



**MINISTRY OF AGRICULTURE AND FOOD SECURITY
LESOTHO**

Agricultural Productivity Program of Southern Africa (APPSA)



VOLUME 3

INTEGRATED PEST MANAGEMENT PLAN (IPMP)

Prepared by:
Ministry of Agriculture and Food Security
Maseru
Lesotho

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The Agricultural Productivity Program of Southern Africa (APPSA) Safeguards forms part of a series which is intended to provide complete documentation for the requirements of a holistic Environmental and Social Safeguards management system for the project. This Environmental Safeguards instrument contains the findings of a study conducted for the Agriculture sector of the Kingdom of Lesotho and the instrument has been developed on the basis of the local conditions and findings.

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Agricultural Productivity Program of Southern Africa (APPSA)

Volume 1: Environmental and Social Management Framework (ESMF)

Agricultural Productivity Program of Southern Africa (APPSA)

Volume 2: Integrated Pest Management Plan

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LIST OF ABBREVIATIONS

AEO	Area Extension Officers
AEZ	Agro Ecological Zone
APPSA	Agricultural Productivity program for Southern Africa
ARC	Agricultural Resource Centres
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CPM	Commission on Phytosanitary Measures
DAES	Department of Agricultural Extension Services
DAO	District Agricultural officer
DAR	Department of Agricultural Research
DDC	District Development Committee.
DE	Department of Environment
DEAP	District Environmental Action Plan
DEO	District Environmental Officer
DHO	District Health Officer
DPPA	Directorate of Planning and Policy Analysis
EMA	Environmental Management Act
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GMO	Genetically Modified Organisms
GoL	Government of Lesotho
IDA	International Development Agency
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
IPPC	International Plant Protection Convention
ISPMs	International Standards for Phytosanitary Measures.
M&E	Monitoring and Evaluation
MAFS	Ministry of Agriculture and Food Security
MDG	Millennium Development Goals
MFDP	Ministry of Finance and Development Planning
MFLR	Ministry of Forestry and Land Reclamation
MLGC	Ministry of Local Government and Chieftainship
MoH	Ministry of Health
MTCIM	Ministry of Trade & Industry, Cooperatives and Marketing
MTEC	Ministry of Environment, Tourism and Culture
NGO	Non-Governmental Organisation
PCU	Programme Coordination Unit
NPV	Nucleopolyhedrovirus
PDO	Programme Development Objective
PMP	Pest Management Plan
PPU	Plant Protection Unit.
PRS	Poverty Reduction Strategy
R&D	Research and Development
RCoLs	Regional Centers of Leadership
SADP	Smallholder Agricultural Development Programme
SAPReF	Southern African Pesticide Regulators Forum
WB	World Bank
WHO	World Health Organization
AWP&Bs	Annual Work Plans And Budgets
PMU	Programme Management Unit

EXECUTIVE SUMMARY

Project Background

The Government of the Republic of Lesotho, through the Ministry of Agriculture and Food Security is requesting funding from the World Bank for participation in the Agriculture Productivity Program for Southern Africa (APPSA). Three other countries, Malawi, Mozambique and Zambia have been participating in the program and Lesotho will be one of the countries joining the Program in its fourth year of implementation.

Agriculture is the single most important sector of the Lesotho economy, contributing about 38% of value-added to GDP, employing 85% of the workforce; and contributing 80% of foreign exchange earnings in 2006. Agriculture continues to be the primary source of livelihood for the estimated 80% of the country's poor who are based in rural areas. Sustained improvements in agricultural productivity and stable food supplies remain essential for reducing high rates of malnutrition and poverty in Lesotho.

In the three current APPSA implementing countries, the programme is supporting agricultural technology generation and dissemination by strengthening and scaling up of regional centers of leadership (RCoLs) on programs of regional importance through regional collaboration. For Lesotho the identified regional priority programs will be on horticulture-based farming system. In the process, APPSA will support efforts to scale up and develop one national research centre in Lesotho into an (RCoL).

The proposed program will have three components, covering:

Technology Generation and Dissemination

This component will support technology generation and dissemination activities associated with the Regional Center of Leadership. The component will also support regional dissemination programs or technology transfer sub-projects to link the Center of Leadership to institutions in the other APPSA countries and enable scaling up of innovations.

The core focus of APPSA supported technology dissemination activities in Lesotho will therefore aim at: improving the content and accessibility of technology messages and knowledge products around horticulture technologies; improving the capacity of the **Department of Agricultural Research (DAR)** and the Department of Field Services (DFS) to strengthen technical training of lead farmers, extension agents and advisory service providers around horticulture, strengthening the capacity of ARD dissemination officers, private sector and civil society engagement; and improving farmer-research-extension feedback mechanisms to obtain a better analysis of farmer preferences. APPSA will also support regional information sharing and exchange activities with other participating countries.

Strengthening of the Center of Leadership

The second component will support capacity building for the Regional Center of Leadership. Within Lesotho, APPSA will support: (i) the upgrading of research infrastructure; (ii) improving management and performance systems; (iii) scientific training at the post graduate level and upgrade skills through short courses or targeted training; and (iv) strengthening seed, regulatory and related services. Investments in physical infrastructure will focus on improving existing facilities at one selected research institution.

Investments in seed and related services will focus on increasing the capacity of pre-basic and basic seed production for the targeted commodities (horticulture including fruits and vegetables) under APPSA, increasing analytical capacity for genetically modified organisms (GMO) detection and mycotoxin analysis, and technical assistance to identify and address regulatory gaps within the technology generation and dissemination system, if necessary.

Coordination and Facilitation

The third component will support implementation of the program and coordination activities. At the national level the program will be fully integrated into the Ministry of Agriculture and Food Security (MAFS). APPSA will also provide an opportunity to scale up the use of multi-stakeholder platforms within the program to ensure all actors within the national agricultural research system are involved.

At the regional level the Program will finance regional facilitation activities including: (i) regional planning, monitoring and evaluation activities needed to establish and monitor regional collaborative activities; and (ii) regional exchange of information, knowledge and technologies. Currently, these functions are most efficiently provided by the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA), a regional entity which has developed a more detailed approach for fulfilling these functions in the three ongoing APPSA countries.

Objectives of PMP

The proposed Program does trigger the World Bank safeguard policy on Pest Management (OP.4.09) and as such this stand-alone Pest Management Plan (PMP) has been prepared to meet the requirements of the policy. The objectives of the PMP include:

- Promoting the use of environmentally friendly practices in pest control;
- Monitoring pesticide use during implementation of APPSA activities,
- Ensuring that project activities comply with Lesotho's laws and regulations on the use of pesticides, and World Bank operational policy OP 4.09; and
- Providing an integrated pest management action plan which can be easily implemented in the event that pest management issues are encountered during implementation of proposed APPSA activities.

Methodology for preparing PMP

This APPSA Pest Management Plan is based on the same principles and elements of the pest management plan prepared for the ongoing Smallholder Agriculture Development Programme (SADP) in the country. Literature review on relevant documents was conducted. Field investigations included visits to the Department of Agricultural *Research* - (MAFS). In addition, visits to the major agrochemical marketing companies in Maseru and other towns were undertaken. Consultations with various key stakeholders such as MAFS, the Plant Protection Unit and the communities in the project impact districts were conducted.

This PMP investigates several alternatives, including biological treatment, mechanical and manual methods for pesticide control, which are recommended for use, with the ultimate objective of progressive reduction in the application of chemical pesticides, by replacing them with the more environmentally friendly options. The PMP discusses these options and makes recommendations for implementation. For APPSA a strong capacity building program will be required to manage and monitor the use of pesticides generated from research activities under the program. APPSA stakeholders will benefit from the developed training plan to be funded under the APPSA.

The implementation of the mitigation measures outlined in the IPMP is estimated to cost US \$ 172,700.00 (See table below). The budget is meant for implementing and monitoring the recommended mitigation measures throughout the project duration. The budget will be integrated into the overall project costs to ensure that the proposed mitigation measures are actually implemented.

IMPACT	5 – YEAR TOTAL (\$)
Provide PM equipment (sprayers)	12,000.00
Provide recommended protective gear	13,000.00
Pesticide inspection, sampling and testing	7,000.00
Routine medical examination	18,000.00
Construct bio-beds, draining channels and draining dams.	20,000.00
Establishment and dissemination of biological control methods	8,000.00
Disposal of chemical pesticides remains according to supplier recommendations	6,000.00
Enforce regulation prohibiting importation of banned chemical pesticides	6,000.00
Conduct awareness campaigns on IPMP.	8,000.00
Total Cost for Pest Management and Monitoring	98,000.00
Identify the implementation team	5,000.00
Decide on the scale of implementation	
Review and set measurable objectives for the IPMP	
Establish a system of regular IPM inspections	
Define the treatment policy selection	
Establish communication protocols	
Develop farmer training plans and policies	
Analyze current housekeeping, maintenance and pest control practices	15,000.00
Provide protective gear	15,000.00
Track progress and reward success	5,000.00
Total Cost for Setting Up IPMP	40,000.00
Training at national level (Ministries)	5,000.00
Training of trainers	10,000.00
Training at district level	2,000.00
Training at community level	2,000.00
Total Cost for IPM Training	19,000.00
Contingency (10%)	15,700.00
GRAND TOTAL	172,700.00

1. INTRODUCTION AND BACKGROUND

1.1 PROJECT BACKGROUND

The World Bank is preparing to support the Government of Lesotho (GoL) in the implementation of the Agricultural Productivity Programme for Southern Africa (APPSA) with the objective of increasing the productivity of horticulture (fruits and vegetables) through the introduction of improved varieties and modern farming technologies. The proposed programme will support agricultural technology generation and dissemination by supporting the strengthening and scaling up of a regional center of research leadership on programs of regional importance through regional collaboration. For identified regional priority programs, APPSA would support efforts to scale up and develop national research centres into regional centers of leadership.

Currently, Malawi, Mozambique and Zambia are in the process of establishing Regional Centres of Leadership (RCoLs) for maize, rice and legumes respectively. Lesotho has elected to establish an RCoL for horticulture-based farming system which will encompass the millet farming system as a whole, including a focus on the full set of crops within the millet farming system, and associated nutrient, soil and water management issues. The programme will be implemented by the Ministry of Agriculture and Food Security (MAFS).

1.2 MAIN GOAL OF THE APPSA PROGRAM

The main goal of the Agricultural Productivity Program for Southern Africa (APPSA) Program is to improve productivity of horticulture farming systems through improved nitrogen use efficiency, reduced loss of crop production from field pests and diseases and post-harvest handling, diversification and improved nutrition.

1.2.1 APPSA Program Components

The proposed program will have the following three components:

1.2.1.1 Component 1: Technology Generation and Dissemination.

Component 1 will support technology generation and dissemination activities associated with the commodity or commodity group being targeted by the RCoLs. This will include research activities targeting the technology priorities defined through regional dialogue and consistent with a regional priority setting study. The component will also support regional dissemination programs or technology transfer sub-projects to link Centers of Leadership to institutions in other countries and enable scaling up of innovations.

The core focus of APPSA supported technology dissemination activities in Lesotho will therefore aim at improvements around the horticulture production technologies. All activities financed under Component 1 will be undertaken through collaborative R&D projects involving the participation of at least two countries. R&D projects will support collaborative research, technology dissemination, training, and other activities (e.g. knowledge exchange).

Lesotho will participate in R&D projects relating to horticulture, as well as in R&D projects relating to the commodity farming systems being targeted by RCoLs in other countries.

Technology generation priorities: Research priorities are expected to cover the full range of issues associated with horticulture, including germplasm collection and characterization, germplasm improvement (plant breeding), crop management, and post-harvest activities including processing and storage.

Technology dissemination priorities: APPSA will support the dissemination of improved technologies by providing resources for RCoLs to engage with a range of partners in scaling up the use of promising innovations of relevance to horticulture. APPSA will help to strengthen the links between researchers, extension agents, input distributors, and farmers and other end users, but lead responsibility for technology dissemination will remain with the national extension system.

Technology dissemination activities supported by APPSA will be designed to encourage participation by diverse partners, in line with principles of pluralism. The pluralistic and inclusive “innovation systems” approach is expected to focus on:

- Improving the content and accessibility of technology messages and knowledge products around horticulture (fruits and vegetables) technologies, including the use of information and communication technologies;
- Improving the capacity of advisory service providers through technical training of Lead Farmers, extension agents, and other actors in private sector or civil society;
- Strengthening the capacity of dissemination officers or technology transfer specialists in research institutes, to enable them to engage more effectively with farmers, extension agents, and advisory service providers;
- Establishing or improving platforms for dialogue and consultation around technology priorities with farmers, private sector, and civil society;
- Improving farmer-research-extension feedback mechanisms to obtain a better analysis of farmer preferences;
- Exchanging information and experiences with other participating countries;
- Conducting research on technology dissemination methods or tools, including those targeting gender specific issues such as household nutrition and food safety.

APPSA will support the expansion of seed multiplication capacity within RCoLs, with the goal of increasing the availability of seed for further multiplication (by farmer-producers, farmer associations, NGOs, or private firms). APPSA will also support the production of farm implements and simple farm machinery, as well as the testing of farm implements and farm machinery in pilot schemes.

1.2.1.2 Component 2: Strengthening Regional Centers of Leadership.

Component 2 supports activities to strengthen the core capacity of the RCoLs. The choice of activities to be financed will be driven primarily by the specific needs of each RCoL, as identified at national level. In general APPSA will support:

- (i) upgrading of research infrastructure including rehabilitation and construction of physical infrastructure; farm, laboratory, and office equipment; and information technology and knowledge management systems;
- (ii) improving administration and performance management systems;
- (iii) developing human capital including by providing scientific training at the post graduate level; by upgrading skills through short courses or targeted training, and scientific exchanges; and
- (iv) strengthening seed production capacity, seed regulatory functions, and related services.

1.2.1.3 Component 3: Coordination and Facilitation.

Component 3 will finance three main categories of activities:

National level research coordination and management: At national level, APPSA will finance project coordination activities, including planning and budgeting, management and administration, monitoring and evaluation, safeguards compliance, and regional engagement. If necessary, APPSA could finance consultants to ensure that all essential project coordination activities are carried out effectively. Government counterpart resources will be used to pay staff-related costs not eligible for IDA funding.

Regional facilitation by CCARDESA: At the regional level, APPSA will finance regional facilitation activities including:

- (i) planning, monitoring and evaluation activities related to regional collaboration;
- (ii) regional exchange of information, knowledge and technologies; and
- (iii) technical assistance and capacity building. Many of these activities will be carried out by CCARDESA, which will play an important role in facilitating the development of R&D projects, including organizing the peer review process and providing quality control.

The regional facilitation activities to be performed by CCARDESA will be supported using funds from two sources, the Regional IDA grant and the participating APPSA countries through their IDA Credits. Financing will be provided to CCARDESA in tranches on the basis of agreed annual work plans and budgets (AWP&Bs).

R&D policy analysis and dialogue: APPSA financing will support analytical work, needs assessments, and policy dialogue or policy harmonization activities in key areas that affect R&D at national and regional level. Work will focus on analysis of relevant policies and legislation for intellectual property rights, operationalization of the SADC harmonized seed regulatory system, implementation of biosafety regulations, and similar topics.

1.3 PROJECT IMPLEMENTING AGENCY

The project implementing agency is the Ministry of Agriculture and Food Security - which is developing the proposal for the Agricultural Productivity Program for Southern Africa. The MAFS will have overall responsibility for APPSA supervision and coordination in Lesotho. Consistent with GoL policies on harmonization and alignment of donor projects, APPSA will be fully executed through existing country institutions and District Agricultural Officer (DAO) with their Area Extension Officers (AEO), will be the main implementing agencies. The project will be integrated to the SADP management structure.

To ensure a closer and more regular supervision and coordination of APPSA implementation, DAOs and AEOs, along with other project partners, will set up a Technical Implementation Coordination Committee. DAOs will also be in charge of:

- Coordinating the preparation of APPSA annual work plans and budgets, including liaising with the SADP secretariat to ensure incorporation of APPSA proposals in the overall MAFS budget;
- Compiling information for proper coordination and supervision by MAFS;
- Preparing quarterly progress reports and organizing meetings of the technical implementation coordination committee; and
- Preparing annual implementation reports for presentation to the “Technology Generation and Dissemination” Technical Working Group.

1.4 INTEGRATED PEST MANAGEMENT

Definitions have been fronted over the years to describe Integrated Pest Management (IPM). In 1967, FAO defined IPM as a pest management system which utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest population at levels below those causing economic injury.

Key elements of an IPM program are:

- (i) 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;
- (ii) Conservation of the ecosystem to enhance and support natural enemies and pollinators
- (iii) Integrating the pest management strategies in the farming system
- (iv) Pests and crop loss assessments

The following are key preconditions for an IPM approach:

- (a) Understanding of the ecological relationships within a farming system (crop, plant, pests organisms and factors influencing their development);
- (b) Understanding of economic factors within a production system (infestation: loss ratio, market potential and product prices);
- (c) Understanding of socio-cultural decision-making behaviour of the farmers (traditional preferences, risk behaviour);
- (d) Involvement of the farmers in the analysis of the pest problems and their management
- (e) Successive creation of a legislative and agricultural policy framework conducive to a sustainable IPM strategy (plant quarantine legislation, pesticides legislation, pesticide registration, price policy)

1.5 JUSTIFICATION FOR THE INTEGRATED PEST MANAGEMENT PLAN

It is anticipated that during the implementation of APPSA activities, use of pesticides and agrochemicals will increase as a result of the need to improve productivity, therefore, an integrated pest management (IPM) that is centred on local farmer needs and is sustainable, appropriate, environmentally safe and economic to use is needed. The requirement for adoption of IPM in farming systems is emphasized in the World Bank operational policy, WB OP 4.09, which supports safe, effective, and environmentally sound pest management aspects, such as the use of biological and environmental friendly control methods.

1.6 METHODOLOGY FOR PREPARATION OF THE IPMP

1.6.1 Field Investigations, Consultations and Literature Review

The field investigations included visits to the proposed research stations to participate in APPSA.

Consultations with various key stakeholders such as MAFS, the Pesticides Control Board, and **CCARDESA** were conducted. Key informant and lead farmer interview questionnaires were specifically developed as data collection tools to gather the relevant primary data required for developing the Integrated Pest Management Plan (IPMP). Structured, semi-structured and open-ended interviews with, farmers' organizations, /farmers clubs and agrochemical companies were also conducted. Appendix 1 provides a list of people and institutions consulted for the APPSA.

Literature review was undertaken to identify priority concerns on pests/diseases, the legislation; and use of pesticides as well as IPM initiatives currently being undertaken or envisaged. Various project, legislative, and policy documents, including the following were reviewed:

- a) The World Bank Safeguard Policy on Pest Management, O.P. 4.09;
- b) Environment Management Act of 2008;
- c) FAO International code of Conduct on the Distribution and Use of Pesticides, 2002;
- d) Bulletin of the World Health Organization, 66 (5): 545-551 (1988)

1.7 STRUCTURE OF THE PEST MANAGEMENT PLAN

Chapter 1 provides a brief background of the project, highlighting the agricultural sector context and the Agricultural Productivity Program for Southern Africa (APPSA). The Chapter narrates the three key components of the project, which focus on technology generation, capacity building and project co-ordination. The Chapter also provides details of the project implementing agency, proposed project cost estimates and key elements of an IPM program and objectives as well as justification for preparing the IPMP are provided in this chapter.

Chapter 2 gives an insight of the pest management practices in Lesotho. Problems and challenges of chemical pesticides, as narrated by farmers and officials of agricultural agencies in the districts are also presented in this Chapter.

Chapter 3 narrates the non-technical plant protection approaches of biological controls, cultural and crop management controls, strategic controls and genetically based controls. The Chapter narrates how some of these controls are used in Lesotho.

Chapter 4 presents the international and national legislation and policies for pesticides management. It also presents regulations for pesticides storage, distribution and disposal.

Chapter 5 highlights the key steps and elements of an Integrated Pest Management Plan. Key elements, among others, include good housekeeping, maintenance and pest control. The Chapter also emphasizes the establishment of a regular system of IPM inspections.

Chapter 6 presents impacts of pest management practices, which are broadly classified as chemical and non-chemical. The non-chemical practices are further grouped into biological, manual and mechanical. Positive and negative impacts, as well as their enhancement/mitigation measures are presented in this Chapter. The Chapter also presents common horticulture (fruits and vegetables) pest problems and the recommended IPM practices to deal with these problems. Principles of selecting pesticides and pesticides to be accepted for the APPSA are described in this Chapter.

Chapter 7 focuses on the Integrated Pest Management and Monitoring Plan, providing the responsible persons or institutions to implement the mitigation measures and monitoring activities.

Chapter 8 presents an overview of the capacity needs, and the necessary training, in order to yield a successful implementation of the IPMP;

Finally, **Chapter 9** gives the conclusions and recommendations.

2. CURRENT PEST MANAGEMENT PRACTICES IN LESOTHO

2.1 COMMON PESTS IN THE FARMS

Production of both crops and livestock in Lesotho is limited by a number of factors, which include aspects of weather, low soil fertility, poor agronomic practices and the incidence of insect pests and diseases.

Lesotho, like most of the countries that depend on agriculture, uses considerable amounts of pesticides as one way of combating pest problems. Pesticides used in Lesotho include insecticides, fungicides, herbicides, fumigants, nematocides, Acaricide and rodenticides. Other products such as growth regulators, repellents, molluscicides and parasiticides are also used, (Table 2-1).

The crops that are commonly grown by the farmers include wheat, beans, rice, maize, sorghum cabbage, tomatoes, onions, gem squash, carrots, peas, water melons, and other different kinds of vegetables. These crops attract a variety of pests that need to be managed in order to avoid damage, leading to low crop yields. Common pests that attack these crops include army worms, green grasshoppers, armoured cricket, rice blast, stem borers and maize ear worms. A list of the crops commonly grown by the farmers and the pests that usually attack them is given in table 1 below, which also gives the pesticides that are used and recommended by the Ministry of Agriculture and Food Security (MAFS) and approved by WHO.

Table 2-1 Pesticides for a 30-hectare orchard per annum.

Chemical	Quantity	Rate of application/10l water	Safety period	Target the following
Spay urea	3*25kg	200g	N/A	Flower stimulation
Zinc-Max	3*25kg	20ml	N/A	Nutrition
Chlorpyrifos	3*25L	8ml	N/A	Scale
Biodew	3*5L	1ml	N/A	Fusarium & Powdery mildew
Flowable sulphur	3*25L	40ml	N/A	Fusarium & Powdery mildew
Dithane/sancozeb	3*25kg	15g	14days	Fusarium & Powdery mildew
Nimrod	3*5L	6ml	14days	Fusarium & Powdery mildew
Spraybor	3*25kg	10g	N/A	Nutrition
Azinphos	3*5L	5ml	14 days	Codling moth
Karate	6*1L	2ml	14 days	Bollworm
Rubigan	6*1L	2ml	21days	Mildew
Calcimax	3*25kg	45ml	0 days	Bitter pit
Mag-Max	3*25kg	30ml	0 days	Nutrition
Calypso	3*1L	1.5ml	21 days	Codling moth
MAP	3*25kg	50g	0 days	Post-harvest nutrition
K-Max	3*25kg	50g	0 days	Post-harvest nutrition
GF 120	3*25L	500ml	1 day	Fruit fly baiting
LAN	450*50kg	90g/tree	0 days	Nutrition
Liming requirements	Would depend on the specific soil analysis and recommendations			
Basal fertilizer	Would depend on the specific soil analysis and recommendations			
Copprox super	3*25kg	40g	0 days	Curly leaf
Thiram	3*25kg	15g	0 days	Curly leaf
Merphan/Captonflo	3*5L	10ml	14days	Various diseases
Endosulfan/thionex	3*6L	10ml	14days	Green aphids
Indar	3*3L	8ml	1day	brown rot
Dipel	3*25kg	5g	0 days	bollworm

2.2 EXISTING PEST MANAGEMENT APPROACHES AND THEIR LIMITATIONS

Farmers carry out routine management of pests in the fields, mainly through the use of pesticides. Farm and crop management techniques are also used to control pests but there are limitations and problems that the farmers face in using these methods. Below are the existing and potential pest management efforts and their limitations.

2.2.1 Growing a Healthy Crop by Starting with Healthy Seed

A crop that germinates from seed that is healthy is likely to be less vulnerable to pest damage. Also, a crop grown from seed that has been bred from resistant strains is less likely to be damaged plant growth and crop storage.

Most of the farmers do not have ready access to good seed at the time of planting and as a result they use seed from the previous harvest. Commercial seed is usually too expensive for the farmers who mostly rely on seed and farm input donations.

2.2.2 Good Farming Practices to Ensure Vigorous Crops

A plant growing in good farm conditions is generally less vulnerable to pest damage than a plant growing under stressed conditions. Good farming practices include timely and recommended soil preparation and planting; and recommended water and nutrient application.

Limitations and constraints for the farmers include lack of appropriate skills/knowledge on water and nutrient management, lack of farm inputs and resources to adequately and timely prepare their farms.

2.2.3 Making the Crop unattractive or unavailable to pests

This strategy includes adjusting planting times to ensure that crop development does not coincide with pest appearance. The success of using this strategy requires good knowledge of the seasons and the ability to forecast the right time for planting.

The farmers need the appropriate training and information through the extension workers to ensure that they plant at the right times.

2.2.4 Crop Diversity or Rotation, Early Planting

Crop rotations or multiple cropping removes the chance for the re-appearance of persistent pests. This strategy depends on the availability of seed to the farmers who, most of the times, are in short supply of adequate and good quality seed.

It was noted during the audit that crop diversification and rotation was practiced to a limited extent. Some of the crops were difficult to sell due to lack of markets. The farmers mentioned lack of markets as one of the reasons why they preferred to stick to the crops that had ready markets. This justifies the need to find mechanisms for linking the farmers to market outlets. Crop rotation is also difficult due to limitations on availability of land.

2.2.5 General Hygiene

Good sanitation of the farmers and surroundings, including crop storage structures and buildings ensures clean and healthy crops as well as seed for planting.

The farmers need to be well trained in crop and seed management to avoid damage. They need to appreciate the importance of preparing their farms in time and the benefits of weeding at the appropriate times.

2.2.6 Biological/ecological control

This is achieved by conserving and enhancing natural biological /ecological controls already in the field and in selected situations, through natural enemies of pests. This may entail the use of botanical pesticides such as *neem* and *tephrosia*. Woody white flies are controlled by using *caris knoack* and for cabbage; diamond back moth is controlled by using *diajedima species*. This method requires research and thorough evaluation before new species are introduced to avoid disrupting existing ecosystems.

The farmers need to be trained in available and appropriate biological controls that can be used to prevent emergence of pests. Farmers are not fully aware of the potential for this control method which, by creating an enabling environment could tame natural biological systems to discourage pests.

2.2.7 Physical Control

Physical controls, such as flooding to eliminate snails are practiced where there is good supply of irrigation water. Other physical controls include hand picking of pests, uprooting interested crop, using fire to remove pests on crop residues and frequent weeding.

These methods are commonly used by the farmers. However, there is need to enhance their application to ensure that they are used in a systematic and coordinated manner.

2.2.8 Use of Pesticides

Pesticides may be used with care to ensure their toxicity to non-target organisms is as low as possible. The effectiveness of pesticides should be as selective as possible. Certain pesticides of natural origin are compatible with integrated pest management (IPM), causing minimum disturbance to natural biological and ecological pest control mechanisms.

It was noted that farmers are using different types of pesticides for the crops and that they type of pesticides used is determined by affordability and availability. Use of pesticides is a commonly preferred method of pest control since it is perceived as a rapid method that does not require much effort. The farmers therefore need to be guided and trained to understand the limitations and environmental consequences of using pesticides. They should be knowledgeable of pesticides that are compatible with IPM and that do not degrade the natural biological and ecological pests control systems. The farmers need to be equipped with information on pesticide application quantities and methods; enforcement of the act that deals pesticides is of primary importance to control importation and use of pesticides.

2.3 EXTENT TO WHICH EXISTING APPROACHES ARE CONSISTENT WITH IPM

Pest management approaches and practices that are consistent with IPM include the physical, biological and chemical pest control techniques. Some of the pesticides management approaches and practices that are not consistent with IPM include overuse of and overdependence on chemical control methods; and limited use of physical and biological methods due to lack of adequate land, technical knowledge and supervision. The use of unlisted or unapproved pesticides and stockpiling of obsolete pesticides are not consistent with IPM. These inconsistent approaches and practices emanate from the following:

- Limited land availability to permit crop rotation and use of some biological methods.

- Lack of training and limited knowledge of IPM practice and benefits by the farmers.
- Inadequate technical supervision of the farmers by the extension workers due to shortage of trained personnel to support IPM.
- Inadequate labelling of pesticides containers. Inappropriate packaging leading to wastage of pesticides.
- Poor information availability and information management on pesticides and their uses.
- Illegal cross border importation of pesticides.
- Lack of systems and controls to enforce IPM approaches and practices across the board. This leads to isolated and independent use of pest control methods.
- Deliberate breach of regulations by the farmers due to limited understanding of the benefits of IPM.

2.4 PURCHASE AND USE OF PESTICIDES BY THE FARMERS

Lesotho does not manufacture pesticides. All the pesticides that are used in the country are imported. There are a number of chemical companies that import these pesticides into the country. These companies, in turn supply pesticides to various users for crops and livestock use.

Although the amount of pesticides used in Lesotho is generally low compared with the other countries, there has been considerable abuse of pesticides importation and use. In some cases, the drive for pesticide importation has been the perceived financial gain by the traders rather than the demand for application to various crops. This has resulted in a build-up of pesticides some of which have been rendered obsolete.

Farmers purchase pesticides on their own depending on their specific needs. The farmers usually seek advice from the extension workers on what types and quantities of pesticides to purchase. The farmers buy pesticides from different suppliers, including illegal suppliers, as dictated by cost.

The Ministry of Agriculture and Food Security, through the extension workers, provides advisory services (extension) to farmers in the use of agricultural chemicals (fertilisers and pesticides) with regard to efficient use to maximise yields. However, the capacity of the extension workers is inadequate. The Ministry does not purchase any pesticides for or on behalf of the farmers although it was noted that some farmers have benefited from pesticide donations in the past. The Ministry is only responsible for purchase of pesticides for migratory pests such as army worms, locusts and armoured cricket, to respond to national emergencies and needs. In collaboration with other stakeholders, the Ministry conducts sprays for these migratory pests.

3. PESTICIDES POLICY, AND LEGISLATION IN LESOTHO

3.1 PESTICIDE POLICY AND REGULATION

Lesotho follows the WHO guidelines for pesticides classification into categories as follows:

- Extremely Hazardous (Category 1 where LD₅₀ is less than).
- Moderately Hazardous (Category II & III where LD₅₀ is more than 1).
- Less Hazardous (Category IV & V where LD₅₀ is more than 100).

Lesotho also follows the guidelines set in the International Code of Conduct on the Distribution and Use of Pesticide by FAO which establishes the voluntary standards that countries may follow for the management of pesticides (WBG, 2007; WBG, 2016a and WBG 2016b). It still is used as a good basis for which IPM programs can be formulated and pesticide management undertaken until such time that Lesotho will have established regulatory framework and system for sound management of pesticides.

The Environmental Management Act (2008) provides for the control and management of the import, export, manufacture, distribution, storage, disposal and use of pesticides. Among other things, the Act provides for the following:

- Prohibits the manufacture, export, distribution, storage and selling of pesticides by any person that does not have a licence issued by the MAFS.
- Requires all premises that store pesticides for sale to be licenced by MAFS.
- Prohibits the distribution of pesticides packed in containers that are not safe for storage, handling or use to prevent harm to human and animal health or the environment.
- Prohibits the use of pesticide containers for any purpose, contrary to the directions given by MAFS.
- Prohibits the sale or holding of pesticides in containers that are not labelled as required by MAFS.
- Prohibits the sale or distribution of feed, or food for human consumption, if a pesticide has been applied to it in contravention of the Act.
- Empowers the Minister responsible for Health or Environment to regulate certain pesticides in food or by-products; to prohibit or restrict the use of certain pesticides at any period in the growth of food crops and to establish standards of maximum residue limits of pesticides in food, feeds and food by products.
- Assigns the duty of care, not to sell food and animal feeds that may contain excessive levels of pesticides, to any person that sells such produce or products.
- Prohibits any person to dispose any pesticide or pesticide container or packaging in a manner that is hazardous to human, animal health or the environment, contrary to any written law.

3.2 INTERNATIONAL LEGISLATION AND POLICIES

3.2.1 World Bank Operational Policy on Pest Management, OP/BP 4.09 (1998)

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

In Bank-financed agriculture operations, the Bank advocates pest populations reduction through IPM approaches such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest.

According to the Bank, rural development and health sector projects have to avoid using harmful pesticides. A preferred solution is to use Integrated Pest Management (IPM) techniques and encourage their use in the sectors concerned.

If pesticides have to be used in crop protection or in the fight against vector-borne diseases, the Bank-funded projects should have a Pest Management Plan (PMP), prepared by the client, either as a stand-alone document or as part of an Environmental Assessment.

The procurement of any pesticides in a Bank-financed project is contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users. With respect to the classification of pesticides and their specific formulations, the Bank refers to the World Health Organization's Recommended Classification of Pesticides by Hazard and Guidelines to Classification (Geneva: WHO 1994-95). The following criteria apply to the selection and use of pesticides in Bank-financed projects:

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

At a minimum, pesticide production, use and management should comply with FAO's Guidelines for:

- i. Packaging and storage;
- ii. Good labelling practice; and
- iii. Disposal of waste pesticide containers on the farm.

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

The proposed project will trigger OP 4.09, since it will support post-harvest pest control, to minimise post-harvest pest damage from eroding crop productivity gained through the program's improved technology adoption by farmers. However, procurement of pesticides will not be financed until it can be demonstrated that local capacity exists to adequately manage their environmental and social impacts, in compliance with OP 4.09 as described above.

3.2.2 Environmental, Health, and Safety General Guidelines (WorldBank)

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on

EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary (IFC, 2007).

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as assimilative capacity of the environment, and other project factors, are taken into account.

When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment (IFC, 2007).

For pesticide management the most relevant sections of the General EHS Guidelines include the following:

1. Environmental

- 1.3 Wastewater and Ambient Water Quality
- 1.5 Hazardous Materials Management
- 1.6 Waste Management

2. Occupational Health and Safety

- 2.4 Chemical Hazards
- 2.5 Biological Hazards
- 2.7 Personal Protective Equipment (PPE)
- 2.8 Special Hazard Environments
- 2.9 Monitoring

3. Community Health and Safety

- 3.5 Transport of Hazardous Materials
- 3.7 Emergency Preparedness and Response

3.2.3 WBG EHS Specific Guidelines: Annual Crop Production

This specific guideline covers information relevant to large-scale production, harvesting, post harvesting processing and storage of major annual crops, including cereals, pulses, roots and tubers, oil-bearing crops, fiber crops, vegetables, and fodder crops, located in both temperate and tropical regions (WBG, 2016a).

The pesticide related issues associated with annual crop production, in this guideline include the following:

- Crop Residue and Solid Waste Management
- Pest Management
- Use and Management of Pesticides

3.2.3 WBG EHS Specific Guidelines: Perennial Crop Production

This specific guideline covers information relevant to large-scale plantation crops and out grower systems and focuses on the primary production and harvesting through farming and plantation

forestry of major multi-year food, fiber, energy, ornamental, and pharmaceutical crops. It includes tree crops (such as olives, citrus, coffee, rubber, eucalypts, and cacao) as well as banana, sugarcane, and palm oil (WBG, 2016b).

The pesticide related issues associated with annual crop production, in this guideline include the following:

- Crop Residue and Solid Waste Management
- Pest Management
- Use and Management of Pesticides

3.2.4 International Plant Protection Convention of FAO (1952)

The International Plant Protection Convention (IPPC) is an international treaty to secure action to prevent the spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control. It is governed by the Commission on Phytosanitary Measures (CPM) which adopts International Standards for Phytosanitary Measures (ISPMs).

3.2.5 International Standards for phytosanitary measures, (FAO)

International Standards for Phytosanitary Measures are prepared by the Secretariat of the International Plant Protection Convention as part of the United Nations Food and Agriculture Organization's global programme of policy and technical assistance in plant quarantine. This programme makes available to FAO Members and other interested parties these standards, guidelines and recommendations to achieve international harmonization of phytosanitary measures, with the aim to facilitate trade and avoid the use of unjustifiable measures as barriers to trade (FAO, 2006).

The International Standards for Phytosanitary Measures (ISPMs) are adopted by contracting parties to the IPPC through the Commission on Phytosanitary Measures. ISPMs are the standards, guidelines and recommendations recognized as the basis for phytosanitary measures applied by Members of the World Trade Organization under the Agreement on the Application of Sanitary and Phytosanitary Measures. Non-contracting parties to the IPPC are encouraged to observe these standards.

The standards of particular emphasis may be ISPM No. 09, ISPM No. 10, and ISPM No. 14.

- **ISPM No. 09 (1998)**, Guidelines for pest eradication programmes
This standard describes the components of a pest eradication programme which can lead to the establishment or re-establishment of pest absence in an area.
- **ISPM No. 10 (1999)**, Requirements for the establishment of pest free places of production and pest free production sites.
This standard describes the requirements for the establishment and use of pest free places of production and pest free production sites as pest risk management options for meeting phytosanitary requirements for the import of plants, plant products and other regulated articles.
- **ISPM No. 14 (2002)**, The use of integrated measures in a systems approach for pest risk management
This standard provides guidelines for the development and evaluation of integrated measures in a systems approach as an option for pest risk management.

3.2.6 International Code of Conduct for distribution and use of pesticides, FAO (2005)

The International Code of Conduct on the Distribution and Use of Pesticides is a voluntary Code of Conduct in support of increased food security, while at the same time protecting human health and the environment. It was adopted in 1985 by the FAO Conference at its Twenty-third Session and has undergone several amendments. It established voluntary standards of conduct for all public and private entities engaged in, or associated with, the distribution and use of pesticides, particularly where there is inadequate or no national legislation to regulate pesticides. Since its adoption it has served as the globally accepted standard for pesticide management (FAO, 2005).

The Code currently embodies a modern approach, of pesticide management which focuses on risk reduction, protection of human and environmental health, and support for sustainable agricultural development by using pesticides in an effective manner and applying IPM strategies. Among other things the Code;

- provides a measure of acceptable practices for government authorities, pesticide manufacturers, those engaged in pesticide trade.
- addresses the need for a cooperative effort between governments of pesticide exporting and importing countries to promote practices that minimize potential health and environmental risks associated with pesticides, while ensuring their effective use.
- emphasizes on training at all appropriate levels as a requirement in implementing and observing its provisions.

The standards of conduct set forth in this Code include the following:

- promotion of the judicious and efficient use of pesticide products in countries which have not yet established regulatory controls on pesticides,
- promotion of practices which reduce risks in the handling of pesticides,
- ensuring that pesticides are used effectively and efficiently for the improvement of agricultural production and of human, animal and plant health,
- adoption of the "life-cycle" concept in handling all types of pesticides, including used pesticide containers;
- promotion of Integrated Pest Management (IPM) (including integrated vector management for public health pests);

Basically, the Code serves as a framework and point of reference for the judicious use of pesticides for all those involved in pesticide matters, particularly until such time as countries have established adequate and effective regulatory infrastructures for the sound management of pesticides. It also demonstrates that pesticide management should be considered as a part of chemical management, as well as of sustainable agricultural development (FAO, 2005).

3.2.7 The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, and entered into force in 1992. The Convention was negotiated in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad and its thrust was to combat the "toxic trade", that was now proliferating.

The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes

defined as “hazardous wastes” based on their origin and/or composition and their characteristics, as well as two types of wastes defined as “other wastes” - household waste and incinerator ash.

The provisions of the Convention center around the following principal aims:

- the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;
- the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and
- a regulatory system applying to cases where transboundary movements are permissible.

The first aim is addressed through a number of general provisions requiring States to observe the fundamental principles of environmentally sound waste management (article 4).

The second aim is addressed by a number of prohibitions eg. hazardous wastes may not be exported to a State not party to the Basel Convention, or to a party having banned the import of hazardous wastes (article 4). Parties may, however, enter into bilateral or multilateral agreements on hazardous waste management with other parties or with non-parties, provided that such agreements are “no less environmentally sound” than the Basel Convention (article 11).

The third aim on the regulatory system is the cornerstone of the Basel Convention as originally adopted. Based on the concept of prior informed consent, it requires that, before an export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with detailed information on the intended movement. The movement may only proceed if and when all States concerned have given their written consent (articles 6 and 7).

The Basel Convention also provides for cooperation between parties, ranging from exchange of information on issues relevant to the implementation of the Convention to technical assistance, particularly to developing countries (articles 10 and 13). The Secretariat is required to facilitate and support this cooperation, acting as a clearing-house (article 16).

The **Basel Convention Technical Guidelines** gives a narrow approach to the definitions and it is focused on reducing the impacts on health and the environment of biocides and phytopharmaceuticals wastes that is based on the major classifications in Annexes I, II, VII of the Basel Convention.

In terms of pesticide wastes the Convention defines them under “Wastes containing principally inorganic constituents, which may contain metals and organic materials”. These are specified as Wastes from the production, formulation and use of biocides and phytopharmaceuticals, including waste pesticides and herbicides which are off-specification, outdated, or unfit for their originally intended use.

3.2.8 Rotterdam Convention on the PIC Procedure

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade was adopted on 10 September 1998 by a Conference of Plenipotentiaries in Rotterdam, the Netherlands. The Convention entered into force on 24 February 2004.

The Convention 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. In essence the purpose of the Convention is to reduce hazards posed by chemicals and pesticides. This is achieved by:

- facilitating information exchange about their characteristics

- providing for a national decision-making process on their import and export
- disseminating these decisions to parties.

The objectives of the Convention are:

- to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm;
- to contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.

The Convention creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure. It built on the voluntary PIC procedure, initiated by UNEP and FAO in 1989 and ceased on 24 February 2006.

The Convention covers pesticides and industrial chemicals that have been banned or severely restricted for health or environmental reasons by Parties and which have been notified by Parties for inclusion in the PIC procedure. One notification from each of two specified regions triggers consideration of addition of a chemical to Annex III of the Convention. Severely hazardous pesticide formulations that present a risk under conditions of use in developing countries or countries with economies in transition may also be proposed for inclusion in Annex III.

Once a chemical is included in Annex III, a "decision guidance document" (DGD) containing information concerning the chemical and the regulatory decisions to ban or severely restrict the chemical for health or environmental reasons, is circulated to all Parties.

The Convention promotes the exchange of information on a very broad range of chemicals. It does so through:

- the requirement for a Party to inform other Parties of each national ban or severe restriction of a chemical;
- the possibility for a Party which is a developing country or a country in transition to inform other Parties that it is experiencing problems caused by a severely hazardous pesticide formulation under conditions of use in its territory;
- the requirement for a Party that plans to export a chemical that is banned or severely restricted for use within its territory, to inform the importing Party that such export will take place, before the first shipment and annually thereafter;
- the requirement for an exporting Party, when exporting chemicals that are to be used for occupational purposes, to ensure that an up-to-date safety data sheet is sent to the importer; and
- labeling requirements for exports of chemicals included in the PIC procedure, as well as for other chemicals that are banned or severely restricted in the exporting country.

3.2.9 Stockholm Convention on Persistent Organic Pollutants

The **Stockholm Convention on Persistent Organic Pollutants** is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have adverse effects to human health or to the environment. Exposure to Persistent Organic Pollutants (POPs) can lead to serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and even diminished intelligence.

APPSA activities will promote increased use of biocides, some of which are listed as POPs. Some illegal trade in these will also be fuelled by the increased activities, thus this convention has to be effected in the implementation of APPSA.

3.2.10 World Food Security and the Plan of Action of November 1996

This declaration seeks to secure effective prevention and progressive control of plant and animal pests and diseases, especially those which are of trans-boundary nature, such as rinderpest, cattle tick, foot-and-mouth disease and desert locust, where outbreaks can cause major food shortages, destabilize markets and trigger trade measures. It promotes regional collaboration in plant pests and animal disease control; and widespread development and use of integrated pest management practices.

3.3 NATIONAL LEGISLATION AND POLICIES

Although the amount of pesticides used in Lesotho is generally low, as compared with other countries, there has been considerable abuse of these toxic substances. In the absence of a regulatory body, chemicals were just imported by some organizations, as deemed necessary. As a result, there were more chemicals than actually required. This resulted in the build-up of pesticides products that became obsolete (Mohai, 2006; Partow & Mohai, 1996)

Lesotho does not have legislation specific to agriculture or agro-chemicals. Attempts have been made to pass such legislation as the bill titled Hazardous and Non Hazardous Waste Management which was drafted in 2008, but for unknown reasons it was not passed into law, a fate similar to the 1986 bill titled Pesticides Management. The only available instruments deal with the distribution and marketing of pesticides as regulated by the office of the Registrar (See table 3-1 below and section 3.3.2)

Table 3-1 Availability of Legal Instruments for Management of Chemicals.
(GOL 2010 c)

Category of Chemicals	Import	Production	Storage	Transport	Distribution/ Marketing	Use/ handling	Disposal
Pesticides (Agricultural Public health and consumer use)	-	-	-	-	X	-	-
Fertilizers	-	-	-	-	X	-	-
Industrial Chemicals list in Manufacturing processing facilities	-	-	-	-	X	-	X
Petroleum Products	X	X	X	X	X	X	X
Consumer Chemicals	-	-	-	-	X	-	-
Chemical Waste	X	X	X	X	X	X	X
Pharmaceuticals	X	X	X	-	X	X	X
Radioactive materials & products containing Radioactive	-	-	-	-	-	-	-

KEY: X indicates legislation in place, - indicates there is no legislation

The Environmental Management Act (EMA) 2008 makes provisions for the management of pesticides and the creation of subsidiary regulation. Currently the governance of agro-chemicals such as pesticides and fertilizers is thus fragmented with responsibilities split between a number of different ministries overseeing environment, agriculture, environment and labour. (GOL 2010 c)

Since Lesotho does not have regulations and/or guidelines of its own, Pesticides are generally regulated by international protocols, declarations and guidelines set by organizations like WHO and FAO. In many instances any pesticide that is allowed in the Republic of South Africa is also given a green light in Lesotho.

The Ministry of Agriculture is in the process of formulating a Policy on Pesticide Management and the regulations proposed in the Environmental Management Act. In the absence of the Plant Protection Unit proposed in the Environment Act, the Plant Protection Sections of the Department of Agricultural Research and Department of Crops are mandated to continue with most of the proposed activities of PPU and hence in this document will be referred to as PP units of MAFS. But revision of this document will refer to PPU if such body is established during the period of this project.

3.3.1 The Environmental Management Act (EMA) 2008

Upon realisation of the importance of having control over the use of pesticides, the Environmental Management Act (EMA) 2008 was promulgated with provisions for the control on the import, export, manufacture, distribution, storage, disposal and use of pesticides. It also has provisions to formulate regulations for better management of pesticides. The regulations provided for the establishment of a Plant Protection Unit (PPU), which was to be established in the Department of Agricultural Research of MAFS. The enforcement of the law facilitates the following outputs / results:

- (a) Registration of all marketed pesticides in Lesotho;
- (b) Registration of all pesticides according to the crops and the target pests and diseases;
- (c) Documentation of all import permits and licenses for selling and storage of pesticides;
- (d) Conducting stakeholders' workshops to create awareness to the general public on the Pesticides Regulations;
- (e) Encouragement on safe usage of pesticides;
- (f) Harmonization of pesticides registration through international bodies such as the **Southern African Pesticide Regulators Forum (SAPReF)**;
- (g) Labelling of pesticides containers according international standards; and
- (h) Carrying out proper disposal of obsolete pesticides stock.

The general goal of having the PPU is that all pesticides used in Lesotho should be registered and that all importers and dealers should be licensed. The benefits from this are:

- 1. Only safe and effective pesticides will be marketed;
- 2. There will be less risk for farmers, consumers and the environment;
- 3. There will be higher export opportunities for agricultural products.

3.3.2 Regulation of Pesticides Storage, Distribution and Disposal

The office of the Registrar is mandated to ensure that all registered and licensed pesticide dealers conform to the regulations for safe handling of the pesticides. Pesticides dealers should follow the "safety" guidelines on transportation, distribution, application, storage and disposal of pesticides.

Lesotho Body, the Plant Protection Unit (PPU) will ensure that all stakeholders observe safe handling of pesticides. The PPU is mandated to make frequent checks in all premises where pesticides are stored to ensure safety. The PPU is also mandated to take stock of obsolete chemicals in all premises.

The PPU will advise the Lesotho Government on how to dispose of obsolete stock. This will involve collecting obsolete stocks from all premises and arranging for incineration in properly assessed and designated sites.

3.4 “GAP ANALYSIS” BETWEEN LESOTHO REGULATIONS AND THE WB’S OP/BP 4.09,

While Lesotho’s EA procedures are generally consistent with the Bank’s policies, there are some gaps regarding pest management. Therefore, under the APPSA the pest management processes as described in this report will be used. Table 3-2 describes the gap analysis and comparison of World Bank and Lesotho pest management procedures.

Table 3-2 Comparison between Bank and Lesotho ESA procedures

Subject/Issue	World Bank Policy	Lesotho Policy	Solution/mitigation
Pest management	<p>The Bank Policy for pest management is “Pest Management (OP 4.09)”. The policy supports safe, affective, and environmentally sound pest management. It promotes the use of biological and environmental control methods.</p> <p>The policy is triggered if procurement of pesticides is envisaged (either directly through the project or indirectly through on-lending); if the project may affect pest management in a way that harm could be done, even though the project is not envisaged to procure pesticides.</p> <p>This includes projects that may lead to substantially increased pesticide use and subsequent increase in health and environmental risks; and projects that may maintain or expand present pest management practices that are unsustainable.</p> <p>The following criteria apply to the selection and use of pesticides in Bank-financed projects:</p> <ul style="list-style-type: none"> • Have negligible adverse human health effects; • Be shown to be effective against the target species; • 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; • Use must take into account the need to prevent the development of resistance in pests. 	<p>Lesotho does not have legislation specific to agriculture or agro-chemicals. The only available instruments deal with the distribution and marketing of pesticides as regulated by the office of the Registrar.</p> <p>The Environmental Management Act (EMA) 2008 has provisions for the control on the import, export, manufacture, distribution, storage, disposal and use of pesticides.</p> <p>It also has provisions to formulate regulations for better management of pesticides.</p> <p>It also provides for the establishment of a Plant Protection Unit (PPU), which has not been established yet.</p> <p>Since Lesotho does not have regulations and/or guidelines of its own Pesticides are regulated by international protocols, declarations and guidelines set by organizations like WHO and FAO.</p> <p>In many instances any pesticide that is allowed in the Republic of South Africa is also given a green light in Lesotho.</p>	<p>APPSA Lesotho will use the Integrated Pest Management Plan (IPMP) as described in this document.</p>

4. STEPS IN SETTING UP INTEGRATED PEST MANAGEMENT PLAN

4.1 IDENTIFY THE IMPLEMENTATION TEAM

Transition to an IPM program requires a diverse, action-oriented IPM Committee. This IPM Committee will be an environmentally conscious Committee and will be part of the District Development Committee lead by the District Agricultural Officer (DAO) as a member of the District Development Committee (DDC). A representative of the Farming Group will be a member of this Committee. The leader of this team should be familiar with pests, pesticides and pesticide regulations. This arrangement is appropriate, because implementation of an IPM program can be tracked as a performance indicator.

IPM leadership is guided by pest management principles and environmental issues. Leadership with such academic background qualifies to serve as an authority to supervise IPM implementation. Other team members could include District Environmental Officer (DEO), agronomists, crop protection experts (entomologists, pathologists) and District Health Officer (DHO).

4.2 DECIDE ON THE SCALE OF IMPLEMENTATION

To determine the scale of implementation, a strategic approach will be taken. IPM will be clearly defined and discussed by the DDC as is done for all other development projects. A representative of the APPSA-PMU must attend these meetings to help explain the IPM approach and give examples of similar documented success studies. Through these discussions comprehension will be achieved, and potential objections will be addressed with successful practical examples.

4.3 REVIEW AND SET MEASURABLE OBJECTIVES FOR THE IPMP

The IPM Committee will set measurable objectives and refine the IPM indicators to be relevant to their district; and determining factors such as:

- When the IPM program will start
- How much it will cost
- What will be accomplished by choosing IPM
- How success shall be monitored

The determination above must be done prior to IPM implementation. Additionally, measurable goals will be set, to track:

- Pest management costs;
- Monitoring of pest activity before and after implementation of the IPM program;
- Number of calls related to pest problems and toxic chemical use reduction.

Furthermore, the time when the shift to IPM will occur must be discussed and agreed upon prior to implementation. The initial step will be to establish an implementation timeline that includes time to execute all of the steps outlined in the implementation plan. It is imperative to include time to organize the administration of the IPM and conduct any farmer training as well as manage the IPM process.

The IPM Committee will gather information on previously implemented or currently being implemented IPM programs; the time it took to develop them and how successful they have been. They will obtain the budgetary and any technical information for the previously implemented IPM programs and analyse the elements to establish lessons to learn. Field visits to currently running programmes will be conducted to get a practical insight.

Reduced pesticide use is the substantive yardstick in measuring an IPM's ability to create a safer environment. The IPM Committee will therefore design an information database that includes annual quantities of pesticides used to enable comparative analysis to the previous years. The goal will be a downward trend over time or ideally, a specific reduction amount, ultimately leading to a scant usage of highly toxic pest control chemicals.

4.4 CURRENT HOUSEKEEPING, MAINTENANCE & PEST CONTROL PRACTICES

While preparing to make a transition to IPM, the IPM Committee will familiarize itself with the organization's current policies and practices with respect to structural maintenance, sanitation and pest control. Occasionally, current practice may be consistent with IPM principles. Familiarization will provide the flexibility necessary to adapt to and prepare for the necessary changes.

Structural maintenance is arguably the most efficient way to keep pests out of a facility because it physically stops pests from entering wherever possible. Structural maintenance will therefore be a regular part of the IPM. Cracks, crevices or other unnecessary openings in the building exterior that can be used by pests as harbourage areas or entry points regardless of size, will be sealed appropriately.

Sanitation deprives pests of food and water. A sanitation plan must therefore be accounted for in the development of an IPM. Staff must be provided with special sanitation training

4.5 ESTABLISH A SYSTEM OF REGULAR IPM INSPECTIONS

IPM's central focus is regular facility inspections. Such inspections are the "lifeblood" for a continuous cycle of IPM activities that may or may not include chemical treatments. Activities will include:

- a) Routine Inspections
- b) Pest Identification
- c) Selection of Control Methods
- d) Monitoring and Evaluation

IPM inspections must emphasize on the four "zones" of pest activity:

- (1) Entry points
- (2) Water sources
- (3) Food sources
- (4) Harbourage areas.

During inspections, all existing pest issues and potential problem areas, inside and outside, must be noted for follow-up.

For in-house IPM programs, the greatest inspection challenge will be establishing routine, proactive surveillance by trained specialists. To ensure this is done, the EMC or an independent consultant will conduct annual inspections and audits.

4.6 DEFINE THE TREATMENT POLICY SELECTION

A clear written policy on how the facility will respond to pests when they appear must be developed. Included in the policy will be definitions of both non-chemical and chemical treatment options and the sequence or prioritization in which they will be considered. It should be unequivocal on when and

where chemical treatments are appropriate. Finally, it should include an “approved materials” list to ensure informed choices when chemical treatments are applied.

The key to an effective IPM is to correctly identify pests that have invaded the area before. Due to pest behaviour variations from one species to the other, the appropriate response will vary accordingly.

Once the pest is identified and the source of activity is pinpointed, the treatment policy will call for habitat modifications such as exclusion, repair or better sanitation. These counter measures can drastically minimize pest presence before chemical responses are considered. Additional treatment options—chemical and nonchemical—can then be tailored to the biology and behaviour of the target pest.

The final step in the pest response cycle is Monitoring. The information gained through ongoing monitoring of the problem will facilitate determination of supplemental treatment options if required.

4.7 ESTABLISH COMMUNICATION PROTOCOLS

Communication protocols must be developed to assist environmental services, facility maintenance, facility management and service providers. IPM is a cooperative effort and therefore effective communication between various parties is essential for success. IPM Committee and farmers must document pest sightings. The IPM Committee will make recommendations and notify APPSA of chemical treatments. They will also communicate with the maintenance team to make the necessary repairs.

4.8 DEVELOP FARMER TRAINING PLANS AND POLICIES

The Farmer Groups will serve as a pool of “inspectors” charged with reporting pest sightings to expedite response times and help limit the scope of new infestations. Training sessions will be conducted to acquaint farmers with IPM principles and their responsibilities for the success of the IPM program.

4.9 TRACK PROGRESS AND REWARD SUCCESS

Measurable objectives set at the beginning, must be measured against the IPM program’s performance at least once a year. Documentation to facilitate the evaluation process is as follows:

- (a) Detailed description of the parameters and service protocols of the IPM program, stating the ground rules.
- (b) Specific locations where pest management work was performed
- (c) Dates of service.
- (d) Activity descriptions, e.g., baiting, crack-and crevice treatment, trapping, structural repair and
- (e) Log of any pesticide applications, including:
 - Target pest(s)
 - The brand names and active ingredients of any pesticides applied
 - PPU registration numbers of pesticides applied
 - Percentages of mix used in dilution
 - Volume of pesticides used expressed in kilograms of active ingredient
 - Applicator’s name(s) and certification identity (copy of original certification and recertification should be maintained.)
 - Facility floor plan on which all pest control devices mapped and numbered

- Pest tracking logs (sightings and trap counts)
- Action plans, including structural and sanitation plans, to correct any pest problems
- Pest sighting memos for IPM Committee to use in reporting pest presence to DEC
- Using these records, and the goals of the IPM program (increased efficacy, lower costs and reduced pesticide use), the IPM Committee must see:
 - Fewer pest sightings and farmer complaints
 - Lower monitoring-station counts over time
 - Lower costs after the first 12-18 months, once IPM's efficacy advantage has had time to take effect
 - Downward trend in volume or frequency of chemical pesticide usage

IPM is a team effort. Therefore, the IPM Committee will track and report the program's successes following each evaluation; and encourage good practices by recognizing farmers who played a role. Communicating the success of the program in reducing toxic chemical use and exposure, reducing pest complaints and lowering costs will help farmers to understand the purpose of the program and appreciate its success. The more they understand, the more likely they will participate willingly in helping expand and institutionalize the IPMP.

After the program has been in place for long enough to show significant results, it is recommended for the IPM Committee to work with APPSA to publicize successes more broadly and to demonstrate the environmentally responsible approach to effective pest management and control. IPM Committee and APPSA will lead by example by sharing success with other stakeholders.

5. IMPACTS OF DIFFERENT PEST MANAGEMENT PRACTICES

IPM will play a key role in the agricultural productivity; leading to a wide range of socio-economic impacts and overall economic development of the country. Agricultural productivity in Lesotho is closely related to reduction of poverty and malnutrition. Hence, small-scale farmers in particular, will play an important role in reducing poverty and malnutrition and creating widespread growth through the implementation of IPM for the APPSA.

On the other hand, pest management practices, if not implemented properly, will have negative impacts on the environment as well as harmful effects on human beings and animals. The following sections provide positive and negative impacts of pest management practices.

5.0 CUMULATIVE IMPACTS OF CHEMICAL PESTICIDES

Conventional agriculture relies heavily on pesticides, often applied as mixtures of products. Each chemical in the mixture targets different soil pests, and co-application saves farmers time and fuel. With a few exceptions for known interactions between pesticides that alter their pesticidal activity, there are no label restrictions on combining pesticides. Exposure to multiple pesticides is thus widespread, from the most heavily exposed farm workers, to neighbours adjacent to or downstream from pesticide application sites such as agricultural fields or structural fumigations.

Chemical exposures do not happen in isolation; everyone is exposed to a range of chemicals on a daily basis. This includes aggregate exposures to a single chemical, as well as cumulative exposure to chemical mixtures. The various pesticides exhibit different exposures which include the following:

- **Aggregate exposure**
Combined exposure to a single stressor (e.g. a pesticide) across multiple routes and multiple pathways.
- **Cumulative exposure**
Combined exposure to multiple stressors that affect a single biological target.
- **Cumulative risk**
Combined risk from aggregate exposures to multiple stressors. There are different ways to consider cumulative risk.

The combined toxicological effects of these cumulative exposures usually take one of two forms:

- **Additive effects:**
The effect of two or more pesticides is equal to the sum of each of the agents when used alone. Often called dose addition, in this case the compounds do not interact in a direct way. Mixture constituents acting via dose addition generally belong to a Common Mechanism Group (CMG), meaning the detailed biological steps leading to particular disease or toxic effect are mechanistically identical. Alternatively, two or more chemicals could have a similar effect on a particular target organ. Therefore, even when individual compounds are present at concentrations below their respective No Observed Adverse Effect Levels (NOAELs), combined exposures could result in measurable effects due to the combined doses of individual components in the mixture.
- **Interactive effects:**

Two or more chemicals can interact with each other to either amplify or reduce a toxic effect. This is particularly true when a scientifically reasonable hypothesis exists for enhancing or reducing a particular effect by metabolic inhibition or induction of enzymes responsible for detoxification. For example, activation of cytochrome P450 by organophosphates can decrease an organism's ability to detoxify pyrethroids, so greater-than-additive toxicity may be observed during periods of simultaneous exposure.

Interactive effects can lead to responses that are greater than or less than those predicted using simple dose-addition models:

- **Synergistic—greater than additive.**
This type of effect includes potentiation, when one substance that normally does not have a toxic effect accentuates the toxicity of a second chemical. It also includes synergistic effects, when the combined effect of two chemicals is greater than the sum of each agent individually.
- **Less than additive.**
This type of effect is called antagonism, when the toxicity of one chemical is reduced as a result of the presence of the other chemical. This type of effect can occur when one chemical induces the production of enzymes responsible for the degradation and clearance of the other chemical, thereby reducing its effect.

5.1 POSITIVE IMPACTS OF CHEMICAL PESTICIDES

Continued application of chemical pesticides results in long term negative impacts which are presented in Section 5.2. On the other hand, chemical pesticides may improve yields in the short term, although this is to the detriment of the soil quality for the long term. The short term positive impacts of chemical pesticides are as follows:

Increase in crop yields

Application of chemical pesticides will protect crops from damaging pests. This will lead to an increase in crop yields, for the short term.

Enhancement measures

Apply chemical pesticides in accordance with recommendations of the IPMP to sustain crop productivity. Adhere to the IPMP recommendations to progressively reduce the use of chemical pesticides.

Increase in economic growth

Increase in crop yields will lead to food self-sufficiency as well as surplus crop for sale; thereby contributing to the overall economic growth of the country, albeit for the short term.

Enhancement measures

Assist farmers in marketing produce and maintain access roads to markets. Train farmers in IPM practices to retain good soil quality and to progressively reduce use of chemical pesticides.

5.2 NEGATIVE IMPACTS OF CHEMICAL PESTICIDES

Depletion of organic soil nutrients

Frequent and continuous application of chemical pesticides to agricultural fields will lower the soil potential and deplete organic soil nutrients necessary for good crop yields, due to chemical imbalance. This would negatively affect crop growth and productivity in the long term.

Mitigation measures

- Apply soil conditioning measures which would also be part of IPM
- Train farmers in proper handling and application of chemical pesticides as recommended by the IPMP and APPSA

Poisoning of non-target species including natural biological pesticides

Poisoning of non-target flora and fauna species may occur due to negligence or lack of knowledge of chemical pesticide potency; equipment malfunction and use of wrong type of equipment; wrong time and method of application (spraying). Chemical pesticides and residues can be dangerous to non-target wild animals; fish and invertebrates as well as aquatic arthropods.

Mitigation Measures

- Supervise and control use of chemical pesticides to ensure that only approved and recommended ones are used;
- Use recommended equipment and approved methods of application;
- Regularly maintain and clean the equipment as recommended in the IPMP
- Use recommended and appropriate protective clothing;
- Conduct training seminars in IPM; and
- Clean equipment and dispose old equipment as recommended by manufacturer.

Adulteration

Dealers may adulterate or dilute their chemical pesticides for financial gains

Mitigation measures

Conduct regular inspection, sampling and testing of chemical pesticides

Water, soil and environmental pollution

Water, soil and environmental pollution may occur due to spillage during loading and offloading of vessels and during storage.

Mitigation measures

- Provide suitable storage warehouse;
- Use bio-beds, draining channels and draining dams for waste pesticides treatment;
- Use chemical remains to re-spray crops;
- Clean equipment in one place designated for such activities;
- Use plants such as water lilies to absorb waste pesticides;
- Take regular stock of pesticides for early tracking of leaks and waste;
- Apply Integrated Pesticide Management;
- Train staff and farmers not to spray toxic chemicals close to water sources; and
- Train staff and farmers to maintain spray equipment in safe operational order

Air pollution and contamination

Spillage of volatile pesticides may result in air pollution. Excessive application of pesticides through fumigation in crop fields and gardens would also result in air pollution. This will pose health risks to people and animals around the areas.

Mitigation measures

- Provide suitable warehouse to protect pesticides from wind drafts;
- Take regular stock of pesticide containers to detect losses and leaks early;
- Apply Integrated Pesticide Management (reduced chemical application);
- Train staff and farmers to maintain spray equipment in safe operational order and to use it properly;
- Provide protective clothing to workers and ensure it is used during pesticide handling and application to crops;
- Train farmers in proper handling and application of chemical pesticides and conduct routine medical examination for workers; and
- Promote IPM to replace harmful chemicals.

Health and safety risks

Staff in research stations and farmers around pesticides storage, handling and spraying areas may be exposed to hazardous chemicals. Pesticides, if not stored correctly, will result in corroded containers, lost labels and release of the chemicals into the environment. Pesticide stockpiles pose a very serious health and safety risk of contaminating drinking water, food or the air. High levels of chemicals from pesticides become harmful to man and aquatic community as the chemicals are eventually washed as run off into water bodies.

Mitigation Measures

- Provide protective clothing to workers and ensure it is used;
- Inspect pesticides handling and storage areas regularly;
- Train staff and farmers in proper handling of chemical pesticides and conduct routine medical examination for workers; and
- Promote IPM to replace harmful chemicals

Health risk from chemical pesticide misuse (over / under application)

Lack of appropriate knowledge of application rates may increase health risks due to misuse, underuse or overuse of the pesticides. These conditions may be detrimental to staff and farmers, crops and wildlife. In trying to be prepared for initiating a control campaign at short notice, stockpiles of chemical pesticides may be maintained. These stockpiles pose serious threats of contaminating drinking-water, food or the air.

Mitigation Measures

- Conduct training sessions and awareness campaigns on appropriate and approved chemical pesticides application; and
- Purchase only enough stocks as required and destroy obsolete stocks of chemical pesticides

Accidental or intentional poisoning

Improper labelling and storage of chemical pesticides may increase chances of accidental poisoning. Availability of pesticides and increased accessibility and knowledge of toxicity levels by staff and farmers may increase the risk of poisoning to kill intentionally or commit suicide due to social pressures and frustration.

Mitigation Measures

- Ensure responsible, mentally sound and mature persons are given charge and control of approved chemical pesticides; and
- Restrict accessibility to chemical pesticides; and conduct regular spot checks to balance stock.

Pesticides resistance in pests

Lack of appropriate knowledge in pesticides application may result in incorrect pesticides application. This may reduce effectiveness of the chemicals on pests, thereby promoting development of pesticides resistance.

Mitigation Measures

Train staff and farmers in correct application of pesticides

5.3 POSITIVE IMPACTS OF NON-CHEMICAL PESTICIDE

Non-chemical pesticides, which include biological controls, manual and mechanical methods of managing pests; entails the use of environmentally and socially acceptable methods on the host, to eliminate pests or diseases.

5.3.1 Positive impacts of biological controls

Reduced environmental and health risks

Application of pests and diseases; insects, bacteria or fungi on the host, to eliminate the pest or disease to control pests biologically, is more environmentally friendly in comparison with chemical control methods. Biological control is applied carefully and selectively without the use of chemicals and hence it has no adverse effects on people's health and the environment.

Enhancement Measures

Establish and disseminate environmental and health benefits of biological controls to the communities for them to appreciate the advantages

Reduction in time spent on application of pesticides

Planting of pest resistant crops in a particular growing season guarantees the farmer of effective pest control for several growing seasons. This reduces the time spent by the farmer in applying pesticides to the same agricultural fields for a good number of growing seasons during which the biological control will be effective. Biological control methods can also be easily integrated in other IPM control methods.

Enhancement measures

Prepare an inventory of indigenous and established biological control methods and conduct community awareness seminars to enhance and exchange community knowledge base.

Increase in soil stability and reduction in soil erosion

The wider environmental benefits of increasing tree cover as biological control of pests will result in increase in soil stability and reduction of erosion.

Enhancement measures

Conduct awareness campaigns on the importance of using new and improved pest resistant seed varieties in controlling pests.

Resistance to pests through improved varieties

The use of resistant clones in the control of diseases; and adoption of fast methods of propagating plantings has environmental benefits as well as advantages of crop resistance to pests.

Tissue culture technology also has the potential to increase biodiversity by replacing the stocks of rare and endangered tree species. The wider environmental benefits of increasing biodiversity and tree cover include improving soil stability, reducing erosion, preventing desertification and stabilizing global climate.

Enhancement measures

Rural people have a tendency of resisting to introduction of new varieties and sticking to traditional seed varieties. Awareness campaigns on the benefits of new and improved seed varieties, which are resistant to pest will help reduce application of chemical pesticides.

5.3.2 Positive impacts of mechanical methods

Reduction in time spent managing and controlling pests

The use of automated and fast machinery to manage and control pests by removing the hosts through weeding reduces time spent by farmers in controlling pests through other methods.

Enhancement measures

Regularly services equipment and machinery to maintain their efficiency.

5.3.3 Positive impacts of manual methods

Reduced pollution on the environment

Use of labour with simple implements/tools is environmentally friendly in the sense that it has no significant impacts on water or air pollution.

Enhancement measures

- Train farmers on the appropriate and efficient use of simple farm implements to significantly minimize environmental pollution; and

5.4 NEGATIVE IMPACTS OF NON- CHEMICAL PESTICIDES

5.4.1 Negative impacts of biological controls

Damage on other unintended crops

Some of the biological controls may not be very selective on hosts and as a result, they may attack other unintended plants or crops. This may create an imbalance in the ecosystem.

Mitigation Measures

- Biological controls must be applied carefully with the full knowledge of the consequences;
- Train staff and farmers on the appropriate application and management of biological controls for various crops; and in IPM

Risk of damage to crops

Biological control agents are known to be slow in action and may take a long period to generate results, thereby posing a great risk of damage to crops. This method is therefore not suitable for use in emergency situations. The slowness of biological agents to act may frustrate IPM programmes as farmers are used to the rapid, though unsustainable results of chemical pesticides.

Mitigation measures

- Educate farmers on the long-term benefits of the biological methods to facilitate their adoption; and
- Phase transition from biological to IPM methods to ensure no appreciable loss of production during transition.

5.4.2 Negative impacts of mechanical methods

Damages to crops

Use of automated machinery to manage and control pests, through weeding, may result in crop damage. Weeding is done when the crops are already established in the fields and the machines used during weeding are usually heavy and occupy a lot of space, hence some crops may be physically damaged in the process. However, the APPSA will target smallholder farmers who are not likely to heavy mechanical and automated machinery to manage and control pests under this programme.

Mitigation measures

Conduct sensitisation and awareness campaigns for farmers on disadvantages of mechanical methods and encourage them to adopt IPM as a sustainable method of managing pests.

High capital, operation and maintenance costs

Machinery is highly costly to purchase, operate and maintain as required. The machines require highly skilled personnel and considerable amounts of fuels to operate as well as financial resources to buy spares for maintenance.

Mitigation measures

Conduct sensitisation and awareness campaigns for farmers on disadvantages of mechanical methods and encourage them to adopt IPM as a sustainable method of managing pests.

Health and safety risks

Personnel operating farm machinery may be exposed to accidents during farm operations and maintenance of the machinery. Some parts of the machinery such as sharp blades may cause harm to operators during operation and maintenance.

Mitigation Measures

Conduct sensitisation and awareness campaigns for farmers on disadvantages of mechanical methods and encourage them to adopt IPM as a sustainable method of managing pests. Where any type of farm machinery is used:

- Provide protective clothing to workers and ensure it is properly used;
- Train farmers in proper operations and handling of machinery; and
- Promote IPM to replace mechanical methods.

Air Pollution

Farm operations such as weeding and movement of farm machinery in the project area will generate dust on the site. Machinery exhausts will generate and release carbon dioxide into the air. Dust from earthworks and carbon dioxide from farm machinery exhausts may cause air pollution.

Mitigation Measures

Mitigation measures for air pollution from vehicle emissions and dust include:

- Regular servicing of farm machinery; and
- Controlling of machinery speeds during farm operations to reduce generation of dust.

Soil Contamination

Fuel and oil leaks from farm machinery; spills from machinery maintenance; and spills from waste oil containers discarded from machinery maintenance will result in soil contamination.

Mitigation Measures

To prevent soil contamination by oils, mitigation measures will include:

- Lining vehicle servicing and fuel/oil storage areas with concrete or appropriate impervious material and connecting the drainage to an oil interceptor; and
- Discarding waste oil containers in approved designated disposal sites.

Soil Erosion

Farm operations such as weeding and movement of farm machinery will cause disturbance of soil strata/structure. This will lead to exposure of loose soils to water and wind and eventually result in soil erosion.

Mitigation Measures

Mitigation measures for soil erosion include:

- Limiting exposure of loose soils by restricting the area of machinery movement and application; and
- Boundary planting of grass and trees around crop fields.

Noise

Operation of heavy farm machinery will cause noise, which is harmful to employees, the general public and animals as it may cause hearing impairment.

Mitigation Measures

Noise pollution can be mitigated by:

- Using appropriate and well-maintained noise mufflers on farm machinery;
- Provide ear protection materials for the workers in noisy areas;
- Using electric motors instead of compressed air driven machinery;
- Reducing noise by using plastic or rubber liners, noise control covers, and dampening plates and pads on large sheet metal surfaces;
- Ensuring that equipment is regularly serviced and maintained; and
- Notification of the public of upcoming loud events

5.4.3 Negative impacts of manual methods

Damages to crops

The use of manual methods with equipment such as hoes and slashers to manage and control pests is slow and tedious and may not be applicable when fast eradication of pests is required. Slow action to pest management through manual weeding may result in crop damage.

Mitigation measures

Conduct sensitisation and awareness campaigns for farmers to adopt IPM as a sustainable method of managing pests. Assist farmers to use alternative and appropriate IPM methods of pest management.

High costs for labour

The use of manual methods such as hoes and slashers for weeding may demand employment of a lot of labour and in turn require considerable amount of money to pay them as wages. Therefore, small scale farming methods under SADP and APPSA may not require large labour forces since they are small-scale.

Mitigation measures

Conduct sensitisation and awareness campaigns for farmers to adopt IPM as a sustainable method of managing pests for long term.

Increase in time spent managing pests

Use of manual methods such as hoes and slashers to manage and control pests by removing the hosts through weeding increases the amount of time spent by farmers controlling pests in the fields.

Mitigation measures

Conduct sensitisation and awareness campaigns for farmers to adopt IPM practices that do not demand large amounts of time, as a sustainable method of managing pests.

Health and safety risks

Manual control methods pose risks of snake bites, hippo or crocodile attacks, depending on which plant and where the operation is carried out.

Mitigation Measures

- Provide protective clothing to workers and ensure it is properly used;

5.5 POSITIVE IMPACTS OF IPM

Increase in agricultural yields

IPM practices will contribute to an increase in agricultural yields through prevention of crop damage and preservation of produce. Increased agricultural productivity is a precondition for growth and development in the Lesotho economy.

Enhancement measures

Train farmers in use of appropriate of IPM techniques to protect crops from pest damage.

Contribution to Food Security

Application of IPM will result in enhanced food security, yields and efficient preservation of produce, subsequently providing and contributing to the overall national goals on food security.

Enhancement measures

- Train pesticides marketers in selection and handling of approved pesticides;

- Train farmers in appropriate application of the various IPM practices; and
- Educate farmers on preservation techniques and timeframes of different integrated pest management options.

Saving in foreign exchange

Promotion and increased application of non-chemical pesticides will result in reduced importation of chemical pesticides thereby saving foreign exchange.

Enhancement measures

- Train suppliers in selection of appropriate pesticides to be eligible for supplying to SADP and APPSA;
- Train farmers in the appropriate application of the various IPM practices to reduce application of chemical pesticides; and
- Enforce regulation prohibiting importation of banned chemical pesticides.

Contribution to offsetting rural/ urban migration

Increase in farm income-generating opportunities due to better yields and availability of surplus produce for sale in the rural areas will help offset rural – urban migration.

Enhancement measures

Assist local communities to establish cooperatives and to market produce to potential markets for additional income.

Improved environmental protection

Increased application of IPM, through the use of biological controls, mechanical methods and indigenous control mechanisms will mean reduced application of polluting chemicals such as organochlorides, pyrethroids and triazines which are harmful to the environment. It will also help reduce application of banned chemicals such as DDT and dieldrine, which are sometimes smuggled across the borders.

Enhancement Measures

- Enforce regulation prohibiting importation of banned chemical pesticides; and
- Educate farmers on harmful consequences of banned chemical pesticides.

5.6 COMMON HORTICULTURE (FRUITS AND VEG.) PEST PROBLEMS AND IPM PRACTICES

Major fruits and vegetable related pest problems and recommended management practices are given in **Table 5.1**. A combined action of natural means of control, natural enemies, chemical and biological control can have a significant impact on potentially damaging pest populations. It is desirable to conserve as many of the natural enemies of the pests as possible.

Table 5-1 Major horticulture pest problems and recommended pest management

Pest and Disease	Citrus	Apples & Pears	Leafy Veges	Root Veges	Grapes	Onions	Tomatoes	Tomato Cucurbits	CONTROL MEASURES/PESTICIDE
<i>Epiphyas postvittana</i> Light brown apple moth	*	*			*			*	
<i>Atherigona orientalis</i> Muscid Fly	*	*			*			*	
<i>Planococcus pacificus</i> Citrus mealybug	*	*							
<i>Guignardia citricarpa</i> Citrus Black Spot	*								
<i>Conogethes punctiferalis</i> Yellow Peach Moth	*	*						*	
<i>Asynonychus cervinus</i> Fullers Rose Weevil	*								
<i>Lactrodectus hasselti</i> Redback spider					*				
<i>Cydia pomonella</i> Codling moth	*	*							
<i>Ditylenchus dipsaci</i> Stem nematode			*	*					
Club root									Flusamide, Solarisation, Liming, Rotation
Bacterial Blight									Solarisation, resistant varieties, crop rotation
Diamond Back Moth									
Aphids									Rogor, Profinophos
Potato cyst nematode (PCN)				*					
Aphids – (some)	*	*	*					*	Rogor, Profenophos
Snails – (some)	*	*	*	*	*			*	Cu. Oxychloride
<i>Aleurodicus disperses</i> Spiralling white fly			*						
<i>Bemisia tabacci</i> Silver leaf white fly			*						
Soft Rot						*			Solarisation, Rotation, If in storage, keep non damaged and dry bulbs
Fungal rots & Spots						*			Benlate
Onion Thrips						*			Gaucha, Furadan
Weeds	*	*	*	*	*			*	Appropriate herbicides

Red Spider Mites							*		Profinophos, Polytrin C, Rogor, Local Concoction, Sanitation
Tomato Fruit Worm							*		Sumicidin, Pyrethroids
Late Blight				*			*		Dithane M45, Ridomil, Metaxy
Early Blight				*			*		Daconil

5.7 PRINCIPLES IN SELECTING PESTICIDES

Selection of pesticides, under the APPSA project implementation will be guided by the consideration of several pest management approaches for cultural, physical and biological measures before resorting to application of chemical pesticides. In addition to that, selection of pesticides will be guided by well researched and tested pesticides through the APPSA program.

The use of pesticides must be guided by the principles of cost efficiency, safety to humans, the bio-physical environment and effectiveness in controlling the pests. Pesticides selection will be made in accordance with the World Bank guidelines for the selection of pesticides (World Bank Operational Manual, GP 4.03) as follows:

- (i) Pesticides requiring special precautions should not be used if the requirements are not likely to be met.
- (ii) Pesticides to be selected from approved list, taking into consideration of: toxicity, persistence, user experience, local regulatory capabilities, type of formulation, proposed use, and available alternatives.
- (iii) Type and degree of hazard and availability of alternatives; and the following criteria will be used to restrict or disallow types of pesticides under Bank loans:
 - a. **Toxicity:** acute mammalian toxicity, chronic health effects, environmental persistence and toxicity to non-target organisms;
 - b. **Registration status** in the country and capability to evaluate long-term health and environmental impacts of pesticides.

5.8 PESTICIDES TO BE ACCEPTABLE TO APPSA

The selection of pesticides to be acceptable under the project will be in line with (a) the World Bank Safeguard Policy OP/BP 4.09 on pest management, and will depend on (b) the hazards and risks associated with pesticide use, and (c) the availability of newer and less hazardous products and techniques such as bio-pesticides.

In addition to the toxic characteristics of the pesticide, the hazards associated with pesticide use depend on how the pesticides are handled. Precautions to minimize environmental contamination and excess human exposure are needed at all stages from manufacture, packaging and labelling, transportation, and storage to actual use and final disposal of unused and contaminated containers. The guidelines in Appendix 2 provide internationally accepted standards on pesticides to minimize the hazards associated with pesticide use.

The use of pesticides under the project will also be guided by the FAO Publication on International Code of Conduct, on the Distribution and Use of Pesticides 1991; *FAO Guidelines for the Packaging, Storage, Good Labelling Practice, Transportation and Disposal of Waste Pesticide and Pesticide Containers* 1985.

6. PEST MANAGEMENT AND MONITORING PLANS

6.1 INTEGRATED PEST MANAGEMENT PLAN

The Integrated Pest Management and Monitoring Plan (IPMP) in Table 6.1 is developed from the impacts and mitigation measures identified in Chapter 5. The IPMP include impacts from application of chemical as well as non-chemical pesticides. The reason why chemical pesticides are included is that in the initial stages of implementation of the IPM, chemical pesticides will still be used but will be gradually phased out as the IPM gets established.

The purpose of the IPMP is to ensure that the identified impacts related to application of pesticides are mitigated, controlled or eliminated through planned activities to be implemented throughout the project life. The IPMP also provides opportunities for the enhancement of positive impacts. The IPMP gives details of the mitigation measures to be implemented for the impacts; and the responsible institutions to implement them.

Implementation of the IPMP may be slightly modified to suit changes or emergencies that may occur on site at the time of project implementation. The plan therefore should be considered as the main framework that must be followed to ensure that the key potential negative impacts are kept minimal or under control. In this regard, flexibility should be allowed to optimize the implementation of the IPMP for the best results in pest management.

The IPMP consists of generic or typical environmental impacts that are derived from the site investigations, public consultations and professional judgment. This is because the specific and detailed impacts cannot be predicted without details for the project design and construction activities as well as the specific project locations. The IPMP will however, provide guidance in the development of more detailed IPMP's, once the project design and construction details are known.

Site specific Integrated Pest Management and monitoring plans will depend on the scope of identified major impacts to be addressed in the implementation of the project. Presented in Table 6-1 below is a generic or typical environmental management and monitoring plan, which would easily fit in the implementation of the APPSA.

6.2 IPMP MONITORING PLAN

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

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

- 1 Number of farmers engaged in IPM capacity building in the project locations:
- 2 Number of farmers who have successfully received IPM training in IPM methods

- 3 Number of trainees practicing IPM according to the training instructions
- 4 Number of women as a percentage of total participating in IPM and successfully trained
- 5 Number of farmers as a percentage of total applying IPM
- 6 Rate of IPM adoption (number of people as a percent of total) every year
- 7 Improvement in farm production due to adoption of IPM as a percent of production without IPM
- 8 Increase in farm revenue resulting from adoption of IPM practices, compared with revenue from conventional practices
- 9 Improvement in the health status of farmers
- 10 Extent to which crops are produced using chemical pesticides compared with total crop production
- 11 Efficiency of pesticide use and handling
- 12 Reduction in chemical pesticide poisoning and environmental contamination
- 13 Number of IPM participatory research project completed
- 14 Overall assessment of activities that are going according to IPMP; activities that need improvement; and remedial actions required

6.3 ESTIMATED COSTS FOR PEST MANAGEMENT AND MONITORING

Estimated costs for managing and monitoring some of the recommended enhancement and mitigation measures are provided in Table 6-1 and summarised in Table 6-2. As it can be noted for Table 6-1, not all the mitigation measures have been assigned costs. It is assumed that some of the mitigation measures will be part of the normal responsibility of the APPSA- PMU, respective government ministries, agro-dealers, transporters, farmers and other relevant stakeholders, within their institutional mandates and budgets.

Costs for purchasing pest management equipment, protective clothing and routine medical examination were calculated for 500 famers for the 5 target districts, assuming that 100 famers per district will be assisted with pesticides, equipment and protective clothing.

It is important to appreciate that some of the stakeholder institutions may not have sufficient capacity to manage environmental and social impacts of pesticides and to adequately monitor implementation of the enhancement and mitigation measures. Therefore, it is necessary to train them. The cost of training for the managing impacts has been provided for table 7-1. The table also includes costs for conducting awareness and sensitisation campaigns on pesticides application, management and adoption of IPM in the project areas. Costs for setting-up, adoption and use of IPM by farmers are provided in table 7-1. The costs for managing and monitoring various mitigation and enhancement measures provided in table 6-2 are estimated for five (5) year project period.

Table 6-1 Integrated Pest Management and Monitoring Plan

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
1. POSITIVE IMPACTS OF CHEMICAL PESTICIDES							
1.1	Increase in crop yield		Implement a long term IPM programme to sustain productivity and combat negative effects of chemical pesticides.	APPSA - PMU Farmers and APPSA participating farmers Cost included in the IPMP overall cost	IPMP	MAFS Costs covered by the main programme budget	Annually
1.2	Increase in economic growth			APPSA - PMU Farmers and APPSA participating farmers	IPMP	MAFS	Annually
2. NEGATIVE IMPACTS OF CHEMICAL PESTICIDES							
2.1	Depletion of organic soil nutrients	Persistent use of chemical pesticides	Apply soil conditioning measures which include IPM	Farmers Costs covered by the main programme budget	IPMP	APPSA - PMU	Quarterly
2.2	Poisoning of non-target species including natural biological pesticides	<ul style="list-style-type: none">Lack of knowledge of chemical pesticide potencyEquipment malfunctionUse of wrong type of equipmentWrong time and method of application (spraying)	<ul style="list-style-type: none">Supervise and control use of chemical pesticides so that only approved and recommended ones are usedProvide PM equipmentRegularly maintain and clean equipment as recommended by supplierDispose old equipment as recommended by manufacturer.Provide recommended protective gearUse recommended and appropriate protective gearConduct trainings in IPM	APPSA - PMU Farmers and APPSA participating farmers <u>12,000.00</u> <u>13,000.00</u>	IPMP	MAFS APPSA - PMU PPU	Quarterly

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
2.3	Adulteration	Lack of controls and enforcement of regulations	Inspection, sampling and testing	Pesticides Transporters, Suppliers and Research stations	<ul style="list-style-type: none"> Packaging and storage standards Product specifications EMA 2008 Pesticides Regulations 	<ul style="list-style-type: none"> PP - DOC & DAR, APPSA - PMU <u>7,000.00</u>	Quarterly
2.4	Health and safety risks	Exposure to pesticides	<ul style="list-style-type: none"> Provide protective clothing and ensure it is used. Train farmers in proper pesticides handling. Routine medical examination 	<ul style="list-style-type: none"> Agro-dealers Transporters Farmers Cost for five districts on farmer random sampling basis <u>11,000.00</u>	<ul style="list-style-type: none"> Labour regulations PPU regulations 	-Min. of Labour. -PP - DOC & DAR -DAO -APPSA - PMU	Annually
2.5	Water, soil and environmental pollution	<ul style="list-style-type: none"> Inappropriate building for storage of pesticides. Cleaning of equipment, Disposal of remains of pesticides Disposal of containers and equipment 	<ul style="list-style-type: none"> Construct suitable warehouse Construct bio-beds, draining channels and draining dams. Use chemical remains to re-spray. Clean equipment in one designated place. Use plants such as water lilies to absorb waste pesticides. Take regular stock of pesticides Use IPM Train farmers not to spray toxic chemicals close to water sources Train farmers to maintain spray equipment in safe operational order 	<ul style="list-style-type: none"> Pesticides Transporters and Suppliers APPSA - PMU Farmers Costs covered in the main rehabilitation programme. Cost for construction of bio-beds in five districts <u>20,000.00</u>	<ul style="list-style-type: none"> Pesticides and equipment manufacturer's recommendations. Water pollution standards. 	<ul style="list-style-type: none"> PP - DOC & DAR Department of Environment Ministry of Water 	Quarterly
		Wrong shelving or stacking	Routine inspection and inventory checks	Agro-dealers	<ul style="list-style-type: none"> PPU regulations, Manufacturer's guidelines 	<ul style="list-style-type: none"> PP - DOC & DAR DAO 	Half yearly
		<ul style="list-style-type: none"> Inadequate storage space. 	Provide adequate and separate storage space for pesticides	Agro-dealers	<ul style="list-style-type: none"> PPU regulations, 	PP - DOC & DAR	Half yearly

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
		<ul style="list-style-type: none"> Bad housekeeping Multipurpose use of warehouse 		Costs covered in the main rehabilitation stages	<ul style="list-style-type: none"> Manufacturer's guidelines 		
		Multi-purpose use of equipment or pesticides	Control use of equipment and pesticides <ul style="list-style-type: none"> Thorough cleaning of equipment Training Integrated Pesticide Management 	Farmers	Pesticides Regulations	<ul style="list-style-type: none"> PP - DOC & DAR DAO Costs covered in the main training budget of the ESMF.	Quarterly
		Illegal disposal of pesticides	Prohibit discharge of pesticides wastes to open dumps where children, domestic animals, rodents and some wildlife species scavenge	Agro-dealers APPSA - PMU	EMA 2008 Pesticides Regulations	PP - DOC & DAR <u>6,000.00</u>	Half yearly
		<ul style="list-style-type: none"> Equipment malfunction Wrong type of equipment. Time and method of application (spraying) 	<ul style="list-style-type: none"> Regular maintenance of equipment. Use recommended equipment. Use approved methods of application. Use recommended protective clothing. Training seminars Integrated Pesticide Management 	Farmers APPSA - PMU Costs covered under other budget lines	<ul style="list-style-type: none"> Manufacturer's recommendations. Equipment maintenance policy 	- PP - DOC & DAR	Annually
		<ul style="list-style-type: none"> Improper cleaning of equipment. Improper disposal of cleaning water and old equipment 	<ul style="list-style-type: none"> Clean equipment and dispose equipment as recommended by manufacturer. Use bio-beds and draining dams to dispose cleaning and drainage waters. Integrated Pesticide Management. 	Farmers Costs covered in 2.2	<ul style="list-style-type: none"> Manufacturer's recommendations. PPU regulations. Water resources regulations 	<ul style="list-style-type: none"> PP - DOC & DAR DAO 	Annually
		Over-stocking	Buying the required and approved quantities only	Agro-dealers	Pesticides Regulations	PP - DOC & DAR	Quarterly

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
2.6	Air pollution and contamination	<ul style="list-style-type: none"> Exposure of pesticides to air. Disposal of pesticides remains in the open Disposal of pesticides containers and equipment in the open 	<ul style="list-style-type: none"> Store pesticides in closed containers Dispose chemical remains according to supplier recommendations. Train farmers in appropriate spraying techniques to avoid chemicals being blown away by wind. Train farmers to maintain spray equipment in efficient operational order 	<ul style="list-style-type: none"> Pesticides Suppliers Farmers <p>Costs covered in 2.5</p>	<ul style="list-style-type: none"> Pesticides and equipment manufacturer's recommendations. Air pollution standards. 	<ul style="list-style-type: none"> PP - DOC & DAR Environment Department. 	Quarterly
		<ul style="list-style-type: none"> Bad housekeeping 	Provide adequate and enclosed storage space for pesticides	<p>Agro-dealers</p> <p>Costs covered in the main rehabilitation works</p>	<ul style="list-style-type: none"> PPU regulations, Manufacturer's guidelines 	PP - DOC & DAR	Half yearly
		Illegal disposal of pesticides	Prohibit disposal of pesticides wastes into open dumps where they will be blown away by wind	<p>Agro-dealers</p> <p>APPSA - PMU</p>	EMA 2008 Pesticides Regulations	DE City/District Councils	Half yearly
		<ul style="list-style-type: none"> Equipment malfunction Wrong type of equipment. Time and method of application (spraying) 	<ul style="list-style-type: none"> Regular maintenance of equipment. Use recommended equipment. Use approved methods of application. Training farmer in appropriate spraying methods 	<p>Farmers</p> <p>APPSA - PMU and APPSA</p> <p>Costs covered in 2.5</p>	<ul style="list-style-type: none"> Manufacturer's recommendations. Equipment maintenance policy 	PP - DOC & DAR	Annually
2.7	Health risk from chemical pesticide misuse (over /under use)	Lack of appropriate knowledge	Training and awareness campaigns	APPSA - PMU	Pesticide manufacturers regulations, IPMP	<ul style="list-style-type: none"> PP - DOC & DAR DE 	Annually

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
2.8	Accidental or Intentional poisoning	Improper labelling or storage Frustration, Social pressures	<ul style="list-style-type: none"> Label and store chemicals in properly labelled shelves Ensure responsible, mentally sound and mature persons are given charge and control of pesticides. Restrict accessibility to pesticides. Spot checking 	Farmers Agro-dealers Costs covered in 2.2	Pesticides Regulations	<ul style="list-style-type: none"> PP - DOC & DAR Min of Labour DAO APPSA - PMU 	Annually
2.8	Pesticides resistance in pests	Lack of appropriate knowledge in pesticides application	Train farmers in correct application of pesticides	Farmers APPSA - PMU APPSA Costs covered in the main training budget of the ESMF	Pesticides Regulations	PP - DOC & DAR	Half yearly
3. POSITIVE IMPACTS OF BIOLOGICAL CONTROLS							
3.1	Reduced environmental and health risks		Establish and disseminate environmental and health benefits of biological controls to the communities for them to appreciate the advantages	APPSA - PMU APPSA \$ 8,000.00	EMA	-DE -MAFS	Quarterly
3.2	Reduction in time spent on application of chemical pesticides		Prepare an inventory of indigenous and established biological control methods and conduct community awareness seminars to enhance and spread knowledge base	APPSA - PMU Costs covered in 3.1	IPMP	Department of Lands	Annually
3.3	Resistance to pests through improved varieties	Rural people have a tendency of resisting to introduction of new varieties and sticking to traditional seed varieties.	Awareness campaigns on the benefits of new and improved seed varieties, which are resistant to pest will help reduce application of chemical pesticides	APPSA - PMU APPSA \$ 8,000.00	IPMP	MAFS	Annually

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
3.4	Preservation of biodiversity and wildlife habitats	Tissue culture technology has the potential to increase biodiversity by replacing the stocks of rare and endangered tree species.	Conduct awareness campaigns on the importance of adopting tissue culture technology as a biological method of controlling pests.	APPSA - PMU APPSA Costs covered in 3.3	EMA Forest Act IPMP	DE Ministry of Forestry and Land Reclamation MAFS	Annually
3.5	Increase in soil stability and reduction of soil erosion	Increasing tree cover as biological control of pests will result in increase in soil stability and reduction of erosion	Conduct awareness campaigns on the importance of using new and improved and pest resistant seed varieties in controlling pests	APPSA - PMU Costs covered in 3.3	IPMP	MAFS	Annually
4. NEGATIVE IMPACTS OF BIOLOGICAL CONTROLS							
4.1	Damage on other unintended crops	Wrong application of method by farmers	<ul style="list-style-type: none"> Apply biological controls carefully with full knowledge of the consequences; Train farmers on the appropriate application and management of biological controls for various crops; and Conduct training seminars in integrated Pesticide Management 	APPSA - PMU Farmers Costs covered in 3.1	IPMP	MAFS	Annually
4.2	Risk of damage to crops	The slowness of biological agents to act may frustrate IPM programmes as farmers are used to the rapid results of chemical pesticides	<ul style="list-style-type: none"> Educate farmers on the long term benefits of the biological methods to facilitate their adoption; and Phase transition from biological to IPM methods to ensure no appreciable loss of production during transition 	APPSA - PMU Costs covered in 3.1	IPMP	EMC MAFS	Annually
5.0 POSITIVE IMPACTS OF MECHANICAL METHODS							

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
5.1	Reduction in time spent on fields managing and controlling pests		Regularly services equipment and machinery to maintain their efficiency	APPSA - PMU Costs covered in 2,2	IPMP	MAFS	Annually
6.0 NEGATIVE IMPACTS OF MECHANICAL METHODS							
6.1	High capital, operation and maintenance costs	Use of heavy and spacious automated machinery	Conduct sensitisation and awareness campaigns for farmers to adopt IPM as a sustainable method of managing pests.	APPSA - PMU	N/A	N/A as it will not be implemented under APPSA	Quarterly
6.2	Damages to crops	Use of heavy and spacious automated machinery	Conduct sensitisation and awareness campaigns for farmers to adopt IPM as a sustainable method of managing pests	APPSA - PMU Costs covered in 3.3	IPMP	MAFS	Annually
6.3	Health and safety risks	Personnel operating farm machinery may be exposed to accidents and sharp blades during farm operations and maintenance of the machinery.	<ul style="list-style-type: none"> • Provide protective clothing to workers and ensure it is properly used; • Train farmers in proper operations and handling of machinery; and • Promote IPM to replace mechanical methods. 	APPSA - PMU Costs covered in 2.2	<ul style="list-style-type: none"> • IPMP • Health Act 	<ul style="list-style-type: none"> • MAFS • Ministry of Labour 	Annually
6.4	Air pollution	Generation of dust and release of carbon dioxide by farm machinery	<ul style="list-style-type: none"> • Regular servicing of farm machinery • Controlling of machinery speeds during farm operations to reduce generation of dust 	APPSA - PMU Costs covered in 2.2	EMA 2008	<ul style="list-style-type: none"> • DE • MAFS 	Quarterly
6.5	Soil contamination	Fuel and oil leaks from farm machinery and spills from discarded waste oil containers	<ul style="list-style-type: none"> • Lining vehicle servicing and fuel/oil storage areas with concrete or appropriate impervious material and connecting the drainage to an oil interceptor • Discarding waste oil containers in approved disposal sites. 	APPSA - PMU Costs covered under main rehabilitation programme	EMA 2008	<ul style="list-style-type: none"> • DE 	Quarterly

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
7.0 NEGATIVE IMPACTS OF MANUAL METHODS							
7.1	Health and safety risks	Snake bites, hippo or crocodile attacks	<ul style="list-style-type: none"> Provide protective clothing to workers and ensure it is properly used; Train farmers in proper operations and handling of farm equipment; and Promote IPM to replace mechanical methods 	APPSA - PMU Farmers and APPSA participating farmers Costs covered in 2.2	N/A	Department of Lands	Annually
7.2	High costs for labour	Employment of a lot of labour requires considerable amount of money to pay as wages	Conduct sensitisation and awareness campaigns in the project implementation area for farmers to adopt IPM as a sustainable method of managing pests.	APPSA - PMU Farmers Costs covered in 3.3	N/A	MAFS	Annually
7.3	Increase in time spent managing pests	Use of hoes and slashers requires long times to be spent by farmers to control pests in the fields	Conduct sensitisation and awareness campaigns for farmers to adopt IPM as a sustainable method of managing pests.	Farmers Costs covered in 3.3	N/A	APPSA - PMU	Annually
8.0 POSITIVE IMPACTS OF IPM							
8.1	Increase in agricultural yields	Non chemical methods are generally slow	Train farmers in timely and appropriate use of pest management techniques to protect horticulture (fruits and vegetables) from <i>Planococcus pacificus</i> Citrus mealy bug, Potato cyst nematode (PCN) and other pests; and to protect other crops from pest damage	APPSA - PMU Costs covered in the main training budget of the ESMF	IPMP	MAFS	Annually

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
8.2	Contribution to Food Security	Non chemical methods are generally slow	<ul style="list-style-type: none"> Train pesticides marketers in selection and handling of approved pesticides Train farmers in the appropriate application of the various IPM practices Educate farmers on preservation techniques and timeframes of different integrated pest management options. 	APPSA - PMU Costs covered in the main training budget of the ESMF	IPMP	MAFS	Annually
8.3	Saving in foreign exchange	Banned chemicals	<ul style="list-style-type: none"> Train pesticides suppliers in selection of appropriate pesticides to be eligible for supplying to APPSA - PMU; Train farmers in the appropriate application of the various IPM practices to reduce application of chemical pesticides; and Enforce regulation prohibiting importation of banned chemical pesticides 	APPSA - PMU APPSA Costs covered in the main training budget of the ESMF	Pesticides Regulations	PP - DOC & DAR	Quarterly
8.4	Contribution to offsetting rural/ urban migration	Banned chemicals	<ul style="list-style-type: none"> Enforce regulation prohibiting importation of banned chemical pesticides; Educate farmers on harmful consequences of banned chemical pesticides; and Assist local communities to establish cooperatives and to market produce to potential markets for additional income. 	Farmers APPSA - PMU	Pesticides Regulations	PP - DOC & DAR 6,000	Quarterly

Item No	Potential Issues / Concerns	Cause of Concern	Control/Mitigation Measure	Responsible Person/Institution and Estimated Cost (\$)	Standards/Regulation	Monitoring Institution and Estimated Cost (\$)	Monitoring Frequency
8.5	Improved environmental protection		<ul style="list-style-type: none"> Enforce regulation prohibiting importation of banned chemical pesticides; and Educate farmers on harmful consequences of banned chemical pesticides. 	APPSA - PMU Cost covered in 8.4	IPMP	APPSA - PMU	Annually

6.4 SUMMARY OF MANAGEMENT AND MONITORING BUDGET

The summary of the cost estimates for the activities in the IPMP are given below. The budget is meant for implementing and monitoring the above recommended mitigation measures throughout the project duration. It is recommended that the budget be integrated into the overall project costs to ensure that the proposed mitigation measures are actually implemented.

Table 6-2 Summary of Management and Monitoring Costs for the five-year period

Impact	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		5 – YEAR TOTAL
	Management Costs (US\$)	Monitoring Costs (US\$)	Management Costs (US\$)	Monitoring Costs (US\$)	Management Costs (US\$)	Monitoring Costs (US\$)	Management Costs (US\$)	Monitoring Costs (US\$)	Management Costs (US\$)	Monitoring Costs (US\$)	
Provide PM equipment (sprayers)	5,000.00		3,000.00		2,000.00		1,000.00		1,000.00		12,000.00
Provide recommended protective gear	6,000.00		3,000.00		2,000.00		1,000.00		1,000.00		13,000.00
Pesticide inspection, sampling and testing		3,000.00		1,000.00		1,000.00		1,000.00		1,000.00	7,000.00
Routine medical examination	5,000.00	3,000.00	2,000.00	1,000.00	2,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	18,000.00
Construct bio-beds, draining channels and draining dams.	8,000.00		5,000.00		3,000.00		2,000.00		2,000.00		20,000.00
Establishment and dissemination of biological control methods	3,000.00		2,000.00		1,000.00		1,000.00		1,000.00		8,000.00
Disposal of chemical pesticides remains according to supplier recommendations		2,000.00		1,000.00		1,000.00		1,000.00		1,000.00	6,000.00
Enforce regulation prohibiting importation of banned chemical pesticides		2,000.00		1,000.00		1,000.00		1,000.00		1,000.00	6,000.00
Conduct awareness campaigns on: <ul style="list-style-type: none"> benefits of new and improved seed varieties on the importance of adopting tissue culture technology on the importance of using new and improved and pest resistant seed varieties 	3,000.00		2,000.00		1,000.00		1,000.00		1,000.00		8,000.00
Grand Total	30,000.00	10,000.00	17,000.00	4,000.00	11,000.00	4,000.00	7,000.00	4,000.00	7,000.00	4,000.00	98,000.00

7. CAPACITY, TRAINING NEEDS AND BUDGET FOR IMPLEMENTATION OF THE IPMP

7.1 CAPACITY NEEDS

Integrated Pest Management (IPM) is a knowledge intensive and interactive methodology. It calls for a precise identification and diagnosis of pests and pest problems. Comprehending ecosystem interplays equips farmers with biological and ecological control knowledge and assists them in making pragmatic pest control decisions.

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

Ineffective communication between farmers, extension agents and researchers from research institutes and universities has often translated into poorly-targeted research or to poor adoption of promising options generated by research. Essentially, the full potential of agricultural research is compromised.

Closer farmer-research investigator interaction, adaptive research and participatory learning approaches in capacity building efforts serves as a remedy to narrowing this gap, making research results more applicable to farmers. Farmers must at least be trained in:

- (a) Biological and ecological processes underpinning IPM options;
- (b) The practical application of newly acquired knowledge, to choose compatible methods to reduce production and post-harvest losses, through frequent field visits, meetings and demonstrations; and
- (c) Adaptive research trails.

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

The major actors and partners will include the following:

The programme beneficiary farmers: As the principal beneficiaries, they will be organized into Farmer Groups for training and adoption of IPM practices. The farmers will receive assistance from Community IPM Action Committees, to coordinate IPM activities in their areas.

At the District level, the **District Development Committees**, through the District Agricultural Officers, will assist the farmers to form the Farmer Groups through whom IPM activities will be implemented. The District Agricultural Officer will provide the technical assistance to the Farmer Groups.

The Department of Agricultural Research (DAR) of the MAFS will backstop the District Development Committees and assist them with the technological advancements in IPM development. They will coordinate with research institutions and organise field days to disseminate the information.

The MAFS will provide logistical and technical support to the APPSA and SADP projects. They will thus provide capacity and policy guidance and oversight for implementation of the IPM at National level. MAFS will, provide the necessary budgetary support and overall monitoring of the IPM activities. The MAFS and the respective districts will provide staff for training local farmers and play a major role with NGOs/CBOs in the public awareness campaigns, production of extension materials, radio and television programs in the respective districts.

Agricultural sector departments have the national mandate in the implementation of crop protection and pest management research. They will provide technical support to APPSA, through the respective Agricultural Development Divisions, in the implementation of IPM. APPSA - PMU management will exploit the sector department's experiences in the implementation of IPM and management of outbreak and migratory pests.

APPSA and SADP will undertake to build the capacities of researchers to train farmers and community leaders in promoting IPM activities. They will also facilitate information sharing with local farmers.

The Plant Protection Units (PPU) of MAFS - Agricultural Research Division and Department of Crops will provide the necessary information on pesticides and train the Farmer Groups in all aspects of pesticides including application rates, methods, storage and disposal of residues. They will also monitor pesticides stocks and potency at the dealers.

The Ministry of Health (MoH): through the District Health Officers, will set up databases on incidence of poisoning, effect of pesticides on human health and environmental contamination. This data will then be used to measure and validate the ameliorating effects of IPM adoption and implementation that is expected to reduce risks to pesticides exposure.

The Department of Environment (DE): through the District Environmental Officers (DEO), will conduct environmental monitoring in relation to IPM. DE will contribute towards training the beneficiary Farmer Groups in environmental pest management.

Partners in capacity building and training will include the following:

- **Research and training institutions:** Agricultural research stations will formulate proposals for research and training programmes for the development of IPM protocols, and training modules for the IPM for APPSA and SADP.
- **Agriculture Services Providers and NGOs** that are providing services to farmers and improving agricultural productivity, environmental management and rural health matters will be identified to provide services and technical support in the implementation of IPM.

7.2 TRAINING

7.2.1 Training Content

Training key role players and stakeholders in IPM is necessary to ensure that they possess appropriate skills for IPMP implementation. The IPMP training program is designed for four levels as presented in the following sections and the training areas for key role players and stakeholders in IPM are provided in Table 7-1.

National level workshop

A total of 30 participants including representatives from the institutions listed in table 7-1 will attend a one day training workshop in Maseru. Members from these key stakeholder institutions will prepare and make presentation on their specific areas of expertise and demonstrate how their technical know-how would be applied in the implementation of IPMP. The main focus of the training workshop will be to establish institutional coordination for implementation of the IPMP.

Training of trainers

25 people will participate in the 3-day training of trainers in IPM. The main objective of this training will be for the participants to acquire and share the necessary knowledge to be able to train district staff and extension workers in the APPSA participating districts. Participants will be drawn from APPSA, SADP, District Executive Committees of the project districts, selected IPM Trainers from Agricultural Research and Development Service Providers and NGOs including pesticides marketers.

Training at district level

Training at the districts level will be targeted to district staff, extension workers, members of the *Agricultural Resource Centres (ARC)* and community leaders. This group of participants, with the assistance of the trainers, will be responsible for imparting the IPM knowledge and practices to the farmers. 35 participants, with the extension workers being the majority (more than fifty percent of the participants) will be trained to assist the farmers in skills to implement the IPMP.

Community level (farmers)

Being beneficiaries, 50 farmers from each participating district, will be selected to participate in the farmer community training in IPM to be conducted in three strategic areas of the district. Areas of training focus will be to inform the farmers about the IPMP implementation and general discussions on indigenous as well as formal pest management practices currently in use.

Table 7-1 Training areas for key role players and stakeholders of IPM

Participants in the training	Roles of participants in IPMP	Training content	Cost US\$ and Duration
<p>National level (ministries)</p> <ul style="list-style-type: none"> • The Department of Agricultural Research (DAR) of the MAFS • Ministry of Forestry correct name please • MAFS • APPSA – PMU management • Ministry of Health (MoH) • Department of Environment (DE) • The Plant Protection Units (PPU) of MAFS 	<ul style="list-style-type: none"> • Providing capacity and policy guidance and/or oversight for IPMP implementation • Monitoring and evaluation of IPMP implementation • Providing logistical and technical support for APPSA training • Training IPM trainers. • Institutional coordination • Monitoring of IPM inputs supply by the dealers • Monitoring illegal stock of pesticides in boarder regions of Lesotho 	<ul style="list-style-type: none"> • General overview of the project • Roles of IPMP stakeholders • Institutional IPMP supportive roles in IPMP implementation • IPMP and environmental and social management • pesticide regulation on: imports, transportation, use, registration and disposal of residues 	Cost for 1 day training workshop \$5,000
<p>Training of Trainers</p> <ul style="list-style-type: none"> • APPSA • PPU • IPM Trainers • Agricultural Research and Development Service Providers and NGOs • Pesticides marketers 	<ul style="list-style-type: none"> • Supervising IPMP implementation • Preparation of IPM training materials • Training extension workers to be fully abreast with APPSA's IPMP and to conduct research in IPM. • To engage farmers in participatory learning and knowledge sharing • To foster Farmer/trainer coordination • To maintain Databases on incidence of poisoning, effects of pesticides on human health and environmental contamination. • To conduct IPMP scientific study, data collection, analysis and storage 	<ul style="list-style-type: none"> • General overview of the project and the IPMP for the APPSA • IPMP stakeholders and their roles • Pesticides (types, classification, labelling registration etc.) • Leadership and training for IPMP • Pesticides and environmental and social impacts; and mitigation measures • Safety and precautionary measures for handling pesticides • IPM tools, indigenous, contemporary and other pest management practices and methods • Management of outbreak and migratory pests. • Pesticide regulations on: imports, registration, transportation, use and disposal of residues • Farmer/Trainer coordination 	Cost for a 3- day training: \$10,000
<p>District level</p> <ul style="list-style-type: none"> • District staff • Extension workers • Members of the <i>Agricultural Resource Centres (ARC)</i> • Lead Farmers 	<ul style="list-style-type: none"> • Supervision of farmers and provision of extension support • Preparation of farmer training materials, leaflets, demonstration material, radio and TV messages, etc. • Training farmers and community leaders in IPM and safety • Organising farmers for participatory learning and knowledge sharing events 	<ul style="list-style-type: none"> • General overview of the project and the IPMP for the APPSA • IPMP stakeholders and their roles • Pesticides (types, classification, labelling registration etc.) • Skills in preparing IPMP work plans and budgets. • Pesticides and environmental and social impacts; and mitigation measures • Indigenous and other pest management methods 	Cost for a 3- day training \$2,000

Participants in the training	Roles of participants in IPMP	Training content	Cost US\$ and Duration
		<ul style="list-style-type: none"> • Safety and precautionary measures while handling pesticides • Management of outbreak and migratory pests. • Pesticide regulation on: imports, transportation, use, registration and disposal of residues • Farmer/Trainer coordination 	
Community level (farmers)	<ul style="list-style-type: none"> • Attending IPM trainings and demonstrations • IPMP implementation 	<ul style="list-style-type: none"> • General overview of the project and the IPMP for the APPSA • IPMP stakeholders and their roles • Pesticides (types, classification, labelling registration etc.) • Pesticides and environmental and social impacts; and mitigation measures • Indigenous and other pest management methods • Safety and precautionary measures while handling pesticides • Management of outbreak and migratory pests. • pesticide regulation on: imports, transportation, use, registration and disposal of residues • Farmer/Trainer cooperation 	Cost for a farmer community training in one district: \$2,000
Total			19,000

7.3 COSTS FOR SETTING UP THE IPMP

In line with the steps for establishing the IPM approaches as outlined in chapter five of this IPMP, table 7-2 presents one year's estimated budget for setting up the IPMP in each of the project districts.

Table 7-2 Budget for setting up integrated pest management and implementation

Activity	Methodology	Cost (\$)
Identify the implementation team	Three-day workshop	5,000.00
Decide on the scale of implementation		
Review and set measurable objectives for the IPMP		
Establish a system of regular IPM inspections		
Define the treatment policy selection		
Establish communication protocols		
Develop farmer training plans and policies		
Analyze current housekeeping, maintenance and pest control practices	Consultant	15,000.00
Provide protective gear		15,000.00
Track progress and reward success	Monitoring and evaluation	5,000.00
TOTAL COST PER DISTRICT		40,000.00

7.3 TOTAL COSTS FOR THE IPMP

The total cost for the IPMP comprises of pest management and monitoring costs, Training costs for IPM, and the Initial costs for setting up the IPMP. The total cost, which is **\$172,700.00**, is summed from costs derived in the respective chapters of the IPMP. The IPMP activities have been budgeted under component 1 (Technology Generation and Dissemination) of the costing budget of activities.

Table 7-3 Total cost for the IPMP

ACTIVITY	COST (\$)
Pest management and monitoring costs (Table 6-2)	98,000.00
Training for IPM (Table 7-1)	19,000.00
Cost for setting up IPMP	40,000.00
Contingency (10%)	15,700.00
GRAND TOTAL FOR THE IPMP	172,700.00

8. CONCLUSIONS AND RECOMMENDATIONS

Among other things, this IPMP has established that there are some initiatives in the use of indigenous knowledge and non-chemical practices for pest management. The IPMP has also proposed activities that need to be carried out to set up IPM practices in the SADP and APPSA target districts.

It is noted that not all IPM practices would be applicable for the APPSA in the short term. Specifically, mechanical methods may be difficult to implement in small scale farming communities where heavy machinery for weeding will be inappropriate. Biological methods are a possible option under both the SADP and APPSA but they take a long time and they need technical know-how as well as patience to adopt. Generally, IPM practices take some time to adopt and to bear the required results. However, IPM practices are highly recommended for long term and sustainable agricultural productivity. SADP and APPSA should therefore:

- i. Introduce the IPM in the SADP and APPSA target districts by using the systematic approach presented in Chapter 4. This will ensure application of all appropriate alternatives prior to resorting to chemical pesticides as remedy for pests.
- ii. Adopt a collective community effort and dissemination of appropriate tools and training. This will maximize IPMP implementation and accelerate progress towards reaching both measurable and tangible results in pest management.
- iii. Adopt a use of chemicals as a last resort approach to prioritize IPM remedies, consistent with sound environmentally sustainable practices.
- iv. Set up a team that incorporates **The Department of Agricultural Research (DAR)**'s management staff with the government's pesticides inspection team so that inspections are jointly conducted, permitting instantaneous discovery of illicit pesticides, followed by immediate impounding and appropriate legal action;
- v. Train farmers in (a) identifying approved pesticide; (b) acceptable disposal practices for expired chemical pesticides; and (c) the general environmental risks associated with the use of expired chemical pesticides;
- vi. Adopt a "safety is the number one priority" approach in IPM approach
- vii. Equip **The Department of Agricultural Research (DAR)**s with "safety packages" to be made available to farmers for free under APPSA and SADP. Packages must include the minimum requirements for pesticide application such as gloves, eyewear, nose mask and appropriate foot wear.
- viii. Thoroughly inform farmers on the dangers of handling chemical pesticides and equipment without sufficient and appropriate protective gear

As the process of pesticides registration in Lesotho continues, it is proposed that the following factors, spearheaded by the PPU, must be implemented:

1. The list of pesticides being considered for registration in Lesotho must be reviewed and updated regularly (preferably annually) to match crop requirements for that year;
2. Priority list and importance of pesticides by crop must be supplied to government by farming organizations, to assist government in setting up quantity limits for importation;
3. Risk assessment of pesticides for registration consideration must be conducted (Appendix 3);
4. Harmonization with the list of registered chemicals in **Southern African Pesticide Regulators Forum (SAPReF)** must be done regularly;
5. For the Registration of "New Active ingredients and formulations", Lesotho will have to conduct at least one year of trials if product is registered in at least one **SAPReF** country.
6. If not registered in any **SAPReF** country, conduct trials for 2 years. Also include residue trials. Thereafter the test results must be submitted to the **Plant Protection Unit (PPU) of MAFS - The Department of Agricultural Research Division.**

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APPENDICES

APPENDIX 1: List of People Consulted.

Government of Lesotho

1. Mr Nchemo Maile, former Principal Secretary, Ministry of Agriculture and Food Security
2. Mr Khotso Moleleki, Director, Public Debt, Ministry of Finance
3. Dr Lefulesele Lebesa – Director for Agricultural Research
4. Mr Ntitia Tuoane – Director of Field Services
5. Dr Lebone Molahlahi – Director of Crops Services
6. Ms Rethabile Nchee – Chief Research Officer – Extension
7. Dr Bataung Kuenene – Chief Research Officer – Crops
8. 'Mathoriso Molumeli – Director of Planning and Policy Analysis
9. Mrs M. Phakisi – Chief Economic Planner
10. Ms Monica Lephole – Chief Research Officer – Nutrition and Food Technology
11. Mrs Keletso Hlelesi – Senior Internal Auditor
12. Ms Puleng Pali – Chief Legal Officer
13. Mr Moeketsi Mokati – Project Director, Wool and Mohair Project (WAMP)
14. Mr. Thekiso Thulo –Local Chief Siloe Mohale's Hoek
15. Mr. Ramabanta Leretholi –Local Chief Matsieng Maseru
16. Mrs. 'Masekonyela Maama –Local Chief Nyakosoba Maseru
17. Mr. Seetsa Theko –Local Chief Machache Maseru
18. Mr. Phanyane Maope –Local Chief Ha Sakoane Berea
19. Mr. Khethisa Khethisa –Local Chief Mahobong Leribe
20. Mr. Mopeli Molapo –Local Chief Ts'ifa-li-Mali Leribe
21. Mr. Keli –Area Extension Officer Molumong Mokhotlong
22. Mr. Tsepo Ramoipone –Livestock attendant Thaba- Tseka

CCARDESA

23. Dr. Monica Murata, APPSA Coordinator

World Bank

24. Melissa Brown, Senior Economist,
25. Ijeoma Emenanjo, Natural Resource Management Specialist and Task Team Leader, Smallholder Agricultural Development Project (SADP)
26. Sarah Simons, Senior Agriculture Specialist

APPENDIX 2: Internationally Accepted Standards on Pesticides

A. GUIDELINES ON USE OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

- 1.** PPE must be kept separate (i.e. in different lockers) from personal clothing.
- 2.** Protective clothing must be thoroughly washed after each application or spray operation before being worn again.
- 3.** Contaminated protective clothing must under no circumstances be washed at home and should not be removed from the store area.
- 4.** Durable, light-weight and comfortable protective clothing must be provided to workers handling pesticides.
- 5.** Overalls can be two-piece (jacket with hood and trousers) or one-piece hooded garments.
- 6.** Hood must close around gas mask.
- 7.** Sleeves must close at wrists with elasticized cuffs and the trousers must have elasticized closures around waist and ankles.
- 8.** Jackets of two-piece suits should seal on the hips.
- 9.** Overalls should preferably be light in colour so that contamination with pesticides can be visible.
- 10.** A clear transparent face shield, which is impervious to solvent and pesticide vapours; and which provides full face protection should be worn as indicated on the product label, when preparing and applying spray mixtures.
- 11.** Safety goggles are an acceptable alternative to a face shield.
- 12.** Non-slippery gloves made of nitrile rubber, PVC, neoprene or butyl rubber that are long enough to give cover to a minimum of 90 mm above the wrist must be used.
- 13.** Lined gloves are not recommended as pesticides can accumulate in the lining material.
- 14.** Gloves should preferably be light in colour so that contamination with pesticides can be visible.
- 15.** Before contaminated gloves are removed from the hands after use, they must first be washed with soap and water. They should again be washed inside out after removal.
- 16.** Unlined, rubber boots that are at least calf-high must be used.
- 17.** To prevent pesticide from entering boots, trousers must be worn outside/over the boots.
- 18.** At the end of each day's spraying boots should be washed inside and outside.
- 19.** A cotton hat with brim should be used for protection against spray drift.

20. A waterproof hat and cape must be worn by operators during overhead spraying.
21. A hood that covers the head, neck and shoulders of workers should be worn for total skin protection during the application of irritant powders (e.g. sulphur).
22. Respirators should be worn when indicated on the product label.
23. Tractors with closed canopies and air conditioning are recommended for maximum safety and comfort during application. This could improve the productivity of operators and the quality of pesticide application and coverage.

Ablution facilities

24. Facilities must be provided for operators to wash or shower at the end of each spray operation or shift.
25. Contaminated washing water generated at the ablution facilities shall not be disposed of into any water source, including rivers, ground water sources and sewerage systems. This water can also be channelled into a mesh-covered evaporation pit like the one for the filling area.

B. GUIDELINES FOR SAFE USE AND HANDLING/APPLICATION OF PESTICIDES

Preparation and mixing of spray formulations

1. Application of pesticides should be selective and targeted (in space and time)
2. Pesticides must be prepared and used in the prescribed manner as indicated on the label(s). Any other way is a criminal offence and this must be communicated to workers as such.
3. Only prepare the amount of spray mixture required for one specific application.
4. If containers with concentrated formulation are transported to filling points further away from the agrochemical store, these containers must be locked into a secure metal or galvanized mesh trunk.

Filling points

5. The mixing and filling area for spray equipment must be well away from any water sources.
6. The floor of the filling point must be of non-porous material (e.g. cement with damp coursing) and must be bunded (retaining wall).
7. Rinse liquid from measuring vessels must be added to the spray tank.
8. Soil and water sources may not be contaminated by run-off and/or spillage. Construct a non-permeable evaporation pit that is either filled with stones or covered with a metal grid, into which contaminated run-off water can be channelled. Add a handful of lime to increase the pH. Ultra-violet radiation from the sun, combined with the high pH will break down active ingredients and water will evaporate. Cover the pit when it rains, to prevent rainwater from filling up the pit. Alternatively, install a tank for contaminated water that can be emptied by a

professional hazardous waste disposal company.

Worker health

9. Workers handling chemicals must be declared medically fit to work with pesticides. This examination must be done by an Occupational Health practitioner that is a general practitioner with a post-graduate diploma in occupational medicine, and not by a clinic nurse or ordinary general practitioner.
10. All workers exposed to and handling pesticides must undergo routine medical examinations (mostly involving a blood test) to test for signs of pesticide exposure. These should preferably be done annually at the end of the spraying season, but the interval between examinations may not exceed two years.
11. Any incident of exposure to pesticides must be documented according to occupational health and safety regulations and labour regulations.
12. All medical records and records of pesticide exposure must be kept for at least 30 years for every worker exposed to pesticides.

Training

13. All farm workers shall undergo training in the meaning of the signs, warning and labels on containers of pesticides.
14. Formal training (i.e. certificates awarded) in the meaning of signs, warning notices and labels on chemical containers, as well as on the interpretation of written instructions must be provided to all workers handling pesticides.
15. Spray operators must receive formal practical training in the safe handling and application of pesticides and must understand the risks involved and precautions to be taken.

C. GUIDELINES ON FORMULATION AND REPACKAGING OF PESTICIDES

1. Distribution and use of pesticides may require local formulation and/or repackaging. In such cases, both SADP and APPSA should ensure that, packaging or repackaging material conforms to FAO pesticide management guidelines, and is carried out only on permissible premises.
2. SADP and APPSA should ensure that; (a) the staff working in such premises are adequately protected against toxic hazards; (b) That the resulting pesticide products will be properly packaged and labelled, and that the contents will conform to the relevant quality standards.
3. Pesticide regulations should be strictly enforced in all SADP and APPSA projects.

D. GUIDELINES ON GOOD LABELLING PRACTICE FOR PESTICIDES

1. Label content:

The purpose of the label is to provide the user with all the essential information about the product and how to use it safely and effectively. The minimum information on the label should therefore tell the user:

What is in the container?

The hazard it represents; and

Associated safety information Instructions for use

2. What is in the container?

The following information identifying the contents of the container should appear on all labels:

(a) Product or Trade name, associated with the product category (e.g. herbicide, insecticide, fungicide, etc.).

(b) Type of formulation -name and code, as per International Formulation Coding System.

(c) Active ingredient, name (ISO) or other locally used common name or in the absence of either the chemical name as used by IUPAC and content. This should normally be expressed as "contains x g ai per kg" (for solids, viscous liquids, aerosols or volatile liquids) or "contains x g a.i. per liter" (for other liquids), or just "y%".

(d) Net contents of the pack. This should be expressed in metric units (e.g. liter, gram, kilogram, which can be abbreviated to l, g and kg).

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3. Safety information

There should be a clear warning on the label in relation to:

* Reading the safety instructions before opening the pack.

* Handling, transport and storage warning symbols.

* Hazard classification/symbol. There may be a necessity to classify the product with relation to its toxicity.

2.3 The following safety precautions should appear on all labels - preferably in black print on a white background:

4. Safety Precautions

The safety text must cover the following product specific advice:

Good agricultural practice;

Relevant protective clothing;

Precautions when handling the concentrate (if applicable);

Precautions during and after application;

Environmental safety during and after application;

Safe storage;

Safe disposal of product and used container; and

How to clean equipment (if a potential risk exists)

5. Safety Pictograms

Safety pictograms reinforcing the safety text should be included.

6. Warning

The following must appear on all labels: Keep locked up and out of reach of children

Other warning phrases may be aimed at good agricultural practice and/or steps which need to be taken to avoid adverse environmental effects.

7. First Aid Advice and Medical Treatment

Most labels should carry first aid and medical advice, where relevant. Additional information regarding symptoms, special tests and antidotal measures may be added, where appropriate, for particular products.

8. Leaflets

Any safety text on the label must also appear on any leaflets associated with it.

E. GUIDELINES ON STORAGE AND TRANSPORTATION OF PESTICIDES

1. APPSA is obliged to promulgate, update and enforce rules and regulations for safe, responsible storage and transport. Areas covered by these rules include maintenance of the original product labels, spill prevention, container adequacy, proper marking in storage, facility specifications, product separation, protection from moisture and contamination by other products, restriction of access, and other measures to ensure product integrity and safety.
2. Pesticide stores must be located away from areas where people or animals are housed and away from water sources, wells, and canals.
3. Pesticide stores should be located on high ground and fenced, with access only for authorized persons.
4. There should be easy access for pesticide delivery vehicles and – ideally – access on at least three sides of the building for fire-fighting vehicles and equipment in case of emergency.
5. Pesticides must not be kept where they would be exposed to sunlight, water, or moisture, which could affect their stability.
6. Storehouses should be secure and well ventilated.
7. Pesticide stocks should be arranged such that the oldest are used first (“first in first out” [FIFO] principle), to avoid the accumulation of obsolete stock.
8. Containers should be arranged to minimize handling and thus avoid mechanical damage which could give rise to leaks
9. Containers and cartons should be stacked safely, with the height of stacks limited to ensure stability.
10. Pesticides should not be transported in the same vehicle as items such as agricultural produce, food, clothing, drugs, toys, and cosmetics that could become hazardous if contaminated.
11. Pesticide containers should be loaded in such a way that they will not be damaged during transport, their labels will not be rubbed off, and they will not shift and fall off the transport vehicle onto rough road surfaces.
12. Vehicles transporting pesticides should carry prominently displayed warning notices.
13. Pesticides should not be carried in the passenger compartments of transport vehicles and should be kept tightly secured and covered at all times during transport.
14. The pesticide load should be checked at intervals during transportation, and any leaks, spills, or other contamination should be cleaned up immediately using accepted standard procedures.
15. In the event of leakage while the transport vehicle is moving, the vehicle should be brought to a halt immediately so that the leak can be stopped and the leaked product cleaned up.
16. Containers should be inspected upon arrival at the receiving station.

17. WHO/FAO guidelines (FAO, 1995a) should be followed for handling pesticide-related products during storage, transport, fires, and spills;

18. There should be official reports and follow-up enquiries in the event of fires, spills, poisonings, and other hazardous events; and

19. Rules and regulations laid down in the Recommendations on the transport of dangerous goods: model regulations (United Nations, 2002) and by international organizations concerned with the specific modes of transport should be respected.

F. GUIDELINES ON DISTRIBUTION OF PESTICIDES

1. Distribution of pesticides should be carried by trained personnel or under proper supervision. Misdirection or mishandling can result in the product falling into the hands of uninformed recipients or causing human or environmental risk.

2. Proper packaging is also important to ensure the confinement of the product and its safe handling.

3. The original package is intended to ensure safe distribution; when repacking is necessary, the new packing should meet the specifications of the original packaging as well as complying with the FAO pest management guidelines

4. Packaging (original or repackaging) should conform to FAO pest management guidelines requirements to ensure safety in distribution and prevent unauthorized sale or distribution of vector control pesticides.

5. The distributor should be aware that the shipment is a hazardous product.

6. The distributor must provide a timely service to ensure that products are available on an agreed date that takes into consideration the time of the original order and other related shipment matters.

7. The procurement process should anticipate shipment and distribution schedules.

8. A distribution scheme for pesticide products should be developed that reduces hazards associated with multiple handling and transportation.

9. The distribution of pesticide products to the point(s) of storage by the supplier should therefore be included in tender documents; and

10. All distributors of pesticides should be licensed.

G. GUIDELINES ON DISPOSAL OF PESTICIDES

1. When pesticides have passed their expiry date, specific methods of disposal must follow FAO pest management guidelines for safe disposal of hazardous materials.
2. Similarly, any equipment that is no longer serviceable should be removed from inventory, decontaminated and disassembled to ensure that it will not be subsequently diverted to other uses.
4. Avoid accumulation of obsolete pesticides by provision for phasing-out when pesticides are to be banned or deregistered, refusal of donations in excess of requirement; and spelling out of product specifications, including required packaging and labelling (long-life label).
5. Adherence to WHO/FAO guidelines for handling pesticide-related products during storage, transport, fires, spills and disposal.
6. Consultation with APPSA for disposal of obsolete pesticides.
7. Prevention of risk to human and environmental health from emptied packaging and containers, rinsates, and outdated products.
8. Ensure provision of instructions for disposal of pesticide containers as label requirements.
9. Leftover agrochemical formulations must not end up in rivers, streams, ditches, storage dams, etc. and should not be emptied out on the ground.
10. Empty pesticide containers must not be re-used and must be disposed of in a manner that avoids exposure to humans and contamination of the environment.
11. Relevant guidelines appearing on the label(s) should be followed.
12. Empty containers may not be burnt/ incinerated on the farm.
13. Empty containers must be rinsed with integrated pressure rinsing devices on the sprayer, or triple-rinsed (rinsed at least three times) with water, and the rinsate added to the spray/race tank/ Dip tank or kept secure until disposal is possible.
14. Triple-rinsed containers can be punctured (in the case of plastics), shattered (in the case of glass) or otherwise rendered unserviceable so as to prevent reuse, where after it may be disposed of in a registered hazardous waste landfill site (operated by a registered hazardous waste removal company).
15. Empty triple-rinsed plastic containers can also be collected and removed for recycling by a registered recycler.
16. Obsolete or unwanted chemicals should preferably be sent back to local suppliers or alternatively be removed by certified or approved chemical waste disposal companies.
17. Leftover formulations should never be combined or mixed while being stored for later removal /disposal.

APPENDIX 3: Pesticides for Registration Consideration in Lesotho

INSECTICIDES

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Alphacypermethrin	Fastac (Ripcord Super)	EC	100g/LT
Acephate	Acephate, Orthene	SP	750g/KG
	Ace	SP	750g/KG
	Lancer	DF	970g/KG
	Lancer	SP	750g/KG
	Asafet	SP	750g/KG
	Novatheren TM	SC	750g/KG
Acetamiprid	Novacetam	SL	222g/KG
	Spear	SP	200g/KG
Aldicarb	Sanacarb	GR	150g/KG
	Temik	GR	150g/KG
Amitraz	Mitac	EC	200g/LT
Azinphos-methyl	Gusathion	SC	350g/LT
Azocyclotin	Peropal	SC	500g/LT
	Peropal	WP	250g/KG
Benfuracarb	Oncol	EC	200g/LT
	Oncol	CS	400g/LT
	Oncol	LS	900g/LT
Betacyfluthrin	Bulldoc 050RC	EC	50g/LT
	Bulldock 0.050g	GR	5g/LT
Bifenthrin	Talstar	EC	100g/LT
	Bisect	EC	100g/LT
Buprofezin	Applaud	WP	500g/KG
Carbaryl	Karbaspray	WP	850g/KG
	Sevin	WP	850g/KG
	Carbaryl	WP	850g/KG
Carbofuran	Karbadust	DP	50g/KG
	Curaterr	GR	100g/KG
	Carbosan	GR	100g/KG
	Carbofuran	GR	100g/KG
	Furadan	GR	100g/KG
Carbosulfan	Marshal	EC	250g/LT
	Marshals suscon	GR	100g/LT
	CMF	EC	250g/LT
	Carbosulfan	EC	250g/LT
Chinomethionat	Morestan	WP	250g/KG
Chlordane	Chlordane	EC	600g/LT
	Termidan	EC	600g/LT
Chlorpyrifos	Dursban	EC	480g/LT
	Dursban	WG	750g/KG

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
	Lirifos	SC	500g/LT/480g/LT
	Apollo	SC	500g/LT
Cyfluthrin	Baythroid	EC	50g/LT
	Baysol	AE/NF	50g/LT
	Sneak	WE	50g/LT
Cyhexatin	Cyhexatin	SC	600g/LT
Cypermethrin	Cypennethrin	EC	200g/LT
	Cypersan	EC	200g/LT
	Cyrux	EC	200g/LT
	Kemprin	EC	200g/LT
	Sherpa	EC	200g/LT
	Cymbush	EC	200g/LT
	Ripcord	EC	200g/LT
	Novacord TM	EC	200g/LT
Cypennethrin + Profenofos	Polytrin C	EC	40 + 400g/LT
Deltamethrin	Bitam	SC	50g/LT
	Deltabak	SC	50g/LT
	K-O Gard	SC	50g/LT
	Crackdown	SC	10g/LT
	Cislin	TB	10g/LT
	Decitab	Tablet	25g/LT
	Deltamethrin	EC	0.5g/KG
	Decis	SC	50g/LT
	K-Otab	Tablet	25g/LT
	Decis forte	EC	100g/LT
Deltamethrin+Endosulfan	Kracker	EC	2.5g + 475g/LT
Deltamethrin+Fenitrothion	Shumba Supper	DP	1.3g + 10g/KG
Deltamethrin+Piperonyl Butoxide	K-Biol	EC	25g + 250g/LT
Demeton-Methyl	Metaxystox (I)	EC	250g/LT
	Demeton-S-Methyl	SC	250g/LT
Diazinon	Diazinon	EC	275g/LT
Dichlorvos	DDVP	EC	1000g/LT
	Dedevap	EC	1000g/LT
	Dichlorvos	EC	1000g/LT
	DDVP 100	EC	100g/LT
	Doom	M/V	100g/LT
Dicofol	Kelthane	EC	185g/LT
Dimethoate	Cygon	EC	400g/LT
	Dimethoate	EC	400g/LT
	Rogor, Perfethion	EC	400g/LT
	Dimet	EC	400g/LT
	Dimethoate 20 WP	WP	200g/KG

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
	Nugor	EC	400g/LT
Disulfoton	Disyston 5g Solvirex Disulfoton	GR GR GR	50g/KG 50g/KG 50g/KG
Disulfoton + Triadimenol	Repulse 5.75g	GR	50g + 7.5g/KG
Endosulfan	Thiodan Endosulfan Endflo Agrisulfan dust Thioflo Thionex Thiokill	EC SC MO EC SC WP SC MO DP SC WP EC EC	350g/LT 350g/LT 350g/LT 350g/LT 475g/LT 475g/LT 350g/LT 350g/LT 50g/KG 475g/LT 500g/KG 350g/LT 350g/LT
Fenitrothion	Sumition	EC	500g/LT
Fenitrothion	Sumithion Fenitrothion Folithion Tracker Garden Insecticide	ULV ULV EC EC EC	1000g/LT 1000g/LT 500g/LT 600g/LT 600g/LT
Fenitrothion + Fenvalerate	Sumicombi 3D	DP	25g + 5g/KG
Fenpropathrin	Meothrin	EC	200g/LT
Fenthion	Labaycid	EC WP	500g/LT 500g/KG
Fenvalernte	Fenkill Felecid	EC EC	200g/LT; 500g/LT 200g/LT
Fenvalernte	Sumicidin Fenvalernte/ Sanvalerate Novacidin TM	EC EC EC EC	200g/LT; 500g/LT 200g/LT; 500g/LT 200g/LT 200g/LT
Fipronil	Regent Fipronil	GR GR	30g/KG 30g/KG
Furfural	Crop Guard	EC	900g/LT
Gamma BHC	Bexadust	DP	6.0g/KG
Imidachloprid	Confidor Confidor 70 Gaucho 70 WS Imidachlorprid Gaucho 600 FS	SL WG WS WS FS	100g/LT, 200g/LT 700g/KG 700g/KG 45 WS 700g/LT 600g/LT

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
	Gaucho 390 FS	FS	390g/LT
	Protect 200 SL	SL	200g/LT
	Protect 700 WS	WS	700g/LT
Imidachloprid 233g/LT	Monceren GT	FS	390g/LT
Imidachloprid/Thiram	Gaucho T	WS	45 WS
	Gaucho 275FS	FS	175g/LT + 100g/LT
	Novacot Dress	FS	350g/LT
Isofenphos	Peril turfgrass Insecticide	SC	500g/LT
Lambda-Cyhalothrin	Karate	EC WG CS	50g/LT 37.5g/LT 50g/LT
	Vajra	EC	50g/LT
	Lambda-Cyhalothrin	EC	50g/LT
	Novathrin	EC	50g/LT
Lufenuron	Match	EC	50g/LT
Mercaptothion	Malathion	WP EC	250g/KG 250g/LT
	Mercaptothion	WP	250g/KG
Methamidophos	Tamaron, Methaphos Sniper, Methamidophos	EC	585g/LT
Methomyl	Methomyl, Lannate	SL	200g/LT
	Methomyl, Lannate	SP	900g/KG
	Methosan, Methomex	SP	900g/KG
Methoprene	Kabat	AE	41.3g/LT
Mevinphos	mevinphos	EC	20g/LT
Mineral oil	Summer oil	EC	-
	Bacoil	EC	835g/LT
Monocrotophos	Nuvacron	WSC	400g/LT
	Monocron	WSC	400g/LT
	Monocrotophos	WSC	400g/LT
	Monostem	WSC	400g/LT
	Azodrin	WSC	400g/LT
	Novacrotophos TM	SL	400g/LT
	Phoskill	SL	400g/LT
Oxydemeton-Methyl	Metasystox [®]	EC	250g/LT
Parathion	Folidol	EC	500g/LT
Pamthion	Pamthion	EC	500g/LT
	Novaper	EC	500g/LT
Pamthion-Methyl	Pamthion-Methyl	EC	500g/LT
Permethrin	Coopex TC	TC	250g/LT
	Tobacco guard	EC	50g/LT
	Tabakskern	EC	5.0g/LT
	Permethrin	EC	100g/LT

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Phenthoate	Elsan	EC	500g/LT
Phoxin	Baythion Ant killer	EC	500g/LT
	Turmoil soil insecticide	EC	500g/LT
	Whack	EC	500g/LT
Pirimiphos-Methyl	Actellic EC	EC	500g/LT
	Actellic dust	DP	20g/KG
	Actellic smoke generator	EU	-
Pirimiphos-Methyl + Permethrin	Actellic Super EC	EC	500g/LT
	Actellic Super dust	DP	16g + 3g/KG
Plus Pencycuron 50 EC	Plus Pencycuron 50EC	EC	50g/LT
Plus Thiram 107EC	Plus Thiram 107EC	EC	107g/LT
Profenophos	Selecron	EC	500g/LT
Propargite	Propargite	EC	570g/LT
			720g/LT
			790g/LT
Prothiophos	Tokuthion	EC	960g/LT
Terbufox	Terrafos	GR	100g/KG
	Counter	GR	100g/KG
Terbufos	Hunter	GR	150g/LT
Tetradifon	Tedion V8	EC	81g/LT
Thiachloprid	Calypso	SC	480g/LT
Thiodicarb	Larvin	FW	375g/LT
Thiophanate-Methyl	Topsin	WP	500g/KG
Triazophos	Hostathion	EC	420g/LT
Trichlorfon	Dipterex	SP	950g/KG
		GR	25g/KG
	Trichlorfon	SP	950g/KG
		GR	25g/KG
Triflumuron	Alsystin	SC	480g/LT
Thiamethoxam	Actara	WG	250g/kg

HERBICIDES

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Acetochlor	Sprint	EC	900g/LT
	Wenner	EC	700g/LT
	Curagrass,	EC	750g/Lt
	Crocodile	EC	700g/LT
	Trophy S		
	Bullet		
	Har-I-cane		

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Acetochlor + Atrazine + Propazine	Tuff-E-Nuff	SC	96g + 202g + 202g/LT
Acetochlor + Atrazine + Simazine	Robust	SC	160g + 165g + 165g/LT
Acetochlor + Atrazine + Terbutylazine	Acetrazine	SC	125g + 187.5g + 187.5g/LT
Alachlor	Alachlor 384, Eland Alachlor 480 Sanachlor 384 Lasso 480 & 384 Lasso MT	EC EC EC EC CS	384g/LT 480g/LT 384g/LT 480g/LT 480g/LT
Ametryn	Gesapax Ametryn Ametryn	SC SC WP	500g/LT 500g/LT 800g/KG
Ametryn + Atrazine	Ametra	SC	250g + 250g/LT
Asulam (Na-Salt)	Asulox	SL	331g/LT
Asulam	Asulam	SL	400g/LT
Atrazine	Atrazine Gesaprim Gesaprim	SC, WP, WG WG SC	500g/LT, 800g/KG, 900g/k 900g/LT 500g/LT
Atrazine + Terbutylazine	Suprazine, Eliminator	SC	600g/LT, 500g/LT
Atrazine + Terbutylazine + Metolachlor	Gadomil	SC	262.5g + 262.5g + 175g/LT
Bendioxide	Basagran	SL	480g/LT
Bromacil	Bromacil Hyvar-X80	WP WP	800g/KG 800g/KG
Bromoxynil	Bromox Buctril DS	EC EC	225g/LT, 450g/LT 450g/LT
Chlorimuron-Ethyl	Classic	WG	250g/KG
Chlorimuron-Ethyl + Metribuzin	Canopy	WG	107g + 643g/KG
Clomazone EC	Novazone	EC	450g/LT
Cyanazine	Cyanazine Bladex	SC SC	500g/LT 500g/LT
Cyanazine + Atrazine	Blazine Bladex Plus	SC SC	250g + 250g/LT 333g + 167g/LT
2-4 -D (Amine)	Embamine 2-4 -D Amine	EC SL	480g/LT 480g/LT
2-4 -D (Ester)	2,4 -D Ester	EC	500g/LT
2-4 -DB	2,4 -DB	AS	480g/LT, 500g/LT
2,4 -D Dicamba	Spotaxe	SL	240g + 80g/LT
2,4 -D MCPA	Rampant Turfgrass Herbicide	WSC	360g + 315g/LT
2,4-D + Picloram	Tordon 101	SL	240g + 65g/LT
Dalapon	Dalapon	SP	850g/KG

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Dicamba	Banvel	EC SL	480g/LT 480g/LT
Diuron	Diuron Diuron	WP SC	800g/KG 500g/LT, 800g/LT
Diuron + Paraquat	Gramuron	SC	300g + 100g/LT
EPTC	EPTAM	EC	720g/LT
Ethidimuron	Ustilan Ustilan	GR WP	100g/KG 700g/KG
Fluazifop-P-Butyl	Fusilade super, Forte	EC	150g/LT
Fluazifop-R-Methyl	Gallant Super	EC	108g/LT
Flufenacet	Tiara	SC	500g/LT
Flumetsulam	Broadstrike	WG	800g/LT
Fluometuron	Cottonex	FW	500g/LT
Flazafulfuron	Kantana	WP	100g/KG
Oxyfluorfen	Goal	EC	240g/LT
Glufosinate ammonium	Basta	WSC	200g/LT
Glyphosate	Mamba/Springbok Ridder weed killer Roundup Cobra + Duiker Shaikdown Turbo	SL SL SL SL	360g/LT 360g/LT 360g/LT 180g/LT 480g/LT 500g/LT
Haloxifop-R-Methyl-Ester	Gallant Super	EC	104g/LT
Halusulfuron	Servian	WG	750g/LT
Hexazinone	Ransom	SL	240g/LT
Hexazinone	Hexazinone, Hexsan Velpar L Velpar SP	SC, SL SC SP	240g/LT 750 DF 240g/LT 900g/LT
Ioxynil +2,4 -D	Actril D.S.	EC	100g +600g/LTD
Isoxatlutole	Merlin	WG	750g/LT
MCPA (K-salt)	MCPA	SL	400g/LT
MCPB	MCPB	AS	400g/LT
Mesotrione	Callisto	SC	480g/LT
Metazachlor	Pree Butisan S	EC SC	400g/LT 400g/LT, 500g/LT
Metolachlor	Dual Magnum + Falcon Gold	EC	960g/LT
Metribuzin	Veto Sencor Contrast Turfgrass herbicide Sencor WP	SC SC SC WP	480g/LT 480g/LT 480g/LT 480g/KG

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
	Metribuzin	SC	480g/LT
Metribuzin + Chlorimuron Ethyl	Extreme plus	WP	107 + 643g/KG
MSMA	MSMA	SL	720g/LT
	MSMA	EC	720g/LT
Nicosulfuron	Sanson	SC	40g/LT
Oxadiazon	Ronstar	EC	250g/LT
Oxyfluorfen	Goal	EC	240g/LT
Paraquat	Paraquat	SL	200g/LT
	Gramoxone	EC	200g/LT
Paraquat Dichloride	Uniquat	SL	200g/LT
Pebulate	Tillam 6E	EC	720g/LT
Pendimethalin + Ametryne + Atrazine	Paragon Plus	WP	350g + 200g + 200g/KG
Pendimethalin + Chlorimuron-Ethyl + Metribuzin	Paragon Extra	WP	437 + 31g + 200g/KG
Prometryn	Gesagard	FW	500g/KG
Sethoxydim	Nabu	EC	186g/LT
Simazine	Simazine	WP	800g/KG
S-Metolachlor	Dual Magnum	EC	960g/LT
	Falcon Gold	EC	960g/LT
S.Metolachlor/Flumetsulan	Bateleur gold	EC	630 + 20g/LT
Tebuthiuron	Tebusan	SC,WP	500g/LT, 500g& 800g/KG
Terbumeton	Terbumeton	SC	500g/LT
	Terbumeton	WP	800g/KG
Terbuthylazine + S-Metolachlor	Sorgomil Gold	SC	600g/LT
Terbuthyn	Terbuthyn	WP	800g/KG
Terbuthyn	Igran	SC	490g/LT
Terbuthyn + S-Metolachlor	Igran +Combi Gold	SC	450g +10g/LT
	Trifluralin	EC	480g/LT
	Trifluralin	SC	500g/LT

FUNGICIDES

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Acibensolar-S-Metlyl	Bion 50WG	WG	500g/KG
Acibanzolar-S-Metlyl	Bion	WG	50g/KG
Anilazine	Dyrene	WP	750g/KG
Azoxystrobin	Ortiva 250SC	SC	250g/KG
Benomyl	Benlate	SC	480g/LT
		WP	500g/KG
		FW	500g/LT
	Fundazol	WP	500g/KG
Bitertanol	Baycor	EC	300g/LT

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Captab	Captab	WP, SC	500g/KG, 500g/LT
Carbendazim	Derosol	SC	510g/LT
Chlorothalonil	Chloronil Daconil Bravo	SC WP FW SC	500g/LT 750g/KG 500g/LT, 720g/LT 500g/LT
Copper Ammonium Nitrate	Copper Count N	SL	316g/LT
Copper oxychloride	Cupravit Demildex Copper oxychloride	WP WP WP FW	850g/KG 850g/KG 850g/KG 600g/LT
Copper Hydroxide	Cung FU 538SC	SC	Copper Equiv. 350g/LT
Cupric hydroxide	Funguran – OH Cupric hydroxide Kocide 101 Kocide DF	WP WP WP WG	770g/KG 770g/KG 770g/KG 614g/KG
Cymoxanil +Mancozeb	Rimit 50.6 WP	WP	500g +60g/KG
Cyproconazole	ALTO 100 SL ALTO G34	SL GR	100g/LT 34g/KG
Cyproconazole +Disulfoton	Alto mix	GR	2.5g +75g/KG
Difenoconazole	Score	EC	250g/LT
Difolatan	Captafol	WP	800g/KG
Dimethomorph + Mancozeb	Acrobat MZ	WP	90g +600g/KG
Dinocap	Karathane	WP	200g/KG
Fenarimol	Rubigan	EC	120g/LT
Fosetyl - Aluminium	Alliette	WP	800g/KG
Hexaconazole	Anvil	SC	50g/LT
Iprodione	Rovral Rovral flo Iprodione Iprodione	SC FW SL SL	250g/LT 255g/LT 255g/LT 255g/LT
Iprodione + Mancozeb	Rovral M	-	-
Mancozeb	Pennozeb Sancozeb Dithane M45 Mancozeb	WG WP WP WG	800g/KG 800g/KG 800g/KG 800g/KG
Mancozeb + Oxadixyl	Sandofan M8	WP	560g + 80g/KG
Maneb (Dithiocarbamate) + Zinc Oxide	Manager Sc	SC	435g + 4.7g/LT
Maneb + Fentin Acetate	Brestan	WP	180g + 540g/KG
Metalaxyl + Mancozeb	Ridomil MZ 70 WP	WP	100g + 600g/KG

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Oruface + Mancozeb	Patafol plus	WP	60g + 640g/ KG
Pencycuron	Monceren	SC	250g/LT
Prochloraz + Carbendazim	Sportac alpha	EC SC	300g + 80g/LT 300g + 80g/LT
Prochloraz + Mangane Chloride	Sporgon	WP	295g/KG
Propamocarb - HCL	Previcurn	SC	722g/LT
Propamocarb Hydrochloride	Propamocarb	SL	722g/LT
Propiconazole	Propiconazole	EC	100g/LT, 200g/LT
Propiconazole	Tilt	EC	250g/LT
Propineb	Antracol	WP	700g/KG
Pyrazophos	Afugan	EC	295g/LT
Sulphur	Wettable Sulphur Kumulus, Triovit	WP WP	800g/KG 800g/KG
Azoxystrobin	Ortiva 250 SC	SC	250g/LT
Acibensolar-S-Methyl	Bion 50 WG	WG	500g/KG
Difenoconazole	Score	EC	250g/LT
Cyproconazole/ Thiamethaxam	Verdadero	GR	10 + 10g/KG
Tebuconazole	Raxil 015 ES Folicur	ES EW EC	15g/LT 250g/LT 250g/LT
Thiram	Thiram Thiulin 50 DS	WP DS	750g/KG 500g/KG
Tolcofox Methyl	Rizolex 50	WP	500g/KG
Tolyfluand	Euparen Multi	WP WP	500g/KG 500g/KG
Tolyfluand Sulphur E	Euparen multi sulphur dust	DP	75g + 920g/KG
Triadimefon	Bayleton	WP	50g/KG
Triadimefon	Bounce turfgrass fungicide	EC	250g/LT
	Shavit	EC	250g/LT
	Bayfidan EC	EC	250g/LT
	Bayfidan G	GR	10g/KG
	Baytan DS	DS	150g/KG
	Baytan FS	FS	150g/LT
Triadimefon + Propineb	Bayleton A	DS	50g + 700g/KG
Triadimenol + Disulfoton	Repulse 5.75g	GR	7.5 + 50g/KG
Trichoderma	Trichoderma	WP	-
Tridemorph	Calixin	EC	750g/LT
Zineb	Zineb 70 WP	WP	700g/KG

FUMIGANTS

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Aluminium phosphide	Gastoxin Phostoxin Alphos + Aluminium Phosphide	TB TB, Pellets	560g/KG 560g/KG
Magnesium phosphide	Degesch plates Degesch strips	FU (plates) FU (strips)	607g/KG 607g/KG
Methyl Bromide + Chloropicrin	Methyl Bromide	GA	980 + 20g/KG
	Metabrom	GA	980 + 20g/KG
	Curabrom	GA	980 + 20g/KG

NEMATICIDES

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Cadusafos	Rugby	GR	100g/KG
Ethoprop	MOCAP	GR	100g/KG
Ethylene Dibromide (EDB)	Ethylene Dibromide (EDB)	EC, MO	1800g/LT
Fernamiphos	Nemacur Nemacur	EC GR	400g/LT 100g/KG
Metham Sodium	Herbifum Metam Sodium	Liquid Concentration SC	510g/LT 510g/LT
Methyl bromide + Chloropicrin	Methyl bromide	GA	980 + 20g/KG
Oxamyl	Vydate	SL	240g/LT, 310g/LT
1,3 Dichloropropene	Telone II	Liquid concentrate	1110g/LT
Metham-Sodium	Herbifume	Liquid concentrate	510g/LT

MOLLUSCICIDES

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Carbaryl + Metaldehyde	Snailban	RB	20 + 30g/Kg
Methiocarb	MesuroI	WP RB (Pellets)	800g/Kg 800g/Kg
Methiocarb	Draza Byluscide Metason	RB EC, WP RB	50g/Kg 250g/L; 700g/Kg 50g/Kg

PUBLIC HEALTH (ENVIRONMENTAL) PESTICIDES

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Alphacypermethin	Fendona	SC WP	58g/Kg 50g/Kg
Betacyfluthrin	Tempo	SC	125g/LT
Brodifacoum	Finale (Rodenticide)	RB	0.02g/Kg 0.05g/Kg; 0.75g/Kg

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
	Klerat	BB	0.05g/Kg; 0.75g/Kg 0.02g/Kg
		CB	0.05g/Kg; 0.75g/Kg 0.02g/Kg
		CB	0.05g?kg; 0.75g/Kg 0.02g/Kg
		BB	0.5g/Kg
Chlorpyrifox	Baygon roach bait	DB	-
Coumatetralyl	Racumin rat bait Racumin rat poison	RB FW	3.75g/Kg 8g/LT
Cyfluthrin	Baythroid H Responsar	WP EW	100g/kg 50g/LT
Cyfluthrin + Propuxur	Blattanex	AE	2.5g/Kg + 10g/Kg
Cyfluthrin + Tetramethrin	Baygon spray	AE	-
D-Allethrin	Baygon mosquito coils	FU (coils)	2g/Kg
D-Allethrin + Piperonyl	Baygon mosquito mats	FU (mats)	50g + 2-g/Kg
Butoxide			
DDVP	Fly bait	RB	5g/Kg
Deltamethrin	Glossinex Crackdonw K-Ogard K-Othrine K-Othrine 15 Deltabak Super crackdown/Cislin K-Othrine K-Othrine	SC SC SC SC E.C SC SC WP DP	200g/LT 10g/LT 10g/LT 10g/LT 15g/LT 50g/LT 25g/LT 25g/Kg; 50g/Kg 2g/Kg
Deltamethrin + Bednet	K-Onet	TB + Bednet	-
Diazion	PCO diazinon	EC	880g/LT
Dichlorvos	Super doom	AE	-
Dichlorvos + Tetremethrin	Baygon fumigator	AE	10g + 2g + 10g/Kg
Fenitrothion	Reskol 64	EC	600g/LT
Fipronil	Fipronil Regent	SC SC	200g/LT 200g/Lt
Flumethrin	Bayricol aerosol	AE	2g/Kg
Lambda-Cyhalothrin	Icon 10 WP Icon 2.5 CS	WP Cs	100g/Kg 25g/LT
Mercaptothion	Kopthion 50 DP	DP	50g/Kg
Methomyl	Dy-fly	RB	10g/Kg
Naled DBM	Dibron	SL	344.9g/LT
Permethrin	Coopex Dust	DP	5g/Kg

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
	Coopex WP Cooper WP Peripel 55 Temephosmostop Tobacco Cuard Imperator Coopex smoke generator	TC WP SC EC EC SC FU	250g/LT 250g/Kg 550g/LT 500g/LT 50g/Kg 100g/LT 135g/Kg
Pemethrin + Piperonyl	Pybuthrin 44	FU	0.39% + 0.382% + 0.206%
Pipperonyl butoxide	Baygon knockdown spray	AE	10g + 2g + 1-g/Kg
Butoxide + D-Allethrin Butoxide + D-Allethrin	Pulvex fly smear	-	0.206% + 0.382% + 0.205%
Phoxim + Honey	Baygon ant bait	RB	0.8G/Kg
Propuxur	Propuxur Baygon dust Baygon fly bait	GA DP RB	0.5 – 2.0% 10g/Kg 10g/Kg
Propuxur + Cyfluthrin	Baygon surface spray	AE	-
Pyrethrins + Piperonyl	Coopermatic fly killer	CB	9g/LT
Butoxide	Flip mosquito larvacide Mosquito larvacide oil Kontakil	- - -	- - -

RODENTICIDES

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Brodifacoum	Finale Klerat	SL BB BB	0.05g/LT; 0.025g/LT 0.05g/Kg; 0.02g/kg 0.05g/Kg
Coumatetralyl	Racumin	FW Liquid BB Tracking powder	8g/LT 3.75g/Kg
Flocoumafen	Storm Supakill	BB -	0.05g/Kg -

PLANT GROWTH REGULATORS

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Alkylated phenol-ethylene condensate	Agal 90 Agripon Super Agrowett Armoblen Astrozon green turf dye Compement	Surfactant Surfactant Nontonic Surfactant Nontonic Surfactant Dye Surfactant Buffer + Spreader	940g/LT 940g/LT - SL Various SL Various - -

	Curabuff G-49 Wetter Kynobuff BB5, Insure	Surfactant (Wetter) Ajuvant -	- - -
Aminofit	Amino Acid Complex	Essential Amino acids for plant growth	
Butralin	Tabamex Tobago	EC EC	360g/LT 360g/LT
Chlorthal-Dimethyl	Razor, Erasor	SC	360g/LT
CU-Max	Copper	Liquid Complex	Copper 50g/LT
Cytokinins + Auxins	Kelpak	SL	0.031mg/LT + 11mg/LT
Ethephon	Ethephon Ethrel Ethrel Latex stimulant	SL SL SL	480g/LT; 217g/LT 480g/LT; 217g/LT 480g/LT; 217g/LT
Heptamethyltrisiloxane	Silwet L77	Adjuvant	1000g/LT
Modified phthalic – Glycerol alkyd resin	Latron B-1956	Speader/sticker	-
Magnesium	Magmax	WP	65g/KG
Multifeed	N,P,K, Micronutrients	Water Soluble Foliar Fertilizer concentrate	19:8:16
N-Decanol	Antak, Decasuckeride Royaltac Suckerkil N-Decanol	EC EC EC	690g/LT; 785g/LT 690g/LT; 785g/LT 690g/LT; 785g/LT
N'Decanol + Octanol	C85 Fair 85	EC EC	400 + 300g/LT 400 + 300g/Lt
Nonylphenol polyglycol ester	Sanawett 90	Wetter/Sticker	945g/LT
NPK + Cronutrient	Green gold plus	-	-
NPK (Plus micronutrients)	Bayfolan, Nitrophoska Turfolan	GR GR	3-2-1 (22) 3-2-1 (22)
Nitrophoska	GR Turfolan	GR 3-2-1(22)	3-2-1(22)
Pendimethalin	Accotab Bacstop Novatop Pendimethalin	EC EC EC EC	330g/LT 330g/LT 330g/Lt 330g/LT
Polyethylene wax	Tax wax Teepol Detergent Teepol disinfectant	Wax (fruit polish) - -	- - -
Polyvinyl Polymer	Mist Control	Adjuvant	20g/LT
Sodium borate	Solubor	WP	20.5% m/m
Sodium molybdate	Sodium molybdate	WP	38.8% m/m
Zinc oxide	Zinc oxide	WP	78.5% m/m
Zinc-Max	Zinc	Liquid Zinc complex	1130g/LT

ANIMAL HEALTH (PARASITICIDES)

COMMON NAME	TRADE NAME	FORMULATION	CONCENTRATION
Alphamethrin	Paracide	EC	70g/Lt
Amitrnz	Milbitrnz	EC	237.5g/kg
Amitrnz	Triatix stock spray Triatix TR	EC	125g/LT
Cargaryl	Pulvex dog shampoo	EC	50g/LT
Chlorfenvinphos	Chlorfenvinphos SUPONA Supona Super	EC EC EC	200g/LT; 300g/LT 200g/LT; 300g/LT 1000g/LT
Chlorfenvinphos + Dioxathion	Tic grease	-	4g + 4g/LT
Chlorpyrifos	Barrier Pulvex dog dip Pulvex dog powder	EC EC DP	480g/LT 150g/LT 10.7g/Kg
Closantel	Prantel	L	25g/LT
Cyfluthrin	Cylence	NF (pour-on)	10g/LT
Cypermethrin	Pouracide	NF	-
Deltamethrin	Decatix Spotton	NF (pour-on)	50g/LT
Febantel + Pyrantel Pamoate	Welpan	TB	1.6% + 1.44% m/v
Febantel + Pyrantel emboate + Praziquantel	Drontal	TB	-
Fenbendazole	Rintal	FW	100g/LT
Fenthion-methyl	Bayopet spotton Ticuvon spotton	L L	100g/LT; 200g/LT 200g/LT
Flumethrin	Bayopet tick rinse Bayticol Drastic deadline	EC EC L (pour-on)	20g/LT 20g/LT 10g/LT
Flumethrin + Piperonyl	Bacdip plus	EC	20 + 100g/LT
Ivomectin	Ivomec	L (injectable) (Endectoparasiticide)	1% M/V
Levamisole Hydrochloride/ Oxychlozanide	Levisan	Flowable concentrate	25 + 34 g/LT
Praziquantel Propuxur	Cestocur Bayopet tic + Flea powder Bayopet dog collar Bayopet cat collar	FW DP - -	25g/LT 10g/Kg 94g/Kg 94g/Kg
Propuxur + Cyfluthrin	Bayopet surface spray	AE	-
Quainthiophos	Bacdip	AE EC -	2g/Kg 500g/LT -

	Bayopet dog and cat shampoo & conditioner		
Rafoxanide	Ranide	FW	-
Thiabendazole	Thibenzole	FW	-
Toltrazuril	Baycox Systamex	SL FW	25g/LT -
Tetrachlorvinphos			
Piperonyl Butoxide			