [ISO]	640-15-3	3018	OP	Oil	I	3	120	ICSC 580; JMPR 1979; Adjusted classification (see note 3)
Triazophos [ISO]	24017-47-8	3018	OP	L	I	3	82	JMPR 1993, 2002; Adjusted classification (see note 3)
Vamidithion [ISO]	2275-23-2	3018	OP	L	I	3	103	JMPR 1988; ICSC 758; Adjusted classification (see note 3)
Warfarin [ISO]	81-81-2	3027	CO	S	R	2	10	EHC 175; HSG 96; ICSC 821
Zinc phosphide [C]	1314-84-7	1714		S	R	2	40.5	EHC 73; ICSC 602

Table 2. Highly hazardous (Class Ib) technical grade active ingredients in pesticides 25

Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Acephate [ISO]	30560-19-1		OP	S	I	4	945	JMPR 1990, 2002, 2005; ICSC 748
Acetamiprid [ISO]	135410-20-7	2588		S	I	3	c140	JMPR 2011
Acifluorfen [ISO]	50594-66-6			S	H	4	1370	Strong irritant to eyes
Alachlor [ISO]	15972-60-8	2588		S	H	4	930	See notes 1 and 3; ICSC 371
Alamycarb [ISO]	83130-01-2		C	S	I	4	330	
Allethrin [ISO]	584-79-2		PY	Oil	I	4	c685	See note 10; EHC 87; HSG 24; ICSC 212; JMPR 1965a
Allidochlor [ISO]	93-71-0			L	H	3	700	Irritant to skin and eyes
Ametryn [ISO]	834-12-8		T	S	H	4	110	
Amitraz [ISO]	33089-61-1		S	AC	4	800	ICSC 98; JMPR 1998	
Anilofos [ISO]	64249-01-0		OP	S	H	4	472	
Azaconazole	60207-31-0			S	F	4	308	
Azamephiphos [ISO]	35575-96-3		OP	S	I	4	1010	
Azocyclotin [ISO]	41083-11-8	2786	OT	S	AC	3	80	JMPR 1989, 1994, 2005
Barban [ISO]	101-27-9			S	H	4	1300	
Bendiocarb [ISO]	22781-23-3	2757	C	S	I	3	55	
Benfuracarb [ISO]	82560-54-1	2992	C	L	I	3	205	
Bensulide [ISO]	741-58-2	2902		L	H	3	270	ICSC 383
Bensultap [ISO]	17606-31-4			S	I	4	1100	
Bentazone [ISO]	25057-89-0		S	H	4	1100	HSG 48; ICSC 828; JMPR 1998, 2004, 2012, 2016	
Benzenodiflupyr [ISO*]	1072957-71-1	2588	PZ	S	F	3	55	JMPR 2013
Bifenthrin	82657-04-3	3349	PY	S	I	3	c55	JMPR 1992, 2009
Bilanafos [ISO]	71048-99-2			S	H	3	268	

Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides 27

Annex 8: Class 1b Pesticides as described by World Health Organization (WHO)



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Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides (cont.)

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Bioallethrin [C]	260359-57-7		PY	L	I	4	c700	See notes 2 and 10; ICSC 227
Bis(tributyltin) oxide [C]	56-35-9			L	EM	3	194	See note 3; EHC 15; Irritant to skin
Bromofenoxim [ISO]	13181-17-4			S	H	4	1217	
Bromophos [ISO]	2104-96-3		OP	S	I	4	c1600	
Bromoxynil [ISO]	1689-84-5	2588		S	H	3	190	
Bromuconazole	116255-48-2			S	F	4	365	ICSC 1264
Bronopol	52-51-7	3241		S	B	3	254	ICSC 415
Butamifos [ISO]	36335-67-8		OP	L	H	4	630	
Butralin [ISO]	33629-47-9			S	H	4	1049	
Butoxydim [ISO]	138164-12-2			S	H	4	1635	
Butylamine [ISO]	13952-84-6	1992		L	F	4	380	Irritant to skin; ICSC 401; JMPR 1981, 1984
Carbaryl [ISO]	63-25-2	2757	C	S	I	3	c300	EHC 153; HSG 78; ICSC 121; JMPR 1996, 2000, 2001
Carbosulfan [ISO]	55285-14-8	2992	C	L	I	3	250	JMPR 1986, 2003; High case fatality reported – see note 15
Cartap [ISO]	15263-53-3		TC	S	I	4	325	EHC 76; JMPR 1995; Usually used in the form of cartap hydrochloride (CAS 15263-52-2)
Chloralose [C]	15879-93-3			S	R	4	400	
Chlordane [ISO]	57-74-9	2996	OC	L	I	4	460	See notes 3 and 4; EHC 34; HSG 13; IARC 79 (Group 2B); ICSC 740; JMPR 1994
Chlorfenac [ISO]	85-34-7		OC	S	H	4	575	
Chlorfenapyr [ISO]	122453-73-0			S	I,MT	4	441	
Chlormequat chloride [ISO]	999-81-5			S	PGR	4	433	ICSC 781; JMPR 1997, 1999, 2017
Chloroacetic acid [C]	79-11-8	1751		S	H	4	650	Irritant to skin and eyes; data refer to sodium salt; ICSC 235

Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides 29

Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides (cont.)

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Chlorphonium chloride [ISO]	115-78-6	2588		S	PGR	3	178	Irritant to skin and eyes
Chlorpyrifos [ISO]	2921-88-2	2783	OP	S	I	3	135	ICSC 851; JMPR 1999
Chlorthiamid [ISO]	1918-13-4			S	H	4	757	ICSC 852
Clomazone [ISO]	81777-89-1			L	H	4	1369	
Clothianidin [ISO]	210880-92-5			S	I	4	389	JMPR 2010
Copper hydroxide [C]	20427-59-2		CU	S	F	4	1000	
Copper oxychloride [C]	1332-40-7		CU	S	F	4	1440	
Copper sulfate [C]	7758-98-7		CU	S	F	3	300	ICSC 751
4-CPA [ISO]	122-88-3		PAA	S	PGR	4	850	
Cuprous oxide [C]	1317-39-1		CU	S	F	4	470	ICSC 421, EHC 200
Cyanazine [ISO]	21725-46-2		T	S	H	3	288	ICSC 391
Cyanophos [ISO]	2636-26-2		OP	L	I	4	610	
Cyhalothrin [ISO]	68085-85-8	3352	PY	Oil	Ix	3	c144	See note 10; EHC 99; HSG 38; ICSC 858; JMPR 1984; 2007; JECFA 2000b
Lambda-cyhalothrin	91465-08-6	2588	PY	S	I	3	c56	See notes 10 and 11; EHC 142; HSG 38; JMPR 2007; ICSC 859
Cyhexatin [ISO]	13121-70-5		OT	S	AC	3	265	EHC 15; JMPR 1994, 2005
Cymoxanil [ISO]	57966-95-7			S	F	4	1196	
Cypermethrin [ISO]	52315-07-8	3352	PY	L	I	3	c250	See note 10; EHC 82; HSG 22/ICSC 246; JECFA 1996; JMPR 2006
Alpha-cypermethrin [ISO]	67375-30-8	3349	PY	S	I	3	c79	See note 10; EHC 142; JECFA 1996; JMPR 2006
Zeta-cypermethrin [ISO]	1315501-18-8	3352	PY	L	I	3	c269	See note 10; HSG 22; ICSC 246; JMPR 2006; JMP 2019
Cyphenothrin [ISO]	39515-40-7	3352	PY	L	I	4	318	

Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD ₅₀ mg/kg	Remarks
Acephate [ISO]	30560-19-1		OP	S	I	4	945	JMPR 1990, 2002, 2005; ICSC 748
Acetamiprid [ISO]	135410-20-7	2588		S	I	3	c140	JMPR 2011
Acifluorfen [ISO]	50594-66-6			S	H	4	1370	Strong irritant to eyes
Alachlor [ISO]	15972-60-8	2588		S	H	4	930	See notes 1 and 3; ICSC 371
Alamycarb [ISO]	83130-01-2		C	S	I	4	330	
Allethrin [ISO]	584-79-2		PY	Oil	I	4	c685	See note 10; EHC 87; HSG 24; ICSC 212; JMPR 1965a
Allidochlor [ISO]	93-71-0			L	H	3	700	Irritant to skin and eyes
Ametryn [ISO]	834-12-8		T	S	H	4	110	
Amitraz [ISO]	33089-61-1		S	AC	4	800	ICSC 98; JMPR 1998	
Anilofos [ISO]	64249-01-0		OP	S	H	4	472	
Azaconazole	60207-31-0			S	F	4	308	
Azamephipos [ISO]	35575-96-3		OP	S	I	4	1010	
Azocyclotin [ISO]	41083-11-8	2786	OT	S	AC	3	80	JMPR 1989, 1994, 2005
Barban [ISO]	101-27-9			S	H	4	1300	
Bendiocarb [ISO]	22781-23-3	2757	C	S	I	3	55	
Benfluracarb [ISO]	82560-54-1	2992	C	L	I	3	205	
Bensulfide [ISO]	741-58-2	2902		L	H	3	270	ICSC 383
Bensultap [ISO]	17606-31-4			S	I	4	1100	
Bentazone [ISO]	25057-89-0			S	H	4	1100	HSG 48; ICSC 828; JMPR 1998, 2004, 2012, 2016
Benzovaliflupyr [ISO*]	1072957-71-1	2588	PZ	S	F	3	55	JMPR 2013
Bifenthrin	82657-04-3	3349	PY	S	I	3	c55	JMPR 1992, 2009
Bilanafos [ISO]	71048-99-2			S	H	3	268	

Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides 27

Annex 9: Class II Pesticides as described by World Health Organization (WHO)



Annex 10: Images taken at Gadar Gayan, IgabiLGA-Kaduna state with Agro-Chemical dealers and farmers as part of the stakeholders’ engagement and data collection in preparation of the PMP



Annex 11: Images taken at Dutsen-wai, Kubau LGA-Kaduna state with Agro-Chemical dealers and farmers as part of the stakeholders' engagement and data collection in preparation of the PMP



Annex 12: Images taken at Dutsen-wai, Kubau LGA-Kaduna state with Agro-Chemical dealers and farmers as part of the stakeholders' engagement and data collection in preparation of the PMP



Annex 13: Images taken at Pambegua, Kubau LGA-Kaduna state with Agro-Chemical dealers and farmers as part of the stakeholders' engagement and data collection in preparation of the PMP



Junction

Officially Banned Pesticides by NAFDAC due to unsafe nature and hazards to human health.

	Chemical Name	Category		Chemical Name	Category
1	2,4,5 Trichlorophenoxy Acetic Acid	Herbicide	16	Ethylene Oxide	Fumigant, Disinfectant
2	Aldrin	Insecticide	17	Flouracetamide	Rodenticide
3	Binapacryl	Fungicide	18	HCF (Mixed Isomers)/BHC	Insecticide
4	Captafol	Fungicide	19	Heptachlor	Herbicide
5	Chlordane	Insecticide	20	Hexachlorobenzene	Fungicide
6	Chlordimeform	Insecticide	21	Lindane (Gammaline 20)	Insecticide
7	Chlorobenzilate	Insecticide	22	Methamidophos	Insecticide
8	DDT	Insecticide	23	Methyl Parathion	Insecticide
9	Delta HCH	Insecticide	24	Mirex	Insecticide
10	Dieldrin	Insecticide	25	Dieldrin	Insecticide
11	Dinoseb & Dinoseb Salts	Herbicide	26	Monocrotophos	Insecticide
12	EDB (1,2-Dibromoethene)	Fumigant	27	Parathion	Insecticide
13	Endosulphan	Acaricide, Insecticide	28	Pentachlorophenol	Herbicide, Insecticide
14	Endrin	Insecticide	29	Phosphamidon	Insecticide
15	Ethylene Dibromide	Fumigant	30	Toxaphene	Fumigant

Other Problematic Chemicals Restricted from Use

Aluminium phosphate	Fumigant	Labelled "poison" with death signs. Mentioned as dangerous. Reasons are aligned with the general concerns for hazardous chemicals.
Calcium carbide		Its use is associated with potential health risks, including the presence of heavy metals like arsenic in the ripened fruits.
Dichlorvos (DDVP) / Sniper and other brands (100ml pack size)	Fumigant	Abuse and misuse to commit suicide, misuse as a household insecticide, and direct misapplication on agricultural produce. Associated with serious public health hazards.
Mancozeb	Fungicide	Identified as highly hazardous and prohibited in the European Union. Reasons are aligned with the general concerns for hazardous pesticides.

SOURCE NAFDAC

Annex 14: officially banned pesticides by NAFDAC due to unsafe nature and hazards to human health.



NAMES		ATTENDANCE	PHONE NO	25/6/2025
SN	NAMES	POSITION	PHONE NO	SIGNATURE
1	IBRIS ADAMU	BALLATHAI DUTSEN WAI	07035108083	
2	Aminu Musa	Sodangin Dutsen-wai	08031388767	
3	Abu Kacibu Adamu	Tafidan B/wai	08036515155	
4	Abu Jani Hassan	Co-ordinator D/wai	07067237614	
5	Bashir Adamu	KHALIL DUTSEN WAI	07033116760	
6	IGUAL SOLEMAN	MAGAJIN GARI D/wai	080255593030	
7	SUNDAY J. DANSON	SECRETARY SECURITY D/wai	08132924999	
8	YAKUBU ISAH	MAJI D/wai	08100220633	
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7	ABDULMUMINI YAU		07032154700	
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Annex 15: PMP Consultations visit and SEP at Dutsen-wai with community leaders, Farmers Agro - dealers



ARK HAU WARD 30th JULY 2025

NAME	PHONE	SIGNATURE
Ishaqa Rabiu	082820026	
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Sulaima Alaa30	07034455333	
Abdullahi Saqali	08028099419	92491
Abdullahi Salihu	08080314668	allias
Sulaiman Nuaz	07034455333	87R
Bakir Ismail		
Munkaila Yusuf		
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Kabiru Isiya	07049391538	
Sulaiman Isah	08086654436	
Abbas A. Abdullahi	09060523012	ams.
MUSA AMADU	0901740	
Ataibakar Seidu	09047919207	



Annex 16: Consultations with the immediate project community of the ATC about PMP and SEP



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ATTENDANCE 19/07/2025
Stakeholders Engagement

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7	Godfrey Attah	08138199055	<i>[Signature]</i>
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9	EMMANUEL SARKI HABILA	08072996787	<i>[Signature]</i>
10	Sunday Habila Sarki	08030616893	<i>[Signature]</i>
11	Ilisa Markus	07635818181	<i>[Signature]</i>
12	Samuel Maisango	09070707072	<i>[Signature]</i>

Annex 17; Consultations with Key Stakeholders from the AIH Community about the PMP and SEP



Annex: Consultations with Key stakeholders including; Women, Youth, Traditional leaders and representations from FMEnv. KEPA, Kaduna SAPZ and Consultant on PMP and SEP at KASARAMI Chikun LGA, (AIH)



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