REPUBLIC OF MAURITIUS

NATIONAL AUDIT OFFICE

PERFORMANCE AUDIT REPORT

USE OF PESTICIDES IN AGRICULTURE

Ministry of Agro-Industry and Food Security

JUNE 2022

NATIONAL AUDIT OFFICE

PERFORMANCE AUDIT REPORT

USE OF PESTICIDES IN AGRICULTURE

Ministry of Agro-Industry and Food Security

JUNE 2022

FOREWORD

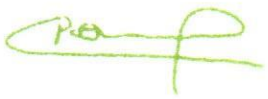
Section 16 (1A) of the Finance and Audit Act requires the Director of Audit to carry out performance audit and report on the extent to which a Ministry, Department or Division is applying its resources and carrying out its operations economically, efficiently and effectively.

I am pleased to submit to the Minister of Finance, Economic Planning and Development, and through him to the National Assembly, this Performance Audit Report entitled "Use of Pesticides in Agriculture". The overuse of pesticides in agriculture motivated the selection of this subject matter.

The objective of this performance audit was to assess the effectiveness of the measures taken by the Ministry of Agro-Industry and Food Security in managing the use of pesticides in agriculture. It covered the period July 2018 to June 2021 and where applicable, updated information is included in the report.

The Ministry was given the opportunity to comment on the content of the Report, which also includes recommendations for improvement. A follow-up audit will be carried out in due course to evaluate the adequacy, effectiveness, and timeliness of actions taken by the Ministry on reported findings and recommendations.

I would like to take this opportunity to thank the Senior Chief Executive and the staff of the Ministry, as well as officials of the Food and Agricultural Research and Extension Institute for their cooperation and collaboration. I also wish to thank my staff who were engaged in the conduct of this audit.



C. ROMOOAH
Director of Audit
National Audit Office
PORT LOUIS

30 June 2022

CONTENTS

Continued

Back to Contents

CONTENTS (*Continued)*

Back to Contents

LIST OF TABLES

FIGURE

This page intentionally left blank

ABBREVIATIONS AND ACRONYMS

ACD	Agricultural Chemistry Division
CAC	Codex Alimentarius Commission
FAO	Food and Agriculture Organization
FAREI	Food and Agricultural Research and Extension Institute
FTL	Food Technology Laboratory
GAP	Good Agricultural Practices
IAEA	International Atomic Energy Agency
INTOSAI	International Standards of Supreme Audit Institutions
IPDM	Integrated Pest and Disease Management
IPM	Integrated Pest Management
MoAIFS	Ministry of Agro-Industry and Food Security
MRL	Maximum Residue Level
NAO	National Audit Office
PRO	Pesticides Regulatory Office
R&D	Research and Development
SAI	Supreme Audit Institutions
UNDP	United Nations Development Programme
WHO	World Health Organisation

This page intentionally left blank

EXECUTIVE SUMMARY

Pesticides have proved to be useful to agriculture and are used worldwide on a large scale to improve and increase the production of a number of crops such as fruits and vegetables. Mauritius is no exception. However, if used improperly or in an inappropriate manner, they can present unacceptable risks to human and animal health and to the environment.

The Ministry of Agro-Industry and Food Security is responsible for the management of the use of pesticides in Agriculture.

Several concerns regarding the danger of the overuse of pesticides in agriculture had prompted debates in the National Assembly and were also reported in the media.

The total importation of pesticides, including those intended for agricultural purposes, increased from 2,500,000 kg in 2016 to 2,700,000 kg in 2020. For the years 2017 to 2021, some 492,000 kg of pesticides were imported for agricultural purposes at a cost of some Rs 275 million.

It is against this background that the National Audit Office (NAO) carried out this Performance Audit entitled "Use of Pesticides in Agriculture" at the Ministry of Agro-Industry and Food Security. It covered the period July 2018 to June 2021.

Key Findings

Rise in The Importation of Pesticides for Agricultural Purposes

The volume of pesticides imported for agricultural purposes for the past five years showed an increasing trend from 80,000 kg in 2017 to 112,000 kg in 2021. The volume of active ingredients used per hectare also showed an increasing trend during the same period.

Pesticides Management Policy

- The document on Pest and Pesticide Management Policy Development issued in 2010 by the Food and Agricultural Organisation (FAO) provides guidance on policy development in support of pesticide risk reduction and sustainable agricultural production. Although the Ministry has been taking several measures, it did not have a comprehensive policy in line with FAO guidance.

- As of April 2022, except for the Maximum Residue Level (MRL) and the non-recommended pesticides used by planters, the Ministry did not have programmes for collecting and storing data, and for carrying out analysis and reporting of same for effective decision making.

- Although different ways to control the use of pesticides were mentioned in the Non-Sugar Sector Strategic Plan 2016-2020 of the Ministry (hereafter referred to as the Strategic Plan 2016-2020), it did not have an implementation plan and targets such as the number of planters to be trained on Integrated Pest Management (IPM), Good Agricultural Practices (GAP) and a national target on pesticide use reduction.

- The Ministry did not monitor the implementation of measures contained in the Strategic Plan 2016-2020. Hence, the effectiveness of measures taken with respect to pesticide management was not known.

The Ministry informed NAO that presently there is no policy on the use of pesticides.

Compliance with the Use of Pesticides Act 2018

- Two objectives laid down in the Strategic Plan 2016-2020, namely the introduction of a new regulation to cater for inspection, information, guidance and control on the proper and safe use of pesticides by farmers and the creation of a Pesticide Unit, namely the Pesticides Regulatory Office (PRO) were successfully achieved by the Ministry. However, it faced numerous challenges in effectively enforcing the Act.

- The number of samples collected for testing by the PRO decreased from 734 in 2019 to 609 in 2021. Samples having pesticide residue exceeding MRL increased from 13 to 23 during the same period. On average, some three per cent of samples tested exceeded MRL. Prior to the Act, the average MRL was some four per cent.

- Agricultural produce contained non-recommended pesticides. For the period 2019 to 2021, over 10 per cent of the samples analysed each year contained non-recommended pesticide residue.

- The number of non-compliant planters increased from 56 in 2020 to 79 in 2021.

- There was no basis to determine offences and the related sanctions as the Act does not explicitly specify the recommended pesticides nor the MRL acceptable for the different types of imported agricultural produce.

- For the years 2020 and 2021, samples were collected from 550 planters out of 8,500 registered planters. According to the Food and Agricultural Research and Extension Institute (FAREI), as of April 2022, there were some 12,000 planters across the island including non-registered ones. Samples were being collected from registered planters only.

- For the years 2020 and 2021, 936 samples were collected from 550 planters at farm gates, markets, auction markets and supermarkets for analysis of pesticide residue. There were

135 non-compliant planters whose samples exceeded the MRL and contained non-recommended pesticides. 128 planters were issued with improvement notices. The Ministry could not issue improvement notices for the remaining seven as they were untraceable. Out of the 128, follow-up was carried out in only eight cases, representing some 6.3 per cent of the total improvement notices issued. Five of the eight planters concerned had taken corrective actions.

- Improvement notices were being issued to offenders for non-compliance. However, as of April 2022, a scrutiny of the test analysis report of the Ministry showed that planters were still overusing pesticides resulting in agricultural produce having pesticides level exceeding MRL and/or still using non-recommended pesticides. The Ministry had not initiated any legal procedures against them.

- As of April 2022, the Food Technology Laboratory (FTL) had three equipment to carry out tests for pesticide residue in agricultural produce. Out of the 60 ingredients prescribed in the Act, the equipment was testing only 33 ingredients. As of April 2022, both FTL and PRO could not operate optimally as two of the equipment were subject to frequent breakdown. The types and number of tests being carried out were thus limited.

The Ministry informed NAO that amendments are being brought to the Act to implement Section 10 of the Act with respect to certificate of pesticide residue and MRLs for imported agricultural produce. Additional staff is required to strengthen enforcement of the Act and for follow-up in case of non-compliance.

Promoting Integrated Pest Management (IPM)

- A pilot project, undertaken in 2007, gave promising result as IPM was successfully implemented. However, this technique was not extended to other regions nor transferred to other planters of cucurbits (a plant of the gourd family). As of April 2022, the development of an integrated strategy and policy to foster the adoption of IPM practices as well as a review of regulatory framework to facilitate the introduction of IPM were not realised.

- An equipment (Cobalt 60 radio-active irradiator) was acquired in May 2015 by the Ministry in collaboration with the International Atomic Energy Agency (IAEA). The equipment is used for sterilising flies under the Fruit Fly Control Programme. A fruit fly rearing facility to the tune of Rs 42.4 million was constructed and is operational since August 2019. Some five million flies were produced per week but not released as the irradiator to sterilise the flies was out of order for more than a year.

The Ministry informed NAO that funds to the tune of Rs 6 million have been earmarked for the financial year 2022-23 for area wide fruit fly suppression with environment friendly techniques.

Shifting towards Organic Agriculture

One of the objectives stated in the Strategic Plan 2016–2020 was to switch to a more sustainable agriculture with a view to limiting the use of pesticides. As of April 2022, the Organic Agriculture Bill was not yet finalised and thus the benefit of organic agriculture was deferred.

The Ministry informed NAO that the draft legislation on Organic Agriculture has been prepared with technical support from FAO.

Training and Sensitisation

FAREI has been carrying out training and sensitisation of planters on the proper use of pesticides. However, the MRL was continuously being exceeded. Also, the training sessions organised in the past seven years 2015 to 2021 did not form part of a defined programme on the use of pesticides or the use of IPM.

Conclusion

Pesticides have been used for pest management and to improve and increase crop production. Their inappropriate use may lead to increased risks to human health and the environment. Analysis reports of samples collected indicate that the pesticide residue have exceeded the MRL and/or that the samples contained non-recommended pesticides. The Ministry has been taking several measures to manage the use of pesticide in agriculture but with varying degree of success.

The Ministry does not have an appropriate policy on pesticides that is in line with good practices embodied in FAO guidance. In 2018, it has taken the initiative to introduce the Use of Pesticides Act. However, the Act has not brought the expected benefits mainly due to several challenges such as insufficient training, frequent breakdown of testing equipment as well as equipment not fully programmed to carry out tests on all ingredients stated in the Act and low level of samples for testing. The Ministry has also been facing challenges in enforcing some sections of the Act.

The Ministry has explored alternative strategies for pest management to reduce the use of pesticides, such as the introduction of IPM and organic agriculture. However, there was no appropriate regulatory framework conducive to using these alternative methods.

Key Recommendations

Strategies and Implementation Plans

- The objectives to control the use of pesticides should be met by having a policy on pesticide management along with a clear implementation plan, indicators, targets and time frame.
- In addition to the analysis of MRL and the use of non-recommended pesticides, the Ministry should have a programme for collection and storage of data, carrying out analysis and reporting same for effective decision making.
- The Ministry needs to monitor and evaluate the implementation and impacts of measures contained in Strategic Plan.
- The Ministry may consider a risk-based approach on the collection of samples for analysis of MRL.

Legislations

- The MRL for imported agricultural produce should be clearly described in the Act so that offences could be determined and appropriate legal actions taken.
- The Ministry should work out an action plan to carry out follow-ups. Penalties for non-compliance with the improvement notices must be enforced. Appropriate training should be given to officers of PRO to enforce the different sections of the Act dealing with offences and penalties.

Strategies for Controlling the Use of Pesticides

- To promote IPM, the Ministry should come up with a strategy with well-defined programmes and targets.
- The Ministry should endeavour to finalise the Organic Bill to reap its benefit sooner.
- The Ministry should strengthen the mechanism in place to ensure that planters are trained on the proper use of pesticides as per the requirement of the Act. Sensitisation and training on the use of pesticides and IPM should form part of a well-defined strategy and implementation plan.

This page intentionally left blank

CHAPTER ONE

INTRODUCTION

This Chapter provides a background of the subject matter examined and describes the audit approach used in carrying out the audit.

1.1 Background

Pesticides, according to the Food and Agricultural Organisation (FAO), are any substance, or mixture of substances of chemical or biological ingredients intended for repelling, destroying or controlling any pest, or regulating plant growth.

Pesticides have proved to be useful to agriculture and are used worldwide on a large scale to improve and increase the production of a number of crops such as fruits and vegetables. Mauritius is no exception. If used in an inappropriate manner, they can present unacceptable risks to human and animal health and to the environment[1].

The use of pesticides has brought along many problems. The main concerns have been the nature, persistence and tolerable levels of pesticide deposits or residues in foodstuffs, vegetables and fruits, amongst others. FAO International Code of Conduct on the distribution and use of Pesticides (2010), indicates that, although pesticides play an important role in agriculture, it poses risks to human health and the environment. Hence there is a need to have sound pesticide management to address those risks.

The Ministry of Agro-Industry and Food Security (MoAIFS) is responsible for the management of pesticides in Agriculture.

1.2 Audit Motivation

The World Health Organisation (WHO) acknowledges that pesticides are potentially toxic to humans and can have both acute and chronic health effects if their use is not properly controlled. They are associated with neurodegenerative diseases such as Parkinson's and Alzheimer's, diseases of the newborn and different forms of cancer. A study carried out jointly by the United Nations Development Policy (UNDP) and the Ministry of Health and Wellness in 2013, had highlighted the harmful effects of the excessive use of pesticides, inter alia, on our health, soil, flora and fauna, ecosystem and the environment[2].

[1] The Organisation for Economic Co-operation and Development (OECD)
[2] Hansard

Several concerns regarding the dangers of the overuse of pesticides in agriculture had prompted debates in National Assembly and were also reported in the media.

The total importation of pesticides including those for agricultural purposes increased from 2,500,000 kg in 2016 to 2,700,000 kg in 2020. For the years 2017 to 2021, some 492,000 kg of pesticides were imported for agricultural purposes at a cost of some Rs 275 million.

It is against this background that the National Audit Office (NAO) carried out this Performance Audit entitled "Use of Pesticides in Agriculture" at the Ministry of Agro-Industry and Food Security.

1.3 Audit Objective

The audit assessed the effectiveness of the measures taken by the Ministry in managing the use of pesticides in agriculture.

1.4 Audit Design

The audit was designed by formulating three audit questions and the answers to these questions supported the conclusion against the objective. The audit questions are as follows:

1. Did the Ministry have a long-term plan of action for reducing the use of pesticides in agriculture?
2. How was the Ministry ensuring that the requirements of the Use of Pesticides Act were followed?
3. What alternative strategies did the Ministry adopt to manage the use of pesticides in agriculture?

1.5 Audit Scope

This performance audit examined the activities of MoAIFS in controlling and monitoring the use of pesticides in agriculture in Mauritius and excluded Rodrigues and Outer Islands. It covered the period July 2018[3] to June 2021 and was supplemented by information related to the period prior to 2018. Also, information up to April 2022 had been included in the report to get an insight of the latest developments in the use of pesticides in agriculture. This report covered the use of pesticides in crops only.

[3] Date from which the Use of Pesticides Act was published in the Government Gazettes.

1.6 Audit Criteria

Audit criteria are the standards to be met by the audited entity. They were used as a basis for evaluating the evidence collected, developing audit findings and reaching conclusions on the audit objective, and were extracted from the following sources:

- Use of Pesticides Act 2018;
- Non-Sugar Sector Strategic Plan 2016-2020; and
- FAO International Code of Conduct on Pesticide Management.

Details on the audit criteria used are in the relevant paragraphs of the Report.

1.7 Audit Methodology

The audit was conducted in accordance with Performance Auditing Standard of the International Standards of Supreme Audit Institutions (INTOSAI)[4]. Different methodologies were used to understand the audit area, along with obtaining sufficient, relevant and reliable audit evidence to support conclusion and recommendations.

1.8 Methods of Data Collection

Data was gathered mainly from files and documents. This was complemented by interviews to confirm the information in files.

1.8.1 Review of Documents

Information relating to policies, guidelines, regulations, structures, processes, systems, procedures and practices was collected through a review of files and documents kept at MoAIFS.

1.8.2 Personnel Interviewed

Key personnel at operational, middle and senior management levels at MoAIFS as well as at the Food and Agricultural Research and Extension Institute (FAREI) were interviewed.

The interviews were used to obtain information and also to confirm the evidence obtained from the documents reviewed and for obtaining explanations where information was not available in the reviewed documents.

[4] INTOSAI is the professional body of Supreme Audit Institutions (SAI) in countries that belong to the UN or affiliated to its specialised agencies. NAO is the SAI for Mauritius and is a member of INTOSAI.

1.9 Data Validation Process

Management of MoAIFS was provided with the audit findings and recommendations to confirm their relevance, accuracy and suitability.

1.10 Structure of the Report

The remaining part of the Report covers the following:

- Chapter Two describes the roles and responsibilities of key stakeholders, the audit area, and key aspects with respect to the use of pesticides in agriculture;
- Chapter Three presents the audit findings based on the three specific audit questions; and
- Chapter Four provides the audit conclusion and the recommendations based on the audit findings.

CHAPTER TWO

DESCRIPTION OF THE AUDIT AREA

This Chapter describes the roles and responsibilities of key stakeholders, the audit area, and key aspects in the use of pesticides in agriculture.

2.1 Roles and Responsibilities of the Ministry of Agro-Industry and Food Security

The mission of MoAIFS is to further develop agriculture and promote agro-industry focusing on safety, supply, quality, innovation and new technology through its service- providing institutions and with stakeholders of the region. Its objective in relation to the control of the use of pesticides is spelt out in the functions of the Pesticides Regulatory Office (PRO), as laid down in Section 6 of the Use of Pesticides Act.

The main functions of PRO are to:

- Regulate, control and monitor the use of pesticides in or on any agricultural produce;
- Develop strategies for the sound use and management of pesticides and for risk reduction associated with the use and disposal of empty pesticide containers;
- Keep relevant information on pesticides;
- Devise a pesticide code of practice; and
- Advise the Minister on any matter related to the use of pesticides.

2.1.1 Agricultural Services – Agricultural Chemistry Division

The Agricultural Chemistry Division (ACD) falls under the aegis of MoAIFS and is mainly responsible for providing analytical support services to the other divisions of the Agricultural Services, Parastatal Bodies, private sectors and to public in general, requiring chemical analysis of samples related to agricultural activities.

The mission of ACD is to provide reliable and timely analytical support to the farming community for the chemical analysis of agricultural materials.

It has a mandate to operate a laboratory, providing analytical support services to the agricultural communities and livestock breeders. It has one section for determining pesticide residue levels in fruits, vegetables, fish, honey and water.

The Food Technology Laboratory (FTL) became operational in 2007 and has been an ISO/IEC 17025 accredited laboratory for selected chemical and microbiological tests since 2011. FTL

aims to support safe production at both primary and processor levels. It is a COMESA Food Safety Reference Laboratory since 2008.

2.1.2 Agricultural Services – Entomology Division

The Entomology Division falls under the Agricultural Services of MoAIFS. Its mandate, among others, is to prevent the entry and establishment of exotic pests, undertake research and development on safe and sustainable pest control programmes, implement action programmes in plant protection, deliver plant protection services and promote biological control as a safer pest control method.

The Entomology Division provides services with regard to fruit fly control for fruit trees and vegetable crops, beekeeping and specific pest/insect problems.

2.2 Use of Pesticides Act

In 2017, MoAIFS emphasised the need to set up a legislative framework for the use of pesticides across the country because pesticides are toxic chemicals and if they are not used properly, this may lead to health and environmental hazards. Furthermore, pesticide residue in harvested fruits and vegetables may pose a threat to human health.

Therefore, the setting up of a legislative framework to regulate the use of pesticides in agriculture would maximise the benefits of pesticides for an effective control of pests in agriculture while at the same time protecting human health and the environment from their harmful effects.

To regulate, control and monitor the use of pesticides in agriculture, the Use of Pesticides Act came into force in September 2018. Part II of the Act states that no person shall, in respect of an agricultural produce specified in the first column of the First Schedule,

a) Use, in or on that agricultural produce, a pesticide other than the pesticide specified in the corresponding second column of that Schedule; and

b) Exceed, when using a pesticide in or on that agricultural produce, the corresponding Maximum Residue Level (MRL) specified in the corresponding third column of that Schedule.

Samples were collected from different sources such as from growers' fields (farm gate level), markets, auction markets and supermarkets, as well as from importers of fruits and vegetables. Results were analysed for determining the residue level of pesticides they contained and were interpreted against the level of use of pesticides set in the First Schedule of the Use of Pesticides Act.

The pesticides level of imported fruits and vegetables were compared to the standards set by the Codex Alimentarius Commission.

2.3 Activities of the Pesticides Regulatory Office

The main activities of PRO consist of:

a) Collection of fruit and vegetable samples (imported and locally produced) for monitoring pesticide residue;
b) Analysing pesticides result;
c) Sending results of analysis to planters and issuing improvement notices to non-compliant planters;
d) Following-up in field;
e) Meeting with growers and sensitisation of stakeholders;
f) Updating pesticide list as per the recommendations of FAREI and as per updated information regarding new pesticides from importers of pesticides; and
g) Attending to complaints with regards to misuse of pesticides and providing proper advice to users.

These are illustrated in Figure 1.

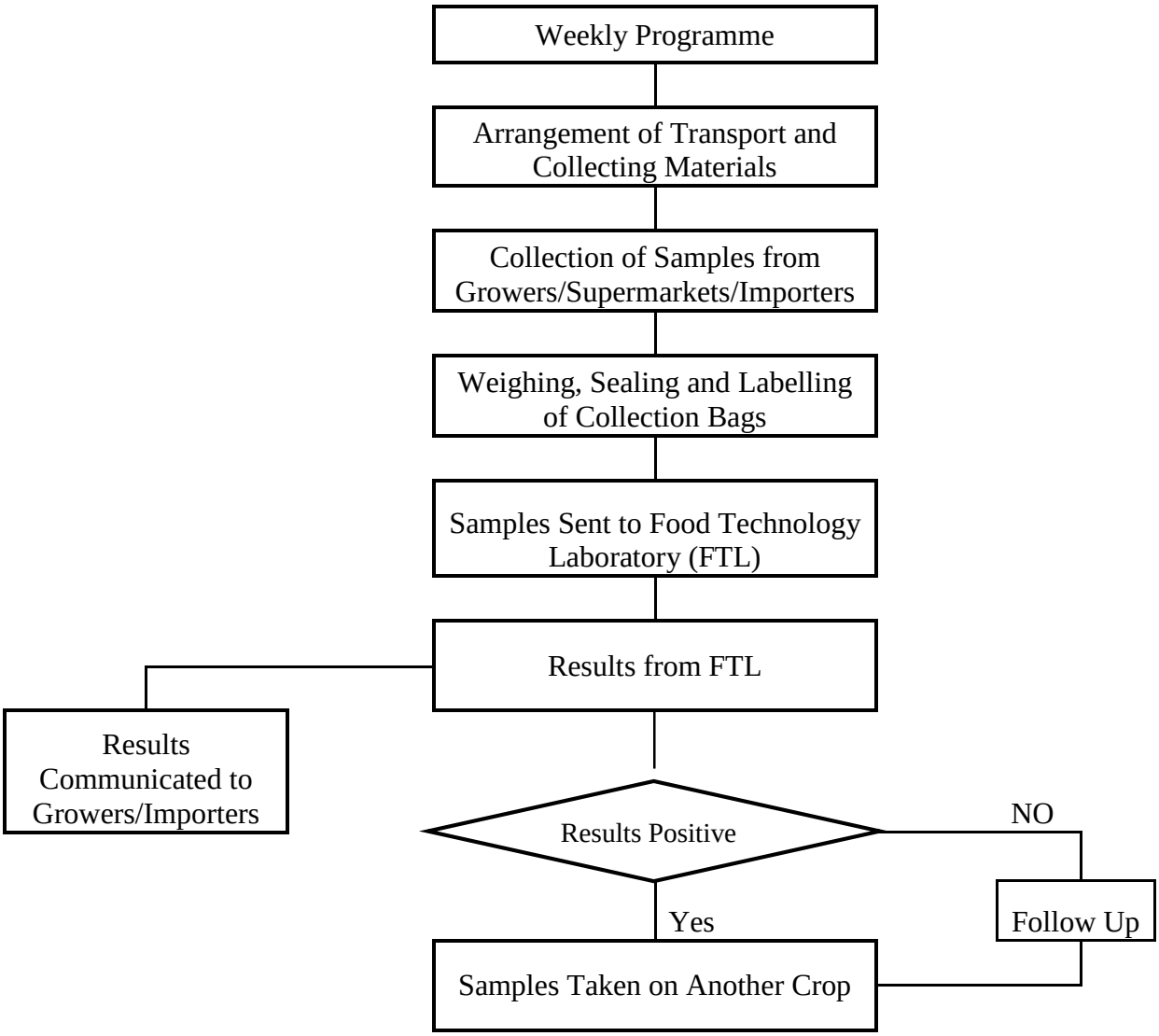


Figure 1: Collection and Testing of Pesticides on Vegetable and Fruits

A weekly plan is prepared for the collection of samples of fruits and vegetables. This plan includes the region to be visited and the number of samples to be collected from growers and supermarkets. Arrangements for transport and other materials like collecting bags and stickers are made. Site visits are carried out by the staff of PRO for the collection of samples. Vegetables and fruits are collected according to the plan. Each sample collected needs to be around 500 – 1000 grams based on the requirement of FTL. A Notice of Collection is issued to the grower/supplier for the samples collected.

Fruits and vegetables are weighed, put into bags and sealed with proper labelling. They are then sent to FTL for analysis. After analysis, the results are communicated to PRO. All results are recorded in the system. Results are analysed by PRO so as to extract lists of growers whose results are satisfactory and those which are not. Results are communicated to all growers and supermarkets where samples were collected.

A follow-up exercise is carried out for all unsatisfactory results. The growers are informed and requested to take corrective actions and not to use pesticides which are not required to be used by law. Another visit is carried out to confirm if corrective action has been taken.

2.4 FAO Code of Conduct

In 2010, FAO issued the International Code of Conduct on the Distribution and Use of Pesticides. Under the Code of Conduct, FAO issued guidance, one of which is the Guidance on Pest and Pesticide Management Policy Development. This guidance was not mandatory but FAO strongly recommended member countries to follow it. It encouraged countries to develop policy implementation plans or action plans to strengthen pest and pesticide management. This Code of Conduct put much emphasis on the role of Integrated Pest Management (IPM) system. In the Non-Sugar Sector Strategic Plan 2016-2020, IPM is referred to as Integrated Pest and Disease Management (IPDM).

2.5 Non-Sugar Sector Strategic Plan 2016-2020

The Ministry had, in 2016, published a Non-Sugar Sector Strategic Plan for 2016-2020 (hereafter referred to as the Strategic Plan 2016-2020) with a view to encouraging increase in production of food crops as well as ensuring food safety. A series of initiatives was undertaken and incentives were given to the actors of the agro-industry. The Strategic Plan 2016-2020 had several measures for pesticide management, namely:

- To have a Research and Development (R&D) programme that will focus on sustainable pest and disease management;
- To review the Dangerous Chemicals Control Act to regulate the import and use of bio-pesticides;

- To train planters in pest and disease identification and protection technologies including Integrated Pest and Disease Management (IPDM) packages;
- To increase consumer awareness for safer foods and the use of eco-friendly practices, coupled with the implementation of the zero pesticide residue regulations in the European Union;
- To promote Integrated Pest and Disease Management including minimal use of agrochemicals (fertilisers and pesticides) in crop production;
- To promote and develop climate-smart agriculture practices such as shift from mineral fertilisers, pesticides and herbicides into biologically active plant protectors and control agents;
- New regulations to be introduced to cater for inspection, information, guidance and control on the proper and safe use of pesticides by farmers; and
- A new Pesticide Unit is to be created under the new regulation.

2.6 Guide Agricole for Good Agricultural Practices

One of the major concerns of growers is the control of crop pests and diseases. To ensure food safety and efficient and sustainable production practices, the Ministry promoted the use of Good Agricultural Practices (GAP). In this context, the Mauritius Standard Bureau in 2015 produced "Specifications for Good Agricultural Practices for Crop Production". Several documents were considered important for GAP, one of which is the Guide Agricole issued by FAREI on the use of pesticides for planters.

As a result, the Guide Agricole emphasises the rational use of pesticides. The aim is to ensure better protection of users and consumers and the protection of the environment.

For each crop, the risk periods of pests and diseases, as well as their scientific names, are indicated. The pesticides to be used, their dosage and the period of application are given in the Guide. The time lag between the last spray and harvest is also indicated.

2.7 Integrated Pest Management

According to the Guidance on Pest and Pesticide Management Policy Development, IPM is defined as: "The careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms". The main reason for the increased attention to IPM is the recognition that pesticide use, and its associated risks, can often be reduced considerably without impacting negatively on production or profitability. The Guidance also elaborated on the benefits and basis of IPM.

- **Benefits of IPM**

The benefits of IPM stretch beyond the agricultural sector and also contribute to policy objectives related to the health, environment and export sectors. Furthermore, the elimination of unnecessary pesticide use tends to reduce production costs. Higher returns and reduced health risks help improve the livelihoods of the rural poor. In several countries, it has been recognised at policy-level that IPM can contribute to rural development and poverty reduction.

- **Basis of IPM**

IPM is more knowledge-intensive and thus can be more difficult for producers to adopt compared to pesticide selection and use. The promotion of IPM requires resource allocation for extension and research, support for farmers' organisations and an overall policy environment that does not encourage the use of pesticides as the primary mode of crop protection. Strategies that are locally developed are often best suited to use of alternative methods.

2.8 Importation of Pesticides

The importation of total pesticides, including those for agricultural purposes and herbicides used in sugarcane, for the years 2016 to 2020 is shown in Table 1.[5]

Table 1 Importation of Pesticides

	2016	**2017**	**2018**	**2019**	**2020**
Total (Tonnes)	2,554	2,427	2,587	2,590	2,700

Source: Environment Statistics

For the years 2017 to 2021, some 492,000 kg of pesticides were imported specifically for agricultural purposes at a cost of some Rs 275 million.

[5] Importation of pesticides consists of both active and inactive ingredients.

2.9 Codex Alimentarius

The Codex Alimentarius, or "Food Code" is a collection of standards, guidelines and codes of practice adopted by the Codex Alimentarius Commission. The Commission, also known as CAC, is the central part of the Joint FAO/WHO Food Standards Programme and was established by FAO and WHO to protect consumer health and promote fair practices in the food trade.

The Codex MRLs have been established through supervised field trials by Codex Alimentarius Commission (FAO/WHO) to facilitate international trade. It is not a toxicity level, it is an agronomic standard. When Codex MRL is being exceeded, it indicates that the farmer has not followed Good Agricultural Practices (GAPs) in the utilisation of the pesticides that is he has not observed the recommended rate and frequency of application or the Pre-Harvest Interval.

CHAPTER THREE

FINDINGS

This Chapter presents the audit findings on the effectiveness of the measures taken by the Ministry of Agro-Industry and Food Security in controlling the use of pesticides in agriculture.

3.1 Introduction

Managing the use of pesticides in agriculture is important. More so, in view of observations made that there was an abuse in the use of pesticides in food crop cultivation or the use of more pesticides than is necessary. This section of the Report examines the effectiveness of measures undertaken by the Ministry and the findings are presented in subsequent paragraphs.

3.1.1 Rise in the importation of pesticides for agricultural purposes

For the period 2017 to 2021, some 492,000 kg of pesticides were imported[6] for agricultural purposes at a cost of some Rs 275 million. According to Statistics Mauritius the volume of imported pesticides for agricultural purposes for the past five years showed an increasing trend between 2017 and 2021 from 80,000 kg to 112,000 kg respectively.

3.1.2 Active Ingredients per Area of Cropland

FAO commonly uses a matrix, the "use of active ingredients per area of cropland" to measure the consumption pattern of pesticides. As per FAO, 30 per cent of the volume of imported pesticides is considered as active ingredients.

According to FAREI, the area of crop land is the same as cultivated land. In the absence of information on cultivated land, the area harvested was used to calculate the usage of active ingredients per unit area as an indication of the use of pesticides. The volume of active ingredients used per hectare showed an increasing trend during the years 2017 to 2021, as shown in Table 2.

[6] The volume of pesticides imported for agricultural purposes is recorded under HS Code 38089130 "Importation of Insecticides for Agricultural Purposes other than bio insecticides" by the Trade Unit of Statistics Mauritius.

Table 2 Active Ingredients per Area Harvested

	2017	2018	2019	2020	2021
Total Importation(Kg)	80,000	110,000	96,000	95,000	112,000
Active Ingredient (kg) (30 %)	24,000	33,000	28,800	28,500	33,600
Area Harvested (Ha)	7,780	7,646	7,334	7,456	7,922
Importation per Area Harvested(Kg/Ha)	10.28	14.38	13.09	12.74	14.14
Active Ingredient per Area Harvested(Kg/Ha)	3.08	4.31	3.92	3.82	4.24

Source: NAO Analysis

3.2 Pesticides Management Policy

Pesticides is part of integrated pest management in crop production. The increasing need to feed a growing population and the concerns about the use of pesticides and associated risks to health and the environment call for the development of an appropriate pest and pesticide management policy. A pesticide policy provides a framework for regulating the use of pesticides for agricultural purposes. It aims to encourage government and other stakeholders to consider the question of, to what extent current pesticide use is justified.

The FAO document on Pest and Pesticide Management Policy Development provides guidance on policy development in support of pesticide risk reduction and sustainable agricultural production. It places pesticide management in the broader context of pest management, and elaborates on linkages between sustainable pest management and policy objectives related to environmental protection, human health, food safety and trade.

Although the Ministry has been taking some measures regarding the use of pesticides, it did not have a comprehensive policy in line with FAO Guidance.

The Guidance describes the different steps that should be followed in the formulation, implementation and evaluation of a pesticide policy. These steps are as follows:

1. Develop Objectives
2. Collect Data and Identify Problem
3. Formulate Policy, which included the following:
   - Preparation of an implementation plan with broad stakeholder involvement;
   - Selection of policy tools to address identified issues;
   - Setting of targets and timeframes; and
   - Allocation of resources.
4. Implement Policy
5. Evaluate Policy

MoAIFS had applied the above measures but could still improve on them as they had not necessarily been applied in the same way as required in the guidance. The measures in the Strategic Plan 2016-2020 were used to assess whether these steps, as prescribed in FAO Guidance, were followed.

3.2.1 Objectives Development

Pest and pesticide management policy formulation often responds to broader development objectives that stretch beyond crop protection. Examples of such development objectives include:

- Enhance crop production and strengthen food security;
- Meet export standards (including MRL and GAP requirements);
- Reduce public health risks (enhance food safety);
- Reduce risk of water contamination;
- Reduce risks to the environment and wildlife; and
- Distribution and use of pesticides.

In the Strategic Plan 2016-2020, the Ministry had several objectives with respect to R&D, training, IPM, introduction of new regulation and setting of a Pesticides Unit to control and reduce the use of pesticides.

Measures related to IPM, training and R&D were ongoing and have been elaborated in paragraphs 3.5.1, 3.5.2 and 3.5.4 respectively. The Ministry successfully introduced new regulations under which PRO was set up.

3.2.2 Data Collection and Problem Identification

Data collection and analysis is key to the policy formulation process. It provides a basis for problem identification, selection of means and monitoring of progress in the application of measures to address these problems. Government should therefore set up programmes for the systematic collection and storage of data.

Except for MRL and non-recommended pesticides used by planters, as of April 2022, the Ministry did not have programmes for collecting data, storing data, carrying out analysis and reporting of same for decision making. Some of the information relevant for policy formulation are:

- Trend in importation of pesticides for agricultural purposes;
- Trend in active ingredients imported;
- Average use of active ingredients per hectare and the trend; and
- Long term effect of pesticides on health and the environment.

The above information would help in identifying problems related to the use of pesticides as well as for decision making.

3.2.3 Policy Formulation

Once issues have been identified and quantified, targets and timeframes can be set and policy formulated to achieve these targets. Pest and pesticide management policy formulation serves to define specific objectives, set targets and select the means to achieve these. Policy formulation should include a policy implementation plan. This could take the form of a strategy, action plan or other type of implementation plan. Such plans can include a broad range of measures to strengthen control on the distribution and use of pesticides and to promote IPM and organic agriculture.

In order to strengthen pest and pesticide management, FAO encourages countries to develop policy implementation plan or action plan in line with the Guidance on Pest and Pesticide Management Policy Development.

According to the FAO Guidance, the scope for such a plan can vary depending on the situation. Possibilities include a:

- Specific commodity or crop that is subject to pesticide abuse or overuse (for example cotton or vegetables);
- Specific pesticide, or group of pesticides, that is a recognised cause of health or environmental issues;
- Specific geographical area that presents pesticide issues (for example intensive vegetable production area, or a watershed area); and
- National scope (for example pesticide use reduction targets, pesticide risk reduction targets, IPM targets, or organic production targets).

Although different ways to control the use of pesticides were mentioned in the Strategic Plan 2016-2020, the Ministry did not have an implementation plan and targets. For example, there were no targets on:

- Number of planters to be trained on IPM, GAP and use of pesticides;
- Number of planters adopting IPM;
- Number of planters under bio-farming; and
- Pesticide use reduction target over a certain period of time.

3.2.4 Policy Implementation and Evaluation

Implementation schedules depend on the nature and contents of the policy and its implementation plan. Allocation of adequate human and financial resources to enable implementation is crucial. Awareness-raising, effective stakeholder involvement and coordination are also important.

Progress towards the achievement of policy objectives or targets should be regularly reviewed or evaluated. Findings will enable a change in course of action if results are not satisfactory. Impediments can be identified and addressed, and policy tools selected to achieve the desired result may be adjusted.

The Ministry did not monitor the implementation of the measures. It also did not evaluate the outcomes of the measures contained in the Strategic Plan 2016-2020. Hence, the effectiveness of measures taken with respect to pesticide management was not known.

The Ministry informed NAO that presently there is no policy on the use of pesticides. The FAO Guidance on Pest and Pesticide Management Policy Development will be used to develop policy in support of pesticide risk reduction and sustainable agricultural production.

3.3 Denmark Case Study

The case study shows how the Danish Government, through the establishment of a national Pesticides Action Plan, successfully controls the use of pesticides in agriculture.

The plan aimed at achieving a 50 per cent reduction in pesticide use. The Government introduced market incentives to encourage low pesticide farming and financed a comprehensive advisory service to work with farmers in using pesticides more effectively. The outcome is presented in Case Study 1.

CASE STUDY 1

National Pesticide Action Plan (Denmark)

The results following the establishment of the national Pesticide Action Plan were remarkable as Denmark's farmers now use half as much pesticides as they did 20 years ago; Danish vegetables are six times less contaminated than their equivalent imports; water quality has doubled; and without significant economic impact to farmers.

The Danes attribute their success to a combination of instruments including clear targets and indicators, a parallel revision programme of all substances in the Danish market, buffer zones for the protection of water resources, and mandatory record keeping. Farmers are supported by a comprehensive independent training system.

Source: Pesticide Action Network-Europe 2007

3.4 Compliance with the "Use of Pesticides Act"

The inappropriate use of pesticides may result in agricultural produce either having excessive or non-recommended pesticide residue.

Two objectives in the Strategic Plan 2016-2020, namely the introduction of a new regulation to cater for inspection, information, guidance and control on the proper and safe use of pesticides by farmers and the creation of a Pesticide Unit were successfully achieved by the Ministry.

However, it faced numerous challenges in effectively enforcing the Act as described in subsequent paragraphs.

3.4.1 Agricultural Produce with pesticides above Maximum Residue Level

"MRL" means the maximum residue level of pesticides as specified in the Use of Pesticides Act 2018. Section 4 of the Act states that no person shall, in respect of an agricultural produce specified in the first column of the First Schedule exceed, when using a pesticide in or on that agricultural produce, the corresponding MRL specified in the corresponding third column of that Schedule.

However, several test results of samples showed that pesticide residue levels exceeded the MRLs. Pesticide Residue Analysis, for example, for samples collected for the month of December 2021 is in Appendix I. Although the number of samples collected decreased from

734 in 2019 to 609 in 2021, those having pesticide residue exceeding MRLs increased from 13 to 23 during the same period. On average, some three per cent of samples tested were exceeding MRL. Details are shown in Table 3. Before the enactment of the Act, the average MRL was some four per cent for the period 2011 to 2018.

If a residue level exceeds MRL, it is considered that the crop was not grown according to GAP, that is, the pesticides had not been applied at the right time and according to the label directions. According to PRO, some users of pesticides were not properly trained on the use of pesticides and were unaware of the type and the actual dosage of pesticides to be used.

Table 3 Percentage of Samples Exceeding MRL

Year	2019	2020	2021	Average
Number of samples collected	734	568	609	
Number of samples exceeding MRL	13	19	23	
Percentage MRL exceeded	1.77	3.35	3.78	2.97

Source: MoAIFS

3.4.2 Agricultural Produce with Non-Recommended Pesticides

Section 4 of the Act specifies that no person shall, in respect of an agricultural produce specified in the first column of the First Schedule – use, in or on that agricultural produce, a pesticide other than the pesticide specified in the corresponding second column of that Schedule.

From an analysis of the Ministry's records, it was noted that several samples of agricultural produce tested contained non-recommended pesticides. For the period 2019 to 2021, each year over 10 per cent of the sample analysed contained non-recommended pesticide residue. This is illustrated in Table 4.

Table 4 Percentage of Samples with Non-Recommended Pesticide Residue

Year	2019	2020	2021
Number of samples collected	734	568	609
Number of samples with non-recommended pesticides	131	62	101
Percentage	17.9	10.9	16.6

Source: MoAIFS

3.4.3 Non-compliant planters

Non-compliant planters are those who have not complied with the Act and from whom the test results of samples showed pesticide residue exceeding MRL and/or had used non-recommended pesticides. Out of 12,000 planters, only 550 were investigated during the years 2020 and 2021. Although the number of planters investigated was low, the number of non-compliant ones increased from 56 to 79 in 2020 and 2021 respectively. The percentage of non-compliant planters increased from 21 to 28 per cent in 2020 and 2021. Non-compliant planters were from both small and corporate growers. Out of the 135 non-compliant planters, 103 were from the small growers. Details are shown in Table 5.

Table 5 Details Regarding Non-Compliant Planters

Year	**2020**	**2021**	**Total**
Number of planters investigated	**264**	**286**	**550**
Number of non-compliant planters	**56**	**79**	**135**
Small Planters	*37*	*66*	*103*
Corporate Planters	*19*	*13*	*32*
Percentage of non-compliant planters (%)	**21**	**28**	**25**

Source: MoAIFS

3.4.4 Pesticides in Imported Agricultural Produce

Section 10 of the Act requires that every importer shall submit to PRO a certificate emanating from a competent authority certifying the residue level of pesticides in the agricultural produce imported. However, the importers did not submit any certificate to PRO as required by the Act. Though the Act provided for sanctions in case of non-compliance, no action had been initiated by the Ministry against these importers.

The Ministry analysed samples of imported agricultural produce and compared the pesticides level with the MRL and non-recommended pesticides in the Codex Alimentarius and the European Union Pesticides Database. For the years 2020 and 2021, 241 imported samples were analysed. In 17 of them, MRLs were exceeded and/or contained non-recommended pesticides.

There was no basis to determine offences and the related sanctions as the Act does not explicitly specify the recommended pesticides nor the acceptable MRL for different types of imported agricultural produce.

The Ministry informed NAO that amendments are being brought to the Act to be able to implement Section 10 with respect to certificate of pesticide residue analysis for imported agricultural produce. A list of imported agricultural produce and MRLs for pesticides has been prepared.

3.4.5 Size of Sample Collected for Analysis

Table 6 shows the weight of agricultural produce collected per million of kilogram produced. On average, for the two years 2020 and 2021, six kilograms of vegetables were collected for analysis for each million of kilogram produced. As the sample size collected is small, there is the risk that the pesticide residue exceeding MRLs and non-recommended pesticides may not be detected in most of the agricultural produce.

For the years 2020 and 2021, samples were collected from 550 planters out of 8500 registered planters. According to FAREI, as of April 2022, the total number of planters across the island, including non-registered planters, was some 12,000 planters. Samples were being collected from registered planters only.

Table 6 Samples of Agricultural Produce Collected to Actual Production

Year	2020	2021	Average
Volume of samples collected (Kg)	568	609	
No of growers concerned	264	286	
Production (Tonnes)	94,410	101,537	
Kg collected per million Kg produced	6.01	5.99	6.00

Source: MoAIFS

The Ministry informed NAO that the number of samples taken for analysis is dependent on the laboratory capacity, adequate number of staff for collecting the samples and transport facilities.

3.4.6 Improvement Notice

As per Section 9 of the Act, where, following an analysis pursuant to subsection (1) (b), it is found that the sample does not comply with this Act, the officer-in-charge shall serve an improvement notice in the form set out in the Third Schedule.

For the years 2020 and 2021, 936 samples were collected from 550 planters at farm gates, markets, auction markets and supermarkets for analysis of pesticide residue. There were 135 non-compliant planters whose samples exceeded MRL and contained non-recommended pesticides. 128 planters were issued with improvement notices. The Ministry could not issue improvement notices for the remaining seven as they were untraceable.

3.4.7 Follow-Up Actions on Improvement Notice

Follow-up actions are important as they serve to ensure that the planters are taking corrective measures and, if necessary, to apply sanctions as per the Act to those who are not.

One of the functions of PRO is to follow up on improvement notices issued to planters whose samples exceeded MRL and /or contained non-recommended pesticides.

The number of follow-ups undertaken in 2020 and 2021 is shown in Table 7. Out of 128 improvement notices issued, only eight follow-ups were carried out representing some 6.3 per cent of the total number of improvement notices issued in the two years.

Table 7 Follow-up Actions on Improvement Notices

Year	2020	2021	Total
Number of Improvement Notices	49	79	128
Number of follow-ups	5	3	8
Percentage	10.2	3.8	6.3

Source: MoAIFS

Of the eight follow-ups, in five cases, that is, 62.5 per cent, had taken corrective actions. This showed the importance of carrying out follow-ups. However, to get a better picture, the number of follow-ups needs to be increased.

The Ministry informed NAO that the number of follow-up is low due to: growers not in field, no crop available for collection of additional samples and transport issues. Additional staff is required to strengthen enforcement of the Act and for follow-up in case of non-compliance.

3.4.8 Non-Application of Sanctions

To better control and monitor the use of pesticides, enforcement plays an essential role in ensuring compliance with the Act. According to Section 13 of the Act, if a person (i) uses, in or on that agricultural produce, a pesticide other than the pesticide specified in the corresponding second column of that Schedule; (ii) applies a pesticide in or an agricultural produce which results in the corresponding MRL specified in the third column of that Schedule being exceeded; or (iii) fails to comply with an improvement notice served under section 9(2) shall commit an offence and shall, on conviction, be liable to a fine not exceeding 10,000 rupees.

In case of a second conviction, the offender shall be liable to a fine of not less than 10,000 rupees nor more than 25,000 rupees and for other subsequent conviction, the offender shall be liable to a fine of not less than 25,000 rupees nor more than 50,000 rupees and to imprisonment for a term not exceeding one year.

So far, only improvement notices were being issued to offenders for non-compliance. However, as of April 2022, a scrutiny of test analysis report showed that planters were still overusing pesticides, resulting in agricultural produce having pesticide level exceeding MRL and/or still using non-recommended pesticides. The Ministry had not initiated any legal procedures against them.

The Ministry informed NAO that no penalty was taken for offence. There is the need to amend the Act to allow Authorised Officers to carry out investigation and prosecution and appropriate training is required.

3.4.9 Analysis of Samples

According to Section 9 of the Act, collected samples must be sent for analysis in a laboratory for determining the residue level of pesticides they contain.

As of April 2022, FTL had three equipment to test for pesticide residue in agricultural produce. Two of them were received as donations prior to the introduction of the Use of Pesticides Act, and another one, the UPLCMSMS Waters-Xevo TQS Micro was acquired in 2017 at a cost of some Rs 26.5 million (Table 8 refers).

3.4.9.1 Testing Capacity of Equipment

The three equipment had been programmed by FTL to test some 160 ingredients. The equipment were used to test some 127 ingredients in imported agricultural produce and 33 ingredients in local produce.

As of April 2022, out of the 60 ingredients prescribed in the Act, the equipment could test for only 33 ingredients. 27 ingredients were not being tested due to equipment not yet programmed as training was required on method development. Appendix II refers.

Although five staff of FTL were trained to programme the equipment, the Ministry explained that further training was required to enable staff of FTL to programme the UPLCMSMS Waters-Xevo TQS Micro to carry out test for additional ingredients. However, such training had been postponed because of the COVID 19 pandemic.

3.4.9.2 Operating Conditions of Equipment

The operating conditions of the three equipment, as of April 2022, are shown in Table 8.

The 3200 Q TRAP LC/MS/System was out of order since February 2020. The UPLCMSMS Waters-Xevo TQS Micro was available for use for a period of 58 months since commissioned in 2017. It was out of order for around 11 months.

These two situations had hampered the activities of FTL and PRO and the types and number of tests to be carried out were thus limited

The Ministry identified the following consequences which arose from frequent breakdown of the equipment:

(i) Failure of the equipment to operate had caused loss of use to the Ministry. The number of samples that could be tested was reduced.
(ii) Analysis of pesticide residue that could only be carried out by this particular equipment was not being done.
(iii) The ongoing accreditation exercise by international assessors at FTL was compromised due to frequent breakdown of the equipment.

The Ministry explained that the delays in repairs were mainly due to the fact that the local technician/engineer took time in troubleshooting as they were not experts in these fields and also after trouble shooting, approval for funding took time and there was additional waiting time before the spare parts arrived in Mauritius.

Table 8 Working Conditions of Equipment

SN	Make	Model	Condition as of April 2022	Remarks
1	Water	Xevo TQ-S Micro	Working	-
2	Water	Quatto Micro GC	Working	-
3	AB Applied Biosystem MBS SCIEX	3200 Q TRAP LC/MS/System	Out of Order	February 2020

Source: MoAIFS

The Ministry informed NAO that the 3200 Q TRAP LC/MS/System was donated by COMESA and commissioned in 2011. The autosampler of the LC System is out of order as from February 2020 and the gas generator attached to the equipment is also not functioning. Being an old model, no spare parts are available and the Ministry has to replace the whole LC System and the gas generator.

3.5 Adopting Alternatives Strategies to Managing Pesticides

To control the use of pesticides in agriculture, the Ministry had recourse to alternative strategies such as IPM, R&D, organic agriculture and training but these had mitigated success as described below.

3.5.1 Promoting Integrated Pest Management (IPM)

According to the Guidance on Pest and Pesticide Management Policy Development, IPM is more knowledge intensive and can thus be more difficult for producers to adopt compared to pesticide selection and use. The promotion of IPM requires resource allocation for extension and research, support for farmers' organisations and an overall policy environment that does not encourage the use of pesticides as the primary mode of crop protection.

The Guidance gave further details on the promotion of IPM, such as:

1. Concerted efforts should be made by governments to develop and promote the use of IPM. Furthermore, lending institutions, donor agencies and governments should support the development of national IPM policies and improved IPM concepts and practices. These should be based on scientific and other strategies that promote increased participation of farmers, extension agents and on-farm researchers.

2. All stakeholders, including farmers and farmer associations, IPM researchers, extension agents, crop consultants, the food industry, manufacturers of biological and chemical pesticides and application equipment, environmentalists and representatives of consumer groups should play a proactive role in the development and promotion of IPM.

3. Governments, with the support of relevant international and regional organisations, should encourage and promote research on, and the development of, alternatives posing fewer risks.

4. Governments should provide extension and advisory services and farmers' organisations with adequate information about practical IPM strategies and methods, as well as the range of pesticide products available for use.

It also mentions that IPM can be a target in its own right (for example, percentage of production area under IPM), or a means to achieve pesticide reduction targets, or pesticide risk reduction targets.

3.5.1.1 Control of Fruit Fly

The Ministry undertook two projects, namely a Pilot Project under IPM in 2007 and another one under the Fruit Fly Control Programme of the Ministry.

3.5.1.2 Pilot Project under IPM

A pilot project (see Case Study below) was undertaken in 2007 which gave promising result as IPM was successfully implemented. However, this technique was not extended to other regions nor transferred to other planters of cucurbits.

In the Strategic Plan 2016-2020, observation was made that the up-scaling and adoption of the IPM techniques had been slow and limited at national level. This was largely due to insufficient infrastructure to raise biological control agents and test environment-friendly alternatives such as botanical pesticides, limited range of bio-pesticides and their high cost.

Similarly, the area-wide application of IPM had proved to be complex to arrange. More importantly, there was no policy and regulatory framework to promote IPM and farmers did not have market incentives to adopt IPM. Grading and labelling of fresh produce were not practised, and public information and awareness were limited. Accordingly, it was planned in the Strategic Plan 2016-2020 to:

i. Develop an integrated strategy and policy to foster the adoption of IPM practices;
ii. Strength institutional capacities (and human resources, infrastructure and equipment) in R&D on IPM technologies, surveillance and early detection of pests and diseases;
iii. Review policy and regulatory framework to facilitate the introduction of IPM technology and regulate the use and disposal of pesticides; and
iv. Increase information and awareness on alternatives to pesticides for farmers and food safety for the general public.

However, as of April 2022, the development of an integrated strategy and policy to foster the adoption of IPM practices and review of regulatory framework to facilitate the introduction of IPM was not achieved.

The strengthening of the institutional capabilities in R&D on IPM technologies and increase information and awareness on alternatives to pesticides for farmers and food safety for the general public are described in paragraphs 3.5.2 to 3.5.4.

3.5.1.3 Project under Fruit Fly Control Programme

An area wide fruit fly control programme in selected regions was being implemented by the Entomology Division of MoAIFS. The objective was to lower the population of fruit flies.

A Cobalt 60 radio-active irradiator was acquired in May 2015 by the Ministry in collaboration with the International Atomic Energy Agency (IAEA) for sterilising flies for the fruit flies control programme. A fruit fly rearing facility to the tune of Rs 42.4 million was constructed and was operational since August 2019.

For the programme, the following targets for the period 2019-2022 were set to:

- Apply fruit fly bait over an area, in order to lower the melon fly population to less than 0.1 fly/trap/day;
- Produce five million flies per week for release in farmers' fields;
- Release sterile melon flies in farmers' fields so as to suppress the melon fly population;

- Lower the damage of cucurbits (pumpkin, cucumber, squash, etc.) to less than one per cent; and
- Reduce the quantity of pesticides used by planters for melon fly control by at least 75 per cent.

However, except for the production of five million flies per week, the remaining targets were not achieved as the irradiator to sterilise the flies, was broken down for more than a year.

The Ministry explained that to implement the area wide fruit fly control programme so as to meet the targets, Rs 10 million would be required over a period of three years to buy the required materials, but only Rs 0.5 million was obtained.

The Ministry informed NAO that funds to the tune of Rs 6 million have been earmarked for the financial year 2022-2023 for areawide fruit fly suppression with environment friendly techniques.

The Gamma irradiator is presently being repaired with funding from the International Atomic Energy Agency (IAEA) and it will be soon operational.

Installation, commissioning and training on the sterile flies ground release machine procured by the IAEA will soon be carried out.

3.5.1.4 Case Study IPM-Success Story in Mauritius

The melon fly caused the highest level of infestation mainly during the summer months in cucurbit crops which included calabash, cucumber, squash, zucchini and pumpkin.

In 2007, a three-year project entitled 'Feasibility Study for the Suppression of the Melon Fly in Selected Areas of Mauritius' was launched.

The programme was implemented in close collaboration with the IAEA to develop and integrate sustainable area-wide suppression methods to control the melon fly and to reduce the use of pesticides.

The main objective of the area-wide melon fly control programme was to transfer new safer technologies rapidly to growers. The latter were continuously encouraged to participate in the control measures by applying bait sprays, practising sanitation and mass trapping of males by the male annihilation technique.

The region of Plaine Sophie which covers an area of 110 ha and occupied by 135 growers was selected for the project. This locality is isolated and is surrounded by forest.

Extension tools such as pamphlets, stickers and video film on melon fly control were prepared for distribution to the growers. Talks, regular site visits and demonstrations were carried out.

The life cycle and behaviour of the targeted fruit flies were explained. Emphasis was laid on the importance of sanitation as growers used to leave infested cucurbits in their fields.

The area-wide melon fly control programme resulted in reduced fruit fly infestations, increased crop quality and yields, reduced pesticide use and increased knowledge by growers on fruit fly control, including sanitation. The level of infestation of cucurbits which was above 30 per cent before project implementation was reduced to less than five per cent one year later. The survey results revealed that 85 per cent of planters obtained an increase in both quality and quantity of cucurbits. The cost of cucurbit production was reduced through a decrease in the use of pesticides and application costs. Some beneficial insects appear to benefit directly from it. Growers observed a higher number of honey bees visiting the cucurbit flowers.

3.5.2 Research and Development

FAO Guidance on Pest and Pesticide Management Policy Development points out that the extent to which IPM can be successfully promoted and adopted depends on a variety of enabling and inhibiting factors. One of the key enabling factors includes investment in IPM research. Development of commodity-specific IPM strategies can also be a useful tool for establishing research and innovation priorities.

One of the missions of FAREI is to conduct applied and adaptive cost-effective research for the introduction and development of novel technologies to increase crop production and improve crop quality to enhance food security in a sustainable manner.

The main principles of IPM as per FAO Guidance on Pest and Pesticide Management Policy Development are as follows:

- **Grow a healthy crop**. The focus is on cultural practices aimed at keeping the crop healthy. Selection of varieties that are resistant or tolerant to pests is an important aspect. Site and crop selection, seed bed sanitation and attention to soil, nutrient and water management are parts of growing a healthy crop.

- **Manage the agro-ecosystem** to suppress the build-up of pests. Agronomic techniques are used to make the field and the crop inhospitable to insect pest species and hospitable to their natural enemies, and to prevent conditions favourable to the build-up of weeds and diseases.

- **Decisions to apply external inputs as supplementary controls are made locally, are based on monitoring of pest incidence and are site-specific**. External inputs may for instance include beneficial organisms such as pest predators, parasites, parasitoids or pathogens of pests (biological-control); manual removal of pests, physical barriers, mechanical devices, pest attracting lures, pheromones, pest traps, biological or chemical pesticides.

During the period 2015-2021, FAREI had been adopting most of the above principles but faced numerous challenges in promoting their adoption, as described below.

Grow a healthy crop

During the period 2015-2022, two Colocasia lines found tolerant to the disease leaf blight, two chilli lines tolerant to disease anthracnose and one potato variety tolerant to disease leaf blight were developed.

However, the number of planters who adopted these varieties was not available as of April 2022.

Manage the agro-ecosystem

This was practised by FAREI through the cultural control and management which provided integrated multiple disease management practices and included a checklist of 17 actions, namely rotation/spacing/aeration air movement/eliminate volunteer crops/drainage/ companion cropping/thinning/ rouging/ avoid field operations when fields are wet/avoid overhead irrigation/control soil pH/use soil organic amendments/ reduce mechanical injury/pruning tool disinfection/ earthing up/sanitation/cover cropping with an antagonist. This was an ongoing process.

Decisions to apply external inputs

Research was carried out on natural enemies of pests, flowering plants and weeds attractive to natural enemies, bio pesticides against major pests and bio fungicides against disease control. These were disseminated to planters through training and published in the Guide Agricole 2019.

As of April 2022, only some 800 out of 12,000 planters were practising the last two techniques which represented some seven per cent.

The Ministry informed NAO that a classical biological control was successfully implemented for the control of the papaya mealy bug, an invasive pest detected in 2013, with the introduction of the parasitoid.

A new package for the control of the diamondback moth has been developed where planters are being empowered to produce their own parasitoids through the use of augmentorium. Such a package has enabled the reduction of insecticide use by 50% in crucifer fields.

Currently, research is being carried out to recover natural enemies of key pests (whitefly, red spider mites, tomato leaf miner, thrips and aphids) in crop production. So far, six species of parasitoids and 23 species of predators have been recovered.

3.5.3 Shifting towards Organic Agriculture

One of the objectives in the Strategic Plan 2016–2020 is to switch to a more sustainable agriculture with a view to limit the use of pesticides.

The Ministry has, as its priorities, to promote safe and sustainable agricultural production techniques to ensure that any locally produced food, whether destined for local consumption or export is safe and healthy.

The Ministry initiated action to prepare an Organic Agriculture Bill to promote the production of quality organic products. The main objective is to protect consumers, producers and the environment among others. It will also set the minimum requirements for, the production, handling, processing and labelling of organic products.

However, as of April 2022, the Bill was not yet finalised and thus the benefit of organic agriculture was thus deferred.

The Ministry informed NAO that the draft legislation on Organic Agriculture has been prepared with technical support from FAO.

3.5.4 Training and Sensitisation

According to FAO, education of farmers is key to achieving desirable changes in pest management. This involves education on alternative, less pesticide dependent and more sustainable, production practices and the economic and social benefits of such alternatives.

Moreover, to ensure proper use of pesticides, clear instructions and training in pesticide risk reduction and management which are essential to proper and responsible use of pesticides are required.

3.5.4.1 Mandatory Training

With regards to training, Section 11 of the Act stipulates that:

(a) Any person who cultivates any agricultural produce for the purpose of sale and who wishes to use or engage in the use of any pesticide shall follow such training programme as the Ministry may approve.

(b) Any person who has followed a training programme pursuant to paragraph (a) shall be issued with a certificate by the Office.

Since the proclamation of the Act in 2018, several training sessions were being organised by FAREI. As of April 2022, 6,450 planters have been sensitised and 65 training courses were organised for 1,715 planters.

3.5.4.2 FAREI Ongoing Training and Sensitisation

The Extension and Training Division of FAREI has the mission of providing cost-effective technical advisory and training service to the farming community for sustainable development of the agricultural sector.

FAREI had been continuously providing training services to planters as part of its mission and for the period 2015 to 2021, training courses in relation to pesticide application, GAP, organic production, hydroponics production and crop production were organised and 5,029 planters were trained (Table 9 refers).

Table 9 Training Courses 2015-2021

Training Courses	**Number of Participants**
Pesticide Application	1,080
Good Agricultural Practices(GAP)	479
Organic Production	1,080
Hydroponics Production	1,932
Crop Production	458
TOTAL	**5,029**

Source: FAREI

However, MRL was continuously being exceeded in spite of more than 6,000 planters had been trained or sensitised on the importance of controlling the use of pesticides for the past seven years 2015 to 2021. Also, the training organised for the past seven years did not form part of a defined programme on the use of pesticides or the use of IPM. They only formed part of the on-going mission of FAREI.

This page intentionally left blank

CHAPTER FOUR

CONCLUSION AND RECOMMENDATIONS

This Chapter concludes against the audit objective based on the analysis and findings supported by audit evidence as elaborated in the previous Chapter. It also presents the recommendations based on the findings and conclusion.

4.1 Conclusion

Pesticides have been used for pest management and to improve and increase crop production. Their inappropriate use may lead to increased risks to human health and the environment. Statistics have shown that the importation and use of pesticides in agriculture have been increasing over the last five years. Analysis reports of samples collected indicate that the pesticide residue have exceeded MRL and/or contained non-recommended pesticides. The Ministry has been taking several measures to manage the use of pesticides in agriculture but with varying degree of success.

The Ministry does not have an appropriate policy on pesticides that is in line with good practices embodied in FAO guidance. In 2018, it has taken initiatives to introduce the Use of Pesticides Act. However, it has not brought the expected benefits mainly due to several challenges such as insufficient training, frequent breakdown of testing equipment as well as equipment not fully programmed to carry out tests on all ingredients stated in the Act and low level of samples for testing. The Ministry has also been facing challenges in enforcing some sections of the Act.

With a view to reducing the use of pesticides, the Ministry has explored alternative strategies for pest management such as the introduction of IPM and organic agriculture. However, there has not been an enabling environment such as an appropriate regulatory framework conducive to using these alternative methods.

4.2 Recommendations

Given the health hazard associated with the excessive use of pesticides such as cancer, as well as the negative impact of pesticides on the environment such as soil and water contamination, it is imperative that the Ministry continues in its actions to control the use of pesticides in agriculture.

In the light of the above, hereunder are the specific recommendations to control and monitor the use of pesticides in agriculture

4.2.1 Strategies and Implementation Plans

- The objectives to control the use of pesticides should be met by having a policy on pesticide management with clear implementation plan, indicators, targets and time frame.

- A national target for reducing the use of pesticides should be established. This will facilitate the development of an implementation plan to meet the set target.

- The Ministry should develop a programme for collecting and storing data, carrying out analysis and reporting of same for decision-making in addition to the analysis of MRL and the use of non-recommended pesticides. Some examples of information important for decision making include the following:

    - Trend in importation of pesticides for agricultural purposes;
    - Trend in active ingredients imported;
    - Average use of active ingredients per hectare and the trend; and
    - Long term effect of pesticides on health and the environment.

- The Ministry needs to monitor the implementation of all measures taken and evaluate their effectiveness in pesticide management. .

4.2.2 Legislations

- The Ministry should strengthen its enforcement mechanism to ensure that individuals using pesticides comply with the Act.

- A risk-based approach could be adopted on collection of samples for analysis of MRL and use of non-recommended pesticides. This will ensure that inspections are carried out where the need is greatest. For example, the Ministry can use data collected from PRO and determined where the risk of contaminated agricultural produce entering the market is higher, that is, whether it is greatest at farm gate or at the markets/supermarkets and whether the risk is higher with small growers or corporate ones.

- The Ministry should conduct additional training for FTL staff to enable them to develop additional programme to test all ingredients prescribed in the Act.

- The Ministry should increase the number of follow-ups on improvement notices so as to obtain reasonable assurance that individuals are taking corrective actions. The Ministry needs to work a plan of action to carry the follow-ups.

- MRL for active ingredients on imported agricultural produce shall be defined in the Act so that offences in relation to failure to comply with the Act could be determined. The Ministry

should ensure that every importer shall submit the certificate, as required by the Act, from a competent authority.

- In addition to issuing of improvement notices, a mechanism for issuing of penalties must be established. Appropriate training should be given to officers of PRO on how to enforce the different sections of the Act dealing with offences and penalties.

4.2.3 Alternative strategies of controlling use of pesticides.

Given the shortage of capacity and the low percentage of planters and agricultural produce being inspected, the Ministry should place emphasis on preventive methods. These are elaborated below.

- The Ministry should strengthen its endeavour to promote IPM. In order to promote same, the Ministry should develop a programme on adopting IPM as part of a well-defined strategy.

- The programme should promote increased participation of farmers, extension officers and researchers. The different IPM techniques identified by the Agricultural Services of the Ministry and those developed under research carried out by FAREI should form part of an implementation plan with different time frames. Officers must be encouraged to conduct impact assessment as part of programme design. The Ministry can develop commodity-specific IPM strategies. The experience gained with the pilot project can be used to implement IPM.

- Planters should continuously be encouraged to participate in the control measures identified by the Agricultural Services and FAREI. Emphasis should be laid on the importance of adopting IPM. As recommended above, this could be facilitated with the adoption of a programme on IPM.

- The Ministry, through FAREI, should continue its research on plant varieties which are more pest-resistant and disseminate same through sensitisation and training to planters.

- The Organic Bill should be finalised and relevant legislations adopted at the earliest as the sooner these are introduced, the earlier the benefits will be reaped.

- The Ministry should strengthen the mechanism in place to ensure that planters are systematically trained on the proper use of pesticides. Sensitisation and training on the use of pesticides and IPM should form part of a well-defined strategy and implementation plan.

This page intentionally left blank

Appendix I

Samples where MRL were exceeded

SN	Fruits and Vegetables	Pesticides detected	MRL as per Act (mg/kg)	Level of Pesticides detected (mg/kg)
1	Spinach	Cypermethrin	0.073	0.7
2	Eggplant	Cypermethrin	0.035	0.5
3	Tomato	Difenoconazole	0.032	2.0
4	Tomato (Salad)	Acetamiprid	0.047	0.5
5	Tomato (Salad)	Azoxystrobin	0.120	3.0
6	Tomato (Salad)	Cyromazine	0.036	0.6
7	Tomato (Salad)	Difenoconazole	0.110	2.0
8	Bell Pepper	Acetamiprid	0.047	0.3
9	Cucumber	Acetamiprid	0.027	0.3

Source: MoAIFS

This page intentionally left blank

Appendix II

List of molecules, as required by the Use of Pesticides Act not being analysed in the laboratory

S/N	Name of Pesticide	Remarks
1	Acetochlor	Further Training on method development required in LCMSMS
2	Ametoctradin	
3	Azadirachtin A / B	
4	Bentazone	
5	Benomyl	
6	Bromacil	
7	Cymoxanil	
8	Cyazofamid	
9	Fluopyram	
10	Fosetyl-aluminium	
11	Glufosinate ammonium	
12	Iprodione	
13	Oxyfluorfen	
14	2, 4 D	
15	Glufosinate	
16	Novaluron	
17	Oxadiazon	
18	Pendimethalin	
19	2, 4 Amine salt	
20	Propineb (zinc propylenebis dithiocarbamate)	Training on method development required in GCMSMS
21	Chlorothalonil	
22	Chorfenapyr	
23	Copper hydroxide	ICPMS needed to carry out the analysis Training required
24	Copper oxychloride	
25	Mancozeb	Training on method development required in HPLC or LCMSMS
26	Metaldehydes (Aldehydes)	
27	Sulfur	

Source: MoAIFS

National Audit Office
Air Mauritius Centre, John Kennedy Street, Port Louis, Mauritius
Tel: (230) 212 2096 Fax: (230) 211 0880 Web: http://nao.govmu.org

Designed & Printed by the Government Printing Department