Ministry of Agriculture and Natural Resources

PEST MANAGEMENT SUPPORT SERVICES STRATEGY FOR ETHIOPIA

April, 2016
Addis Ababa, Ethiopia

List of abbreviations and acronyms

APHRD	Animal and Plant Health Regulatory Directorate
AGP	Agricultural Growth Program
BOA	Bureau of Agriculture
BPR	Business Process Reengineering
CRC-FAO	Central Region Commission
CADU	Chilalo Agricultural Development Unit
CABI	Centre for Agriculture and Bioscience International
CGIAR	Consultative Group of International Agricultural Research
DLCO-EA	Desert Control Organization for Eastern Africa
ETB	Ethiopian Birr
EBI	Ethiopian Biodiversity Institute
EIAR	Ethiopian Institute of Agricultural Research
EAAP	East African Agricultural Productivity Project
FTC	Farmers Training Centre
FFS	Farmers Field School
FAO	Food and Agriculture Organization
HLI	Higher Learning Institutions
HARC	Holetta Agricultural Research Centre
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IAR	Institute of Agricultural Research
ICT	Information Communication Technology
ICIPE	International Centre for Insect Physiology and Ecology
MoANR	Ministry of Agriculture and Natural Resource
MoEFCC	Ministry of Environment, Forest and Climate Change
MoFEC	Ministry of Finance and Economic Cooperation
MoWIHE	Ministry of Water, Irrigation and Hydroelectric
MLND	Maize Lethal Necrosis Disease
NARS	National Agricultural Research System
NCIC	National Crops Improvement Conference
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
PHC	Plant Health Clinic
PPRC	Plant Protection Research Centre
PPSE	Plant Protection Society of Ethiopia
PNAS	Proceedings of National Academy of Science
PMSS	Pest Management Support Services
PIF	Policy and Investment Framework
PHRD	Plant Health and Regulatory Directorate
RBOA	Regional Bureau of Agriculture
RCBP	Rural Capacity Building Project
RARI	Regional Agricultural Research Institute
SO	Strategic Objective
SWOT	Strength Weakness Opportunity and Threat
TOR	Terms of Reference
USDA	United States Department of Agriculture

Foreword

Crop pests, which include insect pests, disease causing pathogens, non-parasitic and parasitic weeds, vertebrate pests (birds and rodents), and established invasive alien species, have been causing economic damage to the Ethiopian agriculture. Particularly, in the smallholder agriculture, which contributes to about 95% of annual crop production in the country, crop losses due to pests are a serious concern where in most cases they have limitation both in technical know-how and financial resources to apply effective pest control tactics and reduce crop damages.

The government of Ethiopia has been providing pest management support services (PMSS) to control major economic crop pests, which encompasses migratory, regular, quarantine and established invasive alien species. Despite all the concerted efforts made in PMSS, the demand for the service significantly increased and outpaced the delivery, due to multiple reasons.

The attributing factors that have been putting pressure on the PMSS include: expansion and intensification of crop production system with crop diversification; increased use of agricultural inputs (pesticides); emergence and expansion of protected agriculture; climate change induced impacts; emergence and spreading of alien invasive species and increased incoming quarantine pests, which have been leading to increased crop damages (yields and quality) that are affecting the efforts to ensure food security. Moreover, it was apparent that as a result of increased use of pesticides in agriculture the risk on the human health and the environment had increased. The PMSS, however, is being challenged and not able to provide services to the standard quality, due to inadequate institutional and technical capacities, limited trained manpower and financial resources. Therefore, revisiting of the PMSS is considered as a step forward to reinvigorate and make it more responsive to the current needs of the country to reduce crop yield losses, due to pests.

The initiative for the development of the strategy was taken by the MoANR and potential stakeholders were identified and involved in the strategy development process. In particular, a task team was established who were pooled from the MoANR, PHRGD, FAO Ethiopia Country Office represented through the Technical Support to the Agricultural Growth Program project, EIAR represented through the Crop Research Directorate, Higher Learning Institution represented by Hawassa University College of Agriculture and DLCO-EA. The draft strategy was presented and discussed in a three days national consultation workshop held in Addis Ababa from Sep 3-5, 2015 where constructive comments were obtained and used as valuable inputs and incorporated to finalize the strategy.

Therefore, I strongly encourage all stakeholders involved in PMSS in the country to own and make effective use of this strategy in a more coordinated manner. I am confident that the strategy will also serve as a foundation to provide a guiding framework to lay down more effective long term pest management support services in Ethiopia and periodically updated whenever necessary to accommodate newly emerging issues and developments in the area of crop pest management that is highly integrated with crop production system.

Finally, I would like to thank all stakeholders and the task team directly involved in producing the strategy and workshop participants who contributed constructive comments, which have been used for further refinement of the PMSS strategy to its present form. The facilitation roles of the MoANR, PHRGD and support of FAO Ethiopia are highly acknowledged.

Wondirad Mandefro

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Preface

The pest management support services (PMSS) in Ethiopia has been provided for more than six decades. Despite, the commendable efforts exerted so far in the area of PMSS to support the smallholder agriculture, the PMSS has not been able to develop to cope with the increased demand for the services. This was basically, due to inadequate institutional and technical capacities, shortage of trained manpower and limited financial resources. As a result, pest incidence, distribution and causing of crop damages significantly increased. The attributing factors include, among others, insufficient knowledge and skills in pest problem identification, monitoring and management; low level of service provision, due to poor communication and inadequate capacity; economic pests are not routinely monitored and their status not properly communicated; informed pest management decisions are not being exercised; increased mismanagement of pesticides and inadequate capacity for applying integrated pest management. As a result of these limitations, there is upsurge of regular pests, establishment and spread of new pests, misuse and abuse of pesticides, and development of pesticide resistance in some pests. The weakness has been fully recognized and actions are being undertaken to reinvigorate the PMSS and the development of this strategy can therefore, be considered as one of the practical steps to take forward and strengthen the overall PMSS in Ethiopia.

The initiative for the development of this strategy was taken by the MoANR, which established a task team wherein key stakeholders were involved, i.e. MoANR, PHRGD, Higher Learning Institutions, EIAR, DLCO-EA and FAO Ethiopia Country Office represented through the Technical Support to the Agricultural Growth Program. The strategy development process was successfully led and effectively coordinated by the MoANR, PHRGD and FAO who provided technical support and played a facilitation role at all stages of the strategy development. In the strategy development process, the task team had thoroughly reviewed the historical development of the PMSS in Ethiopia, carried out SWOT analysis and identified gaps and strategic issues, which led to the formulation of the draft strategy where clearly stipulated strategic directions and action steps and indicative budget for implementation. This draft was further enriched by incorporating comments from the half daylong meeting with the State Minister, His Exc. Ato Wondirad Mandefro.The crop production officer, Dr. Mathew Abang, from FAO Sub Regional Office for Eastern Africa also provided significant inputs. The draft strategy afterwards was presented and discussed in a three days long national consultation workshop where the task team was able to gather valuable inputs and incorporated and produced this final strategy. The strategy was published and made ready for distribution through the financial support of FAO Ethiopia.

In the strategy document briefly provided are review of historical development of the PMSS for the last six decades, situation analysis, strategic issues, the strategy mission, vision, and values, the strategic objective, strategic direction and actions with indicative budget from 2015-19 implementation. Further, in the strategy emphasis was given to the implementation arrangements, roles and responsibilities of key stakeholders and monitoring and evaluation framework as well as to potential risks, their possible impact, the likelihood of their occurrence and mitigation measures that need to be taken.

The task team would like to acknowledge the key stakeholders, which were committed and released their technical staff to take part in the task team and made valuable contributions to the development of the strategy. Above all, concerted efforts of all stakeholders are critical in the course of implementation of the strategy for a sound change in the pest management support services in Ethiopia.

The Task Team

List of experts actively involved in the strategy development

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EXECUTIVE SUMMARY

The Food and Agriculture Organization of the United Nations define **Pest** as any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products (http://www.fao.org/docrep/w3587e/w3587e01.htm# glossary of phytosanitary terms) [Revised, 1995; definition subject to formal amendment of **IPPC**]. Pest problem is as old as agriculture itself and pest management, too, has been there for far too long. People in the ancient world had been trying to solve pest problems in order to avoid economic losses using their wisdom, knowledge and skills to develop and integrate multiple tactics for managing the pests on the crops they grew. The use of different pest control tactics has been common even in the beginning of the twentieth century, i.e., until the time when organic synthetic pesticides introduced and brought a changed attitude for pest management approaches. The introduction of synthetic organic pesticides has allowed the dominance of their use in solving agricultural and public health related pest problems. This has continued to this date and pesticides have been widely in use worldwide.

Pest management support service (PMSS) by governments worldwide has been helping farmers to reduce pest related economic losses in their produces. In Ethiopia PMSS was started in the 1940s with a focus on desert locust, which was causing significant economic damage to all the vegetation in its path. This was further improved and made to include other pests identified at the time to have been causing economic damage to different crops. The support included pest identification, technical training and advice on how to manage pests and provision of inputs to apply pesticides. This was further consolidated over years and by 1992, after aggressive capacity building programs, carried out for about two decades and supported by UNDP, the PMSS in the country was claimed to have become competent in responding to the then needs of the country. This was because National Plant Protection Laboratories were established and staffed, Plant Health Clinics were established and since then are providing closer support to farmers, and quarantine posts were made operational in important international ports of entry and export of agricultural produces.

Since 1992 the support service underwent repeated reorganizations and its responsibility was increased significantly and has been providing services in pest control, quarantine and pesticide regulation. But, in the beginning of the twenty-first century the support service started getting weaker and reached to a point where it was unable to provide the required PMSS and was found to be not coping with the increasing demand for support from service seekers.

Currently major economic pests have not been routinely surveyed, monitored and their status not properly documented and communicated; informed pest management control decisions have not been taken rather the system has been responding to emerging problems in a tactical rather than strategic manner; pest management has been largely dependent on the uncontrolled use of generic pesticides. Moreover, pest management tactics aside from synthetic organic pesticides have not been receiving sufficient attention from users. Due to these, there has been upsurge of regular pests, establishment and spread of new pests, development of pesticide resistance in major economic pests, due to mainly misuse of pesticides and pests, which had local importance turned national problem such as sweet potato virus diseases, bacterial wilt of potato. The latest threat has come from maize lethal necrosis disease, which is affecting the food security and strategic crop of the country.

Lately the PMSS entire situations have been fully understood by decision makers in the MoANR and beyond that it is not in a position to provide all the required support to the expanding crop production in the country hence actions are being taken to reinvigorate the PMSS of the country at the federal level. The actions taken include restructuring and relocating of the PMSS within the MoANR to the Plant Health Regulatory General Directorate (PHRGD) The restructuring of the PHRGD is progressing very well with the approval and implementation of organizational structure but needs budgetary backup and fast tracked recruitment of additional staff. The changes should also come from the regional bureaus of agriculture. The MoANR through the PHRGD initiated and coordinated the strategy development to strengthen and implement more efficient pest management highly integrated with the crop production system.

In order to benefit from the created favourable environment it is essential that the pest management strategy and implementation guidelines be put in place. Taking this into account the MoANR decided and established a task team wherein key stakeholders were involved, i.e. MoANR, PHRGD, Higher Learning Institutions, EIAR, DLCO-EA and FAO Ethiopia Country Office for development of the strategy. In this regard, the FAO country office through the Technical Support to the Agriculture Growth Program, the IPM national consultant reviewed the PMSS in Ethiopia and produced a draft working document, which served for the task team to guide the strategy development process. Then after the task team from the review process identified critical issues that are affecting the PMSS in the country. In order to address these strategic issues identified the following strategic options that are agreed upon by all who provided their inputs to enrich the contents of the strategy document:

1. Develop/improve policy document and submit for approval and seek enforcement
2. Establish and expand the national pest management laboratories and regional plant health clinics and quarantine posts
3. Establish national biosystematics centre
4. Develop material and human capacity
5. Create and/or raise awareness of all stakeholders at all levels
6. Define mandate and harmonize the system of PMSS provisions with a viable coordination/linkage mechanism
7. Upgrade the country's phytosanitary services to meet the international standards and also manage established invasive alien species in the country
8. Establish national ICT usage in PMSS
9. Strengthen pre- and post-registration pesticide management system
10. Promote IPM in PMSS

Following this, strategic actions were outlined to address each of the above described problems and the specific actions needed to be taken to reinvigorate the PMSS of the country were stipulated, timetable to perform them developed and the required budget required by the MoANR at federal level to enhance the PMSS of the country included. The document was first shared with H.E. Ato Wondirad Mandefro, the state minister in the MoANR then after with all the national regions and the federal MoANR, National Agricultural Research bodies and higher learning institutions that have been engaged in teaching agricultural sciences for decades. Finally a national consultation workshop was conducted co-sponsored by FAOET and the MoANR and this final copy of the strategy document was produced.

1. INTRODUCTION

The term **pest** has been in the plant protection dictionary for more than a century. The origin of the term pest is that at first, in late 15th century, this was a term for the bubonic plague. It comes via French **peste** from Latin **pestis** 'plague'. Pest in the sense of 'a destructive plant or animal' is not found until the mid-18th century, when fear of the Black Death has receded.

FAO defines **Pest** as any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products (http://www.fao.org/docrep/w3587e/w3587e01.htm#glossary of phytosanitary terms) [Revised, 1995; definition subject to formal amendment of **IPPC**].

Pest problem is as old as agriculture itself, which began about 10 000 years ago in the fertile crescent of Mesopotamia. In the long past history of crop production, farmed crops have been suffering from pests and diseases causing pathogens with a large loss in yield with the ever present possibility of famine. Even today, with advances in agricultural sciences, losses due to pests and diseases range from 10-90%, with an average of 35 to 40%, for all potential food and fiber crops. All along, there was a great incentive to find ways of overcoming the problems caused by insect pests, diseases and weeds. This is why pest management exists and will continue to be an area of greater scientific emphases in order to increase production and productivity of crops to meet the ever increasing demand for agricultural produces by the growing human population, which is predicted to reach 9 billion by 2050.

Although undocumented, pest management in Ethiopia must have been going on for eons by smallholder farmers who mainly depended on the use of their indigenous knowledge and practices. They were able to select cultivars which can withstand the vagaries of biotic and abiotic factors. To date smallholders are the major actors in the Ethiopian agriculture and produce the lion share of crops produced every year. For instance in 2010 the country produced 22.5 million tons of crop, of which 95 percent was from smallholder farms and the remainder from commercial farms (Precise Consult International, 2012). Providing significant support to smallholder farmers is a key to increase production and productivity in the agriculture sector. They need improved crop varieties, technologies and related knowledge and information on good agricultural practices and pest management.

Although in Ethiopia smallholders are not in general the major users of external inputs, they use different external inputs including pesticides to grow commercial crops such as vegetables and cotton and major cereals like wheat and maize. However, it was all too common that they have been misusing pesticides and applying them without monitoring their crop fields for economic pests, taking actions to control economic pests often after the crops sustained significant damage and not receiving significant support while they are trying to manage regular pests. These have been creating crises in the management of pests and are mainly due to the inability of the pest management support service (PMSS) to respond to the current needs of the farmers.

The situation of PMSS in Ethiopia has remained either inadequately defined and/or less understood like in most African countries. The more holistic system approach, comprising all plant protection issues, has been preferred as opposed to a one type of discipline or even one sector oriented way of handling pest aspects separately, and most often, in uncoordinated manner.

The absence of full-fledged pest management support service system brought about the following: known economic pests have not been routinely surveyed, monitored and their current status properly communicated; informed pest management control decisions are not being exercised rather the system has been responding to emerging problems in a tactical than strategic manner; pest management has been largely dependent on the uncontrolled use of generic pesticides. Other practices have not been receiving sufficient attention. Due to these, there is upsurge of regular pests, establishment and spread of new pests, development of pesticide resistance in major economic pests due to mainly misuse of

pesticides and pest, which had local importance have turned a national problem. All these shortcomings have called for reinvigorating the current pest management support service (PMSS) system of the country. The mother institute that owns this support service is the Ministry of Agriculture and Natural Resources. Therefore, reviewing the past and developing an improved and more responsive pest management support service is the prime responsibility of this institution. It is with this understanding that this draft strategy was developed. Thus a committee of experts drafted this strategy for promoting efficient pest management support service on regular (insects, disease causing pathogens, weeds and vertebrates), migratory and quarantine pests that have been affecting the country's crop production.

2. REVIEW OF HISTORICAL DEVELOPMENT OF PMSS IN ETHIOPIA

2.1 Review of historical development of PMSS

Although undocumented, pest management in Ethiopia has been going on for eons by traditional farmers who have been depending on the use of their indigenous knowledge and practices to manage pests of crops including insect pests, plant diseases, weeds, invasive species and vertebrate pests such as birds and rodents. Nevertheless, in general, before the 1950s in Ethiopia agriculture was diversified and follows old custom trends in most of the country and farms used to experience extensive crop losses due to pests' damages. In the 1950s the Ministry of Agriculture made great strides in plant pest control and increased attention to other important pests besides the desert locust, which was taken as number one pest affecting crop production in general.

It was in 1956 that a permanent locust control staff was organized and independently established with a budget and equipment and armyworm survey and some control actions were started. Permanent plant protection section within the Ministry of Agriculture was established to handle study of crop pest problems, demonstration of modern equipment and pesticides, and training personnel and performing import, export and domestic plant quarantines (USDA, 1958). Moreover, basic plant pest law under which the Ministry of Agriculture could carry out control programs and operate and enforce plantquarantine regulations were developed (USDA, 1958). This section was further strengthened by lifting it up to a division level before the 1970's. Then it was charged with the overall responsibility of the control of pests and plant diseases, the monitoring and control of migratory pests as well as epidemic outbreaks of non-migratory pests and plant diseases, which was made the direct responsibility of this division whereas the routine control of regular pests was made the direct responsibility of the farmers and farmers' cooperatives and associations (UNDP/FAO, 1983).

On management of regular pests the division was mandated to give guidance and support to farmers through the routine extension service and elaboration and testing of preventive and control procedures. National plant protection laboratories were established in 1977 with the objective to provide effective crop protection laboratory and technical support services furnished with adequately equipped, staffed and organized laboratories to provide plant protection support services (UNDP/FAO, 1983).

In the mid-1980s the structure was revised and its organization was raised from division to a department level. Nevertheless due to the widening service need the capacity of the national plant protection support system was found inadequately equipped in terms of both support facilities, such as laboratory services, and trained manpower, either to monitor endemic and epidemic situations of insect pests, plant diseases and weeds effectively or undertake and promote control measures at the national and local levels. Because of this further institution building activities were carried out between 1987 and 1992 (UNDP/FAO, 1987).

By 1987 after thorough revision of the organizational setup the Crop Protection and Regulatory Department was subdivided into 2 Divisions: Crop Protection and Plant Quarantine. The crop protection division was in turn subdivided into 7 units: Entomology, Plant Pathology, Weeds Science, Birds and Rodents, Pesticide Chemistry, Pesticide Application, and Storage Problems. Back then the crop

protection division had 7 plant health offices located in different regions of the country as follows: Bahir Dar (NW), Kambolcha (NE), Jimma (SW), Awassa (S), Zeway (S), Goba (S), and Harer (E). It also had scouts and agents, directly accountable to it, at the regional, zonal and district levels. Agents at the district level were responsible for training farmer brigades, whereas those at the zonal level were most involved in control efforts. Agents provided farmers with motorized knapsack sprayers, fuel, and pesticides.

The Plant Quarantine Division had units for handling policy and regulations on the import and export of plant materials, operations, and technical aspects of quarantine.

By 1992 it was confirmed that the crop protection and regulatory department was rated competent with respect to insect pests, disease causing pathogens, weeds, and vertebrate pests monitoring, surveys, surveillance, identification, and extension and training and in certain cases it was able to provide advice on control (UNDP/FAO, 1993a&b).

After 1992, the crop protection and regulatory department underwent another reorganization and was merged with the crop production department from which the crop production and protection technologies and regulatory department was formed. The crop protection was regressed and organized at division level by merging the different units in the two divisions and forming 3 teams: crop protection team, crop protection laboratories and quarantine team and pesticides registration team (MoANR, 2000 and Merid Kumssa, 2004).

The Ministry of Agriculture was again reorganized in 2004 and was renamed Ministry of Agriculture and Rural Development and the department of crop production and protection was also dissolved and the crop protection was put under a new directorate, Crop Protection and Regulatory Directorate. The mandate of the directorate was revised and made to include all measures necessary to: conduct quarantine controls on plants, seeds and prevent outbreaks of plant diseases and pests. This period also corresponded with the conduct of the Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) 2005-2010 (MoANR, 2006).

In 2008 there was a total shift in the thinking and direction of the Ministry of Agriculture and Rural Development on the ways and how of providing pest management support services in the country at large. In line with this, the crop protection and regulatory directorate was subdivided and the pesticides registration and control, migratory pest control support and the pest regulatory components were maintained within the newly formed Animal and Plant Health Regulatory Directorate. And the pest management support services on regular pests backslide and the staff reduced to one expert and transferred to the crop and livestock extension directorate. Following this arrangement and due to the generalist concept "**one will do it all"** that was being promoted in the BPR process, the major disciplines in crop protection that used to be handled by different experts (entomologists, plant pathologists, weed scientists, vertebrate pests control experts, pesticides application experts) were removed from the structure and all the responsibilities to deal with these different aspects was given to one expert to handle. This arrangement was adopted by all the regions, zones and woredas across the country.

The Ministry of Agriculture and Rural Development was renamed Ministry of Agriculture in 2008 but the pest management support service remained split between the APHRD and the Extension directorates. This was found to be a serious impediment to the provision of effective pest management support service to farmers.

Currently the seriousness of the problem in giving pest management support service was fully recognized that structure that had been operating until the beginning of 2014 was found to be not responsive in helping the control of regular and migratory pests and also newly establishing invasive and quarantine pests. In response to this situation, the MoANR reorganized the pest management support service structure and established the Plant Health Regulatory Directorate General (PHRD) with three directorates:

Crop Protection, Plant Quarantine and Seed Health and Quality Regulatory directorates. The extension directorate has transferred its responsibility in supporting the management of regular pests to the PHRD.

The current mandates of the PHRD and the Extension service support directorate with regard to the provision of pest management support services are the following: the extension service support directorate receives all the necessary technical backstopping in plant protection from the PHRD while providing trainings to experts on major economic crops production packages whereas the crop protection directorate provides all supports in the management of migratory and regular pests as deemed necessary. Moreover, the latter directorate involves in the containment and management of newly introduced and established pests and pests of quarantine importance.

The PHRD strategic goal is to have effective national system to keep plant health and quality and run regulatory works on seeds, pests and pesticides developed and regularly improved. And the strategic objective is to give rapid and quality inspection and certification service; provide rapid and quality inputs evaluation, registration and quality control; deliver rapid and quality pests control service on regular and migratory pests; facilitate the implementation of basic procedures for the regulation of modern agriculture; improve the timely dissemination of information sources applicable to the accomplishment of the tasks of the directorate and strengthen the skill and knowledge base for discharging regulatory activities effectively

2.2 Categories of pests receiving PMSS

2.2.1 Migratory pests' management support service

In Ethiopia locusts (Desert Locust and African Migratory Locust), Army worm and Quelea quelea are migratory pests. The Federal Ministry of Agriculture and natural Resources and Regional Bureaus of Agriculture are responsible for both ground and aerial management of the pests in collaboration with DLCO-EA aerial crew. The MoANR is relatively well organized in dealing with migratory pests, which are having trans-boundary sources.

Within the MoANR in the Plant Protection Directory of the Plant Health and Regulatory Directorate General there is a national team working on this group of pests. The routine activities the team has been carrying out include regular surveillance and survey in areas known to be the ecological niches of the migratory pests, creating awareness in the relevant institutions within the country and beyond, organize funding and carry out control operations whenever the conditions demand. The team has been receiving regular technical and other backstopping from regional and global institutions that have been working on such pests such as the DLCOEA, Central Region Commission (CRC-FAO) and FAO headquarters.

2.2.2 Regular pests management support service

In the last about one decade, the pest management support service that has been given by the MoANR to smallholders was declining and significantly reduced in the last about five years and has reached its lowest point (hit rock bottom) since the pest management support service was started with the control of desert locust more than six decades ago. This is, due to a number of reasons including: repeated reorganization of the pest management support service, the weak organizational structure adopted in the latest past years, lower emphasis given to pest management by decision makers, limited budget allocation, limited staffs assigned and facilities developed, which have been affecting pest surveillance, survey and monitoring of regular pests, hence, resulted in loosely regulated pesticides use by farmers and the free movement and utilization of plant materials with unknown health effect and quality.

The consequence of all these was that a number of new insect pests, disease causing pathogens and weed species have set foot in the country and got established (Fig 1) (Bayeh et al., 2011 and Tebkew et al., 2012). The most recently established insect pests of significance causing economic damage include the cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae), South American tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), Citrus woolly whitefly, *Aleurothrixus*

floccosus (Maskell) (Hemiptera: Aleyrodidae), and white mango scale, *Aulacaspis tubercularis* (Hemiptera: Diaspididae) (Fig 1a).

Fig 1a Examples of newly established insect pests (cotton mealybug, *Tuta absoluta,* citrus woolly whitefly, and white mango scale)

The most recently established diseases causing pathogens with significant economic damage to different economic crops include the maize lethal necrosis disease, garlic rot caused by *Sclerotium cepivorum* Berk., which also affects onion when infected bulbs are used as planting material, Bacterial wilt of ginger, *Ralstonia solanacearum* and new races of wheat stem rust, *Puccinia graminis* f. sp.*tritici* (1b).

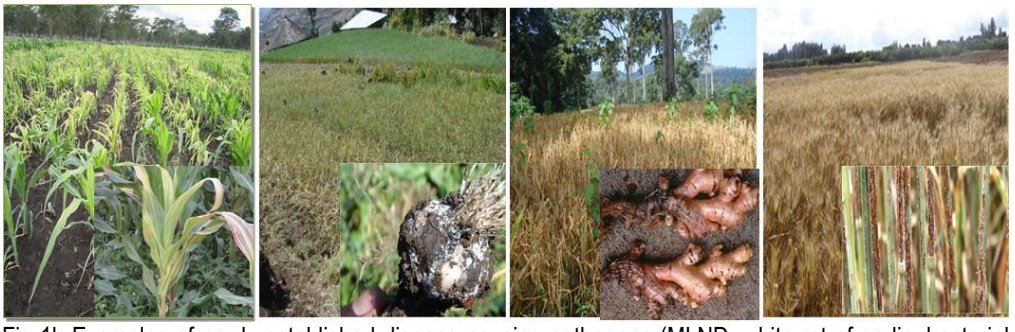


Fig 1b Examples of newly established disease causing pathogens (MLND, white rot of garlic, bacterial wilt of ginger and new races of wheat stem rust

There are a number of plant species that are invasive and have been introduced into the country at different times and have been affecting the country. These include the invasive species: parthenium weed, *Parthenium hysterophorus* L. (Asteraceae); water hyacinth, *Eichhornia crassipes* (C. Mart.) Solms (Liliales: Pontederiaceae; mesquite, *Prosopis* juliflora (SW) DC (Fabacea) and the parasitic weed crenata broomrape, *Orobanche crenata* Forskal on faba bean and semi parasitic species witchweed, *Striga hermonthica* (Delil) Benth. (Orobancheace) on sorghum (Fig 1c).

Fig1C Established invasive economic weeds Parthenium, Prosopis and Water Hyacinth that were introduced at different periods in the past four decades

Pesticides are being mishandled by smallholders, which has become all too common a practice across the country (Fig 2).

Fig 2 Application of pesticides without any protective clothing by unskilled and ill-informed physical laborers is quite rampant a practice (Bayeh, 2012).

Unregulated movement of plant materials has been serving as a vehicle for the spread of major economic pests to newer areas. For instance the use of uncertified tomato seedlings has caused viruses disease in tomatoes in the central rift valley to spread, uncertified onion bulbs used as planting material causes white rot in onions and sprouted tubers of improved potato varieties unchecked for wilt causing bacteria bring about significant wilting in potato in many places across the country (Fig 3).

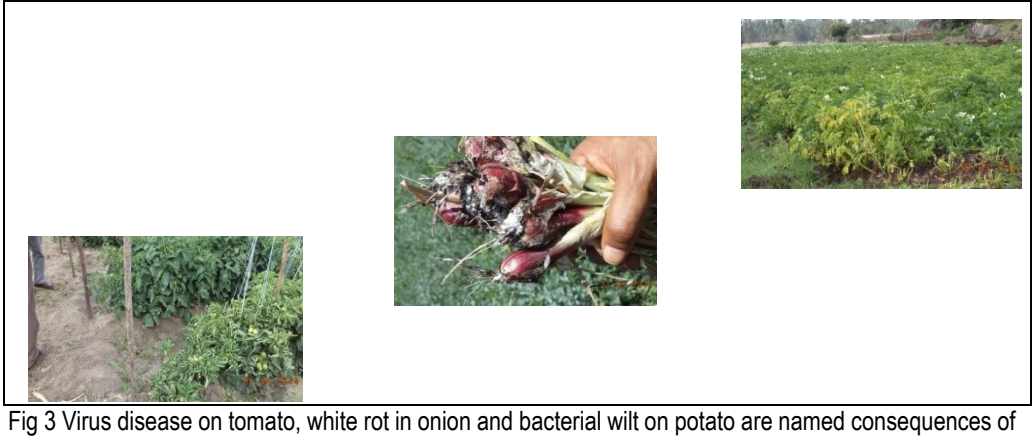


Fig 3 Virus disease on tomato, white rot in onion and bacterial wilt on potato are named consequences of unregulated plant material movement and utilization in the country (Bayeh 2013)

In general in the last about six to seven years the provision of pest management support service by targeting regular pests has been done only whenever there were infestations of outbreak proportions reported by farmers. This has been by-and-large a campaign work and does not constitute to a support coming from a viable/working pest management support services system. Because of this, there has been limited technical support provided to farmers in pest management on regular bases, i.e., there has not been a sustainable and continuous pest management support service hence it was found difficult to solve the recent pest crises in the country. Moreover, there is a difficulty to gauge the contribution of the different sectors involved in providing plant protection support services due to absence of baseline information taken recently and the weak coordination present across the country.

2.2.3 Quarantine pests' management support service

Addressing pest regulatory issues using the countries system and procedures are very apparent at the federal level but it is focused only on promoting or facilitating the export and import of mainly raw agricultural produces' using the defined procedures in the regulatory guideline without updating the support documents- the quarantine pest checklist spanned several decades.

Revision and up grading of phytosanitory measures and procedures that are in use to meet international phytosanitory standards and to tackle emerging phytosanitory problems has not been done for many years. Thus, enforcement of phytosanitary measures has been constrained by a number of things such as shortage of enough trained personnel, physical capacity, and lack of phytosanitary law. Moreover, the regulatory directorate has not been organized in a way it can give rapid response to arising plant quarantine related problems. Moreover, there are no enough resources to do pest risk analyses as needed due to lack of well documented check list of quarantine pests to Ethiopia and expertise to do the job as needed. In general pest risk analyses for quarantine decision making must be done professionally by learning what has gone wrong with the carmine cochineal, which is currently devastating cactus pear, an important fruit and feed source for many in Tigray region.

Although regulating the movement of plant materials across the country was long recognized as an important activity, to date there is no domestic quarantine system put in place to regulate the movement of plant materials across the country. Due to the failure of the pest management support service system to provide domestic quarantine service a number of pests have found their ways to newer areas in different parts of the country and have been causing significant economic damage to different crops this include virus diseases on sweet potato, bacterial wilt on potato, rotting fungi on garlic and onion, woolly apple aphid on apple, cotton mealybug on cotton and mango white scale on mango and quite recently the South American tomato fruit worm, *Tuta absoluta* and the maize lethal necrosis disease. In addition there are reported a number of new weed species including *Orobanche crenata, Cryptostegia grandiflora, Mimosa diplorotricha, Salvia tiliifolia* and *Nicotiana glauca* , which are established and causing economic damage on different crops (Rezene Fessihaye, personal communication). In general the issue of domestic quarantine has not been given the utmost attentions by all concerned as there are no directives, to date, for the placement and implementation of domestic quarantine, to avoid similar crises from happening in the future.

2.3 Laboratories needed to provide PMSS

There used to be well equipped and staffed crop protection related laboratories in the Ministry of Agriculture. Due to the reduced attention plant protection support service received from 2008 on, all the laboratories were closedown and at the moment the experts are not providing the needed technical supports based on diagnostic information. Lately there is an activity going on in the MoANR to bring these laboratories back into operation, but the process is moving at a very slow pace. What is worse is that the plant health clinics and quarantine posts present across the country have been operating very poorly.

The main problems that have been faced by the different laboratories include: lack of support from development projects like the RCBP, AGP and EAAP, lack of staff who could work in the different disciplines (entomology, plant pathology, weed science, vertebrate pests, and quarantine and seed health), the laboratory facilities and guidelines in use have beentoo old and outdated, the internal facilities at the PHCs are incomplete and most are found in bad shape because there has not been any replacement/replenishment since their establishment. These are further complicated by the lack of transportation facilities to conduct pest surveillance, survey and monitoring. The available quarantine facilities are very poor and are not in position to protect the country from potential pests coming from other countries and between regions in the country. There is generally critical shortage of human resource, laboratory facilities, budget and logistics.

2.4 Pest management technologies generation

Pest management support service depends on the availability of information, knowledge and technologies to manage economic pests. These must be generated or adapted from other sources. Crop protection information, knowledge and technologies generation dates back to the 1940s, which was carried out by Italians, followed by the MoANR and the then Alemaya University (Hramaya University) in the early 1960s. These early activities were focused on generation of information and knowledge through surveys.

Plant protection research has been going on, in an organized way, since the establishment of the then Institute of Agricultural Research (IAR) in 1966. The researches at the beginning were focused on plant pathology and entomology. Although weed science research in Ethiopia began in 1967 at Chilalo Agricultural Development Unit (CADU) Kulumsa station in Arsi region, it was at IAR in Holetta Agricultural Research Center (HARC) Agronomy section in 1969 where detailed work on herbicides efficacy evaluation was started. This was expanded in 1970 to Haramaya University-Debre Zeit Agricultural Research Station and in 1974 at the Plant Protection Research Center's (PPRC) of the then Scientific Phytopathology Laboratory (SPL) based at Ambo. Since 1971 and until the beginning of the 1990s weed research was included in plant protection then after it was taken back and integrated with Agronomy research. Research on vertebrate pests control began latter but terminated in 1988 and transferred to MoANR to the then Shola laboratory. The latter inclusions into the division were plant quarantine and seed health research. The disciplines except the vertebrate pest control research are still up and running.

In the course of its existence, plant protection research underwent a number of organizational changes. At the start and for some years afterwards it was running under crop protection department. Following this, the researchers in crop protection were assigned and had been working in different crops teams with other professionals (Breeders, Agronomists, Soil Fertility Experts, Socio Economists, Research Extension experts), which was designed to promote team work, but unfortunately, ended in creating dominance by crop breeders who have been thinking that variety selection is the core for increasing crop production and productivity thus undermining the contribution of pest management technologies.

Currently the research in plant protection is restructured in a way that research activities could be coordinated and the responsibility is given to the Ambo Plant Protection Research Center. Nevertheless in the course of all these reorganizations the research outputs from plant protection disciplines have been declining significantly. This is clear from the poor content of the crop protection manual published by EIAR.

Although the then IAR was the main institution, until 1992, generating crop protection technologies, its linkage with the crop protection division/department of the MoANR had been recognized to be very poor. To date this has not changed significantly and the linkage between the two has remained loose. This is despite the fact that technology generating institutions have increased in their number and include EIAR, RARIs and Universities. Besides generating technologies, information and knowledge, Universities have been turning in graduates in different agricultural fields including crop protection to fill the gaps in the work force both in the research and development organizations. In the 2005 PPSE annual conference the increase in the number of crop protection professionals in the country was reported to be significant. Nevertheless since 2005 the number of post graduate students in plant protection has declined significantly showing that despite the increase challenge coming from migratory, regular and newly establishing pests, the plant protection professional joining the work force has been decreasing both in number and quality. This is further complicated by the severe shortage of trained manpower at the grass root level, which could provide crop protection technology transfer services to all who need it.

Regarding the generated and transferred crop protection technologies; the first modern technology promoted was the use of synthetic pesticides. Accordingly evaluation of insecticides, fungicides, herbicides and rodenticides started in the early years of the existence of the then Institute of Agricultural Research (IAR).

The research outputs from the early years used to be published in annual progress reports and used to be presented in the National Crops Improvement Conference (NCIC) annual conferences. These reports, however, had limited circulation and were not reaching all potential users of crop protection information sources at the time. Useable technologies in entomology, plant pathology and weed science used to be published in leaflets, technical bulletins and monographs. The first organized manual on recommended insecticides was published by IAR (Crowe and Shitaye, 1970). This happened after the time when the side effects of the use of insecticides in agriculture and public health were fully recognized by Entomologists of the time in North America (PNAS, 1969). However, to the present date synthetic insecticides have remained to be very important in managing pests on crops being grown in many areas across the country.

The first crop protection focused research outputs review in Ethiopia was held in 1985 (Tsedeke Abate, 1985). This was conducted about thirty-five years after crop protection was started in the country. Although there were research outputs on identification of pests, estimation of associated yield loss to the damages by the major pests and different pest control methods including cultural, chemical and host plant resistance, none of the 39 contributions to the review conference presented any recommendation on any of the reviewed pests regarding the issue of integrated pest management. The major outputs, however, were different effective pesticides that could effectively control the different major pests; when applied at predetermined rates of application and defined number of rounds of spray.

Twenty years were lapsed following the 1985 crop protection research achievements review and before another review conference was organized. The PPSE instead of the Ethiopian Institute of Agricultural Research took the initiative and organized the second crop protection research achievements review conference in 2005. The proceedings of the conference were produced in two volumes. In this conference it was concluded that although single control method focused activities have been the major focus such as screening of pesticides or germplasms, there were identified IPM packages for a number of pests such as stalk borer of maize, bean fly, barley shootfly, chaffer grabs, tomato fruitworms, grass weeds. Nevertheless generated plant protection technologies have not been fully utilized and plant protection related technologies and knowledge transfer to development actors and the farmers have not improved significantly. Available venues like farmers field schools have not been utilized to demonstrate effective technologies and practices.

2.5 Training provision in pest management

One of the main focuses of the MoANR had been the provision of trainings based on assessment of pre- and in-service training needs of field staff, preparation of training programs and materials and also conducting of the trainings. Technologies, information and knowledge that have been generated by the research system have been compiled into crop production packages' components and have been delivered to users in different training fora. Production and distribution of training materials and provision of trainings to development agents has been followed by the MoANR for more than six decades, i.e., years before the start of the "Minimum Package Program" in 1971 to the present date.

Crop protection recommendations on economic pests are normally incorporated in the crop production packages, however due to the low emphasis given to pest management in the packages, the following gaps were created during practical implementation of acquired knowledge: failure by trainers to communicate the full picture of economic pests and the corresponding management information, miscommunication of crop protection related information to users, misidentification of pests and wrong recommendations provided to farmers who sought technical support on pests causing significant economic damage on their crops, and development agents are prevented from getting sufficient knowledge on pest management strategies and tactics. Because of these, there is insufficient current knowledge transfer in pest management to the actors involved at all levels of the agriculture development.

2.6 Coordination in pest management support service provision

Plant health clinics are directly accountable to the Regional Bureaus of Agriculture in the respective regions wherein they are located. The crop protection experts in the extension directorates of the MoANR and regional agricultural bureaus are loosely connected with the PHRD and the plant health clinics. The structure in the research system completely disregarded crop protection research and gave it the lowest possible emphases. The consequence of these was that the packages provided to development agents and farmers were incomplete and hence contributed to a number of regular pests to cause significant economic damage on the crops of their choices. As described above this has caused the unregulated use of pesticides by farmers and the wider circulation of unhealthy planting materials, thus yield and quality of crops produced have been significantly compromised.

There has been lack of comprehensive organizational setup for plant protection experts to feel comfortable in, an incentive mechanism rewarding them to what they have been doing and to remain in their work position. The lack of recognition of their significance is expressed by the lower professional position at which crop protection experts have been assigned to work unlike their equals working in agronomy or crop production. Apparently there has been lack of proper awareness on the side of decision makers, at all levels, regarding the level of significance of conducting pest surveillance, survey, monitoring and control on regular pests hence their experts are sought only when there was pest outbreak of one sort or another.

2.7 Legislative supportive of pest management support service provision

There are supporting national policies, strategies, regulations and directives on pest management support service and pest management in general, which have been considered in different regulations and decrees. The plant quarantine regulation of 1971 Decree number 56 empowers the Ministry of Agriculture to control insect pests, disease causing pathogens, weeds and vertebrate pests in the country and prevent their entry from other countries. Updated and improved plant quarantine regulation was made in 1992. Pesticide Registration and Control Special Decree was issued in September 1990 but was replaced by another one no. 674/2010. The “National Agricultural Research Policy and Strategy” issued in October 1994 states the type of plant protection research that has to be conducted in the country. In the Policy and Investment Framework (PIF), strategic objective 1 (SO1) aims to achieve a sustainable increase in agricultural productivity. To this end, beside a number of technologies that help increase production and productivity; weed and pest control are included as important factor that should be dealt with in order to achieve SO1.

Although there has not been any documented policy, strategy and directives, regarding institutionalizing of IPM in the regular pest management support system and on how to promote IPM in the country at large, the government of Ethiopia started advocating the importance of implementing IPM in the country in the 1980s. Nevertheless its promotion has been very slow and limited success stories are available regarding IPM implementation (Ferdu Azerefegne and Tsedeke Abate, 2007).

2.8 Current actions of decision makers

Currently institutions and their authorities who have stakes in the PMSS, both at the federal and regional level, are increasingly becoming concerned about the devastating impacts of **quarantine pests**, **established invasive alien pests**, **newly emerging pests** on the national economy and biodiversity. Although the general pest management support service system situation has been fully understood by decision makers and actions are being taken to reinvigorate the system, however it has not gone far enough to involve all the national regions to respond in a similar manner. The actions being taken by the MoANR include restructuring and relocating of the crop protection support system to the Plant Health Regulatory Directorate (PHRD) and drafting of strategy and implementation guidelines to promote pests

management support service on regular, migratory, established invasive alien species and quarantine pests. The relocating of regular pest management from the extension directorate to the PHRD has already been done. The restructuring of the PHRD is progressing very well with the implementation of approved organizational structure, but this did not materialize in the regional governments who are still working using the structure they adopted some 5-6 years ago.

The different institutions which have a direct stake in the PMSS of the country agreed and designed for implementation a strategy for a strong and vibrant PMSS in the country. The Ministry of Agriculture and Natural Resources, as a lead/umbrella institution, organized a working group that prepared this strategy document which was enriched and validated through the participation of all owners and stakeholders. In the preparation of the document experts from the Ministry of Agriculture, EIAR, University and International Organizations (UNFAO, DLCO_EA) were assigned recapitulated the critical issues that should be addressed by the different stakeholders and produced this PMSS implementation strategy. The provision of PMSS following this strategy document will help to reduce economic damage due to regular, migratory, established invasive alien species and quarantine pests, which happen to be the case in the recent past.

3. SITUATION ANALYSES

3.1 Mandate analyses

The PMSS in Ethiopia is defined to embrace all components of plant protection, plant health and other related areas namely:

- Phytosanitary services mainly entrusted with plant health commonly referred to as 'quarantine services',
- Plant Protection Services mainly dealing with the extension part of plant protection
- Plant protection products administration and control mainly addressing pesticides, spraying equipment, pesticide containers, PPE management etc...
- Research and education mainly concerned with generating technologies, conducting research, educating and producing human resources relevant to the fields mentioned above,
- Biosystematics that keeps collections of pests and their natural enemies with descriptions to serve as reference,
- Diagnostic and analytical laboratories, which provide testing and diagnostic services.

These are handled by different institutions homed in different sectors both at the federal and regional governments in Ethiopia. The owners (mandated institutions) are:

1. Ministry of Agriculture
2. Ethiopian Institute of Agricultural Research
3. Ethiopian Biodiversity Institute
4. Higher Learning Institutions
5. Ministry of Environment, Forest and Climate Change
6. Regional Bureaus Agriculture
7. Regional Agricultural Research Institutes
8. Regional Bureaus of Environment, Forest and Climate Change

MoANR

Ministry of Agriculture and Natural Resources is the focal ministry that is working to promote agricultural growth and development in the country. The PMSS related mandates of the Ministry of Agriculture and

Natural Resources are described in the proclamation to provide for the definition of powers and duties of the executive organs of the federal democratic republic of Ethiopia (Proclamation No. 691/2010) and are described below:

- promote the expansion of extension and training services provided to farmers, pastoralists and private investors to improve the productivity of the agricultural sector;
- establish a system to ensure that any agricultural product supplied to the market maintains its quality standard; and follow up the implementation of same;
- conduct quarantine on plants, seeds, animals and animal products brought into or taken out of the country; control the outbreak of animal and plant diseases and migratory pests;
- build capacity for supplying, distributing and marketing of agricultural inputs, and ensure the supply of the inputs;
- ensure the proper administration and control of pesticides and veterinary drugs;
- monitor events affecting agricultural production and set up an early warning system;
- establish a system whereby stakeholders of agricultural research coordinate their activities and work in collaboration;
- ensure the proper execution of functions relating to agricultural research, and conservation of biodiversity.

The detailed activities of the above provisions are stipulated below:

- Provide pest management facilitation and coordination services including pest surveillance, survey, monitoring, identification and documentation; adapt/generate pest management technologies; organize and package pest management information, technologies and knowledge; provide training for experts in pest management at all levels; provide pest control services;
- Provide pesticides registration and import inspection service; issuance of permits for pesticides and pesticide application equipment
- Provide phytosanitary services on import and export; issuance of import permits for plants, plant products and other regulated articles and biological control agents;
- Delivery of competence certificate for pest management related business activities service. This is accorded in proclamation 86/2010;
- Preparation of PMSS policies, regulations, directives etc
- Awareness creation activities

National agricultural research system

National agricultural research system (NARS) includes the Ethiopian Institute of Agricultural Research, regional agricultural research institutes and higher learning institutes. The mandates of these institutions are described below.

EIAR and RARIs

- follow up the implementation of agricultural research policy, initiate new and improved policy proposals and submit the same to the government and when approved, implement and follow up the implemented thereof;
- issue guidelines for proper formulation and preparation of agricultural research prograrns and projects in line with the country's development requirements, where appropriate evaluate whether the proposed projects, programs and budget are in accordance with the guidelines and submit them to the government for approval;

- undertake, or cause, the undertaking of agricultural research activities on the bases of the agricultural research policy and strategy;
- establish a system in collaboration with appropriate organs to make effective coordination between the Federal agricultural research centers and the end users and implement and follow up the implementation so that useful agricultural research results will be popularized and utilized by the end users;
- advertize agricultural research results in the languages of the different nations and nationalities using appropriate means in collaboration with relevant organs in order to widen the agricultural knowledge base of the society;
- collect, organize and disseminate information on agricultural research activities and results that are available in the country and elsewhere in the world and develop and coordinate information exchange mechanisms;
- facilitate conditions for mutual support between agricultural education, research, extension and production in cooperation with relevant organs;
- establish relationships, cooperate and conclude agreements with international and regional agricultural research centers and national organizations having similar objectives, based on the relevant law and implement and follow up the implementation thereof; provide relevant information service to regional agricultural research centers and, upon request, give technical support and assistance to the extent possible.

Universities

- develop programmes of study and provide higher education;
- prepare and supply qualified graduates in knowledge, skills, and attitudes on the basis of needs of the country;
- award academic qualifications in accordance with its programs;
- undertake and encourage relevant study, research, and community services in national and local priority areas and disseminate the findings as may be appropriate;
- undertake, as may be necessary, joint academic and research projects with national and foreign institutions or research centres;
- establish cooperation relations with industries and other institutions in pursuit of its mission.

Regional BoA

- Avail Extension service and technical support to the farmers, render initial proposal for research purposes and follow up their effective application thereof;
- Provide material and technical support with the view to preventing and controlling crops' and animals' diseases as well as anti-harvest pests and weeds;
- Render educational, training and counseling services to the farmers and private investors engaged in the agricultural sector as regards the development, protection and use of the natural resources, follow up and supervise over the development, protection and utilization of same thereof;
- Conduct the appropriate quarantine control on those plants, seeds, animals and products thereof brought into or going out of the Regional State;
- Follow up and supervise over the distribution of agricultural inputs in a desired quality;

- **MoEFCC**
  - prepare programs and directives for the synergistic implementation and follow up of environmental agreements ratified by Ethiopia pertaining to the natural resources base, desertification, forests, hazardous chemicals, industrial wastes and anthropogenic environmental hazards with the objective of avoiding overlaps, wastage of resources and gaps during their implementation in all sectors and at all governance levels;
  - coordinate and as may be appropriate carryout research and technology transfer activities that promote the sustainability of the environment and the conservation and use of forest as well as the equitable sharing of benefits accruing from them while creating opportunities for green jobs.

- **Ethiopian Biodiversity Conservation (EBC)**
  - explore and survey the diversity and distribution of the country's plant, animal and microbial genetic resources;
  - collect samples for ex-situ conservation and facilitate utilization of these genetic resources for research and development;
  - work in cooperation with the concerned federal and regional bodies with respect to protection, research, conservation and utilization of biodiversity resources;
  - develop a national zoological museum and national herbarium for animal and plant specimens to provide researchers and other utilizers with the necessary reference materials.

3.2 Table 1. Outputs of stakeholders' analysis

No	Stakeholders	Expectations	Likely reaction and impact, if expectation are not met	Degree of Importance (Low 1 To High 3)	Institutional Response
1	**Internal**				
	PHRD (MoANR)	policy directions resources facilitation	Complaint, dissatisfaction, Inadequate PMSS provision, Increased pest damage	3	MoANR endeavours to fulfil the expectations
	Extension directorate (MoANR/BoA)	transferable pest management packages and technologies	Continues to demand for solutions from PMSS providers Inadequate pest management practices available	3	PHRD prepare available packages and technologies PHRD request NARS to adapt/generate technology options
	Inputs directorate (MoANR/BoA)	data on registered and recommended inputs demand and facilitate the supplies	request for data low level of inputs supply	2	Improve alignment between directorates
	Coffee and tea development authority	transferable pest management packages and technologies	Continues to demand for solutions from PMSS providers Inadequate coffee & tea pest management practices available	3	PHRD prepare available packages and technologies PHRD request NARS to adapt/generate technology options
	Ethiopian horticulture development agency (MoANR)	acquire current knowledge, information and technologies facilitation on technologies import	search for alternative sources increased pest damage on export crops	1	Accommodate their requests
	Crops research directorates (EIAR/RARIs)	Knowledge, information and technologies communication on identified and researched pest problems	demand for current Knowledge, information and technologies on pest management hinder research on pest management	3	supply the necessary reports, data
	Regional BoA pest management support units	policy directions acquire current knowledge, information and technologies facilitation provide project sourced resource support	Dissatisfactions Poor PMSS provisions Weak linkage and coordination between MoANR and BoA	3	Enhance the supports from federal and regional governments
	Universities' pest management support units	identified training needs, researchable problems, current knowledge, information and technologies exchange	dissatisfactions mismatch between need and qualifications of graduates problem solving research results may not be produced.	2	establish strong linkage and coordination
	MoEFCC forest protection directorate	linkage technical backstopping	dissatisfactions weak protection of forests from pests	2	facilitate the interpretation of its duties and responsibilities

No	Stakeholders	Expectations	Likely reaction and impact, if expectation are not met	Degree of Importance (Low 1 To High 3)	Institutional Response
		information exchange clear direction to share responsibilities in pest management including IAS			
	Biodiversity	share pests and natural enemies database	insignificant protection of biocontrol agents	2	avail the needed databases
	Ethiopian Sugar Corporation Research and Training Directorate	information communication on identified pest problems facilitation	demand for up to date information on pest problems hinder research on pest management and technology introduction	3	supply the necessary reports and data
	Veterinary drugs and animal feeds administration and control agency (MoANR)	access to organized data on registered pesticides and other inputs needed for pest management	demand for up to date data on registered pesticides and others	2	avail the needed data
	Employees in all stakeholder	Favorable work environment Training and career development Commensurate remuneration	Dissatisfactions, low performance, attrition, and weak PMSS system	3	improved working environment and career development
	Pathobiology (AAU)	request on pesticide analyses in impregnated nets and efficacy determination for aerosols and other pesticides information exchange linkage	dissatisfactions low verification outputs	1	Strengthen the linkage
2	**External**				
	MoWE	linkage information, knowledge and technologies on IAS management	dissatisfactions ramification of aquatic weeds (IAS)	2	Strengthen the linkage and avail information, knowledge and technologies the resources
	MoST	scientific research proposals in pest management	re-advertise the availability of funding for research and loss of funding opportunity	2	Encourage researchers to use the opportunity
	MoFEC	justifiable budget request appropriate expenditure report measurable outputs	Reject or withhold budget make institution accountable project failure	3	Abide by the financial laws and rules
	Regional States	policy harmonization linkage and facilitation	Complaint, dissatisfaction, difficulty in PMSS implementation	3	MoANR endeavours to engage continuously with the regions
	Ethiopian standards agency (MoST)	provide standard needs	insist on submission of request delay in standard setting	2	Apply for standard setting

No	Stakeholders	Expectations	Likely reaction and impact, if expectation are not met	Degree of Importance (Low 1 To High 3)	Institutional Response
		participation in development of requested standards			
	Ethiopian Health Institute (MoH)	request on pesticide analyses in impregnated nets and efficacy determination information exchange and linkage	dissatisfactions low verification outputs	1	Strengthen the linkage
	Ethiopian food medicine and health care administration and control authority (MoH)	Avail data on pesticide poisoning	Request for institutionalizing the task and lack of domestic pesticide poisoning data	3	Take organizing of data on pesticide poisoning as one responsibility
	Customs authority	Avail complete data on internationally traded goods	Import and export of agricultural produces and products affected, quality of traded goods compromised, quarantine objects enter the country	3	Train customs service providers, provide technical backstopping as deemed necessary
	Exporters and importers of plants and plant products	Efficient inspection, certification and issuance of import permit certificate of competence information on conditions of export and import	Export and import delay, export reject, and mounting complaints	3	Review and improve import and export related services delivery
	Importers of pesticides, application equipment and biocontrol agents	Efficient registration and inspection service certificate of competence information on conditions of import	Shortage of pest management products, price hike, and mounting complaints	3	Review and improve import related services delivery
	Pesticide applicators	certificate of competence training on safe handling of pesticides and pesticide legislatives information on pests and pesticides	complaint dissatisfaction misuse and abuse of pesticides	3	provide training and current information
	Farmers (Smallholders and Commercial)	Provision of effective PMSS	complaint dissatisfaction misuse and abuse increased economic damage	3	Significantly improve PMSS
	Distributors of local agricultural produces, traders and processors	pest and pest damage free produces improved postharvest management technologies	misuse and abuse postharvest loss	3	avail postharvest management technologies
	Pesticide distributors	competence assurance certificate information on pests and pesticides	dissatisfaction fraudulent practices	3	Provide the services and enforce the legislative provisions

Table 2. List of collaborator institutions identified to provide technical and financial backstopping to PMSS provision reinvigoration in Ethiopia

Collaborators	Field of collaboration	Relative advantages
DLCO-EA	Migratory pest control	Aerial survey and control
UN bodies	Pest management	Technical and financial supports
CABI	Pest management	Pest identification
CGIAR	Pest management	Technical support
Development partners	Pest management resources	Capacity building
Ethiopian Meteorological Agency	Information provision	Availing weather data
Professional associations and societies	Pest management	Current information
NGOs	Pest management	Piloting and demonstration of pest management technologies

3.3 SWOT analyses

The pest management support service system in Ethiopia has passed through different phases in the last six decades. During these decades there have been strengths upon which we can build on; weaknesses from which we need to learn and improve; opportunities to be seized and threats to ward off. This SWOT analyses focus on the general situations of PMSS in the country.

Table 3. SWOT analyses in relation to pest management support service provision in the country

Strength	Weakness
1. Favorable government policy environment to expand agricultural production and increase productivity	1. Low enforcement of the pesticide proclamation 2. Low enforcement of the quarantine regulations 3. Pesticide registration and control lacks regulation
2. Availability of relevant PMSS related policies and legislative (legal provisions) including: a) plant protection decree no. 56/1971, b) plant quarantine regulation no. 4/1992, c) pesticide registration and control proclamation no. 674/2010.	4. Outdated plant quarantine regulation 5. Absence of domestic quarantine system 6. Absence of national pest management support service strategy 7. Limited awareness on the available policies and legislations on plant protection
3. Presence of institutions: – Plant Health Regulatory Directorate (PHRD), – Plant health clinics – Plant quarantine stations posts – Bureaus of Agriculture from regions to woredas, – Agricultural Research Institutes – Agriculture teaching Universities, – Ministry of Environment, Forestry and Climate Change – Professional Societies such as Plant Protection Society of Ethiopia	1. Absence of accredited national plant protection laboratories in the MoANR 2. Inadequate plant protection research laboratories in NARS and Universities 3. Poorly equipped, inadequately staffed and less coordinated plant health clinics, national and local quarantine posts 4. Absence of national biosystematics institution for plant pests and natural enemies 5. Lack of motivation to pursue plant protection as a career 6. Incompetent plant protection experts at zone, woreda and kebele levels 7. Inadequacy of need based trainings to farmers on pest management 8. Lower focus on plant protection technology generation

Strength	Weakness
– Availability of FTCs and presence of development agents in trio in each kebele – Other institutions: Sugar estate, tobacco enterprise, DLCOEA, Adamitulu Pesticide Formulation Plant), NGOs etc	9. Less participation of plant protection experts in plant protection national forums including the conferences of the PPSE 10. Poor linkage between agricultural education, research, development and regulatory in plant pest management 11. Poor linkage between the federal MoANR and the regional bureaus of agriculture in pest surveillance survey, monitoring and management of pests 12. Inadequate resources allocation for pest management support services 13. Inadequate organizational structure to address pest management at all levels 14. Insufficient remuneration to retain experts in some specialized plant protection disciplines
4. Presence of responsive surveillance, survey and monitoring and management service for migratory pests to adapt to the control of regular, invasive and quarantine pests	1. Clearly undefined pest management support service for regular pests 2. Absence of surveillance, survey, pest risk analyses and emergency response on quarantine pests 3. Absence of post entry quarantine and lack of system to follow up imported planting materials at destinations 4. Lack of due attention to alien invasive species
5. Presence of local generated pest management information, knowledge and skill sources for some of the economic pests	1. Lack of regular and systematic pest status documentation and pest and pest management technologies information exchange 2. Limited experiences in IPM promotion 3. Failure to adequately create awareness in stakeholders 4. Lack of post registration regulation of pesticides 5. Availability of limited, locally generated, alternative pest control and crop production enhancing technologies
Opportunities	**Threats**
1. The expanding and growing use of information communication technologies 2. The expansion of Universities 3. The expanding road network connecting different parts of the country 4. The availability of alternative pest control agents and technologies 5. Availability of strong national and international supports to ensure food security 6. The possibility of getting biological and biologically derived pest management agents in the country biodiversity resources 7. Possibilities to work with regional and global organizations working on pest management and related areas	1. Climate change and climate variability 2. Increased possibility of introduction of new pests due to globalization 3. Emergence of resistant pests to pesticide 4. Escalating pesticide price 5. Increasing lack of alternative pesticides to manage some pests 6. Lack of peace and security to monitor and manage trans boundary pests 7. Lessened interest in students to join plant protection fields of study 8. Decline in the quality of graduates 9. Porous international borders 10. Illegal pesticide trade 11. Poorly informed, trained and skilled pesticide users 12. Frequent interception of pesticide residues in export agricultural commodities beyond maximum residue levels permitted by importing countries 13. Lack of corporate-thinking and suppliers bias for high profit than responding to growers demand

3.4 Gaps analyses

The PMSS in Ethiopia is analyzed as follows:

Strengths:

- Favorable government policy environment to expand agricultural production and increase productivity
- The Ethiopian government gave the highest emphases on poverty alleviation and food security and adopted ADLI (Agriculture development lead industrialization) to develop the agriculture sector. The expectation from the government in adopting this is to increase production and productivity of the sector including food fiber and forest plants. The PMSS has benefited from the presence of this policy.
- There are available PMSS related legislative (legal provisions), which are functional including: plant protection decree no. 56/1971, plant quarantine regulation no. 4/1992, and pesticide registration and control proclamation no. 674/2010.
- There are institutions that are directly and indirectly involved in the provision of PMSS to the agricultural sector. Their involvements are in overall regulation of the implementation of PMSS, extension, technical backstopping and provision of resources to farmers; adaptation, generation and transfer of technologies; education and training; service delivery and production of pesticides. The various institutions involved in PMSS are listed in the SWOT analyses table 3.
- Presence of better monitoring and management service for migratory pests
- There is relatively strong monitoring and forecasting and management system for migratory pests like locusts, armyworm and quelea birds. These include conducting regular survey on these pests by national and regional units and DLCO. Besides this there is a new initiative, which involves local communities in monitoring and reporting the occurrence of these migratory pests, which has been operating successfully.
- There are monthly situation reports prepared by national and international institutions on the status and occurrence of migratory pests communicated to all stakeholders involved in the management of these pests. Moreover there has been continuous human and material capacity building to have a functional unit in parts of the country where the threat of migratory pests exists.
- The national migratory pest management has been taking prompt responses as a result of the availability of reliable and organized data base for taking management decisions, particularly on locusts. There has been also strong collaboration with international organizations, which enhances service delivery and logistics support.
- Presence of local generated pest management information, knowledge and skill sources for some economic pests

Since the start of pest research at the then Alemaya College of Agriculture and the establishment of IAR in 1966 and later expansion of the National Agricultural Research System, much crop protection related research activities have been undertaken, and technologies have been generated. Some of the noteworthy achievements are the following:

- Survey, collection, identification and documentation of pests of major crops
- Determination of yield loss for key pests of food and industrial crops
- Chemical control studies against major economic pests
- Cultural and physical control studies on major pests;
- Host plant resistance studies.

Weaknesses:

1. **Policies and regulations:** Although there is a proclamation on pesticide registration and control it has not been properly implemented due to lack of approved detailed regulation and directives. The quarantine regulation under enforcement has been approved in 1992. It is outdated and needs significant updating such as the checklist of prohibited and restricted quarantine pests and also the conditions of entry of restricted plants, plant products and other regulated articles. Besides this domestic quarantine and post entry quarantine activities have not been established. This situation is further aggravated by the limited awareness of all stakeholders on the available policies and legislations in relation to the overall pest management.

2. **National diagnostic and test laboratories:** National and regional pest management laboratories are not providing sufficient pest identification, pesticide formulation and residue analyses, quarantine services, and pest management services and test results like race analyses and bioassay. Some are nonexistent and others poorly equipped, inadequately staffed and less coordinated. Most of the staffs don't have the required knowledge and expertise to handle pest management related activities as needed.

3. **Absence of national biosystematics institution for plant pests and natural enemies:** Having biosystematics program in pest management is very significant because identification is the primary task in devising pest management strategy. Although the need to have such service is long overdue, there has not been any consolidated biosystematics services in the country particularly for insect pests, natural enemies and plant pathogens because there are no reference collections and taxonomic expertise for identifying or confirming the identity of insects or microorganisms. There are good services on identification and confirmation of plant species identity, which is provided by the Natural History Museum of Addis Ababa University whose primary objective is focused on cataloguing the flora of Ethiopia.

4. **Failure to capacitate the PMSS:** Because of the inadequate resources allocation for pest management support services and the organizational structure adopted to address pest management at all levels, pest management technologies generation dissemination has been affected significantly. The competence of plant protection experts at zone, woreda and kebele levels are compromised due to mainly lack of need based trainings to experts and farmers on pest management and also the lack of staffs' interest to pursue plant protection as a career. Moreover, because of the lower job title grades and insufficient remuneration assigned to the positions it was found difficult to retain experts in plant protection disciplines.

   Poor linkage and coordination between the federal MoANR and the regional bureaus of agriculture in pest surveillance survey, monitoring and management of pests has allowed the threat from pests to increase significantly. Moreover, due to the poor linkage between agricultural education, research, development and regulatory in plant pest management; problem identification, technology generation and dissemination has been hampered.

   Despite the significant benefit that can be gained by participating in plant protection national forums where current knowledge and technologies in pest management are shared among professionals working at different levels, participation in such national forums including the PPSE annual conferences has been decreasing significantly.

5. **Poor awareness creation:** Although the level of awareness of the different stakeholders on the significance of pests and pest management varies it can be said that it has been generally low. There has been lower attention given to the promotion of pest management in the agriculture sector by decision makers at all levels. This has been expressed by the current organizational structure and manpower situation where few experts are placed in the extension directorate of each region and

are expected to coordinate the provision of pest management related extension and regulatory services in the respective regions at large. As a result of this multiple regular and quarantine pests have managed to cause significant economic damage on several crops.

Although technology users and other communities have limited understanding regarding pests and pest management services, there exists wide gap between what they know and what should be exercised to mitigate the impacts of pests, pesticides, and other technologies.

6. **Clearly undefined pest management support service for regular pests:** The federal and regional governments provide pest management support service on regular pests. However, there is no clearly defined pest management support service for regular pests and the responsibilities of the two bodies in this regard are not articulated unambiguously. This has contributed significantly to outbreaks of regular pests, which are causing significant economic damage and confusion in the handling of the outbreaks by different stakeholders.

7. **Poor phytosanitary services and low focus on invasive alien species:** Improvement in the direction of making the Phytosanitary service more effective in order to prevent the introduction of new pests into the country and efficient to tackle emerging phytosanitary problems has not been made after the induction of the plant quarantine regulation and the termination of FAO funded institutional building project.

   Endeavour to direct the phytosanitary measures and procedures that are in use to the International Standard on Phytosanitary Measures are very minimal. Phytosanitary procedures like pest risks analyses, post entry quarantine, regular surveillance, survey and emergency response on quarantine pests are not in practice. As a result of this quarantine pests have gained access into the country without being intercepted. Furthermore, lack of emergency response and eradication system to control alien invasive species has caused introduced pests such as parthenium and prosopis to spread widely in the country. The management of established invasive alien species is not only the responsibility of the agricultural sector but also other sectors such as the construction sector, ministry of environment, forestry and climate change, municipalities etc.…

8. **Information communication technologies use in pests management:** There is lack of regular and systematic pest status documentation and economic pest and pest management technologies information exchange among stakeholders in the agriculture sector. As the result of this users were not getting sufficient early warning signals that could assist them to prepare themselves in combating the current economic pests affecting the sector and the available management options and where they can access them.

9. **Limited experiences in IPM implementation:** Experiences in IPM implementation in Ethiopia are limited in area and scope. Some of these are sited as follows: the integrated late blight management on potato in West Shewa zone of Oromia region; integrated bacterial wilt management on potato in the Amhara region; integrated cotton pests management in cotton in Arba Minch area; integrated management of chafer grubs on barley in western Shewa; integrated management of diamond back moth on cabbage in eastern Shewa; integrated management of enset mealybug; integrated fruit fly management in Upper Awash and integrated management of maize stalk borer on maize; and integrated grass weeds management on wheat in Bale; integrated striga management.

   What are described above clearly show that the promotion of IPM is far below than the expectation attached to it by the lead institutions who want to see IPM promoted across the country in order to significantly reduce the use of synthetic organic pesticides.

   Some of the limiting factors that derailed the effective implementation of IPM include the lower focus on generating alternative pest control tactics and crop production enhancing technologies, lack of

post registration control of pesticides, shortage of information and knowledge on IPM. Users' perception and appreciation of the effect of pesticide use is dominant over the use of other alternatives pest management practices and IPM.

10. **Misuse and lack of tracking mechanism for pesticides:** When pesticides are imported in bulk there is no confirmatory laboratory tests carried out. Due to the lack of effective pesticides tracking mechanism, widespread mishandling of pesticides after import, during distribution and use has been routinely encountered. The distribution of pesticides by bulk importers, retailers and kiosks is not abided fully by the rules of safe handling of pesticides. There has been use of pesticides on pests/crops combinations other than for what they were registered for. Use of expired pesticides, application of pesticides at lower/higher doses than the recommended rates and frequencies are recorded experiences.

Opportunities:

1. **The expanding and growing information communication technologies use in the country:** The pest information exchange particularly for migratory pests has been the use of fixed and mobile communication radio gadgets. This has been replaced with wireless telephones and cell phones. Moreover, there are web based technologies that can be used for pest information exchange. These technologies have been considered as opportunities in the enhancement of pest management support service in Ethiopia.

2. **The expansion of Universities:** The presence of agriculture and related teaching Universities and colleges is considered as the main provider of trained manpower for improved PMSS. Moreover, these teaching institutions are also mandated to do research on pests and pest management. Therefore, the expansion is believed to be an opportune for furthering PMSS.

3. **The expanding road network connecting different parts of the country:** The paved roads in the country have increased access to more agricultural areas across the country. This has created favorable conditions for conducting PMSS activities including surveillance, surveys, monitoring, control and delivery of pest management inputs.

4. **The availability of alternative pest control agents and technologies:** Pest control agents include synthetic organic pesticides and biological and biologically derived products. Moreover, different cultural and good agricultural practices help minimize pests damage. These practices and the use of biological and biologically derived pest control agents availability are considered alternatives to the use of synthetic organic pesticides.

5. **Availability of strong national and international supports to ensure food security:** Feeding the increasing human population has been a challenge and deriving force to promote food security initiatives. Among the initiatives, increasing food production and productivity is a major one. Pests are reported to cause significant yield losses and threaten food security. Effect of pests can be minimized through the use of effective PMSS. There are global and national emphases given to support initiatives to ensure food security. Therefore, the available support for food security is a favorable environment for enhancing PMSS.

6. **Bio-prospecting for pest management agents:** The possibility of getting biological and biologically derived pest management agents in the country's biodiversity resources has not been exploited well. Nevertheless there are a number of findings such as disease resistance sources in Ethiopian barley gene pool, different entomopathogenic fungi (*Metharizium anisopilae* and *Beauveria basiana*) isolated from different pests, fungal antagonists (Trichoderma) extracted from forest soils, parasitoids (*Encarsia formosa* on white flies) from cotton, and entomopathogenic nematodes from chafer grabs have been reported. Moreover, a number of botanical species have been evaluated against storage

and field pests and some (neem, birbira and pyrethrum) were found to be very effective. These show the possibility of getting biological and biologically derived pest management agents in the Ethiopian biodiversity.

8. **Collaboration with regional and global organizations:** Globally there are institutions having the capacity to provide technical, material and financial backstopping to promote pest management. These include FAO, CABI, DLCO-EA, CGIAR centers and regional economic communities such as COMESA, IGAD. It is possible to work in collaboration with these regional and global organizations to enhance PMSS.

Threats:

1. Climate change

Although climate change has been part of a natural process, due to the increased anthropogenic interference as a consequence of elevated CO_2 release in to the atmosphere, the global temperature has been raising. Both increase and decrease of rainfall are occurrences related to the changing climate, which affects the reproduction and behavior of pests. The change has been helping pests to increase their presence at levels they have not been able to reach at and are causing significant economic damage in agriculture. Unless adaptation and mitigation strategies are put in place to reduce threats from pest damage aggravated by climate change there will be increasing economic losses in the sector due to pests' damages. Therefore, having in place a responsive PMSS to the changing climate is important in order to minimize the effect of pests, which will be favored by the changing climate and enhance the contribution of natural enemies in natural pest control.

2. Globalization and pest movement

Globalization and the expedited movement of plants, plant products and other regulated articles have increased the possibility for introduction of new pests to countries. It is possible to intercept some but not all incoming quarantine pests due to high volume and variety of commodities imported through various ports of entry. The actions we have been taking need to be expounded in order to cope with the high risk of pest introduction. This is aggravated by the porous international borders of the country. Therefore we need to make our PMSS respond to this emerging scenario.

3. Pesticides related threats

Emergence of resistant pests to pesticide is happening in the country. For instance diamond back moth to lambda cyhalothrin, bollworm in cotton to endosulfan, aphids to dimethoate and onion thrips to profenophos are some of the pesticide resistances reported in the country. The causes for resistance development include: increasing lack of alternative pesticides to mange economic pests and under/over use of available pesticides, presence of poorly informed, trained and skilled pesticide users and also the escalating price of new generation of pesticide. Moreover, lack of corporate-thinking and suppliers bias towards high profit than responding to growers demand such as the failure to supply new generation seed dressing pesticides has been a challenge. All these have allowed illegal pesticide trade to proliferate and become threat to both for the growers and consumers.

4. Pesticide maximum residue limit

The maximum residue levels set by individual countries varies significantly and is stringent. There has been interception of pesticide residues in coffee, sesame, and haricot beans beyond permissible levels. As a consequence of this a number of consignments have been rejected by a number of importing countries. This demands the PMSS to maintain a high standard pesticide use and management to meet the desired international market quality requirements.

5. Migratory pests management and workplace security

Lack of peace and security in recession areas of locusts in the neighboring countries like Eritrea, Somalia and Yemen has made close monitoring and early intervention migratory pests very difficult. For instance the 2014 desert locust outbreak that originated in Somaliland has managed to cross the highlands of Ethiopia including Addis Ababa, which was invaded after almost half a century. This was a result of the failure by Somaliland to monitor and intervene early and communicate to Ethiopian counterparts working on desert locust monitoring and control. There has also been insecurity in some woreda within South East Somali region of Ethiopia where desert locust traditionally breeds as it was witnessed during the 2007/8 desert locust outbreak.

6. Education in pest management

Graduate school level training in pest management began at the then Alemaya college of Agriculture in 1979 by enrolling competent plant science graduates. This attracted more post graduate students to join the discipline, which contributed a lot to the fulfillment of trained manpower in pest management profession in the country. But through time students interest to join pest management fields of study has decreased significantly, which is expressed by the availability of opportunities to study other science fields with high market demand such as medicine and engineering, which are attracting the best students. Moreover, there is a decline in the quality of education, graduates and theses in pest management.

3.5 Strategic/critical issues identified

Followed a thorough analysis, the key strategic issues were identified:

1. Policies and regulations outdated, not enforced or absent
2. Plant Protection Laboratories non-functional or poorly equipped
3. Pest focused biosystematics not organized or inadequate
4. Capacity and coordination/linkage of PMSS poorly developed
5. Poor awareness on PMSS policies, legal provisions and practices
6. Clearly undefined mandate and system in PMSS
7. Poor phytosanitary services and low focus on invasive alien species
8. Information communication technologies are least in use in PMSS
9. Misuse/abuse of pesticides and lack of tracking mechanism
10. Limited experiences in IPM promotion

3.6 Experiences of other countries in PMSS (Kenya, Tanzania & India)

3.6.1 PMSS in Kenya

Pest management support services in Kenya are organized under the Ministry of Agriculture, Livestock and Fishery by three separate institutions and are the plant protection service division, pest control product board of Kenya and Kenya Plant health Inspectorate Service.

Plant Protection Service Division

The organizational structure of pest management support service in Kenya is described below: Under the government of Kenya there is secretary of agriculture, livestock and fishery, which has three principal secretaries including the principal secretary of agriculture (state department of agriculture). Below this department there is a directorate of crop resources, agribusiness and market development. The functions of this directorate include the following:

i. Coordinate the development and review of crops, agribusiness management and value addition policies and strategies;
ii. Oversee development of fertilizer cost-reduction strategies;
iii. Promotion of Public-Private Partnership in Agribusiness and Market Development;
iv. Collaboration with relevant stakeholders in the development of crop technologies;
v. Registration of new pesticides and herbicides in collaboration with other agencies.

The plant protection service division is under the above directorate and provides service on the control of regular and migratory pests. Its organizational structure extends through county, sub-county and down to wards and oversees the works of the pest control board of Kanya and the Kenyan plant health inspectorate service.

Pest Control Products Board of Kenya

The board is led by a board of directors and is run by a chief executive officer. There are three general managers under the CEO. The first one provides technical support service, the second one manages compliance and enforcement and the third one handles financial and administrative issues. It has set five strategic objectives to meet and include:

i. Ensure institutional stability
ii. Enhance capacity building on pesticide regulation
iii. Enhance compliance of pest control products to set standards
iv. Safeguard human health and environment from pesticide risk
v. Enhance information flow and communication

Kenya Plant Health Inspectorate Service (KEPHIS)

KEPHIS is the government parastatal whose responsibility is to assure the quality of agricultural inputs and produce to prevent adverse impact on the economy, the environment and human health. It is overseen by a board of directors and run by a manging director who oversees three general managers handling quality assurance, phytosanitary services and finance administration. Moreover there is an office which manages cooperation. The strategic objectives of this directorate include the following:

i. To protect plants from pests, weeds and invasive species.
ii. To facilitate review and strengthening of the policy, legal and regulatory framework, so that it is in tandem with both local and international agricultural sector emerging issues.
iii. To contribute towards improved levels of agricultural productivity.
iv. To support compliance to market requirements.
v. To build adequate technical and infrastructural capacity to facilitate efficient and effective delivery of the KEPHIS mandate.
vi. To mobilize adequate financial resources and ensure optimal allocation and utilization to enable full implementation of planned programmers and activities.
vii. To enhance synergies through information and resource sharing with stakeholders.
viii. To enhance the visibility and corporate image of KEPHIS

3.6.2 Pest management support services organizations in Tanzania

The organizational structure of the Ministry of Agriculture Food Security and Cooperation (MAFC) of the republic of Tanzania shows that the Ministry is led by a Minister under him is put a permanent secretary who oversees all the organizational activities. There are 12 support offices and six directorates. The directorates are led by designated directors and include research and development director, Training Institute Division Director, Crop Development Director, National Food security Director, Agriculture Land Use Planning and Management Director, Agricultural Mechanization Division Director.

The crop development directorate has four divisions manged by assistant directors and include Extension Service Assistant Director, Agricultural Inputs Assistant Director, Crop Promotion Assistant Director and Plant Health Assistant Director. The plant health services include management of migratory pests (quelea bird, armyworm, and locusts), larger grain borer, water hyacinth and also providing phytosanitary services.

3.6.3 Pest management support services organizations in India

The government of India has Ministry of Agriculture and farmers' welfare, which has three departments under it: department of agricultural research and education, department of agriculture, cooperation and farmers' welfare and department of animal husbandry, dairying and fisheries.

Under the department of agriculture and cooperation there is plant protection division, which oversees the directorate of plant protection, quarantine and storage and also the pesticide monitoring and

documentation. The department also coordinates activities related to the Rotterdam Convention. This directorate is subdivided into Integrated Pest management (23 stations), Plant quarantine (33 stations), Pesticides regulation, locust control (five circle offices and 23 outposts), and Human Resources Development. The pesticide regulation is again subdivided into three: Central Insecticide Laboratories, Secretariat of Central Insecticides Board/Registration Committee, and Regional Pesticides Testing Laboratories.

3.7 Previous pest management support services organization in Ethiopia

The implementation organogram that was operational in 1992 when the PMSS was rated competent after the different laboratories were established and the human resource was built to cope with the support service needed in the country at the time is annexed (Annex II). Then the pest management support service had been provided by the plant protection and regulatory department, which was dichotomized as crop protection and plant quarantine divisions. Further the crop protection division was subdivided into seven sections representing the major disciplines that should be addressed. The PMSS provision is currently organized, at the federal level, to be provided by three directorates, which are put under one directorate general. And they are: Plant Protection Directorate, Plant Health and Production Phytosantary Regulatory Directorate, Crop Varieties Registration Regulation and Seed Quality Regulatory Directorate.

The organizational structures of these countries are different from one another, but show commonality in how they are providing the different services, i.e., pest control, pesticide management and phytosanitary aspects. The services in Kenya are organized by putting standalone institutions, but fully under the supervision of the Ministry of Agriculture, livestock and Fishery whereas the structure in Tanzania puts the regulatory and pest control bodies in same organ. The Indian structure gives significant emphases to IPM and has put it at equal footing with quarantine, pesticide regulation and migratory pest control. Therefore by critically evaluating the three countries organizational structures and the previous organogram from Ethiopia the team felt that separating the regulatory from the other services or putting them all under same organizational structure are possibilities. Therefore, by taking into consideration the other countries experiences, the previous organogram from Ethiopia and the separate organograms developed for the three directorates (Annex III) two options are developed and illustrated below.

4. PEST MANGEMENT SUPPORT SERVICE STRATEGY

4.1 Vision, mission and values

Mission
Provide pest management support services that could significantly and sustainably reduce losses due to pests and ensure increased crop productivity and produces and products quality for domestic and export markets.

Vision
Create proactive and sustainable pest management support service system that promotes the growth and transformation of Ethiopian crop production, utilization and marketing in the 21st century.

Values

- Workforce integrity and professionalism
- Commitment to conventions and rules pertinent to plant protection
- Devotion to promotion of safety first pest management technologies
- Competence and dynamism in PMSS system
- Promote public and public-private partnership in pest management

4.2 Strategic goal

To create safe, environmentally friendly, cost effective and socially acceptable plant pests' management support services that contribute to sustainably increase crop production and productivity and thereby enhance marketing system for ensuring production distribution and proper utilization.

The objectives are to:

- enhance institutional and technical capacities to timely detect and response to eradicate or prevent the spread of new pest species,
- identify and prioritize effective and environmentally sound and socially acceptable pest management strategies to reduce pest incidence, restrict their distribution and reduce related yield losses.
- build technical capacity of implementing institutions including increased community awareness and involvement in pest management program to ensure sustainable development.

4.3 Strategic options /strategic directions

The following criteria were used to qualify whether an issue is critical to PMSS promotion: most central, biggest impact, most immediate and closest to values of PMSS provision.

1. **Policies, proclamations and regulations that are outdated, not enforced or absent**
   Strategic option chosen: Develop/improve policy document and submit for approval and seek enforcement awareness on the legislative documents created at all levels.
2. **Pest management laboratories non-functional or poorly equipped**
   Strategic option chosen: Establish and expand the national pest management laboratories and regional plant health clinics and quarantine posts.
3. **Pest focused biosystematics not organized or inadequate**
   Strategic option chosen: Establish national biosystematics center
4. **Capacity and coordination/linkage of PMSS poorly developed**
   Strategic option chosen: Develop material and human capacity with a viable coordination/linkage mechanism
5. **Poor awareness on PMSS policies, legal provisions and practices**
   Strategic option chosen: Create and/or raise awareness of all stakeholders at all levels
6. **Clearly undefined mandate and system in PMSS**
   Strategic option chosen: Define mandate and harmonize the system of PMSS provisions
7. **Poor phytosanitary services and low focus on invasive alien species**
   Strategic option chosen: Upgrade the country's phytosanitary services to meet the international standards
8. **Information communication technologies least used in PMSS**
   Strategic option chosen: Establish national ICT usage in PMSS
9. **Misuse/abuse of pesticides and lack of tracking mechanism**
   Strategic option chosen: Strengthen post-registration pesticide management system
10. **Limited experiences in IPM promotion**
    Strategic option chosen: Promote IPM in PMSS

4.4 Expected outputs of the strategic options

1. Policies and regulations that are outdated are updated, those not enforced to date enforced and new ones developed
2. Pest diagnostic laboratories, pesticide analytical laboratory and seed health laboratories brought back to functional form, existing plant health clinics upgraded and new ones established as needed and quarantine facilities, all across the country, enhanced and/or established

3. Pest focused biosystematics facilities established and made operational
4. Capacitated PMSS with efficient and responsive coordination and linkage mechanism put in place
5. PMSS proactive policies, legal provisions and practices accorded by the government are adapted fully by decision makers at all levels
6. Mandates of providers of PMSS at all levels clearly defined and they operate in a system that allows all involved to smoothly exchange up to date pest related information sources all across the country in fast tracks and carry out or support pest management operations accordingly
7. The sanitary and phytosanitary services of the country made responsive to safeguarding the country from further introduction of alien pests and also within the country movement of introduced alien pests to unaffected areas
8. Use of information communication technologies in PMSS mainstreamed and implemented
9. Appropriate mechanism to regulate the registration, quality, movement, application, storage and disposal of pesticides deployed
10. IPM effectively promoted in the smallholder agriculture, which accounts for more than 90% of the annual agricultural produces and pesticide misuse and abuse significantly reduced.

4.5 Strategic actions and indicative budget (2015-19)

The strategy implementation period is five years. In this respect, the indicative budget is also worked out for the next five years as indicated on table 4. Annual detailed budget shall be worked out by the federal and respective regions for activities that fall within their jurisdiction.

Table 4. Strategic issues and the planned strategic actions and indicative budget for each critical issue for 2015-2019

No.	Strategic issue	Proposed strategic actions	Responsible body	Time table					Resource required
				2015	2016	2017	2018	2019	
1	Develop/improve policy document and submit for approval and seek enforcement	Draft national and regional phytosanitary proclamation	MoANR	■					**878100.00**
		Upgrade and enforce the plant quarantine regulation	MoANR	■					**641700.00**
		Finalize pesticide registration and control regulation	MoANR	■					**477020.00**
		Develop directives for enforcement of quarantine and pesticide regulations and also for biopesticides	MoANR	■					**2074200.00**
		Create awareness on the legislations and regulations at all level	MOANR, Regions	■					
2	Establish and expand the national pest management laboratories and regional plant health clinics and quarantine posts.	Establishing national pest diagnostic laboratories, greenhouses and insectary	MoANR, EIAR/NARS, Universities	■	■	■	■		**246000000.00**
		Establishing national analytical laboratories	MoANR, EIAR/NARS Universities		■	■	■		**41800000.00**
		Establishing and upgrading plant health clinics	MoANR, and National Regions		■	■	■		**80700000.00**
		Establishing and expanding quarantine posts	MoANR, and National Regions		■	■	■		**48000000.00**
3	Establish national biosystematics center	Equipping the centre with the necessary facilities and infrastructure	MoANR,			■	■	■	**65920000.00**
		placing competent taxonomic experts in various disciplines	MoANR			■	■	■	
		Training and developing the required human resource	EIAR/NARS, Universities			■	■	■	
4	Develop material and human capacity	Improving resource allocation for running PMSS across the country,	MoANR,	■	■	■	■	■	**80490000.00**
		• Allocation of budget	National regions		■	■	■	■	
		• Workout appropriate organizational structure both at the federal and region level	MoANR and National regions		■	■	■	■	
		• Allocate vehicle	National regions		■	■	■	■	
		• Give technical support and training	MoANR		■	■	■	■	
		• Training and developing the required human resource,	Universities		■	■	■	■	
	Create and/or raise awareness of all stakeholders at all levels	Producing different awareness creation/enhancement tools	MoANR,		■	■			**3000000.00**
		Establishing awareness raising platforms	MoANR, National Regions	■					
		Engaging regularly with stakeholders at all levels	MoANR, National Regions		■	■	■	■	**612000.00**
6	Define mandate and harmonize the system of PMSS provisions with a viable coordination/linkage mechanism	Clearly defining pest management support service for regular pests	MoANR, National Regions	■					**1500000.00**
		Drafting and approving directives and guidelines on PMSS implementation	MoANR, National Regions	■					

No.	Strategic issue	Proposed strategic actions	Responsible body	Time table					Resource required
				2015	2016	2017	2018	2019	
		Defining responsibility of federal and regional institution	MoANR, National Regions						
		Creating appropriate coordination mechanism for stakeholders,	MoANR, EIAR/NARS, National regions						
		Establishing strong linkage among institutions	MoANR, EIAR/NARS, National regions						
7	Upgrade the country's phytosanitary services to meet the international standards	Strengthen quarantine inspection services	MoANR,						**10048500.00**
		Develop pest risk analyses protocol	MoANR, NARS						
		Establish post entry quarantine	MoANR, NARS						**1568000.00**
		Put in place early detection and rapid response system	MoANR, National regions						**6034000.00**
		Establish national surveillance system	MoANR, EIAR/NARS, National regions						
		Establish system to identify free and low pest prevalence areas	MoANR,						
	Manage established invasive alien species in the country	Design and implement management options for established invasive alien species	MoANR, EIAR/NARS, National regions, MoEF, MoWE, MoTrans						**3400000.00**
8	Establish national ICT usage in PMSS	Identify personnel to be trained on ICT related to pest management	MoANR, EIAR/NARS, National regions,						**2500000.00**
		Train staff in ICT related to pest management	Universities						**612000.00**
		Develop database software for pest management	MoANR						
9	Strengthen pre- and post-registration pesticide management system	Create wider awareness on pesticides management	MoANR, National regions						**2500000.00**
		Enforce the available pesticide registration and control legal provisions	MoANR, National regions						
		Implement nationwide PSMS (Pesticide stock management system) and promote pesticide stewardship	MoANR,						
10	Promote IPM in PMSS	Determine crop-pest combinations for IPM implementation	MoANR, NARS, National regions						
		Develop or search and adopt pest and crop management practices for identified crop pest combinations	NARS, National regions						**33000000.00**
		Produce guidelines for use	NARS, National regions						
		Implement IPM through FFS and other appropriate mechanisms	MoANR,, National regions						
	Total indicative budget								**631755520.00**

4.6 Implementation of the strategy

4.6.1 Roles and responsibilities of stakeholders in PMSS implementation

The PMSS in its present setting has been one of the primary causes for the recent upsurge of regular pests, unchecked movement of quarantine pests that have been affecting the most economic crops in the country. The most recent unfortunate scenarios are the epidemics of stem and yellow rusts on wheat, cotton mealybug on cotton, mango white scale on mango, the South American tomato fruit worm, *Tuta absoluta* on tomatoes, and the maize lethal necrosis disease (MLND) on maize and the invasive weeds such as the wild tobacco, etc

The need for appropriate shares of responsibilities and accountabilities in PMSS implementation can be illustrated by taking the case of the MLND incidence in relation to the national PMSS provision. Critical gaps were observed, which allowed the introduction and spread of this disease on the most strategic grain crop of the country, maize. The MLND is caused by viruses, which require molecular diagnosis to detect their presence in maize seed lots being introduced into the country and on growing maize plants in the field. Because there was no laboratory that could provide such diagnostic service, and technical knowledge and expertise, the disease was introduced into the country and spread quickly in the seed growers' farms unnoticed. The problem was noticed after significant loss was sustained by maize seed growers. In 2014, some seed growers in the rift valley lost all their harvest due to the disease.

It was realized that the maize seed growers use the emasculation technique to detassel maize florets from the female parent instead of using male sterile lines when producing hybrid seeds. While the laborers exercise this, they might have spread MLND causing viruses mechanically. This might have been the primary cause for the high disease incidence and significant seed losses sustained by many maize seed growers who have been working in the rift valley. Therefore, the causes for the introduction and spread of MLND could be attributed to gaps that existed at different levels in the PMSS, which include gaps in the phytosanitary service, gaps in diagnosing the disease in the maize fields , technical capacity gaps at seed grower farms, gaps in surveillance, survey and monitoring of pests, lack of effective coordination between seed growers and PMSS providers such as PHCs or plant protection experts at zones, woredas and kebeles; gaps in pest information exchange...

In general if the PMSS had put the capabilities, responsibilities and accountabilities of all actors in the agriculture and other sectors; and all the responsible bodies were facilitated well to perform their respective tasks, it should not have been that accessible for such devastating pests to set foot and spread in the country easily. The entry into the country and spread could have been curbed if the following bodies could adequately fulfill the responsibilities indicated hereunder. The same approach is applicable to control outbreaks of regular pests, migratory pests and entry and spread pf other pests. Therefore, it is important to clearly stipulate the responsibility and accountability of the actors in the national PMSS as follows.

Federal Plant Health Regulatory Directorate

1. Develop or improve PMSS related laws, regulation and directives, communicate to all beneficiaries, proactively supervise enforcement, collect feedbacks and improve legal provisions;
2. Coordinate at the national level PMSS provision on regular, migratory and newly establishing quarantine pests;

3. Nationally coordinate pest surveillance, survey and monitoring on regular, migratory and quarantine pests and run pest information exchange network across the country;
4. Run all the national diagnostic laboratories that are instrumental in identifying economic (regular and migratory) and quarantine pest species and also the analytical laboratories;
5. Organize regular trainings, implement capacity building initiatives and experience sharing events to higher level plant protection experts;
6. Carry out phytosanitary services both at national and regional levels (domestic quarantine);
7. Regulate nationally pesticide registration, distribution, application, and disposal;
8. Produce pest information communication materials and distribute them across the country
9. Establish national pest data base and administer the system;
10. Render technical and material backstopping to regional PMSS providers;
11. Represent the country in all forums being organized on plant protection related issues.
12. Work with partners in soliciting funding to carry out PMSS related programs;

Regional Plant Health Regulatory Bodies

1. Enforce pest related national laws, regulations and guidelines and provide feedbacks regularly to the national authorities;
2. Coordinate in a national region PMSS provision on regular, migratory and newly establishing quarantine pests;
3. Coordinate in a national regions pest surveillance, survey and monitoring on regular, migratory and quarantine pests and take part in pest information exchange network across the country;
4. Run the PHCs which are instrumental in identifying economic pests (regular and migratory) and quarantine pest species in a national region and also establish more PHCs as deemed necessary;
5. Organize regular trainings and experience sharing events to plant protection experts in a national region;
6. Carry out phytosanitary services in a national region;
7. Enforce national regulations on pesticide management in a national region
8. Produce national region specific pest information communication materials and distribute across a regions;
9. Provide pest related information regularly to help update a national pest data base;
10. Render technical and material backstopping to PMSS providers in a national region;
11. Represent anational region in all forums being organized on plant protection related issues.
12. Assign adequate PMSS staff in a region.

Zonal Plant Health Regulatory Bodies

1. Enforce pest related national laws, regulations and guidelines and provide feedbacks regularly;
2. Coordinate as well as carry out in a zone PMSS provision on regular, migratory and newly establishing quarantine pests;
3. Coordinate as well as carry out in a zone pest surveillance, survey and monitoring on regular, migratory and quarantine pests and take part in pest information exchange network across the country;
4. Run the PHCs which are instrumental in identifying economic (regular and migratory) and quarantine pest species in a zone;
5. Organize regular trainings and experience sharing events to plant protection experts in a zone;
6. Carry out and phytosanitary services in a zone;

7. Enforce national regulations on pesticide management in a zone
8. Distribute pest information communication materials;
9. Provide pest related information regularly to the national pest data base through a national region;
10. Render technical and material backstopping to PMSS providers in a zone;
11. Represent the zone in all forums being organized on plant protection related issues.
12. Assign adequate PMSS staff in their respective a zone.

Woreda Plant Health Regulatory Bodies

1. Enforce pest related national laws, regulations and guidelines and provide feedbacks regularly;
2. Coordinate as well as carry out in a woreda PMSS provision on regular, migratory and newly establishing quarantine pests;
3. Coordinate as well as carry out in a woreda pest surveillance, survey and monitoring on regular, migratory and quarantine pests and take part in pest information exchange network across the country;
4. Utilize the services of PHCs, which are instrumental in identifying economic (regular and migratory) and quarantine pest species in a woreda;
5. Organize regular trainings and experience sharing events to development agents and contact farmers in a woreda;
6. Carry out and phytosanitary services in a woreda;
7. Enforce national regulations on pesticide management in a woreda
8. Distribute pest information communication materials;
9. Provide pest related information regularly to the national pest data base through the zones
10. Render technical and material backstopping to development agents and contact farmers in a woreda;
11. Represent a woreda in all forums being organized on plant protection related issues.
12. Assign adequate PMSS staff in a a woreda.

Kebele Plant Health Regulatory Bodies

1. Enforce pest related national laws, regulations and guidelines and provide feedbacks regularly;
2. Carry out PMSS on regular, migratory and newly establishing quarantine pests;
3. Carry out pest surveillance, survey and monitoring on regular, migratory and quarantine pests and take part in pest information exchange network across the country;
4. Utilize the services of PHCs, which are instrumental in identifying economic (regular and migratory) and quarantine pest species in a kebeles;
5. Organize regular trainings and experience sharing events to contact farmers in a kebeles;
6. Carry out sanitary and phytosanitary services in a kebeles;
7. Enforce national regulations on pesticide management in a kebele
8. Distribute pest information communication materials to farmers;
9. Provide pest related information regularly to the national pest data base through a kebele;
10. Render technical and material backstopping to farmers in a kebeles;
11. Represent a kebeles in all forums being organized on plant protection related issues.

PMSS by National Agricultural Research System

1. In consultation with PMSS providers at national, regional, zonal, woreda and kebele levels gather data on current economic pest problems that need to be addressed;
2. Develop research topics on the current economic pest problems
3. Adapt and/or generate and transfer technical information, knowledge and skills on the management of current economic pests;
4. Take part in the provision of technical trainings and experience sharing events;
5. Proactively participate in crop pest information exchange network;
6. Contribute to the strength of the national pest data base;
7. Take part in all forums being organized on plant protection related issues.

PMSS by Higher Learning Institutions

1. Conduct national needs assessment for plant protection experts;
2. Define the study curricula accordingly;
3. Proactively work to attract competent students to join agricultural and plant protection related fields of study;
4. Produce competent plant protection professionals;
5. Carry out research on topics related with the current economic pest problems;
6. Adapt and/or generate and transfer technical information, knowledge and skills on the management of current economic pests;
7. Take part in the provision of technical trainings and experience sharing events;
8. Proactively participate in the pest information exchange network;
9. Contribute to the strength of the national pest data base;
10. Take part in all forums being organized on plant protection related issues

Other Responsible Institutions

Ministry of Environment, Forest and Climate Change, Ministry of Transport, Roads Authority and others including government and private plant protection products suppliers are also important partners and have their shares of responsibilities in promoting sustainable PMSS.

This PMSS implementation mechanism gives significant rooms wherein the private sector can engage in PMSS such as involvement of the unemployed use as trained pesticide applicators and pest management inputs (local multiplication of biocontrol agents) suppliers, in pesticide disposal by joining with different private importers or users, contribute in the national pest surveillance data acquisition, in provision of training in pest management and consultation in policy formulation….

4.6.2 Organograms to implement the PMSS in Ethiopia

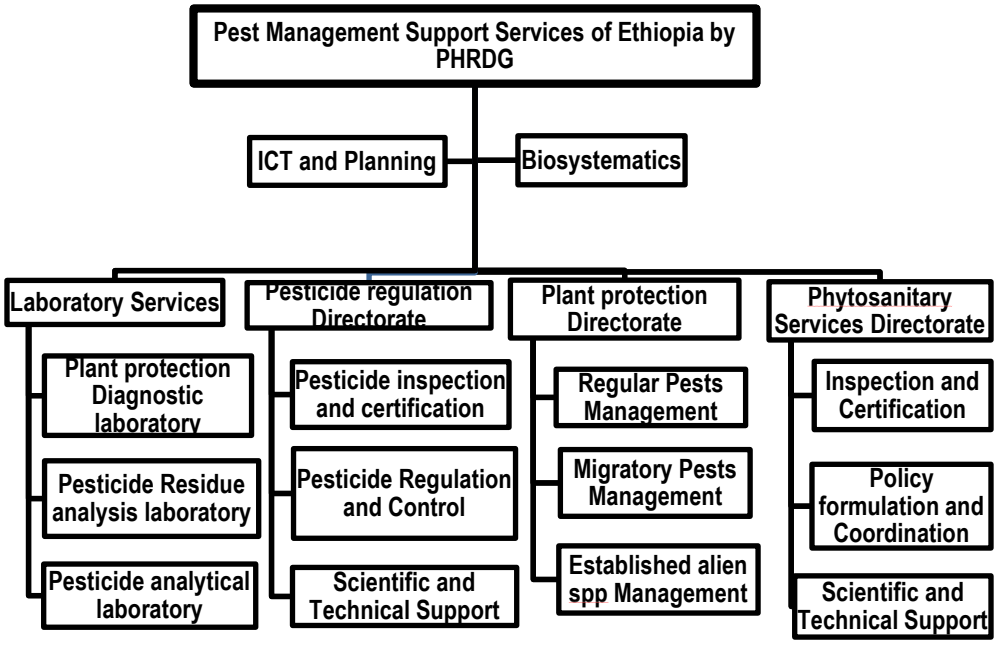
Organogram Option 1

The plant health and regulatory directorate general leads the pest management support service in the country. It gets ICT, planning and biosystematics technical supports and is divided into laboratory services, pesticide regulation, plant protection and phytosanitary services directorates.

The ICT technical support focuses on pest information collection, processing, storage and communication through a national pest network. The planning component provides support in planning, monitoring and evaluation of pest management support services. The biosystematics will help in holding national voucher specimens collection and maintenance and provision of pest identification services. The laboratory

services handle plant protection diagnostics (plant pathology, entomology, weeds science, vertebrate pests…), pesticides residue analyses and pesticide analytical laboratories.

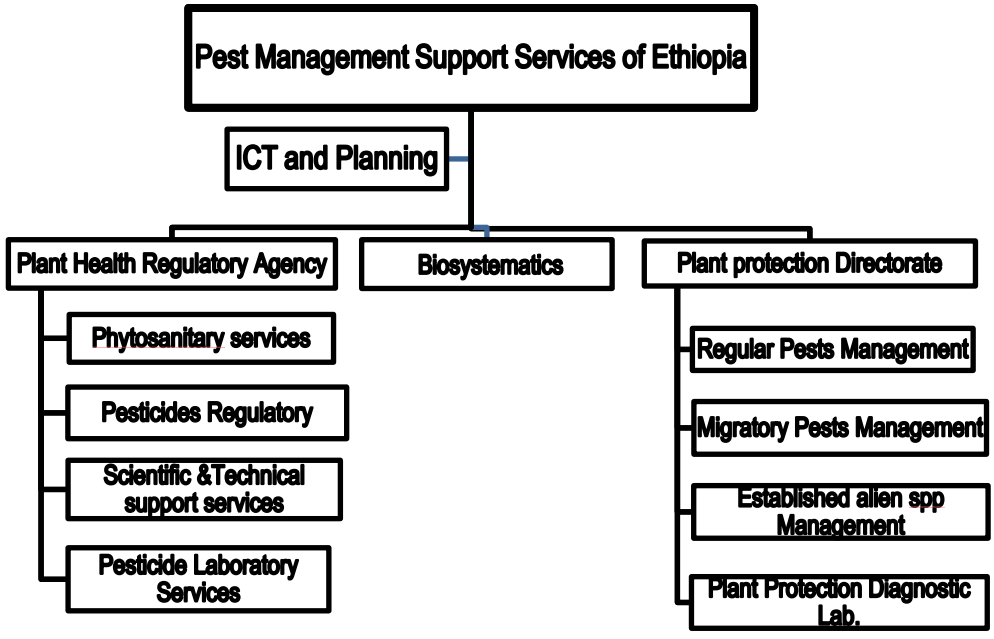
The pesticide regulation directorate has three components under it: pesticide inspection and certification, pesticide registration and control, scientific and technical support. The plant protection directorate has regular pest management, migratory pest management and established invasive alien species management under it. Phytosanitary service directorate contains inspection and certification, policy formulation and coordination and scientific and technical support. The laboratory services will be led by a director.



Organogram Option 2

The pest management support services in the country is governed by two independent organs namely plant health regulatory agency and plant protection directorate being accountable to the Ministry of Agriculture and Natural Resources. The ICT, planning and biosystematics technical supports are as described in option one above.

The ICT technical support focuses on pest information collection, processing, storage and communication through a national pest network. The planning component provides support in planning, monitoring and evaluation of pest management support services. The biosystematics will help in holding national voucher specimens collection and maintenance and provision of pest identification services. The plant health regulatory agency encompasses phytosanitary services, pesticide regulatory services, scientific and technical support services and pesticide laboratory services whereas the plant protection directorate includes regular pest management, migratory pest management, established alien invasive pests management and plant protection diagnostic laboratories.



4.6.3 Implementation arrangement and coordination

The PMSS implementation arrangement deals with mainly on the management of migratory, regular and quarantine pests and focuses on pest prevention, containment and eradication strategies. The prevention strategy is mainly the responsibility of the Plant Health and Production Phytosantary Regulatory Directorate whereas pest containment and management is the responsibility of the Plant Protection Directorate. The Plant Health and Production Phytosantary Regulatory directorate carries out both domestic and international quarantine related issues and perform all the activities in policy area, capacity development and quarantine laws development and enforcement. On the other hand, the plant protection directorate implements the containment and management of migratory and regular pests as well as newly established introduced pests threatening different economic crops such as parthenium weed, cotton mealybug, maize lethal necrosis disease…. The two directorates are not mutually exclusive in their responsibilities and share many things in common.

The organization of PMSS in the regional bureaus of agriculture across the country is still as it used to be since the start of the implementation of the BPR in 2006. The organizational structure and manpower situation in relation to PMSS is the placement of a lone plant protection expert in the extension directorate of each region who is expected to coordinate the provision of crop protection related extension services in the respective regions at large.

In all the national regions the PMSS provision is left entirely for the extension directorates in the respective national regions and the zones, woredas and kebeles in them. As they are, the processes are not well organized to respond to the current needs of farmers across the country on how to manage pests of economic importance. In general, the PMSS system in the national regions across the country is currently non-responsive to the needs of farmers due to the downsized manpower in crop protection and its consideration as one service in crops packages to be delivered by the extension directorate, the lower budget allocated for the service and critical shortage of transport and laboratory facilities and the disincentive to the experts in plant protection due to the lack of attention to their career development.

Although the role of plant health clinics (PHC) in providing crop protection related technical backstopping have never been clearly defined, the extension processes in the respective national regions have been utilizing the services of the professionals in the PHC whenever there were pest problems of outbreak proportions. Thus the PMSS in the national regions needs to be looked into and changed in order to make it more responsive to the demands of farmers. Therefore, similar organizational structures adopted by the federal MoANR should be considered by putting the PHCs at the core to coordinate pest management provisions.

The PMSS implementations in the regions need to start by having in place professionals in plant diseases, insect pests, weeds and vertebrate pests' managements as well as in plant quarantine and postharvest pest management. Where there are PHCs in the national regions' sits of regional government such as in Tigray, Amhara and SNNPR, it is possible to make use of them as pest management implementation core units for the respective regions.

At zonal levels, existing PHCs could take the responsibility, but in the absence of a PHC, plant protection professionals in plant pathology, entomology and weed science should be recruited, assigned to work in the zonal BoA and receive significant in service trainings before getting them involved in pest management routines. On the other hand, at woredas level, a generalist expert who can handle plant protection related issues in collaboration with agronomists and crop production experts could suffice, as they will get significant backstopping primarily from the zonal experts.

Overall the implementation should be nationally coordinated by the Plant Health Regulatory Directorate of the MoANR through the two directorates under it, which should connect in broken lines with the regional bureaus of agriculture and also with the different plant health clinics for increased pest information exchange and networking.

The PHCs should continue to be directed by the respective national regional bureaus of Agriculture and work with all the zones, woredas and FTCs in the regions. This should work both for pest management and plant quarantine services. The PHCs are also expected to provide technical support for the zonal bureaus of agriculture in their respective national regions. The current number and location of PHCs is not sufficient to provide efficient PMSS across the country hence the zonal bureaus are expected to provide regular support to all the woredas within them. In turn the woreda offices are expected to provide similar service to FTCs and farmers.

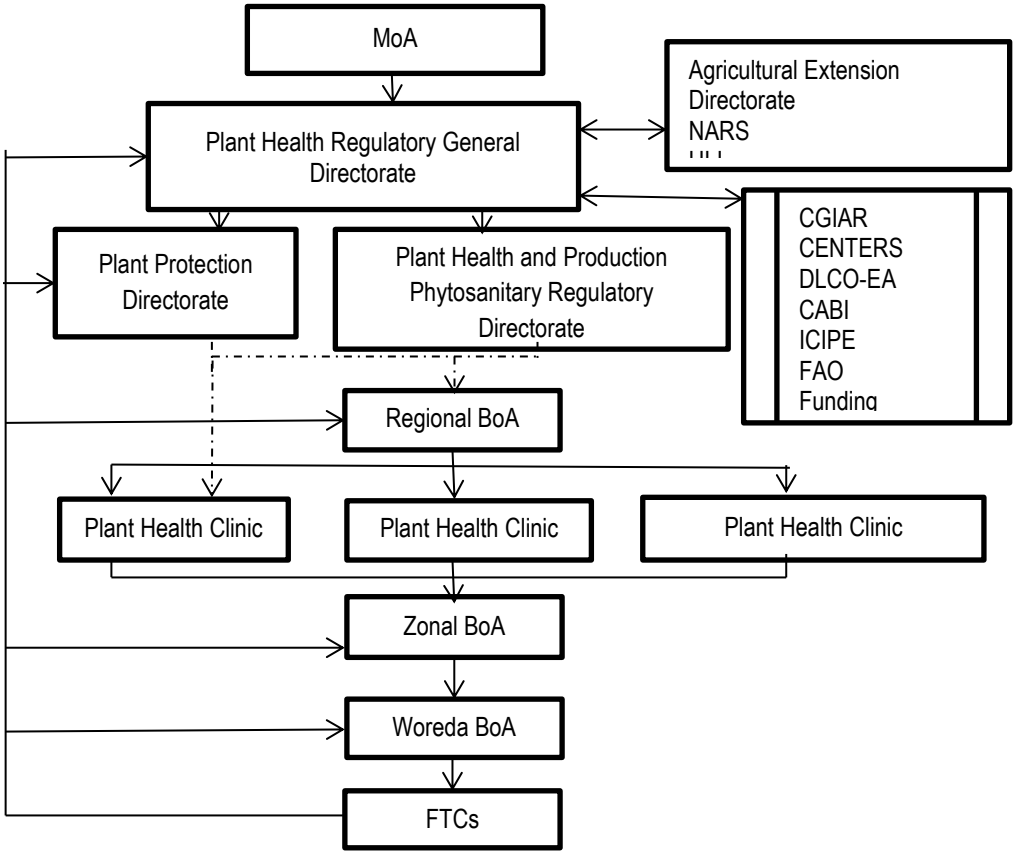
The country does not have well developed pest information exchange system due to both lack of a system to promote the network and also lack of sufficient professionals who can conduct pest identification services and provide feedback to the higher and parallel placed offices. Due to this the status of regular pests around the country at anyone season are not known fully, introduction and establishment of new pests go unnoticed and are intercepted only after they caused significant economic damage to different economic crops. Because of this we need to put in place pest information exchange network with efficient feedback loops at all levels in the PMSS workflow.

The organogram described below demonstrates that we need to have two ways of interaction at all levels so that pest information flow between all the actors in the PMSS could be fastened. The entire PMSS should continue to get significant support from the extension directorate of the MoANR in receiving

information on current pest problems; from NARS in getting technical support to manage pest problems; from higher learning institutions in developing trained human resource who in the future will join the workforce in the PMSS and are well informed about the needs of farmers that should be addressed while getting trained. However, the linkage with higher learning institutions has been poor and the number of students joining plant protection related fields has been declining significantly. Currently high calibre students are not showing interests to join agriculture fields and the situation is worse in plant protection. Therefore, the causes for this scenario need to be understood and solutions found in order to reinvigorate the PMSS of the country.

4.6.4 Implementation resource needs

Although the government of Ethiopia is fully committed to reinvigorate the PMSS in the country, the resources being allocated may not be sufficient enough to cater for all the needs of this long neglected service. Therefore we need to continue seeking for financial and technical supports from global and regional institutions, which should be the responsibility of the PHRD to perform. This cannot easily be facilitated by leaving it to the responsible directorates in the MoANR and it was agreed to have in place a plant protection advisory council as soon as possible. The PMSS advisory council/board that will be established will advise and provide technical backstopping to the MoANR in the implementation of the PMSS strategy and soliciting of funds to address the most salient problems identified in this strategy document. Its form and detailed operational modality will be put together and presented to the State Minister.



4.7 Monitoring and evaluation in PMSS implementation

Table 6. Detailed monitoring and evaluation activities during the promotion of the detailed PMSS provision related activities

Evaluation	Monitoring				
	Monitoring question	**Indicators**	**Data sources/Methods**	**Responsibilities**	**Timeframe**
Policy needs addressed	Are all the required laws, regulations and guidelines current?	Documents produced and enforcements witnessed	MoANR, National regions,	MoANR, National regions,	Two years later
PMSS organizational structure adopted	Is the PMSS structure put in place responsive to the needs of the country?	Pest problems successfully addressed	MoANR, National regions,	MoANR and BoA	One year later
Human resource situation in PMSS providers	Is the needed human resource fulfilled?	Fully staffed PMSS team present at all levels	MoANR, National regions,	MoANR and BoA	One year later
	Are they capable of providing the services?	Presence of well trained and responsive staff	MoANR, National regions,	MoANR, BoA, NARS, HLI	One year later
National and regional plant protection laboratories situation	Are all the different laboratories needed in PMSS put up?	Appropriate buildings put up to house the different laboratories	MoANR, National regions,	MoANR, National regions,	Three years later
	Are the different laboratories needed in PMSS fully equipped and running?	Laboratories well equipped Needed facilities fulfilled Needed expendables supplied	MoANR, National regions,	MoANR and BoA	Three years later
PMSS provision situation	Are PMSS providers coordinated and linked within and between national regions and at the federal level?	PMSS providers are current in their knowledge of pest problems and management from across the country	MoANR, National regions, zones, woredas, NARS, HLI	MoANR, National regions, zones, woredas, NARS, HLI	One year later
	Are farmers receiving pest forecasting data and management advices?	Transport facility put in place and survey and monitoring data gathered, processed and shared	MoANR, National regions,	MoANR, National regions, zones, woredas, NARS, HLI	Ever year
	Are plant protection experts at all levels and farmers receiving trainings regularly?	Trainings organized/offered	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles, NARS, HLI	Ever year
	Are pest control operations technically supported regularly?	Pest problems/outbreaks effectively controlled	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles	Ever year
	Are invasive pests being managed?	Reduction of threats from invasive pests	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles	Ever year
IPM promotion	Is IPM promoted in the smallholders?	Pesticide use reduction	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles	Two years later

Evaluation	Monitoring				
	Monitoring question	**Indicators**	**Data sources/Methods**	**Responsibilities**	**Timeframe**
	Are the needed IPM promotion resources availed?	Distributed knowledge and skill resources	MoANR, National regions, NARS and HLI	MoANR, National regions, zones, woredas, kebeles, NARS, HLI	Two years later
	Are farmers organized into IPM-FFS?	Team work	MoANR, National regions, NARS and HLI	MoANR, National regions, zones, woredas, kebeles, NARS, HLI	Two years later
ICT usage in pest management	Are pest problems communicated fast and on a regular base?	Timely control of pest problems effected	MoANR, National regions,	MoANR, National regions, zones, woredas, NARS, HLI	Two years later
Plant quarantine services situation	Are the laws and regulations made current?	Intercepted and eradicated quarantine pests	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles	Two years later
	Are the plant quarantine laboratories put up?	Appropriate buildings put up to house the different laboratories	MoANR, National regions,	MoANR, National regions	Three years later
	Are the posts equipped and facilitated?	Laboratories equipped Needed facilities fulfilled Needed expendables supplied	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles	Three years later
	Are the posts staffed fully?	Quarantine threats reduction	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles	Two years later
	Are the posts networked?	All staff fully aware of the country's current situation	MoANR, National regions,	MoANR, National regions, zones, woredas, kebeles	Three years later

4.8 Risks and assumptions

Table 1 Risk matrix for pest management support service strategy implementation

Risk	Impact	Probability	Mitigation
Uncontrolled or unregulated activities performed by different stakeholders involved in pest management operations across the country	Poor pest management system rules over the country	Very high	• Enforce existing laws, regulations and guidelines • Develop the missing laws, regulation and guidelines • Create wider awareness on the laws, regulations and guidelines available in the country
The PMSS strategy not owned by all stakeholders	Uncoordinated and emergency response based tactical pest control continue to be the norm	Very high	• Circulate the PMSS strategy document • Wider awareness creation • Provision of technical trainings
The diagnostics laboratories and the plant health clinics failing to respond to the country's needs	Economic damage by pests increases and farmers continue taking actions as tradition dictates	Very high	• Putting up the national laboratories • Fully capacitating the labs in the shortest time possible • Provide specialized and long term technical trainings • Provide sufficient funding sustainably • Develop a mega project/program
Stakeholders failing to work in coordination		Very high	• Establish national platform • Put in place an efficient network for exchange of pest related information • Employ current ICT gadgets
Threat from economic pests continue to be a threat to smallholder farmers	Infestation and economic damage by pests increases	Very high	• Recruit capable experts • Aggressively train junior experts • Boost the material capacity of the service providers • Strengthening pest surveillance, survey and monitoring • Establish an efficient pest network Ethiopia • Deliver effective control technologies • Train farmers regularly on how to manage economic pests
Effective insecticides not delivered	Infestation and economic damage by pests increases	Very high	• Enforce the pesticide law • Regulate the quality of imported pesticides • Train farmers on the safe use of recommended and registered pesticides Fast delivery of insecticides ensured
Failing to promote biological control of economic pests	Dependency on the use of pesticides will continue		• Build the capacity to use biocontrol agents by establishing the national biological control laboratory

Risk	Impact	Probability	Mitigation
			• Promote the significance of natural enemies in controlling economic pests
Failure to intercept all incoming quarantine pests and local movement of new pests between different agro-ecologies	Establishment and spread of new pests that cause significant economic damage	Very high	• Strengthen the capacity of existing quarantine posts • Establish new quarantine posts • Train experts regularly • Create wider public awareness on the negative impacts of introduced pests • Public mobilization to eradicate incipient populations of quarantine pests • Establish internal quarantine system
Misidentification of pests and provision of wrong recommendations on how to control them	Economic damage by pests will continue	Very high	• Establish biosystematics laboratory • Build the material and human capacity of the lab • Provide expert identification service of pests • Build the pest collection of the country for future use
Failing to promote IPM in all farming systems and agro-ecologies	Dependency on the use of pesticides will continue		• Train experts on IPM and its means of promotion • Produce IPM implementation guidelines for the economic pests affecting crop production in the country • Create wider awareness in decision makers, development workers, farmers and others • Mobilize smallholder farmers across the country to adopt IPM

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Annex I: Selection of strategic options to address the critical issues

The following criteria were used to qualify whether an issue is critical to PMSS promotion: most central, biggest impact, most immediate and closest to values of PMSS.

1. **Policies and legislative provisions outdated, not enforced or absent**

   Strategic option 1:
   - Develop/improve policy document and submit for approval and seek enforcement

   Strategic barrier
   - This option may take time to finalize, which may also require human and material resources.
   - Perception of decision makers on the significance they may attach to the current provisions

   Strategic option 2: Adopt policy recommendations and regulations from international bodies for which Ethiopia is a signatory

   Strategic barrier
   - It does not take into account country specific economic, social, political and environmental conditions.

   Strategic option 3: Advocate the current provisions and work under this environment

   Strategic barrier
   - Some of the issues will remain unaddressed
   - The outdated provisions will be adhered

   Option 1 is found to be more appropriate and needs to be taken for program development because it responds very well to the strategic issue. The following are the program highlights:
   a) Draft phytosanitary proclamation
   b) Upgrade and enforce the plant quarantine regulation
   c) Finalize pesticide registration and control regulation
   d) Develop directives for enforcement of quarantine and pesticide regulations and also for biopesticides

2. **Pest management laboratories non-functional or poorly equipped**

   Strategic option 1: Establish and expand the national pest management laboratories and regional plant health clinics and quarantine posts.

   Strategic barrier
   - Requires significant funding and expertise
   - Rigid and inadequate remuneration

   Strategic option 2: Strengthen the existing national and regional pest management laboratories and quarantine posts

   Strategic barrier
   - The service will not reach all who need it
   - Increasing threat of quarantine pests and pest status shift

   Although option one requires the allocation of significant funding, it will allow us respond better to the increasing threat of pests in general. Based on these the following are the areas that require interventions:
   a) Establishing national pest diagnostic laboratories and greenhouses /insectary
   b) Establishing national analytical laboratories
   c) Establishing and upgrading plant health clinics
   d) Establishing and expanding quarantine posts

3. **Pest focused biosystematics not organized or inadequate**

   Strategy: Establish national biosystematics center
   a) Establishing center for national reference collection
   b) Equipping the center with the necessary facilities and infrastructure

c) Training and placing competent taxonomic experts in various disciplines

4. **Capacity and coordination/linkage of PMSS poorly developed**

Strategy: Develop material and human capacity with a viable coordination/linkage mechanism

a) Improving resource allocation for running PMSS across the country,
b) Training and developing the required human resource,
c) Creating appropriate coordination mechanism for stakeholders,
d) Establishing strong linkage among institutions.

5. **Poor awareness on PMSS policies, legal provisions and practices**

Strategy: Create and/or raise awareness of all stakeholders at all levels

a) Producing different awareness creation/enhancement tools
b) Establishing awareness raising platforms
c) Engaging regularly with stakeholders at all levels

6. **Clearly undefined mandate and system in PMSS**

Strategic option 1: Define mandate and harmonize the system of PMSS provisions

Strategic barriers

- Resistance to this option in the name of constitutional provisions

Strategic option 2: Harmonize existing PMSS provisions

Strategic barriers

- Failure to respond to current needs promptly
- Inability to fulfill accountability
- Lack of concern to responsibilities

Option one focuses on defining the mandates of pest management bodies at the federal and regional levels. Moreover, the different stakeholders need to harmonize their working procedures for better execution of PMSS related activities. To these effects the following need to be addressed:

a) Drafting and approving directives and guidelines for federal and regional institution on PMSS implementation
   - Improving pest management support service for migratory pests
     - Conducting regular survey, monitoring and reporting
     - Strengthening pest forecasting and early warning system and exchange situation data nationally and internationally
     - Updating national migratory pests database
     - Providing control, technical backstopping and advisory services
     - Offering trainings on pest management at all levels
     - Facilitating delivery of supplies and logistics
   - Clearly defining pest management support service for regular pests and stipulate responsibilities of institutions by considering the following services:
     - Producing updated national pest checklist database
     - Conducting regular pest survey, monitoring and reporting
     - Strengthening pest forecasting and early warning system
     - Providing pest identification service
     - Providing technical backstopping and advisory service to growers on pest and pest management
     - Offering trainings on pest management at all levels
     - Facilitating delivery of supplies and logistics
     - Developing and demonstrating pest management packages and technologies for different users
     - Developing economic pest and pest management database

7. **Poor phytosanitary services and low focus on invasive alien species**

Strategies:

- Upgrade the country's phytosanitary services to meet the international standards
  - Establish national surveillance system
  - Strengthen quarantine inspection services

- Undertake pest risk analyses
- Put in place early detection and rapid response system
- Establish post entry quarantine

➢ Design management for established invasive alien species in the country
- Design/implement management options for established invasive alien species

8. Information communication technologies least used in PMSS

Strategy: Establish national ICT usage in PMSS

a) Train staff in ICT related to pest management
b) Develop database software for pest management
   - Establish pest information exchange network
   - Develop cell phone SMS platform for pest monitoring, forecasting and reporting
   - Put in place satellite aided information exchange

9. Misuse/abuse of pesticides and lack of tracking mechanism

Strategy: Strengthen post-registration pesticide management system

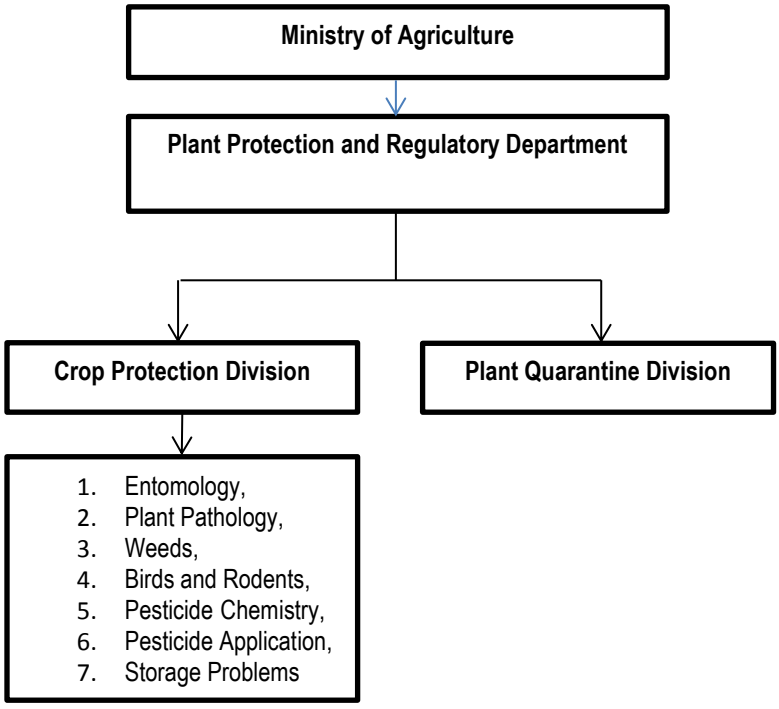
a) Create wider awareness on pesticides management
b) Enforce the available pesticide registration and control legal provisions
c) Implement nationwide PSMS (Pesticide stock management system) and promote pesticide stewardship

10. Limited experiences in IPM promotion

Strategy: Promote IPM in PMSS

a) Determine the major economic pests and affected crops
b) Develop or search and adopt pest and crop management practices for identified crop pest combinations
c) Produce guidelines for use
d) Implement IPM through FFS and other appropriate mechanisms

Annex II: Organogram of the PMSS in 1992 when noted better competent



Annex III Organogram of the Plant Health and Production Quality Control Regulatory General Directorate