MINISTRY OF GREEN ECONOMY AND ENVIRONMENT

ZAMBIA INTEGRATED FOREST LANDSCAPE PROJECT

INTEGRATED PEST MANAGEMENT PLAN

ACRONYMS

ADSP	Agricultural Development Support Project
CERC	Contingency Emergency Response Component
CSA	Climate Smart Agriculture
EMA	Environmental Management Act
EPA	Environmental Protection Agency
EU	European Union
ESMF	Environment and Social Management Framework
FAO	Food and Agriculture Organization of the United Nations
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
LC	Lethal Concentration
LD	Lethal Dose
MoA	Ministry of Agriculture
MGEE	Ministry of Green Economy and Environment
MSDS	Material Safety Data Sheet
NDC	Nationally Determined Contribution
NGOs	Non - Governmental Organizations
OP	Operational Policy
PIU	Project Implementation Unit
PAN	Pesticide Action Network
WB	World Bank
ZEMA	Zambia Environmental Management Agency
ZIFLP	Zambia Integrated Forest Landscape Project
ZMD	Zambia Meteorological Department

CONTENTS

FPIC	Free Prior Informed Consent
PIU	Project Implementation Unit
PMP	Pest Management Plan
POP	Persistent Organic Pollutants
PPE	Personal Protective Equipment
SAN	Sustainable Agriculture Network
SCCI	Seed Control and Certification Institute
WB	World Bank
WHO	World Health Organization
ZAA	Zambia Agrochemical association
ZEMA	Zambia Environmental Management Agency

1 EXECUTIVE SUMMARY

1.1.1 Background

As a result of vulnerability of the impacts of climate variability and human activities, the Government of the Republic of Zambia (GRZ) through the Ministry of Green Economy and Environment (MGEE) and working with the World Bank has embarked on the Zambia integrated forest landscape Project in Zambia (ZIFLP) Project (the "Project") for the Eastern Province. The project aims to reduce livelihood vulnerability and enable climate-resilient growth in key economic sectors.

For purposes of providing guidance on pesticide use to project beneficiaries as and when such need arises during project implementation, GRZ has prepared this Integrated Pest Management Plan (IPMP). The IPMP was prepared through literature review and is made up of an Introductory Chapter, a review of common pests which may be relevant to the project, a review of applicable pest management options and finally a management plan presenting recommendations on pest management under the ZIFLP project. This integrated Pest Management Plan was Prepared by Godfrey Phiri Environmental and Social Inclusion Specialist for the Zambia integrated forest Landscape Project.

1.1.2 The ZIFLP Project

The Zambia integrated forest landscape Project (ZIFLP) Project (the "Project") aims to reduce livelihood vulnerability and enable climate-resilient growth in key economic sectors Forestry, Agriculture and Wildlife. The objective of the Project is to increase the ecosystem resilience and productivity within vulnerable landscapes and enhance the disaster related preparedness of Zambia. The project supports rural communities in Zambia by integrating low carbon livelihoods and climate resilience with natural resource sustainability.

This Zambia integrated forest landscape Project (ZIFLP) targets nine districts of the eastern province: Nyimba, Petauke, Sinda, Katete, Chadiza, Vubwi, Chipata, Mambwe and Lundazi. The ZIFLP project will promote a sustainable forest and land management impact program. It will build on the government's vision to manage productive landscapes to enhance forest products and services for improved income generation, poverty reduction, job creation, protection and maintenance of biodiversity, and contribute to mitigation of climate change.

1.1.3 Project Development Objective

The Project Development Objective (PDO) is "to improve landscape management and increase environmental and economic benefits for targeted rural communities in the Eastern Province and to

improve the Recipient's capacity to respond promptly and effectively to an Eligible Crisis or Emergency".

The benefits the project intends to generate are both economic and those that would result from

improved capacity to manage natural resources and climate resilience.

1.1.4 Project Components

The above Project Development Objective (PDO) will be achieved through activities under the following components:

Component 1: Enabling environment

Component 2: Livelihood and low-carbon investments

Component 3. Project management

Component 4: Contingent emergency response

1.1.5 Integrated Pest Management Plan Objective

The project has prepared this IPMP to meet the requirements of OP/BP 4.09 which may be triggered.

Specific objectives of the IPMP are:

To review the relationship between pests and crop productivity

To identify common pests likely to affect implementation of the project

To explore alternative ways of managing pests and recommend environmentally friendly and socially acceptable approaches to pest management in the APPSA program

To identify issues of concern in pesticide use and recommend measures for enhanced public and occupational health and safety.

1.1.6 Integrated Pest Management Plan Context

The ZIFLP Project is not designed to provide specifically any pesticides or agro-chemicals. However, it is anticipated that communities would likely request assistance with increasing crop and livestock diseases which may require pest control. There could also be an expansion in agriculture land as a result of setting up of smallholder farmer led Irrigation Scheme, development of forest plantations or the introduction of climate-resistant varieties which may require pest control. In such cases, the sub-projects may include the funding of pesticides or agro-chemicals necessary for the control.

Project's Institutional Framework

Under Component 3 of the project: *Project Management, Coordination, and Monitoring*, a Project Management Implementation Unit (PIU) was established under the Ministry of Green Economy and Environment (MGEE) to implement most of the project's investment sub-projects and activities – the required capacities for procurement, financial management, monitoring and evaluation, safeguards implementation, and sub-project and activity execution.

Other responsible institutions directly involved in the implementation of the project components are:

- The Ministry of Green Economy and Environment
- The Zambia Environmental Management Agency
- The Local Authorities
- The Forest Department
- The Ministry of Agriculture
- The Ministry of Fisheries and Livestock

2 METHODOLOGY AND CONSULTATION

This IPMP has been prepared in accordance with applicable World Bank safeguard policies related to pest management, and which involved the following activities, among others:

Literature/ Data Gathering and Review;

Public consultations and discussions with relevant sector institutions;

Data collation and analysis, consisting of literature reviews; Determination of potential impacts; Identification of impact mitigation measures; Preparation of a Pesticide Management Plan; and Preparation of sub-project guidelines; and

Review of comments from stakeholders.

2.1.1 Regulatory Framework

Preparation of the Integrated Pest Management Plan (IPMP) to guide implementation of pest management interventions under the ZIFLP project will have to satisfy both the national and World Bank requirements.

2.1.2 World Bank Requirements

World Bank requirements in relation to pest management are elaborated under Operational Policy (OP) 4.09.

2.1.3 National Guidelines for Pest Management in Zambia

1. The Constitution of Zambia (Amendment), 2016
2. The Plant Pests and Diseases Act, Cap 231
3. The Environmental Management Act, 2011
4. The Environmental Management (Licensing) Regulations, SI 112 of 2013
5. The Water Resources Management Act, 2011
6. The Zambia Wildlife Act, No. 14 of 2015
7. The Forests Act, No. 4 of 2015
8. The Public Health Act, Cap 295 of 1930
9. The Occupational Health and Safety Act, 2010

2.1.4 International Agreements

At the international level, Zambia is a signatory to both the Stockholm and the Rotterdam Conventions.

2.1.5 Common Pests in Project Area

The common pests and diseases that affect production of crops in Eastern Province are discussed below:

2.1.6 Insects

1. American bollworm: (*Helliothis armigera*)
2. Aphids (*aphididae*)
3. Armyworm (*spodoptera sp.*)
4. Bean fly or bean stem maggot (*Ophiomyia phaseoli*)
5. Beetles
6. Bugs (heteroptera sp.)
7. Cutworms (*agritos sp.*)
8. Grass hoppers (*acridoidea*)

9. Leaf hoppers (cicadellidae jassidae)
10. Mites (tetranychidae)
11. Nematodes or eel worms (meloidogyne sp., Heterodera sp., Phatylenchus sp.)
12. Stem- or Stalk borers (busseola fusca, sesamia, calamistris, chilo partellus)
13. Thrips (*thripidae*)
14. White fly (bemisia tabaci) *Diseases*
15. Angular leaf spot (*Isariopsis griseola*)
16. Anthracnose (colletotrichum sp.)
17. Bacterial blight (*xanthonomus oryzae*)
18. Common blight (xanthomonus phaseoli) and Halo bright (pseudomonas phaseolicola)
19. Damping off (pythium sp., Rhizoctania sp)
20. Downy mildew (Peronospora sp., plasmopora sp., pseudoperonospora sp.)
21. Leaf spots
22. Loose smut (*ustilago nuda*)
23. Mosaic virus
24. Powdery mildew (odium sp., erysiphe sp)
25. Rust (uromyces sp., puccinia sp.)
26. Wilt
27. Rust

2.1.7 Seed borne Diseases

The table below presents a list of some important seed borne organisms. The list is not exhaustive.

Some important seed borne organisms of relevance in NRZ

Crop	Organism	Disease
Maize	Fusarium spp Diplodia spp Erwinia stewartii Scleropthora microspora	Cob rot Cob rot Bacterial leaf blight Downy mildew
Sorghum	Spacelotheca spp Claviceps microcephala Claviceps purpureum Ergot	Smut Ergot Fusarium moniliform Seed rot
Groundnuts	Aspegillus spp Fusarium spp	Seed rot Seed rot
Beans	Colletotrihum Lindermuthianum Pseudomonas phaseseolicola Xanthomonus phaseoli Bean common mosaic virus	Anthracnose Halo blight Common blight

Soya beans	Peronospora manshuria Sclerotinia sclerotorium Phomoosis sp Colletotrichum sp	Downy mildew Stem rot Seed rot leaf stem blight
Pea	Ascochytapisi Mycosphaerellapisi	Leaf spot Leaf spot

2.2 Weeds

Apart from insects and diseases, weeds are quite a significant pest which can significantly reduce crop yield if not properly managed.

2.3 Pest Management Interventions

There are four common approaches to pest control namely physical or mechanical, chemical control, biological control and integrated encompassing a range of interventions.

2.4 Physical and Mechanical Pest Control

This option entails use of physical or mechanical means to destroy or control the target pest. This option includes examples such as

- Weeding using hands or a hoe
- Weeding using a harrow
- Handpicking of pests e.g., removal of caterpillars or grasshoppers by hand
- Scaring away or trapping of birds
- Burning of crop residue
- Trapping of pests e.g., use of rodents or bird traps
- Putting up physical barriers e.g., a wire mesh or net to prevent pests from attacking the crop

3 CHEMICAL PEST CONTROL

The chemical control option involves use of herbicides for weed control, insecticides for insect control or fungicides for disease control.

4 BIOLOGICAL PEST CONTROL

The biological control option involves use of animals, insects, bacteria or viral agents which can either be predators (e.g., predatory bugs and spiders), parasites (e.g. some type of wasps) or pathogens (e.g. types of bacteria, fungi, viruses, nematodes) to feed on or attack the target pest species with the aim of killing or suppressing their growth and development.

5 INTEGRATED APPROACH TO PEST CONTROL

The Integrated Pest Management (IPM) option involves the systematic application of more than one option for enhanced effectiveness and is based on the principle of ecosystem management to create a conducive environment for the crop and less so for the pest.

6 IMPLEMENTATION PLAN

The preferred approach to pest management under the ZIFLP is IPM. This can be achieved by following a stepwise process elaborated below:

Step 1: Field Assessment and Pest Identification

Step 2: Threshold determination and Action Planning

Step 3: IPM Implementation

Considerations under Physical/Mechanical Control

Considerations under Biological Control

Considerations under Chemical Control

Considerations under Cultural Practices

Table 1: Institutional Roles and Responsibilities

No.	Institution	Proposed Responsibility
1	Extension staff under the Ministry of Agriculture	Provide training and other forms of knowledge transfer to farmers on the management of pests affecting their fields/crops including practical knowledge on IPM, knowledge on choice, safe use and disposal of pesticides
2	Participating farmers	Control pests in their fields in compliance with the provisions of this IPMP and other applicable protocols
3	ZEMA, the Regulatory Agency in pesticide management	Effectively enforce the provisions of the Environmental Management (Licensing) Regulations, SI 112 of 2013 Conduct awareness and sensitization campaigns on pesticides not allowed in the country and safe usage Conduct environmental monitoring for pesticide contamination and take corrective action were applicable.

4	Pesticide Dealers	Ensure that only registered pesticides are sold Comply with the provisions of the Environmental Management (Licensing) Regulations, SI 112 of 2013 on importation, transportation, storage distribution and disposal of pesticides Fully understand the pesticides in their custody including pesticide toxicity, health and safety hazards and environmental risks Provide information to farmers and other buyers on safe use and management of pesticides
5	Agro Chemical Association of Zambia	Promote the safe use of pesticides by ensuring that all their members comply with the provisions of the PTS Regulations and other protocols
		relating to agro-chemical management including those of FAO, WHO, Rotterdam Convention,
6	Seed Control and Certification Institute (SCCI)	Enforce compliance with protocols for safe breeding and production of seeds and ensure that only certified seed is on the market in compliance with the provisions of the Plant Variety and Seeds Act.
7	Zambia Bureau of Standards	Enforce pesticide product standards by actively monitoring the market and testing products to ensure quality in efficacy and other aspects of the product

7 MONITORING AND REPORTING

The proposed plan for monitoring IPMP implementation is presented n the table below.

Table 2: Table: IPMP Monitoring Plan

IPMP Activity	**Where is the parameter to be monitored?**	**How is parameter to be monitored /type of monitoring equipment ?**	**/Frequency of measurement or continuous?**	**Annual Monitoring cost:** (USD)	**Responsibility**
Training in safe use of chemicals	Training programs and attendance lists	Review of training documentation on, trainee interview	Annual	Included in project coordination and management costs	Provincial Ext. staff
Training in IPM	Training programs and attendance lists	Review of training program, trainee interview	Annual	Included in project coordination and management costs	Provincial Ext. staff/Safeguards Specialists at PIU

Ground water pollution	Borehole, water well in target fields/areas as appropriate	Sampling and lab analysis	Semi-annually effective year after use of project procured agrochemicals	To use existing government facilities 6 000	Provincial extension staff/Safeguards Specialists
Surface water pollution	Runoff receiving water body	Sampling and lab analysis	Semi-annually effective year after use of project procured agrochemicals	6 000	Provincial extension staff
Soil contamination	soil in target fields	Sampling and lab analysis	Semi-annually effective year after use of project procured agrochemicals	9,000	Provincial extension staff
IPM adoption and effectiveness	Commodity research teams and farmers	Social surveys	Annual effective first year of training and sensitisation	12 000	Provincial Extension Staff/ Safeguards Specialist
Public and occupational health and safety concerns such as poisoning due to misuse or improper handling of pesticides	Workers and surrounding community	Incidence reports/surveys	Each time incidence is reported Annual surveys in surrounding communities	Included in operational costs 15 000	Farmers/ Provincial Extension staff /Safeguards Specialist
Occupational health and safety concerns such as injury due to poor working conditions	Workers	Incidence reports/surveys	Each time incidence is reported Inclusion of agenda item in staff meetings	Included in operational costs	Farmers/ Prov. Extension Officers
TOTAL				**48 000**	

8 PROPOSED BUDGET

The table below gives an indicative budget for implementation of the plan.

Table 3: Proposed Budget

No	Activity	Cost (US $)
1	**Training and Capacity Building Costs**	
1.1	Training, sensitization and Awareness in IPMP and its implementation	15,000
1.2	Training in safe and environmentally friendly pesticide use including (i) understanding and interpretation of labels and symbols on pesticides, (ii) formulation, dosing and calibration of equipment, (iii) transportation, storage and disposal of pesticides and pesticide containers and (iv) personal safety and hazard understanding for self-protection	30,000
1.3	Training and sensitization in biological control of pests	14,000
1.4	Development and enforcement of an occupational health and safety protocol covering (1) mechanical control, chemical (2) control and (3) biological control aspects of occupational health and safety.	10,000
2	**Monitoring and Reporting Costs**	
2.1	Water sampling and analysis (surface water resource)	5,000
2.2	Water sampling and analysis (underground water resources)	5,000
2.3	Soil sampling	9,000
2.4	Monitoring of trial biological control programs	6,000
2.5	Monitoring of IPM adoption and implementation	6,000
	Total Costs	**100,000**

8.1 BACKGROUND

As a result of vulnerability of the impacts of climate variability and human activities, the Government of the Republic of Zambia (GRZ) through the Ministry of Green Economy and Environment (ZIFLP), and working with the World Bank has embarked on improving landscape management and increase environmental and economic benefits for targeted rural communities in the Eastern Province and to improve the Recipient's capacity to respond promptly and effectively to an Eligible Crisis or Emergency. The benefits the project intends to generate are both economic and those would result in improved capacity to manage natural resources and climate resilience, for the Eastern Province of Zambia (EP). The project aims to reduce livelihood vulnerability and enable climate-resilient growth in key economic sectors.

For purposes of providing guidance on pesticide use to project beneficiaries as and when such need arises during project implementation, ZIFLP has prepared this Integrated Pest Management Plan (IPMP).

This IPMP has been prepared in compliance with the provisions of the World Bank Operational Policy 4.09 triggered by some activities proposed under the ZIFLP and development.

The project's sub-components that have triggered the preparation of this IPMP are under Component 1: *Promoting Diversified, Resilient, Sustainable Livelihoods*. These activities include the promotion of alternative livelihoods and includes increased small ruminant, agroforestry, agro-processing, aqua culture, fingerlings production, fi, mushrooms production, and other service industries that are non-natural resource dependent and culturally acceptable activities.

Activities under this component will be implemented through a program that (a) encourages farmers to adopt diverse and climate resilient farming practices, (b) advances technologies to introduce more efficient processing, and (c) helps reduce post-harvest loss. This component includes construction of storage facilities, fish farming, rearing of poultry, ruminants and fingerlings, growing of pastures and packaging of non-forest products and farm produce, fruit orchards, fruit nurseries, mechanized gardening and farming of high value crops and forest trees.

In view of the above there is need for effective management of pesticides and pests in a manner that does not pose health and safety risks to the farmer, users of products, the public and the environment – water, soils and biodiversity inclusive of which this IPMP addresses.

The IPMP was prepared through literature review and is made up of an Introductory Chapter, a review of common pests which may be relevant to the project, a review of applicable pest management options and finally a management plan presenting recommendations on pest management under the ZIFLP.

9 THE ZIFLP

The Zambia Integrated Forest Landscape Project (ZIFLP) aims to promote the adoption of sustainable landscape management practices and CSA as an alternative. Community empowerment, strengthening local and traditional governance, and land use planning are the key to integrating and optimizing multiple land uses within the landscape. However, collective action

is unlikely in the absence of rights to use, benefit from, and protect natural resources. Opportunities for transforming the system will include village land use plans, improved governance, matching land use with land characteristics, and poverty reduction outcomes including emission reduction payments. This will require strong monitoring systems for livelihoods/economics, governance, the

implementation of land use plans, and resources monitoring and protection. The project supports rural households in the eastern province of the country by integrating livelihood improvements and climate resilience with natural resource sustainability. Key interventions focus on the following:

the protection of livelihoods from the effects of climate change on water and land resources; improved adaptive response to water scarcity through irrigation and water-saving techniques;

mainstreaming climate change considerations into sectoral investment plans and policies regarding water and land use management;

enhanced disaster risk management capacity in a changing climate and improved understanding of emissions reduction within various sectors or different sectors.

The project will lead to an Emissions reduction Development Program in Zambia contributing to the landscape pillar of the Africa Climate Business Plan, with a focus on reducing climate risks and vulnerabilities through a mix of interventions.

In support of Zambia's climate change program objective, the ZIFLP has been designed and aims to reduce livelihood vulnerability and enable climate-resilient growth in key economic sectors. The focus is on ensuring sustainability of poor rural community livelihoods in an environment already highly stressed by climate change and expected to undergo further important changes in the next decades. By improving agricultural and forestry practices, the project will simultaneously yield climate mitigation benefits and will complement the Zambia Integrated Forest Landscape Project which is helping to create an enabling environment for emissions reductions purchases in the Eastern Province. The project aligns with key national strategies and the country's Intended Nationally Determined Contribution (INDC). The proposed project has been conceived around four components through which it will offer a menu of interrelated activities which can be tailored to the participating targeted province.

The Zambia Integrated Forest Landscape Project (ZIFLP) targets nine districts in eastern province: Nyimba, Petauke, Sinda, Katete, Chadiza, Vubwi, Chipata, Mambwe and Lundazi.

The ZIFLP will promote a sustainable forest management impact program. It will build on the government's vision to manage landscapes to enhance forest products and services for improved income generation, poverty reduction, job creation, protection and maintenance of biodiversity, and contribute to mitigation of climate change.

9.1.1 Project Development Objective

To improve landscape management and increase environmental and economic benefits for targeted rural communities in the Eastern Province and to improve the Recipient's capacity to respond promptly and effectively to an Eligible Crisis or Emergency". The benefits the project intends to generate are both economic and those that would result from improved capacity to manage natural resources and climate resilience. improve natural resource management in select districts to support sustainable livelihoods, and in the event of an eligible crisis or emergency, to provide immediate and effective response to the eligibale crisis or emergency.

The above Project Development Objective (PDO) will be achieved through activities under the following components:

Component 1. Promoting Diversified, Resilient, Sustainable Livelihoods

Component 2: Developing Infrastructure for Resilience and Market Access

Component 3. Management of Community Forests and Protected Areas

Component 4: Project Management, Coordination, and Monitoring

Component 5: Contingency Emergency Response Component (CERC) (Standardized)

Through these components, ZIFLP will offer a selection of interrelated activities that can be tailored to the needs of participating areas. The project also includes standard Contingency Emergency Response component.

9.1.2 Project Components

ZIFLP comprises five components; (1) Promoting Diversified, Resilient, Sustainable Livelihoods; (2) Developing Infrastructure for Resilience and Market Access; (3) Management of Community Forests and Protected Areas; (4) Project Management, Coordination, and Monitoring, and (5) Contingency Emergency Response Component (CERC).

Figure 1-1 presents the project's theory of change. Many of the communities in the eastern province derive their livelihoods from the natural resource base particularly through subsistence agriculture, fishing and exploitation of forest resources. All districts experience issues of land degradation, deforestation, declining agricultural productivity and soil erosion. Thus, unless the value of these natural resources is increased and captured by local people, these resources will continue to be degraded through neglect, inefficient or illegal use, or replacement by low value land use options.

The ZIFLP project will promote a sustainable forest management impact program. It will build on the government's vision to manage productive landscapes to enhance forest products and services for improved income generation, poverty reduction, job creation, protection and maintenance of biodiversity, and contribute to mitigation of climate change.

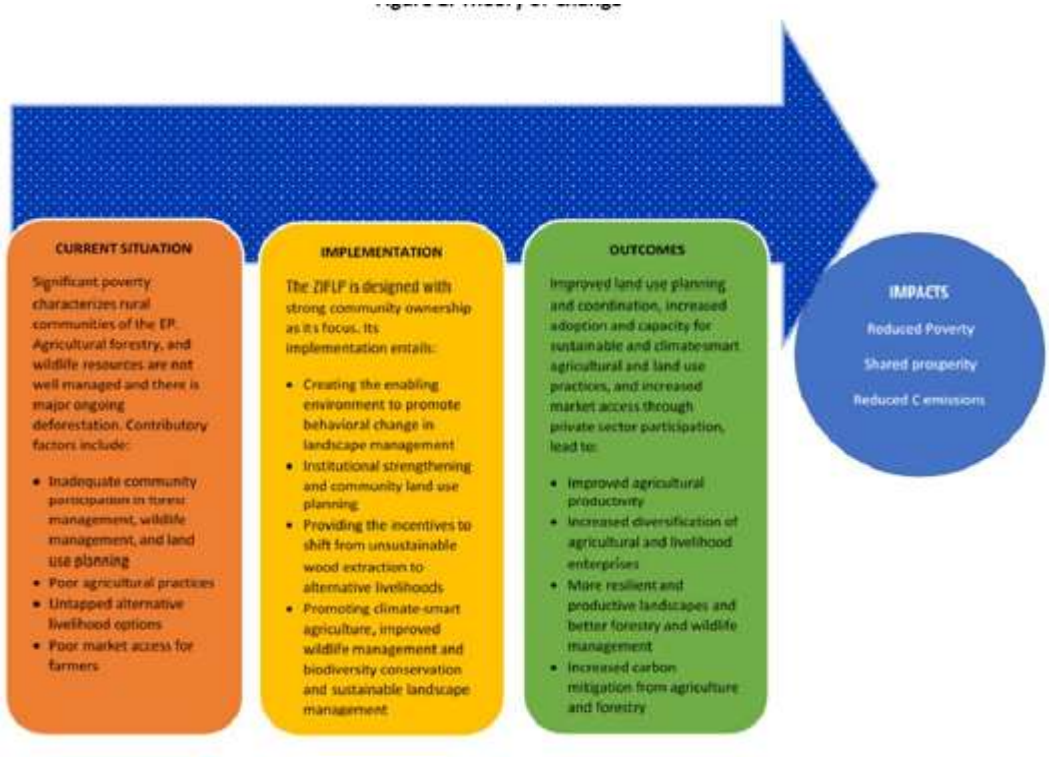

Figure 1-1. Theory of Change

The project will use a community-led landscape approach – that is, an integrated approach to sustainably manage land, forest and water resources for multiple purposes and functions. The components are defined with a view of reversing degradation through adaptation and alternative livelihoods measures, improving management of the protected areas estate, and improving infrastructure for resilience and facilitating creation of new opportunities through more developed market access.

ZIFLP aims to improve the livelihoods and resilience of rural communities by improving the management of the rich natural resource base that rural communities are dependent upon through: (a) diversification and increased sustainability of rural livelihoods; (b) improved management of protected areas and surrounding landscapes; and (c) improved forest management through the creation of community managed forests. The project also supports ward level development planning, technical assistance (TA), workshops, and trainings aimed at capacity building and institutional development.

1.2.2.1 Component 1. Promoting Diversified, Resilient, Sustainable Livelihoods

This component is designed to create conditions for rural communities facing climatic impacts to strengthen their resilience through the adoption of diversified livelihoods that are (a) better adjusted to climate changes, (b) less dependent on natural resources and (c) provide more varied and reliable sources of income. This component also supports ward level development planning, technical assistance (TA), workshops, and trainings aimed at capacity building and institutional development.

Within ZIFLP, the livelihoods component is indelible from the efforts to improve infrastructure for resilience, facilitate community forest management practices, strengthen protected areas and establish national hydro-meteorological system. The activities under this component have direct connection to the efforts to alleviate the pressure on protected areas and national forests. In addition, to complement and multiply positive effects of diversified and more sustainable livelihoods, ZIFLP intends to improve small infrastructure helping communities withstand the pressures of natural disasters, harness the positive side of the climate risk and establish better access to markets.

The implementation of activities under this component pursues the following objectives: (i) increase smallholder production and improve productivity; (ii) diversify value chains; (iii) mitigate farmers risks through the introduction of basic financial services; and (iv) facilitate adoption of alternative livelihoods as sustainable and resilient activities with reduced reliance on natural resources.

To achieve these objectives, the following subcomponents stipulating complementary and mutually reinforcing activities have been determined: (1) Diversifying livelihoods and improving farming practices; (2) Developing productive infrastructure for sustainable livelihoods; (3) Strengthening communities and expanding services. In composition, these activities form an integrated approach to alleviating the problem of vulnerability of rural communities to growing climate change impacts and help strengthen their resilience and adaptive capacity. As an accompanying and equally

important effect, their implementation is anticipated to elevate economic wellbeing of targeted communities.

9.1.3 Subcomponent 1.1. Diversifying livelihoods and improving farming practices

Activities under this subcomponent will be implemented through a program that (a) encourages farmers to adopt diverse and climate resilient farming practices, (b) advances technologies to introduce more efficient processing, and (c) helps reduce post-harvest loss. These activities will be funded through small grants program to strengthen community climate resilient adaptation. The small grants will fund priority adaptation sub-projects identified through the process of participatory community natural resource management and climate resilient planning. Grants will be available at the ward, community/group, and individual innovators (champions') levels and will be disbursed directly to beneficiaries. At the community/group level, the interventions will equally target women-headed households, as well as households classified as very or extremely vulnerable.

9.1.4 Component 3. Management of Community Forests and Protected Areas

Under this component, the project pursues the objective of establishing Community Forest Management groups as well as Natural Forest Regeneration areas to more effectively manage available forests and to create minimal necessary conditions for restoring degraded forest areas to ultimately improve and diversify livelihoods through responsible and sustainable use of natural resources by communities. In addition, this component addresses the problem of insufficient funding of the established protected areas in the LMN. Main activities include developing basic infrastructure, strengthening capacity and management to protect and preserve biodiversity and ecosystem services.

9.1.5 Subcomponent 1.3. Community Forest Management and Natural Forest Regeneration

This subcomponent supports the implementation of two types of community-driven sustainable forestry activities: Community Forest Management (CFM) and Natural Forest Regeneration (NFR). They include identifying, adoption, restoration, management and usage of forest areas. CFM is a small to medium scale effort stipulating creation of legal entities, development of management plans and establishment of community forest management groups (CFMG) to manage and use specified forest areas at community level. Simultaneously, this subcomponent intends to promote among communities the establishment of areas for Natural Forest Regeneration (NFR) – low-cost grass-root initiative under the authority of local traditional leaders to create conditions for fast, unimpeded regeneration of forests and their further usage to meet community needs in an environmentally considerate manner.

9.1.6 Subcomponent 1.4. Improved Management of Protected Areas and National Forest Reserves

This activity supports the effective and sustainable management of important conservation landscapes, the Lukusuzi and Luambe National Parks and the Game Management Area Landscape. The broader conservation landscapes include interconnected networks of protected areas including (i) national parks, (ii) game management areas, and (iii) national forest reserves. The project will support a landscape approach to the sustainable management of the ecosystems to preserve the biodiversity and ecosystem services for the wellbeing of people with focus on forest dependent communities and potential to develop tourism opportunities.

9.1.7 Component 4: Project Management, Coordination, and Monitoring

This component will finance TA, works, goods, workshops, and operational costs to support the project's dayto-day implementation and management, including procurement, FM, environmental and social safeguards, and preparation of annual work plans and organization of audit reports. The component also includes the design and implementation of a communication strategy to report on the project results and to raise awareness about land degradation, restoration and climate change impacts, vulnerability, and adaptation. It also supports the M&E system to report on the project's expected results (disaggregating by gender, where appropriate) and systematizes the project's lessons learned. The component also finances impact evaluation to assess project's impacts on specific elements such as adopted livelihoods.

9.1.8 Component 5: Contingency Emergency Response Component (CERC)

This contingency component can be triggered by a joint Government and World Bank agreement in case of an emergency. This component had been embedded in the project to finance early recovery and/or specific emergency works, goods, and services, in case of eligible emergencies/crises/disaster caused by natural or manmade hazard including public health crisis. The mechanism is designed to support enhancement of preparedness, early recovery activities, and provision of rapid response to disaster that can be implemented in a relatively short period. This component was considered necessary because of the inherent risks in Zambia's current socioeconomic and climate related hazards (unexpected flooding or drought, an aggravation of the state of fragility, as a result of influx of large groups of displaced people, including both (cross boarder and internal displacements) that could potentially shift priorities. Reallocation of funds to CERC can only be done when there is a serious disruption of the functioning of a community or society causing widespread human, economic, or environmental losses that exceed the ability of the affected community or society to cope using its own resources. Following such a disaster event where both the region and national resources cannot sufficiently and adequately address the situation, the Government of the Republic of Zambia (GRZ) may trigger activation of CERC according to national law and subject to the World Bank's activation policy.

10 PESTS AND CROP PRODUCTIVITY

The term pest in crop production refers to external biological agents that compete with and interfere with the proper growth and development of a target crop. Examples include weeds, insects and disease pathogens such as viruses and bacteria. Damage to the crop may arise from competition for available nutrients, water, light or space or may manifest by way of harm where a particular pest subsists and feeds on the plant or transmits disease pathogens. Pests can thus either directly harm the plant or may pave way for secondary infestation by disease or other pests. Arising from this damage the crop may not be able to realize its full productive potential or may even die. Pest management is thus vital for sustained agricultural productivity because without proper pest management a farmer's effort can be of no benefit.

Pests affect food crops, causing significant losses to farmers and threatening food security. Outbreaks and upsurges can cause huge losses to crops and pastures, threatening the livelihoods of vulnerable farmers and the food and nutrition security of millions at a time.

Plant pests and diseases spread in three principal ways:

trade or other human-migrated movement

environmental forces – weather and windborne

insect or other vector-borne – pathogens

11 INTEGRATED PEST MANAGEMENT PLAN OBJECTIVE

The project is preparing this IPMP to meet the requirements of OP/BP 4.09 which has been triggered.

This Integrated Pest Management Plan (IPMP) has been prepared as a supplement to the Environmental and Social Management Framework (ESMF). It is meant to be used as a guide to pest management in the food legume crops technology development and dissemination activities of the project. The Plan has been prepared in compliance with the WB's Operational Policy 4.09, the Environmental Management (Licensing) Regulations, 2013 (Statutory Instrument no. 112 of 2013 under the Environmental Management Act (No. 12 of 2011), the Plant Pests and Diseases Regulation Act (CAP 231 of the Laws of Zambia).

Specific objectives of the IPMP are:

To review the relationship between pests and crop productivity

To identify common pests likely to affect implementation of the project

To explore alternative ways of managing pests and recommend environmentally friendly and socially acceptable approaches to pest management in the APPSA program

To identify issues of concern in pesticide use and recommend measures for enhanced public and occupational health and safety.

The IPMP is an approach that establishes a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks.

IPMP is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.

12 INTEGRATED PEST MANAGEMENT PLAN CONTEXT

The ZIFLP is not designed to provide specifically any pesticides or agro-chemicals. However, it is anticipated that communities would likely to request assistance with increasing crop and livestock diseases which may require pest control. There could also be an expansion in cultured land as a result of canal rehabilitation, or the introduction of climate-resistant varieties which may require pest control. In such cases, the sub-projects may include the funding of pesticides or agro-chemicals necessary for the control. Should this prove necessary, the project would

require that the mitigation plans under the sub-grant agreements include the recommended management measures specified in the IPMP (depending on the prevailing crop);

not fund any of pesticides that are phased out, banned or restricted; and

promote the use of integrated pest management techniques and the safe use, storage and disposal of agro-chemicals as appropriate.

Thus, the Plan provides guidance for the management of pests for major crops grown in the eastern province. The IPMP provides:

a list of the most common pests to crops grown in the project area;

various approaches to pest management;

a list of commonly used pesticides in the agricultural sector in Zambia;

a list of pesticides phased out, banned, or restricted; and

those that are banned, restricted, or no longer in use, but are still recommended in Zambia.

Under Pest Management OP4.09, the Bank uses various means to assess pest management in the country and support PM and the safe use of agricultural pesticides. In Bank-financed agriculture operations, pest populations are normally controlled through integrated pest management (IPM) approaches, such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest. The Bank may finance the purchase of pesticides when their use is justified under an IPM approach.

13 PROJECT'S INSTITUTIONAL FRAMEWORK

13.1 Project Implementation Unit

Under Component 2 of the project: *Project Management, Coordination, and Monitoring*, a Project Implementation Unit (PIU) was established within the Ministry of Green Economy and Environment (MGEE). The PIU will report to the Permanent Secretary (PS) of MGEE and will be granted a high degree of autonomy to ensure efficient and timely implementation of the project. The PS may delegate his authority to a senior officer (director level), to whom the PIU will directly report. The PIU will be granted operational autonomy to apply rules, criteria, and procedures agreed with the World Bank. The PS, as the accounting officer of MGEE, will delegate financial management, procurement, tender evaluation, selection and contracting responsibilities to the PIU. Notwithstanding these provisions, the PIU's actions will be accountable to the MGEE and subject to review by the Office of the Auditor General.

The PIU roles are to support development within the current and successor agencies – which would typically implement most of the project's investment sub-projects and activities – the required capacities for procurement, financial management, monitoring and evaluation, safeguards implementation, and sub-project and activity execution. In the interim, the PIU will undertake these

roles on behalf of those agencies through the services of consulting firms, or by procuring an appropriate Implementation Support Consultancy that would be embedded within each agency.

The core roles of the PIU are fiduciary (procurement and financial management), management and coordination, reporting, monitoring and evaluation, the application of the Investment Framework (including safeguards frameworks), and monitoring of and technical support to the project. It will review the results and recommendations of each pre-feasibility and feasibility study, apply the Investment Framework and make recommendations on investment ready sub-projects. The PIU will ensure the application of social and environmental frameworks (ESMF and RPF) by assessing the capacity of sponsor agencies to prepare safeguards instruments and to implement safeguards requirements (as the case may be). In the event that sponsor agencies are found to have insufficient capacity in these areas, it will work with the agency to prepare a support plan and TORs, as well as procure the additional required services. The PIU will monitor the activities of all agencies involved in the project and their consultants, evaluate performance, propose measures to enhance performance and ensure timely implementation, and provide regular reporting to the World Bank.

13.2 The Ministry of Green Economy and Environment

The Ministry of Green Economy and Environment is broadly responsible for the following functions:

Coordinating the setting of the national vision, goals and development priorities and engender consensus among various stakeholders;

Facilitating the preparation of long- and medium-term national development plans in order to promote economic diversification and rapid socio-economic growth and development.

Monitoring and evaluating the implementation of national development plans, programmes and projects in order to ensure timely implementation, value for money and attainment of set objectives;

Coordinating the production and dissemination of quality official statistics for timely policy intervention, planning, decision making and research;

Coordinating project identification, design and appraisal of public investments to facilitate attainment of set objectives;

Coordinating the production and dissemination of quality official statistics for timely policy intervention, planning, decision making and research;

Coordinating project identification, design and appraisal of public investments to facilitate attainment of development

The ministry oversees the implementation of the 7NDP which has been discussed under section 2.1.2 of this report.

The implementation of the low carbon investment projects and thus the operation of the ESMF will be overseen by the ZEMA through the PIU.

13.3 The Zambia Environmental Management Agency

The Environmental Management Act establishes the Zambia Environmental Management Agency (ZEMA). ZEMA is a statutory body and the following are the main functions of ZEMA:

Integrated environmental management and the protection and conservation of the environment and sustainable management and use of natural resources;

The prevention and control of environmental pollution and environmental degradation;

Provide for public participation in environmental decision making and access to environmental information

Undertaking environmental auditing and monitoring; and

Facilitating the implementation of international environmental agreements and conventions to which Zambia is a party.

In line with the EMA, all environmental assessment reports are supposed to be submitted to ZEMA for review, after which ZEMA undertakes verification inspection and consultations with the interested and affected parties (IAPs) as well as with authorizing agencies such as WARMA for water projects, Energy Regulation Board for energy projects, FD for projects affecting forests, planning authorities, prior to making a decision.

Thus, in the event that the individual projects trigger environmental assessments, the reports will also need to be submitted to ZEMA for approval. ZEMA also carries out periodic environmental audits of the approved projects.

13.4 The Local Authorities

The Local Government Act provides for the establishment of Councils in districts, the functions of local authorities and the local government system. Some of these functions relate to district planning, pollution control and protection of the environment.

During the planning and implementation of project interventions, it is imperative that the projects comply with the planning specifications and any relevant by laws set up by the relevant local authorities.

13.5 The Forest Department

According to section 5 of the Forests Act, No. 4 of 2015, the main function of the Forest Department is the rationalisation of the exploitation of forest resources and the promotion of sustainable forest management.

Other functions include the following:

control, manage, conserve and administer National Forests, Local Forests and botanical reserves;

adopt and promote methods for the sustainability, conservation and preservation of ecosystems and biological diversity in forest areas and open areas;

collect, compile and disseminate information on forest resources in any area and advise on areas requiring afforestation, re-forestation and protection of flora threatened or in danger of extinction;

establish and promote the establishment of plantations;

devise and implement participatory forest management approaches for indigenous forests and plantations involving local communities, traditional institutions, non- governmental organisations and other stakeholders, based on equitable gender participation;

facilitate equitable access to forest resources for commercial, recreational and indigenous use; g. promotes and regulate beekeeping;

Since some of the project interventions as indicated of this document interface with those of the Forest Department, the creation of partnerships with the local communities and relevant civil society for effective forest management will be effective in promoting community-based natural resource management and sustainable livelihoods such as beekeeping if the Forest Department is consulted and involved.

13.6 The Water Resources Management Authority

Some of the functions of the Water Resources Management Authority as enshrined in the Water Resources Management Act of 2011, is to ensure the management, development, conservation, protection and preservation of the water resource and its ecosystems; provide for the equitable, reasonable and sustainable utilisation of the water resource; ensure the right to draw or take water

for domestic and non- commercial purposes, and that the poor and vulnerable members of the society have an adequate and sustainable source of water free from any charges; and create an enabling environment for adaptation to climate change.

Among the functions of the Authority are included the following:

ensuring extensive participation in interagency and intra-agency research planning related to climate change; and

▪ investing in climate change education on water issues and supporting the sharing of information about Government and local responses to water impacts of climate change.

The proposed project interventions are directly linked to functions of the Water Resources Management Authority (WARMA). The key interventions of the project seek to achieve the following:

the protection of livelihoods from the effects of climate change on water and land resources; improved adaptive response to water scarcity through irrigation and water-saving techniques;

mainstreaming climate change considerations into sectoral investment plans and policies regarding water and land use management;

enhanced disaster risk management capacity in a changing climate and improved understanding of and advocacy for climate change implications within various sectors or different sectors.

The establishment of projects for the promotion of sustainable water management practices will require that WARMA is directly involved. Any infrastructure for water harvesting measures such as dams, canal, will require that permission is sought from the Authority. It is important that WARMA is consulted and involved for the above stated project interventions.

13.7 The Disaster Management and Mitigation Unit

The Disaster Management and Mitigation Unit (DMMU) is vested in the Office of the Vice President and was created in 1994. The following are the objectives of DMMU:

To put in place appropriate preparedness measures in order to manage disasters effectively and efficiently.

To activate response mechanism for effective and timely search and rescue operations in order to save life and reduce damage to property.

To put in place measures to restore livelihoods and other life support systems to affected communities.

To mitigate the disruptive and destructive effects of hazards and all disasters in order to reduce their impact on vulnerable communities, assets and the environment

To put in place preventive measures in order to reduce the negative effect of hazards and strengthen the national capacity for disaster management in order to avoid the adverse impact of hazards.

To effectively co-ordinate disaster management activities through a body of procedures and practices in order to avoid duplication of efforts and resources at all levels.

In view of the fact that the interventions are helping the target beneficiaries to improve their capacity to prevent or respond to climate change induced disasters, it is important that DMMU is actively involved in the implementation of the project interventions.

13.8 The Zambia Meteorological Department

The Zambia Meteorological Department (ZMD), under the Ministry of Transport and Communication, is charged with the responsibility of weather observation, analysis and prediction, for purposes of protecting life and property, safeguarding the environment, provision of advice and assessment for policy formulation as well as contribution to sustainable development.

In Zambia, ZMD is the National Meteorological Service and the primary provider of meteorological services. The department has offices in every Provincial capital and some districts, and it is responsible for providing weather and climate information to the public and various sectors of the economy. ZMD is also the custodian of the official records of Zambian Weather and Climate.

Some of the functions and responsibilities of ZMD are:

To process and analyze meteorological data for use in the planning of economic development and rational exploitation of natural resources;

To provide meteorological services for the development of agriculture, water resources and other weather sensitive economic sectors;

To conduct research in meteorology and co-operate with organizations concerned with meteorological research and applications;

The ZMD will be involved in all the components of the interventions but particularly critical in the implementation of sub-component which aims to Strengthen beneficial use of hydro-meteorological services.

The following section illustrates how relevant ZMD is to the project:

Agriculture: Prior to the commencement of each Rainy Season, the ZMD issues a Seasonal Rainfall Forecast in order to provide some indication of the quality (timing and nature of the rains) of the coming season. Farmers use the forecast to choose the best planting date, cropping strategies, tillage practices, etc. The Crop-Weather Bulletin is a popular publication which helps farmers to follow the performance of the rainy season (e.g. as it related to dry spells, number of rainy days, etc) every ten days during the crop growing period.

Water Resources Management: The design of drainage systems in towns and cities depends on past records of rainfall intensity. Special problems arise in the replacement or renewal of many civic facilities, e.g. storm water disposal systems, many of them designed and built many years ago, which must now be re-designed to cope with the changing patterns of runoff, due to the greater density of buildings and hard-paved areas, Knowledge of the quantity of water delivered by short heavy falls of rain is essential for such planning. Scheduling of irrigation is more economical when meteorological data is used. The weather statistics often required are evaporation, air temperature, relative humidity, wind speed and sunshine duration.

14 METHODOLOGY AND CONSULTATION

This IPMP has been prepared in accordance with applicable World Bank safeguard policies related to pest management, and which involved the following activities, among others:

Literature/ Data Gathering and Review;

Public consultations and discussions with relevant sector institutions;

Data collation and analysis, consisting of literature reviews; Determination of potential impacts; Identification of impact mitigation measures; Preparation of a Pesticide Management Plan; and Preparation of sub-project guidelines; and ▪ Review of comments from stakeholders.

15 DETAILED AND IN-DEPTH LITERATURE REVIEW

Review on the existing baseline information and literature material was undertaken and helped in gaining a further and deeper understanding of the proposed project. A desk review of the Zambian legal framework and policies related to pesticide use was also conducted in order to the relevant legislations and policy documents that should be considered during project implementation. Among the documents that were reviewed in order to familiarise and further understand the project included:

15.1 World Bank Related Documents

World Bank Project documentation for the ZIFLP Project

World Bank ZIFLP Draft Project Appraisal Document (PAD)

World Bank Safeguards Policy OP 4.09

World Bank IPMP documents for other agricultural projects

15.2 Zambian Legislative Documents

The Constitution of Zambia

The Environmental Management Act

The Environmental Management (Licensing) Regulations

The Plant Pests and Diseases Regulation Act

The Environmental Impact Assessment Regulations

The Water Resources Management Act

The Forests Act

The Lands Act

The Urban and Regional Planning Act

The Public Health Act

The Occupational Health and Safety Act

16 INTERACTIVE DISCUSSIONS

Stakeholder consultation formed part of the methodology in preparing this IPMP where a list of all the project interested and affected stakeholders was prepared and stakeholder engagement was undertaken through interviews (face-to face) and a workshop will be held with these key

stakeholders in February 2019. The stakeholder consultation was significant to the preparation of this IPMP and formed the basis for the determination of potential project impacts and design of viable mitigation measures.

17 INTEGRATED PEST MANAGEMENT

This section describes in brief the IPM approach and then links the strategic issues under the ZIFLP that have implications for pests and pesticides management with the IPM approach.

The conventional approach to use of pesticides has the following drawbacks:

- Human toxicity; poisoning and residue problems
- Destruction of natural enemies and other non-target organisms
- Development of resistance in target organisms
- Environmental pollution and degradation
- Pesticides are expensive and good management of their use requires skills and knowledge

Because of the drawbacks of reliance on pesticides, a crop protection approach is needed that is centred on local farmer needs that are sustainable, appropriate, environmentally safe and economic to use. Such approach is called Integrated Pest Management (IPM). In 1967, FAO defined IPM as **"a pest management system that in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible manner as possible, and maintains the pest population at levels below those causing economic injury".**

18 PESTS AND CROP PRODUCTIVITY

The term pest in crop production refers to external biological agents that compete with and interfere with the proper growth and development of a target crop. Examples include weeds, insects and disease pathogens such as viruses and bacteria. Damage to the crop may arise from competition for available nutrients, water, light or space or may manifest by way of harm where a particular pest subsists and feeds on the plant or transmits disease pathogens. Pests can thus either directly harm the plant or may pave way for secondary infestation by disease or other pests. Arising from this damage the crop may not be able to realize its full productive potential or may even die. Pest management is thus vital for sustained agricultural productivity because without proper pest management a farmer's effort can be of no benefit.

Pests affect food crops, causing significant losses to farmers and threatening food security. Outbreaks and upsurges can cause huge losses to crops and pastures, threatening the livelihoods of vulnerable farmers and the food and nutrition security of millions at a time. Plant pests and diseases spread in three principal ways:

- trade or other human-migrated movement
- environmental forces – weather and windborne
- insect or other vector-borne – pathogens

The requirement for adoption of IPM in farming systems is even emphasized in the WB OP 4.09, which supports safe, effective, and environmentally sound pest management aspects, such as the use of biological and environmentally friendly control methods.

The following are key preconditions for an IPM approach which will be adopted by all the sub projects within ZIFLP that will be screened and found to require pesticide use:

Understanding of the ecological relationships within a farming system (crop, plant, pests' organisms and factors influencing their development

Understanding of economic factors within a production system (infestation: loss) Understanding of socio-cultural decision-making behaviour of the farmers (traditional preferences, risk behaviour)

Involvement of the farmers in the analysis of the pest problems and their management

Successive creation of a legislative and agricultural policy framework conducive to a sustainable IPM strategy (plant quarantine legislation, pesticides legislation, pesticide registration, price policy)

This IPMP for ZIFLP has been developed by following and applying the key elements of an IPM program namely:

Ensuring that sub project investments under ZIFLP use of available, suitable, and compatible methods which includes resistant varieties, cultural methods (planting time, intercropping and crop rotation), biological control, safe pesticides etc. to maintain pests below levels that cause economic damage and loss

Ensuring that sub project investments under ZIFLP conserve the ecosystem to enhance and support natural enemies and pollinators

Ensuring that sub project investments under ZIFLP integrate the pest management strategies in the farming system

Ensuring that sub project investments under ZIFLP conduct analysis based on pests and crop loss assessments

19 IPMP IN ZIFLP PROJECT INVESTMENTS

This Integrated Pest Management Plan (IPMP) addresses the ZIFLP's need to promote ecosystem approach in pest management where sub project investments will entail the use of pesticides.

The project's sub-components that have triggered the preparation of the IPMP are under Component 1: *Promoting Diversified, Resilient, Sustainable Livelihoods*. These activities include the promotion of alternative livelihoods and includes increased small ruminant, agroforestry, agro-processing, aqua culture, fingerlings production, fish production, mushrooms production, and other service industries that are non-natural resource dependent and culturally acceptable activities.

Activities under this component will be implemented through a program that (a) encourages farmers to adopt diverse and climate resilient farming practices, (b) advances technologies to introduce and (c) helps reduce post-harvest loss. This component includes construction of storage, value addition facilities, fish farming and fish, rearing of poultry, ruminants and fingerlings, growing of pastures and packaging of non-forest products and farm produce; fruit orchards, fruit nurseries, gardening and farming of high value crops.

In view of the above there is need for effective management of pests in a manner that does not pose health and safety risks to the farmer, users of products, the public and the environment – water, soils and biodiversity inclusive of which this IPMP addresses.

Therefore, this IMPF will ensure that this sub project and others yet to be identified apply the elements of IPM as described above and the preconditions for the same in order to minimise the adverse impacts associated with pesticide use in the agriculture sector. It is for this reason, that every sub project investment that is screened and found that pesticides use is certain, an Integrated Pest Management Plan (IPMP) will be developed as a mandatory requirement.

This approach will benefit the ZIFLP sub projects in terms of enhancing good human and environmental health and improving economic well-being of the farmer. Finally, the IPMP has been designed with focus on the general principles of IPM and every sub project investment that will have components of pesticide use will be required through enforcement, monitoring and review to follow these principles namely; -

The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:

Crop rotation,

Use of adequate cultivation techniques (e.g., stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing)

Use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material

Use of balanced fertilisation, liming and irrigation/drainage practices

Preventing the spreading of harmful organisms by hygiene measures (e.g., by regular cleansing of machinery and equipment)

Protection and enhancement of important beneficial organisms, e.g., by adequate plant

Protection measures or the utilisation of ecological infrastructures inside and outside production sites.

Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning,

forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.

Based on the results of the monitoring, the users have to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms, threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatment, where feasible.

Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.

The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and the environment.

The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g., by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.

Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.

Based on the records on the use of pesticides and on the monitoring of harmful organisms, the professional user should check the success of the applied plant protection measures.

20 REGULATORY FRAMEWORK

Preparation of the Integrated Pest Management Plan (IPMP) to guide implementation of pest management interventions under the ZIFLP will have to satisfy both the national and World Bank requirements.

21 WORLD BANK REQUIREMENTS

World Bank requirements in relation to pest management are elaborated under Operational Policy (OP) 4.09. The policy places emphasis on pest management within the context of environmental management. To that effect it puts preference to use of biological or integrated approach and less so on synthetic chemical use. Qualifying projects will have to consider this and make informed

decisions aided by consideration of other factors during the project's environmental assessment process.

The Bank will only fund projects which do not involve use of pesticides or where use of such is included it should be justified and supported with demonstrated capacity starting at the country level covering the regulatory framework and institutional capacity for monitoring and enforcing safe, effective, and environmentally sound use of pesticides. It is also desirable to have demonstrated knowledge of IPM by the beneficiary institution or people implementing a subproject. As noted earlier, IPM approaches use a combination of biological control, physical and mechanical control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest and to some degree limited use of pesticides.

In endorsing the use of pesticides, the Bank will require evidence to the effect that the pesticides being used meet the following criteria:

They must have negligible adverse human health effects.

They must be shown to be effective against the target species.

They must have minimal effect on non-target species and the natural environment. The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies. Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them.

Their use must take into account the need to prevent the development of resistance in pests.

Highly toxic or hazardous pesticides may not be used and these include formulated products that fall in WHO classes IA and IB, or formulations of products in Class II, if (a) the country lacks restrictions on their distribution and use; or (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly.

22 NATIONAL GUIDELINES FOR PEST MANAGEMENT IN ZAMBIA

Zambia does not endorse indiscriminate use of pesticides and to that effect promotes an integrated pest management approach. Although agricultural policies put emphasis on agricultural productivity including promotion of pesticide use to address the low productivity issue, safe use of such chemicals is encouraged. Specifically, the following pieces of legislation have direct relevance and give guidance on pest management.

22.1 The Constitution of Zambia (Amendment), 2016

The Constitution is the supreme law of the Republic of Zambia and any other law and customary practice that is inconsistent with its provisions is considered void.

Section 255 of the Constitution sets out the principles that underpin the management and development of Zambia's environment and natural resources. Thus, the application of pesticides requires that human health and the environment are protected in line with the principles on which the constitution is based.

22.2 The Plant Pests and Diseases Act, Cap 231

This Act provides for prevention of the introduction of pests and diseases into the country and the spread thereof. The Act further provides for designation of certain pests and disease vectors as requiring destruction. The Act is enforced by the Phyto-sanitary Services Department under the Ministry of Agriculture.

22.3 The Environmental Management Act, 2011

The principal legislation governing environmental management in Zambia is the Environmental Management Act (EMA) of 2011. The Act provides for the sustainable management of natural resources and protection of the environment, and the prevention and control of pollution.

Part IV which deals with environmental protection and pollution control, particularly Division 5 of the Act deals with pesticides and toxic substances. The Act demands that a person who intends to manufacture, import, export, store, distribute, transport, blend, process, re-process or change the composition of a pesticide or toxic substance or who intends to re- process an existing pesticide or toxic substance for a significantly new use, shall apply to the Agency for a license.

With respect to pesticides, the functions of ZEMA are to:

- control the importation, exportation, manufacture, storage, distribution, sale, use, packing, transportation, disposal and advertisement of pesticides and toxic substances;
- provide for the labelling and packaging of pesticides and toxic substances;
- review the use and efficacy of pesticides and toxic substances;
- provide for the monitoring, in the environment, of pesticides and toxic substances and their residues;
- establish laboratories for pesticides and toxic substances;
- establish and enforce procedures and regulations for the storage of packages and containers of pesticides or toxic substances;
- collect data from industries on the production, use and effects on human health and the environment, of pesticides and toxic substances;

22.4 The Environmental Management (Licensing) Regulations, SI 112 of 2013

There are several parts in this statutory instrument giving regulatory powers to ZEMA to control the discharge of water pollutants, air emission pollutants, pesticides and other toxic substances, waste (both municipal and hazardous) and ozone depleting substances. The part of relevance to the project V.

Part V of the SI 112 of 2013, controls the manufacture, import, export, storage, distribution, transport, blending, processing, re-processing or changing the composition of a pesticide or toxic substance or re-process an existing pesticide or toxic substance for a new use through a licensing system. A person who intends to do any of the above activities is required to apply to ZEMA for a pesticide and toxic substance license in Form VIII set out in the First Schedule of the regulations.

Schedules 10 through 13 provide guidelines on the transportation, labelling, storage and disposal options for pesticides and toxic substances in Zambia.

These requirements all need to be complied with as a matter of statutory requirement. However, ZEMA's enforcement capacity is inadequate and cases of non-compliant are common with dealers selling repackaged pesticides without proper labelling, some labels lacking vital information while the registration process rarely includes testing and verification of the efficacy and hazard characteristics of the pesticides under consideration. Of serious concern is the fact that a list of banned or strictly restricted pesticides is non-existent thereby rendering the registration process to be porous. This therefore means that not all pesticides registered and allowed by ZEMA may necessarily be allowable under the PPCR Phase II project which would not sponsor pesticides category 1a and 1b of the WHO classification.

22.4.1 The Water Resources Management Act, 2011

The Water Resources Management Act was developed to establish the Water Resources Management Authority and define its functions and powers; provide for the management, development, conservation, protection and preservation of the water resource and its ecosystems; provide for the equitable, reasonable and sustainable utilisation of the water resource; ensure the right to draw or take water for domestic and non- commercial purposes, and that the poor and vulnerable members of the society have an adequate and sustainable source of water free from any charges; create an enabling environment for adaptation to climate change**;** provide for the constitution, functions and composition of catchment councils, sub-catchment councils and water users associations; provide for international and regional co-operation in, and equitable and sustainable utilisation of, shared water resources; provide for the domestication and implementation of the basic principles and rules of international law relating to the environment and shared water resources as specified in the treaties, conventions and agreements to which Zambia is a State Party.

Among the functions of the Authority are included the following:

ensuring extensive participation in interagency and intra-agency research planning related to climate change; and

investing in climate change education on water issues and supporting the sharing of information about Government and local responses to water impacts of climate change.

The sub project interventions where pesticides may be applied will ensure that the water resource is not contaminated to protect existing ecosystems.

22.5 The Zambia Wildlife Act, No. 14 of 2015

The Zambia Wildlife Act was promulgated among other functions to:

provide for the establishment, control and management of National Parks, bird and wildlife sanctuaries and for the conservation and enhancement of wildlife eco-systems, biological diversity and objects of aesthetic, pre-historic, historical, geological, archaeological and scientific interest in National Parks; and

provide for the sustainable use of wildlife and the effective management of the wildlife habitat in Game Management Areas.

Inappropriate application of pesticides has potential to pollute ecosystems and biological diversity, which includes wildlife.

22.6 The Forests Act, No. 4 of 2015

The Forest Act provides for the establishment and declaration of National Forests, Local Forests, joint forest management areas, botanical reserves, private forests and community forests; provide for the participation of local communities, local authorities, traditional institutions, non-governmental organisations and other stakeholders in sustainable forest management; provide for the conservation and use of forests and trees for the sustainable management of forests ecosystems and biological diversity; and establish the Forest Development Fund.

The Act also provides for the implementation of the United Nations Framework Convention on Climate Change, Convention on International Trade in Endangered Species of Wild Flora and Fauna, the Convention on Wetlands of International Importance, especially as Water Fowl Habitat, the Convention on Biological Diversity, the Convention to Combat Desertification in those Countries experiencing Serious Drought and/or Desertification, particularly in Africa and any other relevant international agreement to which Zambia is a party.

The Act is the main legal instrument for the establishment, control, utilization and management of forests. The act provides for the establishment of the Forestry Department whose main function is for the promotion of sustainable forest management.

22.7 The Public Health Act, Cap 295 of 1930

This Act provides for the prevention and suppression of diseases and the general regulation of all matters connected with public health in Zambia. Amongst other things, the Act prohibits anyone from causing a nuisance, where nuisances are given to include:

The pollution of potable water;

Any collection of water or any cesspit, latrine or urinal found to contain mosquito larvae;

Any collection of water, sewage or waste which permits or facilitates the breeding of parasites, insects or other agents which may lead to the infection of people or domestic animals;

The accumulation or deposit of waste which is offensive or injurious or dangerous to health;

The discharge or noxious matter or waste water into a water course not approved for the reception of such discharge;

Premises without sufficient lighting or ventilation;

Dangerous buildings and overcrowded premises;

Factories giving rise to smells and effluents which are offensive or dangerous to health.

GRZ will ensure that the environs of the project are in sanitary conditions and does not generate conditions that can lead to the proliferation of vermin, fly strike or other nuisances. This legislation will also govern the disposal of solid waste and wastewater generated arising from pesticide use.

22.8 The Occupational Health and Safety Act, 2010

This Act is promulgated to establish the Occupational Health and Safety Institute and provide for its functions; provides for the establishment of health and safety committees at workplaces and for the health, safety and welfare of persons at work; provide for the duties of manufacturers, importers and suppliers of articles, devices, items and substances for use at work; provide for the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work.

While it is true that some the carrying out of some interventions will be done by the communities, there is a possibility for some interventions to be contracted out. When the former occurs, the provisions of the Occupational Health and Safety Act will thus apply. Even when activities are carried out at community level, there will be need to provide for the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work.

The health and safety risks of pesticide application will need to be considered, Material Safety data Sheets (MSDS) observed, and the health and safety of employees safeguarded.

23 INTERNATIONAL AGREEMENTS

At the international level, Zambia is a signatory to both the Stockholm and the Rotterdam Conventions.

23.1 The Stockholm Convention

The Stockholm convention restricts parties from production and use of pesticides classified as Persistent Organic Compounds (POPs). These chemicals are restricted because of their chemical characteristics of not only being toxic but equally persistent with high potential for bioaccumulation.

23.2 The Rotterdam Convention

The Rotterdam Convention on the other hand provides for Prior Informed Consent and requires that any country exporting the pesticides listed under the Convention notify the recipient country in writing and get their prior written consent before the chemicals are exported. Section 10.2 is a list of pesticides banned or severely restricted by the United States of America (Environmental Protection Agency (EPA), the European Union (EU), the Stockholm Convention (for POPs) and the Rotterdam Convention (PIC), Pesticide Action Network (PAN) and the Sustainable Agriculture Network (SAN).

24 COMMON PESTS IN PROJECT AREA

This chapter presents common pests and diseases that affect production of crops in NRZ.

Communities in NRZ mainly grow legumes which include common beans (*Phaseolus vulgaris*), groundnuts (*Arachis hypogeae*), soybeans (*Glycine max*) and cowpea (*Vigna unguiculata*). Non-legume crops include grains such as maize (*Zea mays*), Sorghum (*Sorghum bicolour*), and rice (*Oryza sativa*), as well as tomatoes and okra. All these crops are vulnerable to pest attack.

25 WHAT PESTS ARE

Pests are organisms that damage or interfere with desirable plants in our fields and orchards, landscapes, or wildlands, or damage homes or other structures. Pests also include organisms that impact human or animal health. Pests may transmit disease or may be just a nuisance. A pest can be a plant (weed), vertebrate (bird, rodent, or other mammal), invertebrate (insect, tick, mite, or snail), nematode, pathogen (bacteria, virus, or fungus) that causes disease, or other unwanted organism that may harm water quality, animal life, or other parts of the ecosystem.

25.1 INSECTS

25.1.1 American bollworm: (Helliothis armigera)

American bollworm larvae feed on bud, flowers and bolls of cotton, on tomato, on bud and pods of beans and peas, on the milky-ripe grain of maize cobs, sorghum and wheat. Also, sunflower and groundnuts may be severely attacked. The larvae bore into and feed on the inner parts of the fruits or plant, often with the hind part of the body exposed.

25.1.2 Aphids (aphididae)

Aphids are small, soft bodied, more or less pear shaped polyphagus insects. They live in colonies on different parts of the plant, mostly on young shooters and leaves. They pierce and suck the plants and also produce a sugary extract which encourages the development of “sooty mould”. They also transmit viruses.

25.1.3 Armyworm (spodoptera sp.)

Army worms feed on plants of numerous families including groundnuts, maize, beans, sorghum, wheat, tobacco, tomato, rice and okra. The older stages of the caterpillars devour the leaves of their

hosts completely or leave only the midrib, while young caterpillars crap off the tissue on one side of the leaves so that they dry up.

25.1.4 Bean fly or bean stem maggot (Ophiomyia phaseoli)

This is the significant pest on beans. The small, black flies insert their eggs into the primary leaves of the seedlings. They attack the petiole and main stem to the base of the stem, where the feeding causes the swelling and cracking of the stem. Young plants when attacked start wilting and eventually die.

25.1.5 Beetles

Beetles feed on various parts of many crops. They cause damage to the leaves and they can also destroy the flowers so that fruit and seed setting is affected. For example, **lady birds (epilachna sp.)** may skeletonise the leaves of maize, wheat and cucurbits, and may cause them to shrivel dry up. Blister beetles, or **pollen beetles (mylabris sp.)**, black with red orange or yellow transverse bands, feed on the flowers of crops such as groundnuts, cowpea, beans, pasture legumes and okra, and are able to completely destroy the fruit and prevent seed setting.

25.1.6 Bugs (heteroptera sp.)

Bugs are very destructive pests which may cause great damage to many crops and are found sucking on leaves, stems, petioles, flowers and buds causing whole plants to wilt, dry up and eventually die. The grains and seeds of cereals, especially rice, wheat, sorghum and sunflower, are important sources of food for a number of bug species.

25.1.7 Cutworms (agritos sp.)

Cutworms may cause considerable damage in nurseries and newly planted fields by cutting the roots and lower stems of seedlings. During the day they remain hidden in the soil, near their host.

25.1.8 Grasshoppers (acridoidea)

They chew the leaves of plants and will attack a wide range of crops. They can also be transmitters of virus.

25.1.9 Leaf hoppers (cicadellidae jassidae)

Leaf hoppers generally live-in scattered colonies on the underside of leaves where they suck the sap, and damage the plants through their feeding and toxic salivary. They are probably more damaging as vectors of virus diseases. Their main hosts are maize, cotton, rice and groundnuts.

25.1.10 Mites (tetranychidae)

Mites are tiny, yellow or cream coloured and feed on the underside of the leaves and also produce a speckling of very small, white or yellowish spots on the leaves. The spider mites attack numerous plants for including beans, cotton, groundnuts, tomatoes, egg -plant and cucurbits.

25.1.11 Nematodes or eel worms (meloidogyne sp., Heterodera sp., Phatylenchus sp.)

These are whitish transparent microscopic, cylindrical worms and spend some of their time in the soil, penetrating the roots of the plants forming galls (root knot nematodes.). The root system is

eventually stunted and reduced. Nematodes attack a great number of plant species, including beans, potatoes, sunflower, etc.

25.1.12. Stem- or Stalk borers (busseola fusca, sesamia, calamistris, chilo partellus)

These borers feed as young larvae on the leaves while the older larvae bore into stems and inflorescences, and cause so called dead heart effect. Stalk borers are severe pests on maize, sorghum and wheat.

25.1.13. Thrips (thripidae)

These are small slender insects, 1-2mm long that pierces and suck the leaves of onions, tobacco, groundnuts, Lucerne and green legumes.

25.1.14. White fly (bemisia tabaci)

This is a tiny white insect with about 1mm in length, they live in colonies on the underside of the leaves where they suck the sup and causes leaf fall etc. direct injury is caused to many including cowpeas. They also transmit viruses.

25.2 Diseases

Crops targeted under the program are susceptible to many diseases caused by fungi, bacteria, viruses, micro plasma and nematodes. These organisms survive and propagate in various ways and may survive on plant residue, in soil, in alternate host and in or on the seed of plants. Key diseases of the target crops are as listed below:

25.2.1 Angular leaf spot (Isariopsis griseola)

Angular leaf spot causes angular, dark brown lesions on bean leaves, which can be so numerous that the leaf is given a checker board appearance. A characteristic symptom is a production of black spore-masses on the underside of the leaf.

25.2.2 Anthracnose (colletotrichum sp.)

This is common on many hosts such as beans, soya beans, cucumber, sorghum, tobacco and wheat. It causes seed destruction, cotyledon spotting and foliage browning. On leaves it often starts as dark green, water-soaked spots, which enlarge and become brown with darker borders. Dead portions of veins may be seen on the underside. On bean pods, the sunken, pink coloured cankers are conspicuous.

25.2.3 Bacterial blight (xanthonomus oryzae)

Bacterial blight appears only on rice leaves first as watery, dark green stripes, which latter become light brown.

25.2.4 Common blight (xanthomonus phaseoli) and Halo bright (pseudomonas phaseolicola)

These are both bacterial diseases of beans which may be seed borne and share many similarities in the symptoms and action. First, small water-soaked spots appear on the leaves, and then the lesions turn brown and increase. In halo blights the spots can be surrounded by broad yellow circles. Spots also appear on stems where they turn into a reddish colour. On pods, small water-soaked spots appear and grow larger. The tissue around each spot is reddish-brown. Finally, the spots dry and

form sunken areas covered with dry bacterial ooze. All kind of beans from soya beans to French beans are affected.

25.2.5 Damping off (pythium sp., Rhizoctania sp)

These are soils inhabiting fungi affecting near the soil line and thereby killing vary young seedlings before or just after emergence.

25.2.6 Downy mildew (Peronospora sp., plasmopora sp., pseudoperonospora sp.)

Downy mildews attack Lucerne, and soya beans. First symptom is a mottling with pale green areas all over the leaf. The spots soon become yellow and angular in contrast to the otherwise green blade. The entire leaf dies quickly.

25.2.7 Leaf spots

Leaf blight on sorghum, maize, wheat and rice caused by *helminthopsorium sp*., develops long pale brown spots on leaves which may spread and kill the leaves. The ears and stems may also be infected.

Leaf spots are caused by many different pathogens and appear on many crops sometimes very severely. In general, these lesions first appear on the older and lower leaves and then move upwards. They usually start as small, mostly brown, round spots which increase in number and size causing withering and premature defoliation.

Leaf spot of groundnuts (*cercopora sp.*) are small, round, brown spots increasing in numbers causing defoliation of the leaves. The yield and quality of nuts may be drastically reduced. Long pale brown spots with reddish edges on sorghum are caused by *cercospora sp*.

Leaf spots of various shapes and colours on sunflower, tomato, soya bean, sweet potato and wheat are caused by *septoria sp*.

25.2.8 Loose smut (ustilago nuda)

This is a seed borne disease of wheat and other cereals where the infection is carried inside the seed. When infected seed is planted, the mycelium of the pathogen keeps pace with the growing point of the host plant and at flowering the ear is almost completely replaced by a mass of dark brown spores. These spores are dispersed by the wind and may infect the ovary of florets on neighbouring plants. The germinating spores penetrate the ovary wall and complete the infection cycle. Control is by use of systemic fungicides capable of penetrating the seed and controlling the internal infection, or resistant varieties and certified seed.

25.2.9 Mosaic virus

Cause a mottling of light green areas and dark green patches of affected leaves. The leaves develop irregularly. The leaf edges are usually curled downwards and sometimes become very narrow. Fruits may have odd shapes and yield is reduced. The disease may be seed borne and attacks a wide range of host plants.

25.2.10 Powdery mildew (odium sp., erysiphe sp)

Symptoms are first seen as white powdery pustules on either upper or lower leaf surfaces, soon covering the whole leaf which turns necrotic.

Powdery mildew is very destructive during the dry season, particularly on tobacco, wheat, peas, cucurbits and okra.

25.2.11 Rust (uromyces sp., puccinia sp.)

This disease causes yellowish, orange, red or brown, slightly raised pustules, appearing on the leaf surfaces. Rusts are particularly important pathogens of members of the graminae family i.e. cereals and pasture grasses, but also many other crops, such as beans, peas, tobacco, sunflower, Lucerne, eggplant and sweet potatoes may be attacked, sometimes severely. They have complex life cycles frequently involving alternate hosts.

25.2.12 Wilt

Wilt can be caused either by fungal (e.g. *fusarium spp.*, *verticillium spp.*), or bacterial organisms (e.g. *xanthomonas spp.pseudomonas spp.*, *erwinia spp.*). Infected plants appear generally unhealthy, chlorotic, and wilt. The initial symptoms are a yellowing of the foliage and a gradual wilting and withering, and ultimately the plant becomes permanently wilted and dies. Wilts cause very serious losses in cotton, tobacco, potatoes, groundnut, sunflower, maize, cucumber, eggplant, cassava, etc., particularly under wet conditions.

25.2.13 Rust

Common rust (*puccinia sorgi*) is a fungus which produces small powdery pustules on the leaves of maize and other plants. Alternative host is oxalis sp. Other diseases of significant effect on maize include Southern rust (*puccinia polysora*) which is a fungus producing small pustules, lighter in colour than *puccinia polysora*). Others are Leaf blight (*helminthosporium turcicum*), a fungal disease producing slightly oval small spots on the leaves, later increasing in size as well as Stalk rot (*diplodia maydis*) a fungus causing browning of the pith of internodes which are easily broken. The cobs may also be affected. One viral disease of significant importance to maize is Maize streak virus which is transmitted by leaf hoppers and causes yellow streaks along the veins and stunted growth.

26 SEED BORNE DISEASES

Pathogens carried on or in seeds has an opportunity for early infection of the crop and act as a centre from which a disease can spread. Infected seed can be the means of introducing the disease into areas previously free, if special measures are not taken to control the importation. Table 14 presents a list of some important seed borne organisms. The list is not exhaustive.

Table 4:Some important seed borne organisms of relevance in NRZ

Crop	Organism	Disease
Maize	Fusarium spp	Cob rot

	Diplodia spp Erwinia stewartii Scleropthora microspora	Cob rot Bacterial leaf blight Downy mildew
Sorghum	Spacelotheca spp Claviceps microcephala Claviceps purpureum Ergot	Smut Ergot Fusarium moniliform Seed rot
Groundnuts	Aspegillus spp Fusarium spp	Seed rot Seed rot
Beans	Colletotrihum Lindermuthianum Pseudomonas phaseseolicola Xanthomonus phaseoli Bean common mosaic virus	Anthracnose Halo blight Common blight
Soya beans	Peronospora manshuria Sclerotinia sclerotorium Phomoosis sp Colletotrichum sp	Downy mildew Stem rot Seed rot leaf stem blight
Pea	Ascochyta pisi Mycosphaerella pisi	Leaf spot Leaf spot

26.1 WEEDS

Apart from insects and diseases, weeds are quite a significant pest which can significantly reduce crop yield if not properly managed. Weeds compete with crops for nutrients, water, and light and impair the efficiency of field machinery. Yield losses due to weed competition occur mainly during the initial stages of growth and early weed control gives the greatest increase in the yield.

27 PEST MANAGEMENT INTERVENTIONS

Ensuring sustained crop production require effective and timely control of pests which can cause crop damage or interfere with its growth either directly e.g. insects or indirectly by disease pathogens which spread diseases. Only then will the crop grow well to realise its full yielding potential. There are four common approaches to pest control namely physical or mechanical, chemical control, biological control and integrated encompassing a range of interventions.

27.1 PHYSICAL AND MECHANICAL PEST CONTROL

This option entails use of physical or mechanical means to destroy or control the target pest. This option includes examples such as:

- Weeding using hands or a hoe
- Weeding using a harrow

- Handpicking of pests e.g., removal of caterpillars or grasshoppers by hand
- Scaring away or trapping of birds
- Burning of crop residue
- Trapping of pests e.g., use of rodents or bird traps
- Putting up physical barriers e.g., a wire mesh or net to prevent pests from attacking the crop
- The advantages associated with this option are:
- Reduced risk of harm to Non-Target Plant Species due to high precision in the selection of target pest species provided the workers are well trained and committed.
- Reduced risk of harm to Fauna species due to high precision in the selection of target species provided the workers are well trained and committed.
- Reduced pollution risks (soil, water and air) in that the activity does not involve the discharge of polluting substances nor are residuals pollutants expected.

Immediate results as the pest factor is immediately removed leaving the crop free and without interference to its growth:

Reduced cost of monitoring compared to chemical or biological control methods

Lesser demand on expertise as activities such as hand pulling/picking, burning and digging/uprooting can be done by anyone with minimal training provided they are physically fit.

Less demand on sophisticated equipment as simple tools which can easily be used compared to chemical or biological means which may require relatively sophisticated equipment and technology transfer.

Employment creation as more people will be required to implement a physical/mechanical pest control program compared to use of chemicals and or biological means.

Key disadvantages include:

- Labour Intensive as it requires a lot of people to accomplish and make any meaningful impact.
- Increased Occupational Health and Safety Risks e.g., injury from snake bites, pricks and injury from use of sharp tools.
- Slow and takes long to accomplish thereby making the methods less efficient and best suited for targeting control in small areas.
- Require repeated action to eliminate or stabilize populations below injury level as the seed bank (weeds).
- Very difficult if not impossible to directly address disease infestation.
- May in itself contributes to more infestation e.g., when hand or mechanical weeding is done when the grass seed has matured and the action acts to enhance dispersal.

27.2 CHEMICAL PEST CONTROL

The chemical control option involves use of herbicides for weed control, insecticides for insect control or fungicides for disease control. These chemicals may be applied using aerial spray, tractor drawn boom spray or by knapsack sprayer targeting foliage or soil depending on nature of chemical action, level of infestation, age of the plant and size of the target area to be controlled. Tables 6-1 up to 6-4 provide a list of pesticides identified to be in general use during the study for preparation of agricultural projects in Zambia, funded by the World Bank, while Table 6-5 present a listing of banned pesticides still in use in the agricultural sector in Zambia. Amongst the key advantages of chemical control include:

Ability to control large areas with ease as pesticide application can be done covering a large area with ease within a short period of time.

Effective control potential due to high potent formulations readily available on the market thereby making pest control programs effective.

Relatively less labour intensive as pesticide applications requires less labour per unit area controlled compared to physical or manual control. This makes it easy to implement on a large scale with less labour.

Quick manifestation of control results in comparison to biological control thereby allowing for quick restoration of plant growth and productivity.

The key disadvantage of the chemical approach to pest control is pollution and health considerations together with uncertainty on the chemical's effect on valued non target plant and animal species. Other disadvantages include:

Increased Occupational health and Safety Risks e.g., chemical poisoning if not properly handled.

Soil and water contamination thereby limiting the use to which the available water and land can effectively be put to.

Long term residual effects as some chemicals have potential to remain potent in the environment for a long time thereby limiting other land use activities.

Public Health concerns equally count among the disadvantages of pesticide use as many pesticides have been discovered to have carcinogenic effects apart from causing reproductive and growth problems as these chemicals ate taken up by humans through the food chain.

Chemical resistance can also be triggered where chemicals are continuously used for specific target species thereby rendering the chemical ineffective in the long run.

27.3 BIOLOGICAL PEST CONTROL

The biological control option involves use of animals, insects, bacteria or viral agents which can either be predators (e.g., predatory bugs and spiders), parasites (e.g., some type of wasps) or pathogens (e.g., types of bacteria, fungi, viruses, nematodes) to feed on or attack the target pest species with the aim of killing or suppressing their growth and development. For example, Lady Beetles feed on aphids. In most cases control is achieved when the population level of the introduced biological agent has reached its peak to overwhelm the target pest species being controlled. The advantages of biological control include:

Cheap to run once established as there are no incremental costs and invasive control remain effective over time

Pollution free as the control method does not present pollution risks to the environment even though the potential of the agent mutating to attack and contaminate other species cannot be ruled out.

Amongst the key disadvantages are:

High capital investment in breeding the biological control agent to critical population levels for effective control

Risk of the control agent attacking the non- target plant or animal species.

The need for long term monitoring of aftereffects is another disadvantage as the behaviour and characteristics of a given biological control agent can change over time and become invasive thereby affective beneficial plant and animal species.

Delayed manifestation of results as biological control takes long to reach equilibrium and may not be ideal where results are needed in a short period of time

27.4 INTEGRATED APPROACH TO PEST CONTROL

The Integrated Pest Management (IPM) option involves the systematic application of more than one option for enhanced effectiveness and is based on the principle of ecosystem management to create a conducive environment for the crop and less so for the pest. The approach is effective in that a health crop will have better resilience and ability to withstand pest attack or competition than a weak plant. Consequently, apart from proper and well measured integration of the physical/mechanical, chemical and biological it also embraces cultural practices aimed at manipulating environmental conditions such as proper provision of nutrients and water, crop rotation, intercropping, strip/alley cropping, use of natural pest repellents, use of resistant varieties, use of natural/plant-based pesticides as opposed synthetic ones etc. This option is noted to be more effective than any single method because of the combined effect of the various control methods incorporated. It also focuses on pest specific interventions thereby limiting harm to non-target species, the environment and human life in general.

The main disadvantage of this option is that it is more expensive than any single option due to incremental activities required. It also requires the based on a full understanding of each target pest's life cycle in order to identify the best point of intervention and as such takes long to effectively develop. However, the approach can cost effective if well planned with constant monitoring of crop fields thereby allowing for selection of the best option or combination of options capitalizing on more environmentally friendly and effective low-cost interventions.

One major challenge in implementing the IPM approach to pest management is lack of knowledge about IPM, its practice and full benefits amongst the majority of farmers and service providers of the agricultural extension service inclusive. It should however be appreciated that aspects of IPM are unconsciously implemented as these constitute part of the traditional way of farming e.g., intercropping and crop rotations as well as shifting cultivation and fallowing. However, the practice is not applied to its full whether on the part of the commercial or subsistence farmers. Similarly, at research level the practice does not receive the attention it deserves.

28 STATUS REVIEW OF PEST MANAGEMENT IN ZAMBIA

Pests continue to present a major challenge in crop production in Zambia. Consequently, pest management is one of the major aspects of crop management in Zambia. Whilst appreciating the benefits of adopting an IPM approach to pest management, knowledge about the full benefits and practice of IPM is generally lacking. It should however be appreciated that aspects of IPM are implemented as these constitute part of the traditional way of farming e.g. intercropping and crop rotations as well as shifting cultivation and fallowing. However, the practice is not applied to its full whether on the part of the commercial or subsistence farmers.

The most widely applied mode of pest control constitutes physical/mechanical mostly by resourced poor small-scale farmers and chemical control (mostly by resource rich commercial farmers and moderate resource rich emergent farmers). Biological control is very limited in both cases. Unlike trends in chemical use where more and more farmers are adopting pesticide use including small scale farmers biological control remain static in its application even though aspects of its may be taking place in fields without the conscious knowledge of the farmers. The growing trend in pesticide use however raises concern regarding occupational, public and environmental health.

A survey conducted on some farmers and agro dealers during a project review exercise for the Conservation Agricultural Project implemented under the Conservation Farming Unit of the Zambia National Farmers Union showed that only basic information on pesticide use exists. It was further revealed that much of this information was limited to occupational health and little information was made available concerning public and environmental health such as the fate of herbicides in the soil, potential for surface and ground water contamination and the implications thereof. Information on the long-term effects (e.g. mutagenic, carcinogenic and reproductive effects) was also not so much availed together with information on what to do in case of acute effects such as poisoning in direct ingestion cases. Other observations made included the following:

Material Safety Data Sheets (MSDS) are not readily available. Most agro dealers, especially small-scale dealers do not stock them and some do not even know them. Even large dealers too do not make these readily available.

Information on MSDS is too detailed in some cases and may contain user unfriendly information and does not encourage many users to read. In other cases, the information is scanty and does not contain all the important information about the product and its effects yet in other cases the information is contradictory from manufacturer to manufacturer

Labels (which should ideally contain vital information from MSDS) on some products are not user friendly – too small to read and language too technical

The different formulations of the same product e.g., Atrazine has 25%, 42%, 90% etc formulations by different manufacturers and this present a challenge to the user since he/she has to deal with one chemical bearing different product formulations whose degree of effects/effectiveness are different due to varying concentrations. This situation becomes more challenging when calibrating sprayers to ensure correct concentration of the chemical sprayed

Information on herbicide use does not in most cases include the aspect of sprayer calibration yet this information has a strong bearing on correct dosage application.

The tendency by agro dealers to offer an alternative where the farmer's preferred or known product choice is unavailable presents a challenge to application of the acquired knowledge in that the new product may present knowledge requirements which are not yet possessed by the user thereby increasing the risk of poor handling/management and consequent risks.

The hurried manner in which agro dealers provide the information on the use of agro chemicals in general is inadequate to facilitate adequate knowledge for effective use of the product. Practical demonstrations are vital in most cases for effective learning, but agro-dealers are not readily available for this purpose.

In view of the above it is desirable that:

The Zambia Environmental Management Agency (ZEMA) and other players such as the Zambia Agrochemical Association (ZAA) be included in the implementation of the ZIFLP to build capacity and put in place an effective monitoring system that ensure that only registered herbicides are being distributed to farmers and that formulations are maintained in their registered state (without re-formulation) and that farmers acquire appropriate knowledge in the use of pesticides.

All dealers should have in possession Material Safety Data Sheets (MSDS) for all chemicals being sold and this information should be explained to buyers. An MSDS is a source of information on likely hazards that may arise from the use of chemicals. Generally, an MSDS should contain information such as:

Pesticide Identification (Name of the substance/trade name; preparation/other ingredients.

Name, address and telephone of company/supplier

Composition and information on ingredients

Hazards identification

First aid measures

Fire-fighting measures

Spillage, accident release measures

Handling and storage

Exposure controls and personal protection

Physical and chemical properties

Stability and reactivity

Toxicological information

Ecological information

Disposal considerations

Transportation information

National regulations and references - Other information deemed appropriate.

Further, a simplified sheet should be made available to target farmers in a language easily understood by them. Farmers interviewed and some dealers were unable to confirm availability of MSDSs.

29 IMPLEMENTATION PLAN FOR ZIFLP

The preferred approach to pest management under the ZIFLP is IPM. This section provides guidance on how best to maximize pest management interventions with minimal negative impacts on the environment and human health using the principles of IPM. The section is not meant to provide a detailed prescription of cultural practices required to raise each target crop as such information is very well appreciated by both research teams and farmers. Further, cultural practices differ widely depending on the characteristic of each particular crop species being grown and the agro-ecological and other environmental conditions prevailing at each particular site. Rather, the section is meant to bring to the fore vital IPM considerations for incorporation in prevailing cultural practices applicable at each project site. It should be noted that IPM cannot be applied as a cast

transplant of interventions and practices, rather it is a set of interventions developed based on a good understanding of prevailing environmental and other conditions at a given field incorporating the most fitting aspects of IPM tools commensurate with resources at the farmer's disposal. This can be achieved by following a stepwise process elaborated below:

29.1 STEP 1: FIELD ASSESSMENT AND PEST IDENTIFICATION

The first step in IPM is crop or field monitoring involving observations of the field and immediate surroundings to identify the presence of pests or conditions which may be conducive for pest proliferation within the context of prevailing cultural practices. **This exercise should be carried out at every stage of the crop calendar starting at harvest through field preparation up to harvest time again.** This exercise may involve walking through each field randomly or following a transect pattern taking note of pest infestation, growth stage and rates of infestation for each pest species in a given crop. The information collected can then be recorded and ranked to give an indication of relative prevalence for each category of pest. Pests recording a higher level of infestation will in this way be prioritized for action while giving not losing site of the need to address the other pests too though prevailing at a relatively lower rate of infestation.

The importance of conducting an all year round monitoring of pests is to ensure collection of adequate information for planning purposes. This is because effective IPM requires timely planning. For example, identification of pests prevailing at harvest time and their pattern of growth will help to plan the next crop with a view to controlling the identified weeds in a timely manner. The historical data collected through such monitoring will thus provide vital information in planning the best combination of IPM interventions.

29.2 STEP 2: THRESHOLD DETERMINATION AND ACTION PLANNING

Results of field assessment conducted should lead to a determination of whether or not action is needed to address the pest or condition prevailing as well as decision making on when to institute such action. Where a pest is present an assessment of the level of infestation is made and if it reaches a threshold of potential damage appropriate preventive action should be taken against that particular pest or a combination of pests using any or a combination of biological, cultural, physical/mechanical and chemical management tools. In this way, rather than having a fixed scheduled program of e.g. chemical spray, results of monitoring should help decide if or not action should be taken and the nature and level of action to be taken. Similarly, results of environmental conditions monitoring will be used to determine and assess if or not the prevailing conditions favour pest infestation or plant growth based on which action can be taken to manipulate the ecosystem or environmental conditions in favour of the crop.

29.3 STEP 3: IPM IMPLEMENTATION

The implementation stage will involve application of one or a mix of IPM interventions identified as best suiting under prevailing circumstances. Below are a number of considerations to be borne in the implementation of choice interventions.

29.3.1 Considerations under Physical/Mechanical Control

Develop and strictly enforce adherence to safety rules and codes of conduct;

Provide training to all staff on occupational health and safety as well as on ensuring personal protection and safety;

Provide appropriate safety gear;

Reduce the harmful characteristics of impact sources by devising less harmful ways of effecting project activities

Localize project impacts as much as possible by taking precautions in effecting project activities so as to limit effects on non-target elements of the environment

Explore ways and means of enhancing the resilience and regenerative/recovery capacity of impacted elements of the environment deemed useful

Streamline Better Management Practices as an integral part of project implementation.

8.3.2. Considerations under Biological Control

Use proven host specific biological control agents,

Conduct specificity tests in the host environment before release,

Quarantine biological control agents undergoing specificity test.

Develop and strictly enforce adherence to safety rules and codes of conduct;

Provide training to all staff on occupational health and safety as well as on ensuring personal protection and safety; Provide appropriate safety gear; Provide First Aid medical facilities;

Recruit qualified First Aid Attendants; Maintain emergency responsiveness

Reduce the harmful characteristics of impact sources by devising less harmful ways of effecting project activities

Localise project impacts as much as possible by taking precautions in effecting project activities so as to limit effects on non-target elements of the environment

Explore ways and means of enhancing the resilience and regenerative/recovery capacity of impacted elements of the environment deemed useful

Streamline Better Management Practices as an integral part of project implementation.

29.3.2 Considerations under Chemical Control

Consider both human health and environmental effects of target pesticides before use

- Sensitize and train workers on pesticide management, calibration of sprayers,
- Develop and enforce protocols for safe use of pesticides
- Avoid direct spray on water bodies,

Avoid washing sprayers in natural water bodies,

Avoid spraying during windy conditions, wear personal protective gear (appropriate respirators), avoid spraying in areas close to settlements and other populated areas, use wetting agents to minimize dripping.

Use only recommended pesticides at recommended application rates. Do not overdose,

Contain any spills and clean up to avoid contamination of the environment

Dispose of chemical containers properly

Develop and strictly enforce adherence to safety rules and codes of conduct;

Provide training to all staff on occupational health and safety as well as on ensuring personal protection and safety;

Provide appropriate safety gear;

Reduce the harmful characteristics of impact sources by devising less harmful ways of effecting project activities

Localise project impacts as much as possible by taking precautions in effecting project activities so as to limit effects on non-target elements of the environment

Explore ways and means of enhancing the resilience and regenerative/recovery capacity of impacted elements of the environment deemed useful.

Streamline Better Management Practices as an integral part of project implementation.

Store pesticides under lock and key on impermeable surface that is bundled

Wash hands before eating, drinking or using the toilet.

Remove clothing immediately if pesticide gets inside, wash thoroughly and put on clean clothing."

Appendices 1 and 8 further elaborates considerations needed in chemical control of pests.

29.3.3 Considerations under Cultural Practices

Timely removal of weeds before they seed to reduce seed bank build up

Cleaning of equipment to eliminate potential sources of infestation

Use of clean seed free of pests and diseases

Cleaning the field before planting. This can be done e.g. by allowing weeds to germinate before planting after which they can be controlled by a choice of appropriate herbicide or cultivation and planting thereafter

Avoid clearing and burning non target plants

Control erosion by limiting land clearing and setting up sediment traps along storm ways

Develop and strictly enforce adherence to safety rules and codes of conduct;

Reduce the harmful characteristics of impact sources by devising less harmful ways of effecting project activities

Localize project impacts as much as possible by taking precautions in effecting project activities so as to limit effects on non-target elements of the environment

Explore ways and means of enhancing the resilience and regenerative/recovery capacity of impacted elements of the environment deemed useful

Streamline Better Management Practices as an integral part of project implementation.

Provide training to all staff on occupational health and safety as well as on ensuring personal protection and safety;

Provide appropriate safety gear;

30 INSTITUTIONAL ROLES AND RESPONSIBILITIES

Implementation of the IPMP under the ZIFLP will require effective participation of key players in a coordinated manner under the leadership of Ministry of Green Economy and Environment. Key players in this regard and their roles are presented in table below:

Table 5:Institutional Roles and Responsibilities

No.	Institution	Proposed Responsibility
1	Extension staff under the Ministry of Agriculture	Provide training and other forms of knowledge transfer to farmers on the management of pests affecting their fields/crops including practical knowledge on IPM, knowledge on choice, safe use and disposal of pesticides
2	Participating farmers	Control pests in their fields in compliance with the provisions of this IPMP and other applicable protocols

3	ZEMA, the Regulatory Agency in pesticide management	Effectively enforce the provisions of the Environmental Management (Licensing) Regulations, SI 112 of 2013 Conduct awareness and sensitization campaigns on pesticides not allowed in the country and safe usage Conduct environmental monitoring for pesticide contamination and take corrective action were applicable.
4	Pesticide Dealers	Ensure that only registered pesticides are sold Comply with the provisions of the Environmental Management (Licensing) Regulations, SI 112 of 2013 on importation, transportation, storage distribution and disposal of pesticides Fully understand the pesticides in their custody including pesticide toxicity, health and safety hazards and environmental risks Provide information to farmers and other buyers on safe use and management of pesticides
5	Agro Chemical Association of Zambia	Promote the safe use of pesticides by ensuring that all their members comply with the provisions of the PTS Regulations and other protocols relating to agrochemical management including those of FAO, WHO, Rotterdam Convention,
6	Seed Control and Certification Institute (SCCI)	Enforce compliance with protocols for safe breeding and production of seeds and ensure that only certified seed is on the market in compliance with the provisions of the Plant Variety and Seeds Act.
7	Zambia Bureau of Standards	Enforce pesticide product standards by actively monitoring the market and testing products to ensure quality in efficacy and other aspects of the product

31 TRAINING AND CAPACITY BUILDING

A number of capacity building interventions will be required under the project in order to ensure effective implementation of the IPMP in an environmentally friendly and socially acceptable manner. The following interventions are hereby proposed:

Training of staff in the life cycle management of pesticides covering selection, usage and safe disposal of containers. Trainees should be sensitized enough to use only pesticides with authentic and clear labels showing all the necessary information including expiry dates, occupational/public health and safety as well as basic environmental safeguards. This will also help avoid adulteration and sale of expired herbicides.

Building capacity in ZEMA for enhanced monitoring of importation, production, distribution and use of pesticides

Training/Sensitisation in the use of personal protective equipment, treatment of any pesticide poisoning, interpretation of material safety data sheets and labels on pesticide containers and safe storage of pesticides

Training in First Aid and Emergency Response with a focus on treatment of chemical poisoning and pesticide spill management

Sensitisation on weather and other environmental related considerations insecticide application e.g., avoiding spraying when it is about to rain, when it is windy, when it is too hot or when the soil is wet or in ponded areas or areas close to water sources (e.g., rivers, dambos, wells, etc) and populated areas.

Training will be provided in both formal and informal settings including Field Days as appropriate in meeting the specific training objectives. A training needs assessment would help in setting the training agenda and ensure that the training sessions area relevant and tailored to answer to farmers' pressing information needs. Table below is a Capacity Building Implementation Plan for the proposed IPMP.

Table 6:Capacity Building Implementation Plan and Budget

No.	Activity	Start Date	End Date	Responsibility	Proposed budget (US $)
1	Training in safe and environmentally friendly pesticide use including (i) understanding and interpretation of labels and symbols on pesticides, (ii) formulation, dosing and calibration of equipment, (iii) transportation, storage and disposal of pesticides and pesticide containers and (iv) personal safety and hazard understanding for self-health protection	Year 1 (formal training) Year 1 (Awareness and sensitisation)	Year 3 Year 5	Provincial Government staff/ Safeguards Specialists	Provided in total budget
2	Construction /rehabilitation of basic pesticide storage facilities	Year 2	Year 3	Safeguards Specialist at PIU/ Safeguards Specialist at NPCU	10 000
No.	**Activity**	**Start Date**	**End Date**	**Responsibility**	**Proposed budget (US $)**
3	Training, sensitization and Awareness in IPM and its implementation	Y 1 (formal training) Year 1 (Awareness and sensitisation)	Year 4 Year 5	Provincial Staff/Safeguards Specialists	provided in total budget

4	Development and enforcement of an occupational health and safety protocol covering (1) mechanical control, chemical (2) control and (3) biological control aspects of occupational health and safety.	Year 1	Y 1	Safeguards Specialists	provided in total budget
Total					**29 000**

31.1 Monitoring and Reporting

Effective implementation of the IPMP will require regular monitoring of its implementation for timely corrective actions. Monitoring will cover all aspects of the IPMP implementation starting at the field level where all participating institutions will monitor aspects such as:

31.1.1 Implementation of proposed capacity building interventions

Adoption and Effectiveness of the chosen combination of IPM interventions e.g., by monitoring the number of research and seed production programs implementing IPM and level of effectiveness

Environmentally friendliness of applied IPM interventions e.g., by monitoring the prevalence/survival of non-target plant and animal species

31.1.2 Soil and water contamination

Public and occupational health and safety e.g., Incidences of poisoning or injury

Monitoring results will be used to improve implementation of the IPMP through documentation of lessons learnt on the most effective, environmentally friendly and cost-effective combination of interventions.

The proposed plan for monitoring IPMP implementation is presented on Table below.

Table 7:IPMP Monitoring Plan

IPMP Activity	**Where is the parameter to be monitored?**	**How is parameter to be monitored/type of monitoring equipment?**	**/Frequency of measurement or continuous?**	**Annual Monitoring cost:** (USD)	**Responsibility**
Training in safe use of chemicals	Training programs and attendance lists	Review of training documentation, trainee interview	Annual	Included in project coordination and management costs	Provincial Ext. staff
Training in IPM	Training programs and attendance lists	Review of training program, trainee interview	Annual	Included in project coordination and management costs	Provincial focal point. staff/Safeguards Specialists at PIU
Ground water pollution	Borehole, water well in target fields/areas as appropriate	Sampling and lab analysis	Semi-annually effective year after use of project procured agrochemicals	To use existing government facilities 6 000	Provincial extension staff/Safeguards Specialists
Surface water pollution	Runoff receiving water body	Sampling and lab analysis	Semi-annually effective year after use of project procured agrochemicals	6 000	Provincial focal point staff

Soil contamination	soil in target fields	Sampling and lab analysis	Semi-annually effective year after use of project procured agrochemicals	9,000	Provincial focal point staff
IP adoption and effectiveness	Commodity research teams and farmers	Social surveys	Annual effective first year of training and sensitisation	12 000	Provincial point Staff/ Safeguards Specialist
Public and occupational health and safety concerns such as poisoning due to misuse or improper handling of pesticides	Workers and surrounding community	Incidence reports/surveys	Each time incidence is reported Annual surveys in surrounding communities	Included in operational costs 15 000	Farmers/ Provincial Extension staff /Safeguards Specialist
Occupational health and safety concerns such as injury due to poor working conditions	Workers	Incidence reports/surveys	Each time incidence is reported Inclusion of agenda item in staff meetings	Included in operational costs	Farmers/ Prov. Focal point Officers
TOTAL				**48 000**	

31.2 Proposed Budget

Effective implementation of the IPMP will require adequate provision of funds to cover planned activities. The Table below gives an indicative budget for implementation of the plan. It should however be noted that the adopted IPM approach in practice will mean spreading pest management costs across all aspects of crop management in breeding, seed multiplication, demonstration fields and postharvest management of crop. Therefore, only aspects aimed at capacity building and monitoring are included here as elaborated in the implementation and monitoring plans in the preceding sections.

Table 8:Cost for Implementing the IPMP

No	Activity	Cost (US $)
1	**Training and Capacity Building Costs**	
1.1	Training, sensitization and Awareness in IPMP and its implementation	15,000
1.2	Training in safe and environmentally friendly pesticide use including (i) understanding and interpretation of labels and symbols on pesticides, (ii) formulation, dosing and calibration of equipment, (iii) transportation, storage and disposal of pesticides and pesticide containers and (iv) personal safety and hazard understanding for self-protection	30,000
1.3	Training and sensitization in biological control of pests	14,000
1.4	Development and enforcement of an occupational health and safety protocol covering (1) mechanical control, chemical (2) control and (3) biological control aspects of occupational health and safety.	10,000
2	**Monitoring and Reporting Costs**	
2.1	Water sampling and analysis (surface water resource)	5,000
2.2	Water sampling and analysis (underground water resources)	5,000
2.3	Soil sampling	9,000
2.4	Monitoring of trial biological control programs	6,000
2.5	Monitoring of IPM adoption and implementation	6,000
	Total Costs	**100,000**

32 REFERENCES

1. Project Documentation for ZIFLP
2. World Bank OP 4.09
3. Crop Protection Handbook 2009 MEISTER PRO
4. The Who Recommended Classification of Pesticides by Hazard and Guidelines To Classification 2009
5. Major crop Diseases Manual of Zambia
6. Zambia Seed Technology Handbook
7. Agricultural Field insect Pest of Zambia and Their Management
8. Improved Vegetable Production Practices for Smallholder Farmer in Zambia
9. GRZ, 1997, Environmental Impact Assessment Regulations, Government Printers
10. GRZ, 2011, Environmental Management Act, Government Printers
11. GRZ, 2016, The Second National Policy on Agriculture, Ministry of Agriculture and Livestock

33 APPENDICES

33.1 APPENDIX 1: PRECAUTIONS FOR USING PESTICIDES

Pesticides are poisonous and must be used with caution. **READ THE LABEL BEFORE OPENING A PESTICIDE CONTAINER**. Follow all label precautions and directions, including requirements for protective equipment. Apply pesticides only on the crops or in the situations listed on the label. Apply pesticides at the rates specified on the label or at lower rates. Avoid using pesticides where alternative options work. Use the right equipment

Legal Responsibility: The user is legally responsible for any damage due to misuse of pesticides. Responsibility extends to effects caused by drift, runoff, or residues.

Transportation: Do not ship or carry pesticides together with food or feed in a way that allows contamination of the edible items. Never transport pesticides in a closed passenger vehicle or in a closed cab.

Storage: Keep pesticides in original containers until used. Store them in a locked cabinet, building, or fenced area where they are not accessible to children, unauthorized persons, pets, or livestock. DO NOT store pesticides with foods, feed, fertilizers, or other materials that may become contaminated by the pesticides.

Container Disposal: Dispose of empty containers carefully. Never reuse them. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Consult your county agricultural commissioner for correct procedures for handling and disposal of large quantities of empty containers.

Protection of Non pest Animals and Plants: Many pesticides are toxic to useful or desirable animals, including honeybees, natural enemies, fish, domestic animals, and birds. Crops and other plants may also be damaged by misapplied pesticides. Take precautions to protect non pest species from direct exposure to pesticides and from contamination due to drift, runoff, or residues. Certain rodenticides may pose a special hazard to animals that eat poisoned rodents.

Posting Treated Fields: For some materials, *restricted entry intervals* are established to protect field workers. Keep workers out of the field for the required time after application and, when required by regulations, post the treated areas with signs indicating the safe re-entry date. Check with your county agricultural commissioner for latest restricted entry interval.

Pre-harvest Intervals: Some materials or rates cannot be used in certain crops within a specified time before harvest. Follow pesticide label instructions and allow the required time between application and harvest.

Permit Requirements. Many pesticides require a permit from the county agricultural commissioner before possession or use. When such materials are recommended, they are marked with an asterisk (*) in the treatment tables or chemical sections of this publication.

Processed Crops: Some processors will not accept a crop treated with certain chemicals. If your crop is going to a processor, be sure to check with the processor before applying a pesticide.

Crop Injury: Certain chemicals may cause injury to crop (phyto-toxicity) under certain conditions. Always consult the label for limitations. Before applying any pesticide, consider the stage of plant development, the soil type and condition, the temperature, moisture, and wind. Injury may also result from the use of incompatible materials.

Environmental Conditions: Apply in the evening and avoid doing so during hot days (to avoid vapourisation and the risk of chemical vapour inhalation) as well as reduced efficacy due to rapid degradation of chemical under heat. Rainy days should also be avoided as the pesticide will easily be washed off the crop.

Personal Safety: Follow label directions carefully. Avoid splashing, spilling, leaks, spray drift (avoid spraying when it is windy), and contamination of clothing. NEVER eat, smoke, drink, or chew while using pesticides. Provide for emergency medical care IN ADVANCE as required by regulation.

Adopted from University of California Agriculture and Natural Resources, Integrated Pest Management Program. The above provisions are in tandem with the provisions contained in the Environmental Management (Licensing) Regulations under the Environmental Management Act (2011)

33.2 APPENDIX 2: TRANSPORTATION OF PESTICIDES AND TOXIC SUBSTANCES

(Tenth Schedule of the Environmental Management (Licensing) Regulations)

GENERAL GUIDELINES FOR TRANSPORTATION OF PESTICIDES AND TOXIC SUBSTANCES

Ensure that the emergency procedure information card relating to the pesticide(s) or toxic substance(s) is in the vehicle or conveyance.

Ensure that all hazard warnings are displayed, not obstructed, and that they are kept clean at all times.

Follow the route as advised by the transporter or operator.

Ensure that the vehicle is not left unattended at any time

Ensure that the vehicle has certificate of fitness.

Ensure that the First Aid Equipment is in the vehicle at the times.

WARNING SIGNS FOR VEHICLES TRANSPORTING PESTICIDES OR TOXIC SUBSTANCES

A hazard-warning panel for pesticides and toxic substances shall be in form of an equilateral triangle and a square set with its sides at an angle of 45^{o} to the vertical respectively and the length of the sides shall be

a) in the case of signs on hazard-warning panels, 200millimetres; or

b) in the case of signs on compartment labels 95millimetres.

A sign for hazard-warning panels shall, for any part of the sign that is not black, have a black border at least 5millimetres wide.

HAZARD-WARNING PANELS FOR TRANSPORTATION OF PESTICIDES AND TOXIC SUBSTANCES

Product	*Colour of Symbol*	*Lettering*	*Background*
Flammableliquids	Black	Black	Red
Flammablegases	Black	Black	Red
Flammablesolid White with vertical red stripes		Black	Black
Corrosive substances	Black	White	White upper half black lower half
Toxic gases	Black	Black	White
Organic peroxides	Black	Black Black	Yellow
Oxidising substances	Black	Black	Yellow
Substances emitting			
spontaneously	Black	Black	Blue flammable gases when in contact with water
Harmful substances	Black	Black	White upper half combustible

HAZARD-WARNING SYMBOLS FOR TRANSPORTATION OF PESTICIDES AND TOXIC SUBSTANCES

Colour Code	*Warning*
Red	Danger
Purple	Danger
Amber	Warning
Green	Warning

34 LABELLING OF PESTICIDES AND TOXIC SUBSTANCES

(Eleventh Schedule of the Environmental Management (Licensing) Regulations)

PICTOGRAMS

The pictograms set below shall be put on labels either as singly or in combination with appropriate ones to give complete instructions.

Flame	Flame over circle	Exploding bomb
		
Corrosion	Gas cylinder	Skull and cross bones
		
Exclamation mark	Environment	Health Hazard
		

COLOUR CODING CLASSIFICATION FOR PESTICIDES

			Oral		Dermal	
Hazard Class	*Color Band*	*Signal Word*	*LD50 (mg/kg bw)*	*Hazard Statement*	*LD50 (mg/kg bw)*	*Hazard Statement*
Category 1	Red	Danger	5 or less	Fatal if swallowed	50 or less	Fatal in contact with skin
Category 2	Red	Danger	5 - 50	Fatal if swallowed	50 - 200	Fatal in contact with skin
Category 3	Yellow	Danger	50 - 300	Toxic if swallowed	200- 1000	Toxic in contact with skin
Category 4	Blue	Warning	300 - 2000	Harmful if swallowed	1000 - 2000	Harmful in contact with skin
Category 5	Green	Warning	2000 -10000	Maybe harmful if swallowed	2000 - 10000	Maybe harmful in contact with skin`

35 STORAGE OF PESTICIDES AND TOXIC SUBSTANCES

(Twelveth Schedule of the Environmental Management (Licensing) Regulations)

WAREHOUSING

A pesticide and toxic substance warehouse should be located away from homes, highly populated areas, drinking water sources, seismic activity and areas liable to flooding.

The floors in the building should be of concrete with a load bearing capacity sufficient to withstand the weight of the stock, racking and any mechanical handling equipment to be used. Floors should be impervious to liquids, free from cracks and smooth to facilitate cleaning.

The building should be designed such that escape in case of emergency should be possible in at least two directions. Emergency exits should be clearly marked.

The warehouse should have access from at least two sides to facilitate firefighting, regardless of wind direction.

A warehouse should have special provision for bunding.

The building should permit reasonable movement of materials and enough space to allow hygienic working conditions and clear access to fire-fighting equipment.

The walls of the warehouse should be of non-flammable type and all piping and electrical wiring should be sealed.

The roof of the warehouse should be able to effectively keep out rain, be able to provide both ventilations to allow fumes and heat to escape in case of fire and at the same time provide protection against direct sunlight.

The warehouse should have drains which should not be directly linked to waterways or public sewers. They should be linked by a closed system to an evaporation tank.

The evaporation tank should be emptied from time to time depending on the accumulation of solid waste. It should be covered during the rainy season to avoid filing by rainwater.

36 STORAGE

All products should be stored under lock and key with proper warning signs displayed clearly to keep away unauthorised persons. Pesticides and toxic substances must be stored in a separate warehouse, away from any other goods especially food and stock feed.

Before storing any pesticides ensure that they are properly labelled and are of good quality and acceptable condition. If any of the products are not in good condition, do not store them together with other products but take appropriate action.

If pesticides and toxic substances are to be stacked inside the warehouse, stacking heights should not exceed three metres unless the use of racking prevents overloading of the lower tiers.

Persons loading pesticides and toxic substances in the warehouse should pay special attention to "THIS SIDE UP" signs on cartoned packs.

Pesticides and toxic substances should be stored separately, preferably according to their use in the field e.g., herbicides, insecticides etc. The objective of this is to prevent cross contamination as well as minimise the risk of fire and consequent environmental contamination often presented by mixed storage arrangements.

All stocks in the warehouse should be frequently inspected for firmly fixed and legible labels on containers, leakages, caking of powders, pulverisation of granules, sedimentation or gelling of liquids, change in colour due to oxidation, dampness of packages and corrosion or deterioration of containers. All leakages must be treated as being extremely toxic.

Spillages should not be cleaned out with water. They must be swept up and kept in a special labelled container awaiting safe disposal. Liquids should first be absorbed by saw dust, earth or any other absorbent before being cleaned up.

A warehouse must have an emergency spills treatment kit consisting of a PVC apron, neoprene gloves, a gas mask, a brush or broom, a dustpan, saw dust, earth or any other absorbent, an empty clearly labelled container (for collecting wastes) and a spade.

Always strictly follow the rule "First-in First-out".

37 DISPOSAL OPTIONS FOR PESTICIDES AND TOXIC SUBSTANCES

(Thirteenth Schedule of the Environmental Management (Licensing) Regulations)

Pesticides and toxic substance waste, expired pesticides or toxic substances and spillages, obsolete and leftover products and packaging materials for pesticide and toxic substances shall be disposed of in the following manner:

Product Use by Recycling If an alternative use exists, the product may be re- used or may be reformulated for the purpose for which it is included to be used.

High Temperature Incineration (High Temperature Thermal Oxidation) Should be considered when disposing of most pesticides and toxic substances, but should NOT be used when disposing-

inorganic materials; or

organic products containing heavy metals such as mercury and lead.

Chemical Treatment Shall be used as a disposal technology for a few specific unformulated pesticides and some other toxic substances. The products of decomposition from such treatment should not be toxic or present environmental hazard.

Long Term Storage Compounds including those containing heavy metals and in particular, organo-mercury compounds cannot be disposed of safely using existing technology. These products shall be contained and stored safely until a suitably acceptable disposal technology is developed. A full risk analysis should be made for all materials stored to ensure maximum safety over the longest foreseeable period.

Landfill (For Incinerator Ash and Slag Only) Landfilling is not an acceptable disposal option for pesticides and toxic wastes which can be leached. Incinerator ash and slag can be disposed of at approved landfill sites.

Waste Solidification/Fixation The process involves the mixing of chemical and other waste with building materials such as cement, silicates and polymers, causing the mixtures to solidify into an impervious mass. Waste treated in this way can be disposed of at a landfill. This should be applicable to inorganic waste. Organic waste could easily leach into ground water with time and should therefore not be used in disposing organic pesticides or toxic substances.

37.1 Packaging Materials Disposal

Contaminated packaging material shall be disposed of as follows:

Export -Where no safe disposal facilities exist in Zambia, export of pesticide and toxic waste to another country with facilities shall be done in accordance with these Regulations and the applicable law in that country.

Return to Manufacturer–if the manufacturer is willing to accept pesticides or toxic substances wastes or expired obsolete stocks.

37.2 INSTRUCTIONS FOR CLEANING UP SPILLS AND LEAKED PESTICIDES

First read the instructions on the product label or material safety data sheet.

All unauthorized persons should be kept away from the contaminated area.

The store should be ventilated immediately as much as possible.

Work in teams of at least two people. All persons involved should wear appropriate protective clothing. Eyewash, water and soap should be kept at hand.

In case of leakage: put the leaking drum into another drum or pump its content into another drum. As a very temporary "first aid" measure, it is often possible to stop leakage by rolling the drum in such a position that the leak is on top.

Absorb the leaked product with absorbent material (sand, sawdust, earth, lime or spill-control material), sweep up and pack the material. Lay a ring (small dike) of absorbent material around the contaminated area. Wet the area with a detergent solution (e.g., 10 percent saturated sodium carbonate solution or 5 percent caustic soda solution), scrub the floor and then sweep the solution into the ring of absorbent material. Remove the material after all liquid has been absorbed. Repeat if necessary. Clean equipment with detergent solution.

Contaminated soft surfaces of earth, sand or gravel should be excavated, packed and labelled. Contaminated absorbent materials and soil should be regarded as hazardous waste and should be carefully packed and properly labelled for disposal or temporary storage until disposal can take place.

37.3 LIST OF BANNED PESTICIDES

1.UNDER THE SAN, EPA, EU, POPS, PIC AND PAN

(Source: Sustainable Agriculture Network, Prohibited Pesticide List (September 2009, www.sanstandards.org)

Active Ingredient	EPA[2]	European Union[3]	POP[4]	PIC[5]	PAN[6] Dirty Dozen	*SAN Regulatory Status*
1. 1,2-dibromoethane (ethylene dibromide)	X	X		X	X	Prohibited since November 2005
2. 1,2-dichloroethane (ethylene dichloride)	X	X		X		Prohibited since November 2005

List 1 substances, which were included in the July 2008 version of SAN Prohibited Pesticide List are no longer included.

U.S. List of "Banned" or "Severely Restricted" Pesticides and U.N. PIC Pesticides

Pesticides banned or severely restricted in EU as a consequence of the application of Directive

79/117/EEC, Council Regulation 805/2004/EC and Directive 91/414/EEC

Stockholm Convention on Persistent Organic Pollutants

Rotterdam Convention on Prior Informed Consent

37.3.1 PESTICIDES BANNED UNDER THE STOCKHOLM CONVENTION

The following pesticides, classified as Persistent Organic Pollutants were banned under the Stockholm Convention and belong to the original list of “The Dirty Dozen” and may not be sponsored under the program

Aldrin,

Chlordane,

DDT,

Dieldrin,

Endrin,

Heptachlor,

Hexachlorobenzene,

Mirex,

Toxaphene;

The following pesticides were added to original list of banned pesticides since August 2009 and may not be sponsored under the program

Chlordecone,

Alpha hexachlorocyclohexane,

Beta hexachlorocyclohexane,

Lindane,

Pentachlorobenzene;

38 BANNED PESTICIDES (PESTICIDES IN CLASSES LA, IB AND 11 OF THE WHO CLASSIFICATION)

The list of pesticides is a compilation of all products recommended and used in Zambia per responses of interviewed stakeholders during the study conducted in 2011 for an agricultural project, the Agricultural Development Support Project (ADSP), funded by the Bank. Comparatively this list has a number of pesticides that are phased out, banned and or restricted in other countries as noted in the official use status as shown in this document.

According to regulation 40 of the SI No. 112 of 2013,

The Minister may, on the advice of ZEMA, ban, severely restrict or restrict the use or production of a pesticide or toxic substance where the Minister determines that the unregulated use or production of the pesticide or toxic substance is or is likely to be harmful to human health, animal or plant life or the environment.

ZEMA shall publish a list of the banned, restricted and severely restricted pesticides and toxic substances in a daily newspaper of general circulation in Zambia within seven days of the ban or restriction.

Table 9:Insecticides recommended and used by different stakeholders

Insecticide								
Group #	Chemical Group	Item #	Insecticide Name	Trade Name	WHO Classification	Crops	Main insects Controlled	Official Use status
1	Avermectin	1	Abamectin	Dynamec	IV	Tomato, Cotton	Red Spider Mite,	
2	Carbamate	2	Carbaryl,	Carbaryl, Sevin Carbax,	II	Tomato, Rice, Pearl Millet, Soybean	Tomato moth, Green Stink Bug, Spotted stem borer, African Pink Stem Borer, Epilachna beetle, Bollworm, Spotted stem borer, Cutworm, Epilachna beetle, Armoured Cricket	
		3	Carbofuran	Furadan	Ib, II	Cowpeas, Carrots	Black Beetle, sorghum Stem Fly, Sweet Potato weevils, nematodes	Banned or restricted in other countries

Insecticide								
Group #	Chemical Group	Item #	Insecticide Name	Trade Name	WHO Classification	Crops	Main insects Controlled	Official Use status
		4	Ethiophencarb	Ethiophencarb	II	Cabbage	Aphids	
		5	Methomyl,	Methomex 90SP	Ib	Pearl Millet, sorghum,	Bollworm	

		6	Pirimicarb	Primor	II	Cotton, Cabbage, Rape, Okra, Pumpkin	Sucking, Aphids, Turnip Mosaic Virus,	
3	Cyclodiene organochlorine	7	Endosulphan	Endosulfan, Thiodan, Thiokill	II	Cotton, Rice, Millet, Peas, Soybean, Maize	Bollworms, Sucking, Spotted stem borer, African Pink Stem Borer, Bollworm, Spotted stem borer, Pod moth, Epilachna beetle, Cutworm,	Use should be discouraged because it has human and environmental health hazards. Already banned in 56 countries because of its high toxicity and environmental persisten t, Endosulfan has been Nominated by the EU for a global ban under the Stockholm Convent.
		8	Lindane	Gamma BHC	II	Soybeans	Aphids	
4	Neonicotinoid	9	Acetamiprid	Spear, Acetam	II	Cotton, Paprika	Sucking	

		10	Imidaclopri d	Confidor imidagold	II	Hot Pepper, Maize	White fly Termites	
		11	Thiametho xam	Renova	IV	Coffee	Antestia bug	
5	Organopho sphate	12	Acephate	Orthene	III	Irish Potatoes, Tobacco	Cutworm, Budworm, Aphids,	
		13	azamethiph os			Tilapia fish	Parasites	
		14	Chlorpyrifo s-methyl	Chlorban	III	Soybean	Epilachna beetle	

Insecticide								
Gro up #	Chemical Group	Ite m #	Insecticide Name	Trade Name	WHO Classifi cation	Crops	Main insects Controlled	Official Use status
		15	Chlorpyrifo s,	Dursban, Chlorpyrifos,	II	Cabbage, Tomato, Rice, Soybean , Cowpeas, Irish Potato, mushroom	Whitefly, Black beetles, Cutworm, Brown Leaf Beetle, Termites	
		16	Demeton-S- Methyl	Metasystox	Ib	Rice	Aphids	Believed to be obsolete or discontinued for use
		17	Diazonon	Diazinon	II	Cowpeas	Coreid Bug	
		18	Dichlorvos,	Vapona 50EC	Ib	Tomato, tilapia fish	Tomato moth, parasites	Banned or restricted in other countries

19	Dicofol,	Dicofol	III	Tomato, mushroom	Red Spider Mite, mites	
20	Dimethoate	Rogor, Nugor	II	Cotton , Soybean	Sucking, Aphids	
21	Fenitrothion	Shumba	II	Cowpeas	Coreid Bug	
22	Fenthion	Lebaycid 50EC	II	Cabbage, Pumpkins, Cowpeas	Leaf Minor, Melon Fly, Bean Fly	Believed to be obsolete or discontinued for use
23	Quinalpos	kinalux	II	Cowpeas	Bean Fly	
24	Malathion	Malathion	III	Tomato Soybean	Tomato moth, Epilachna beetle	
25	Mercaptothion, Malathion		III	Soybean, mushroom,	Aphids, *Phorid fly (* Megaselia) *Sciarid fly (*Lycoriella, mites	
26	Monocrotophos	Phoskil, Monocrotopo, Monocron, Azodrin	Ib	Cotton, Cabbage, Tomato, Rice, Soybean	Sucking, White Fly, Cabbage flea Beetle, Spotted stem borer, African Pink Stem Borer, Epilachna beetle, Spotted stem borer, Groundnut Caterpillar leaf minor	Banned or restricted in other countries. Possible alternatives are Malathion, Chlorophypos, Dimethoate, Fenitrothion, Diazinon Azamethiphos;
27	methamidophos	Metamidofos Monitor	Ib	Paprika	Aphids	Banned or restricted in other countries

		28	Phorate	Umet	Ia	Groundnut	Groundnut Thrips	Banned or restricted in other countries
		29	Profenofos	Curacron	II	Cotton	Sucking	
		30	Terbufos	Hunter	Ia	Groundnut	Groundnut Thrips	Banned or restricted in other countries

Insecticide								
Group #	Chemical Group	Item #	Insecticide Name	Trade Name	WHO Classification	Crops	Main insects Controlled	Official Use status
		31	Triazophos	Hostathion	Ib	Cotton	Sucking	
		32	Trichlorphon	Dipterex, Granules	II	Soybean Coffee, Tilapia fish	Cutworm , Antestia bug, parasites of fish	
6	Organotin	33	Cyhexatin	cyhexatin	II	Tomato,	Tomato Russet mites	
7	Organosulfite	34	Propargite,	Propargite 30 WP	III	Tomato	Red Spider Mite	
8	Pyrethroid	35	Alpha cypermethrin	Fastac	II	Cotton, Cabbage, Rape, Tomato, Onion, Okra, Hot Pepper, Pumpkins, Pearl Millet,	Bollworms, Diamond back moth, Aphids, Bugrada bugs, Thrips, Red Cotton Bugs, White fly, Leaf Eating Beetles, Bollworm, Armoured Cricket	

						Soybean, Cowpeas, Cattle	, Pod moth, Tsetse fly	
		36	Cypermethrin	Cyrux, Ripcord,	II	Cotton, Cabbage, Rape, Tomato, Rice, Soybean, Cowpeas, mushroom	Bollworms, Diamond back moth, white fly, Tomato Moth, spotted stem borer, African Pink Stem Borer, Bollworm, spotted stem borer, Brown Leaf Beetle, Sweet Potato weevils, Coreid Bug, termites	
		37	Deltamethrin	Decis, Decitab	II	Cotton, Cabbage, Tomato, Rice, Pearl Millet, cattle	Bollworms, White fly, Bollworm, Spotted stem borer, tsetse fly	
		38	Fenvalerate	Fenkil	II	Cotton, mushroom	Bollworms, flies. *Phorid fly (*Megaselia) *Sciarid fly (*Lycoriellal termites	
		39	Permethrin,	Actellic, Insect Killer,	II	Rice, Cowpeas, mushroom	Black Beetle, Sweet Potato weevils, termites	
		40	Tralomethrin,	Scout	II	Pearl Millet	Bollworm	

Insecticide

Group #	Chemical Group	Item #	Insecticide Name	Trade Name	WHO Classification	Crops	Main insects Controlled	Official Use status
		41	Apistan			Bees	Mites	
		42	Amitraz			Bees	Mites	
		43	Bayvarol,			Bees	Mites	
		44	Lambda-Cyhalothrin	Karate, Kafu	II	Cotton, Cabbage, Rape, Tomato, Pumpkins, paprika	Bollworms, Diamond back moth, Harlequin bugs, Aphids, Bugrada bugs, Leaf Eating beetles	
9	Tetranortriterpenoid /Insect growth regulator	45	Azadractin	neem extract	IV	Cabbage, Rape, poultry	Diamond back moth, Aphids, mites, ticks' lice	

Table 10:Herbicides recommended and used by different stakeholders

Herbicides								
Group #	Chemical Group	Item #	**Chemical Name**	**Trade Name**	**WHO Classification**	**Crops**	**Main Weeds Controlled**	**Official Use status**
1	Aryloxyphenoxy propionates	1	Fluazifop-p	Fulsilade Supper	III	Cotton	Butyl grass	
		2	Propaquizafop	Agil-100EC	Unlikely to present acute hazard in normal use	Cotton	Annual/Perenial (A/P)	
2	Benzoic acid	3	Chlorthal or D.C.P.A	Dathal 75% w.p.	Unlikely to present acute hazard in normal use	Many Vegetables and Lucerne	Many germinating grasses and some broadleaf weeds	
3	Bipyridylium	4	Paraquat	Gramoxone (200g/l)	II	Potatoes, Cotton	All Types	Among the dirty dozen. Currently under intensive controversial discussion due to its toxicity to animals and its serious and irreversible effect if absorbed

4	Chloroacetamide	5	Acetochlor	Acetochlor 900	III	Cotton	Annual Grasses	
		6	Alachlor	Lasso 480g/l	III	Maize, Soya, Groundnuts	Most annual grasses and some broad leaves	
		7	Metolachlor	Dual magnum	III	Cotton	Annual broadleaf	
5	Chloro-carbonic acid	8	Dalapon	Gramevin 85% w.p Dalapon 80% w.p.	Unlikely to present acute hazard in normal use	Tree crops, Lucerne	Most annual and perennial grasses	
6	Dinitroanaline	9	Trifluralin	Treflan E.C (478g/l)	Unlikely to present acute	Cotton, Groundnuts, Soybeans,	Most annual grasses and some broadleaf weeds	

Herbicides								
Group #	Chemical Group	Item #	**Chemical Name**	**Trade Name**	**WHO Classification**	**Crops**	**Main Weeds Controlled**	**Official Use status**
					hazard in normal use.	Sunflower, Some vegetables		
		10	Pendimethalin	Prowl	III	Cotton	Annual Grasses	
7	Glycines	11	Glyphosate	Glyphosate360 Cycat	Unlikely to present acute hazard in normal use	Cotton	All Types	
8	Oxyacetamide	12	Flufenacet	Tiara	III	Cotton	Annual Grasses	

9	Phenoxy-carboxylic acid	13	2, 4-D	Weedkiller D (70% 2, 4-D ester), Weedkiller D (48% 2, 4-D ester), 2, 4-D Amine (72%), Shellamine (72% 2, 4-D Omine)	III	Maize, Wheat , Sorghum	Most Broadleaf weeds	Highly suspected to be an endocrine disruptor
10	Thiocarbamate	14	Butylate	Suttan 720 g/l	Unlikely to present acute hazard in normal use	Maize	Most grasses and some broadleaf weeds. At least partial control nutsedge	
		15	E.P.T.C	Eptam 6E (720g/l)	II	Potatoes, and some vegetables	Germinating grass and broadleaf weeds. Some control of nutsedge	
11	Triazine	16	Atrazine	Atrazine 80% w.p. Gesaprim 80% w.p. Gesaprim 50% w.p.	Unlikely to present acute hazard in normal use	Maize, Sorghum	Most germinating broadleaf and grass weeds	

Herbicides								
Group #	Chemical Group	Item #	**Chemical Name**	**Trade Name**	**WHO Classification**	**Crops**	**Main Weeds Controlled**	**Official Use status**
				19Gesaprim 10% granules				
		17	Atrazine + Cymazine	Brazine , Maize Weed Killer	II	Maize	Most germinating broadleaf and grass weeds	
		18	Ametryn	Ametryn 500SC	III	Cotton	Annual Grasses	
		19	Cyanazine	Bladex 50% W.P.	II	Maize	Most germinating broad leaf and grass weeds	
		20	Prometryne	Gesagard 80% w.p.	Unlikely to present acute hazard in normal use	Cotton, Groundnuts	Most broadleaf weeds and some grasses	
		21	Simazine	Simazine 80% w.p.	Unlikely to present acute hazard in normal use	Maize, Tree crops	Many broadleaf weeds and many annual grasses	
				Gesatop 50% w.p				
		22	Terbutryne	Igram 50%f.w.	Unlikely to present acute hazard in normal use	sorghum	Most annual grasses and some broadleaf weeds	
12	Urea	24	Diuron	Diuron 80% w.p.	Unlikely to present acute hazard in normal use	Tree crops, Cotton	Most annual broadleaf weeds and grasses	

		25	Fluometuron	Cotoran 80% w.p.	Unlikely to present acute hazard in normal use	Cotton	Most annu8al broadleaf weeds and many annual grasses	
				Cotoguard				
				Cottonex				
Herbicides								
Group #	Chemical Group	Item #	**Chemical Name**	**Trade Name**	**WHO Classification**	**Crops**	**Main Weeds Controlled**	**Official Use status**
		26	Linuron	Afalon 50%	Unlikely to present acute hazard in normal use	Potatoes, Onions	Most annual broadleaf weeds and some grasses	

Table: Fungicides recommended and used by different stakeholders

Fungicides								
Group #	**Chemical Group**	**Item #**	**Fungicide Name**	**Trade Name**	**WHO Classification**	**Crops**	**Main insects Controlled**	**Official Use status**
1	2,6-dinitroaniline	1	Flumetralin	Prime	Unlikely to present acute hazard in normal use	Tomato	Late blight	
2	Acylalanine	2	Metalaxyl	Ridomil	III	Cabbage	Downy Mildew	
3	Alkylenebis(dithiocarbamate)	3	Mancozeb,	Dithane M-45,	III	Tomato, Pumpkin, Carrot, Cabbage, Onion	Late blight, Anthracnose, Carrot leaf bright, Black rot, Purple Blotch, Mildews, Anthracnose	Evaluated by EPA as being carcinogenic
4	Azole	4	Difenoconazole,	Score250EC	III	Tomato	Late blight	
		5	Hexaconazole	Anvil	III	Okra, Pumpkins	Powdery Mildew	
		6	Tebuconazole	Folicur	II, III	Soyabeans	Soybean Rust	

Fungicides								
Group #	Chemical Group	Item #	Fungicide Name	Trade Name	WHO Classification	Crops	Main insects Controlled	Official Use status
5	Benzimidazole	7	Benomyl	Benlate	III	Tomato, Onion, Okra, Carrot, Mango, paprika	Tomato powdery mildew, Late blight, Purple Blotch, Powdery Mildew, Carrot leaf bright, Mango Anthracnose	
6	Benzimidazole	8	Carbendazim	Arrest, Assure, Carbendazim	III	Jatropha	Jatropha wilt	
7	Dicarboximide	9	Iprodione	Roval Flo	III	Citrus	Leaf Spot of Rough Lemon	
8	Dimethy ldithiocarbamate	10	Thiram	Thiram 80 WP	III	Cabbage	Black rot	
9	Inorganic	11	Copper Hydroxide	Funaguran OH	II	Cabbage, Tomato, Bananas, Mango, Coffee, Citrus, Paprika	Downy Mildew, Leaf Spot and Head browning of Cabbage, Late Blight, Bacterial Spot on foliage and Tomato fruit, Sigatoka Disease of banana, Bacterial Black Spot of Mango, Coffee Berry Disease, Coffee leaf rust disease, Cercospora leaf and fruit spot of citrus, Orange Scab	
10	Inorganic	12	Copper Ox chloride	Copper Ox chloride	II			
11	Methoxyacrylate	13	Azoxystrobin	Ortiva	III	Soybeans	Soybean Rust	
12	N-trihalomethylthio	14	Captan	Captan	Unlikely to present acute hazard in normal use	Mango, seed treat for beans , Maize	Mango Anthracnose,	

Fungicides								
Group #	**Chemical Group**	**Item #**	**Fungicide Name**	**Trade Name**	**WHO Classification**	**Crops**	**Main insects Controlled**	**Official Use status**
13	Triazine	15	Anilazine	Anilazine	II	Tobacco	Alternalia	
14	Chloronitrile	16	Chlorothalonil	Bravo 500, Encor Daconil	III	Cabbage, Rape Tomato, Onion, Okra, Carrot	Downy Mildew, Leaf Spot and Head browning of Cabbage , Late Blight, Purple Blotch, Powdery Mildew, Carrot leaf bright,	
15	Sulphur	17	Sulphur	Dusting Sulphur	Unlikely to present acute hazard in normal use	Tomato	Tomato powdery mildew	
16	Triazole	18	Triadimenol	Baytan	III	Coffee	Coffee Leaf Rust	
17	Triphyenyltin	19	Triphenyltin Acetate	Brestan,	II	Soybeans	Red leaf blotch	

Table 11:Table 4: Insecticides Phased out, Banned, or Restricted

BANNED, RESTRICTED OR NO LONGER IN USE PESTICIDES THAT ARE STILL IN RECOMMENDATION IN ZAMBIA									
	Chemical Group	**INSECTICIDES**							
Group #		**Item #**	**Insecticide Name**	**Trade Name**	**Oral LD_{50} mg/kg**	**WHO Classification**	**Crops**	**Main insects Controlled**	**Official Use status**
1	Carbamate	1	Carbofuran	Furadan	14.4	Ib, II	Sorghum, Cowpeas, Carrots	Black Beetle, sorghum Stem Fly, Sweet Potato weevils, nematodes	Banned or restricted in other countries

BANNED, RESTRICTED OR NO LONGER IN USE PESTICIDES THAT ARE STILL IN RECOMMENDATION IN ZAMBIA									
	Chemical Group	**INSECTICIDES**							
Group #		**Item #**	**Insecticide Name**	**Trade Name**	**Oral LD_{50} mg /kg**	**WHO Classification**	**Crops**	**Main insects Controlled**	**Official Use status**
2	Carbamate	2	Methomyl,	Methomex 90SP	17	Ib	Sorghum,	Bollworm	Banned or restricted in other countries
3	Organophosphate	3	Dichlorvos,	Vapona 50EC	56 -108	Ib	Tomato	Tomato moth,	Banned or restricted in other countries
		4	Methamidophos	Metamidofos Monitor	30	Ib	Paprika	Aphids	Banned or restricted in other countries
		5	Monocrotophos	Phoskil, Monocrotopos, Monocron, Azodrin	14	Ib	Cotton, Cabbage, Tomato, Rice, Soybean	Sucking, White Fly, Cabbage flea Beetle, Spotted stem borer, African Pink Stem Borer, Epilachna beetle, Spotted stem borer,	Banned or restricted in other countries. Possible alternatives are Malathion, Chlorophypos, Dimethoate, Fenitrothion,

								Groundnut Caterpillar leaf minor	Diazinon Azamethiphos
		5	Phorate	Umet	2-4	Ia	Groundnut	Groundnut Thrips	Banned or restricted in other countries
		6	Terbufos	Hunter	1.6	Ia	Groundnut	Groundnut Thrips	Banned or restricted in other countries
		7	Triazophos	Hostathion	82	Ib	Cotton	Sucking	Banned in Zambia
BANNED, RESTRICTED OR NO LONGER IN USE PESTICIDES THAT ARE STILL IN RECOMMENDATION IN ZAMBIA									
	Chemical Group	**INSECTICIDES**							
Group #		**Item #**	**Insecticide Name**	**Trade Name**	**Oral LD_{50} mg /kg**	**WHO Classification**	**Crops**	**Main insects Controlled**	**Official Use status**
		8	Demeton-S-Methyl	Metasystox	30	Ib	Rice	Aphids	Believed to be obsolete or discontinued for use

Table 12:Banned , Restricted Or No Longer In Use Pesticides That Are Still In Recommendation In Zambia

	Banned, Restricted or No Longer In Use Pesticides That Are Still In Recommendation In Zambia		

	Herbicides							
	Chemical Group	**Chemical Name**	**Trade Name**	**Oral $LD_{50\ mg}$ /kg**	**WHO Classification**	**Crops**	**Main Weeds Controlled**	
1	Bipyridylium	Paraquat	Gramoxone (200g/l)	150	II	Potatoes, Cotton	All Types	Among the dirty dozen. Currently under intensive controversial discussion due to its toxicity to animals and its serious and irreversible effect if absorbed
2	Dinitroaniline	Nitralin	Plaza in 75% w.p.	2000+	III	Cotton, Groundnut, Soya	Most annual grasses and some broadleaf weeds	Believed to be obsolete or discontinued for use as pesticide