Republic of Uganda

Ministry of Agriculture, Animal Industry and Fisheries

AGRICULTURE CLUSTER DEVELOPMENT PROJECT

Pest Management Plan

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Acronyms

ACB	Agricultural Chemicals Board
ACDP	Agriculture Cluster Development Project
ACEs	Area-based Cooperative Enterprises
ATAAS	Agricultural Technology and Agribusiness Advisory Services
BMPs	Best Management Practices
CCU	Climate Change Unit
DAO	District Agricultural Officer
DEO	District Environment Officer
DPO	District Production Officer
EC	Emulsifiable Concentrate
EIDs	Emerging Infectious Diseases
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmer Field School
GAL	Government Analytical Laboratory
GoU	Government of Uganda
IPM	Integrated Pest Management
IPM CRSP	Integrated Pest Management Collaborative Research Support Project
LD_{50}	Lethal Dose (kills 50% of target organisms)
LG	Local Government
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MRL	Maximum Residue Limits
MWE	Ministry of Water and Environment
MoWT	Ministry of Works and Transport
MSIP	Multi-Stakeholder Innovation Platform
NAADS	National Agricultural Advisory Services
NAPA	National Adaptation Plan activities
NARO	National Agricultural Research Organization
NDA	National Drug Authority
NEMA	National Environment Management Authority
NEMP	National Environment Management Policy
NEPA	National Environmental Policy Act
NGO	Non-Government Organization
NOGAMU	National Organic Agriculture Movement in Uganda
NSCS	National Seed Certification Service
PMP	Pest and Pesticides Management Plan
RPOs	Rural Producer Organizations
UCDA	Uganda Coffee Development Authority
UNADA	Uganda National Agro-Input Dealers Association
UNBS	Uganda National Bureau of Standards
URA	Uganda Revenue Authority
USAID	United States Agency for International Development
WHO	World Health Organization
WP	Wettable Powder

Definition of Terms

Active Ingredient (a.i.) – The material in the pesticide formulation responsible for the toxic (or other desired) effects on the target pest.

Acute Dermal LD_{50} – The dose of a pesticide absorbed through the skin that kills 50 percent of a population of test animals; usually expressed in milligrams of pesticide per kilogram of body weight of test animal.

Acute Effect – The immediate effects (as opposed to delayed effects) of a pesticide.

Acute Oral LD_{50} – The dose of a pesticide ingested by mouth that kills 50 percent of a population of test animals; usually expressed in milligrams of pesticide per kilogram of body weight of test animal.

Adulterated – Any pesticide that has been illegally manipulated and whose purity and strength fall below the quality stated on its label.

Aerosol – A fine mist of solid or liquid particles suspended in air.
Agro-ecosystem – The ecological community and physical environment in an agricultural land unit.
Aquatic – Pertaining to water.

Biological Control – The use of natural enemies (predators, parasites, or disease agents) to control pests.

Chronic – Pertaining to long duration or frequent occurrence.

Concentrate – A pesticide, as sold, before being diluted for application.

Cultural Controls – Crop management and other practices that make the environment less favorable for pests e.g., field sanitation, crop rotation, diversification, harvesting practices, time of planting, trap crops.

Dermal – Pertaining to the skin and one of the major ways that pesticides can enter the body.

Dose – The measured and prescribed quantity of a pesticide.

Ecological – Consideration of the interrelationship between living organisms and the environment.

Economic Damage – Damage caused by pests to plants, animals, or other resources that result in loss of income or reduction in value.

Economic Injury Level – The point at which the vale of the damage caused by a pest exceeds the cost of controlling the pest

Ecosystem – An ecological community together with its physical environment.

Effectiveness and Efficacy – The ability of a pesticide to produce a desired effect on a target organism

Emulsifiable Concentrate (EC) – A liquid pesticide consisting of an active ingredient, a solvent, and an emulsifier that mixes with water to form an emulsion.

Environment – All of the living organisms and non-living features of a defined area.

First Aid – Emergency treatment given to an injured person before he/she is treated by a trained doctor

Formulation – A mixture of active ingredients combined during manufacture with inert materials. Inert materials are added to improve the mixing and handling qualities of an insecticide.

Integrated Pest Management (IPM) – Use of a variety of biological, cultural, and chemical control methods in a cohesive management scheme designed to maintain pest populations at levels below those causing economic injury.

LC_{50} – The lethal concentration of a pesticide in the air or in a body of water that will kill half of a test population; given in micrograms per milliliter of air or water.

LD_{50} – Abbreviation of a median lethal dose MLD. A dose of pesticide that kills 50 percent of a population of test animals; usually expressed in milligrams of pesticide per kilogram of test animal body weight

Leaching – Removal of chemical substances from the soil by the movement of water.

Maximum Residue Limit (MRL) – The maximum residue level likely to arise when a pesticide is used according to recommendations reflecting good agricultural practices.

Monitoring – Sampling or observations of pesticide use, pesticide residues, natural enemies, etc.

Pest Management – Any deliberative action to prevent or reduce the density or harmful effects of a pest population

Pesticide – From "pest" and "cide" (a Latin derivative meaning killer), a natural or synthetic chemical agent that kills or in some ways diminishes the action of pests. It is a general term that includes herbicides, insecticides, nematicides, fungicides, antibiotics, rodenticides, plant growth regulators, etc.

Pesticide Management – Deliberative actions to reduce the harmful effects of pesticides; includes legislation and regulations as well as safe application, storage, and disposal.

Pesticide Resistance – Genetic qualities of a pest population that enable individuals to resist the effects of certain types of pesticides that are toxic to other members of that species.

Pests – Commonly include harmful insects, mites, ticks, weeds, bacteria, fungi, rodents, birds, and others.

EXECUTIVE SUMMARY

Introduction

Providing sufficient, affordable, and safe food for the increasing world population is one of the biggest challenges the international agricultural community faces. According to FAO, food demand will double by 2050. To meet this, cereal yields in developing countries will have to increase by 40% and an additional 100-200 million hectares of land may be needed. Other estimates predict that already before 2030, the world cereal production will have to increase by 50%. The Project Development Objective of the Agriculture Cluster Development Project (ACDP) is to raise agricultural productivity and marketed production for selected commodities in cluster areas, with special attention for small-scale farmers in order to address unmet domestic demand and to expand regional exports. In line with Government's strategy, this will be achieved through increased productivity, value addition and exports of selected commodities, namely; maize, beans, rice, and cassava.

Agriculture Cluster Development Project

Project Development Objective

The objective of the proposed project is to raise productivity, production, and commercialization of selected agricultural commodities in specified clusters of districts across the country. This will raise farm and agribusiness incomes while substantially lowering transactions costs in markets for agricultural commodities. Special attention will be given to raising productivity and marketed production on small-scale farming operations in the project clusters. Special attention will also be given to proactively ensure inclusion within project activities of farming households (and agribusiness firms) in which women and youth play a prominent role in the management of the farm (and/or agribusiness) enterprise. Five focus commodities (maize, beans, rice, cassava and coffee) have been selected according to the priorities articulated in the operationalization framework for the non-ATAAS components of the Development Strategy and Investment Plan (DSIP).

Target Areas

The ACDP will be specifically implemented in the Districts of Masaka, Mpigi, Rakai, Iganga, Bugiri, Namutumba, Pallisa, Tororo, Butaleja, Kapchorwa, Bukwo, Mbale, Soroti, Serere, Amuru (including Nwoya), Gulu, Apac (including Kole), Oyam, Lira (including Dokolo), Kabarole, Kamwenge, Kasese, Kyenjojo (including Kyegwegwa), Mubende, Kibaale, Hoima, Masindi, Kiryandongo, Ntungamo, Kabale, Bushenyi, Isingiro, Nebbi, Arua (including Nyadri), and Yumbe.

Project Components

The activities and investments to be supported under the proposed project are organized into four components. Component 1 would support activities related to expanding access to and use of key agricultural inputs. Component 2 would support the rehabilitation and expansion of existing small irrigation schemes for rice, assist formation of water user groups and look at water management and conservation. Component 3 would support activities and investments to improve post-harvest handling of the selected commodities and to improve the efficiency of output markets for these commodities and would also support measures to eliminate bottlenecks and trouble spots in rural access roads and market places. Component 4 would support capacity building and operations of the key institutional actors (particularly MAAIF, District governments, farmer organizations, and

cluster committees). Component 4 would also support activities to develop, improve, and implement policies and regulatory frameworks for the production and marketing of the 5 selected commodities.

Pest Management Plan

This Pest Management Plan is meant to enhance IPM within Uganda. The scope of this pest management plan includes:

- A history of pest problems, present pest problems and crop history;
- Analyzes the vulnerability of Uganda to pest attacks;
- Quantifies the losses attributed to these pests and diseases;
- Identifies the key pests and diseases of the major crops in Uganda;
- A review of the impact of the current pest control measures;
- Proposes appropriate integrated pest management strategies for the pests and diseases;
- Defines an appropriate implementation strategy for the proposed measures;
- Comprehensive strategies for handling, transportation and application of pesticides in compliance with national and international requirements relating to the different chemicals;
- Identifies capacity building and training needs;

Preparation of the Plan

Literature Review - A comprehensive literature review was conducted to obtain information on history of pests in Uganda, economic losses due to pests, existing pest management practices, common pesticides and their environmental and health risks, key environmental, occupational health and safety legislation including the World Bank Safeguard Policies, and the International Best Management Practices (BMPs) related to agricultural projects and the use of pesticides.

Capacity Assessment - The institutional mandates of Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Ministry of Water and Environment (MWE), Ministry of Health (MoH), National Agricultural Advisory Services (NAADS), National Environment Management Authority (NEMA), National Agricultural Research Organization (NARO), Uganda Revenue Authority (URA), Uganda National Bureau of Standards (UNBS), District Agricultural Officers (DAOs) etc. and National Laboratories were reviewed in addition to consultations to understand their roles and specific responsibilities in the management of pests and pesticides use in Uganda including the procurement, storage, use, disposal, and monitoring of pests and pesticides. The capacity of the above institutions and agencies was assessed in terms of institutional management systems specifically for managing pesticides right from planning, documentation, use and handling, monitoring systems, reporting and evaluation practices. That served as a basis to develop an appropriate capacity building and monitoring framework.

Field Reconnaissance - Current pest control knowledge, attitudes, and practices of farmers were ascertained by undertaking field reconnaissance visits to the cluster districts. Wholesalers and retailers as well as open markets were surveyed in Kampala to assess availability of pesticides and protective equipment and clothing. An informal group discussion was held with the District Agricultural Officers and Sub-County Extension Officers from a sample of the selected clusters in order to obtain general pests and diseases and farming information. To reach the farmers in the cluster districts, the District and Sub County officials in the agricultural extension were the guides.

The district offices of NAADS and their sub-county coordinators as well as the sub-county local government leadership were part of the team that visited the farmer households.

Keys Laws, Regulations and Policies

Plans and Policy Framework

- The National Environment Management Policy, 1994
- The National Trade Policy, 2006
- The 2003 National Agricultural Research (NAR) Policy
- Plan for Modernization of Agriculture (PMA)
- Draft Uganda Organic Agriculture Policy, July 2009

National Laws and Regulations

- The Constitution of the Republic of Uganda, 1995
- The Agricultural Chemicals (Control) Act, No. 1 of 2006
- The National Agricultural Advisory Services Act, 2001
- The Agricultural Seeds and Plants Act (Cap 28)
- The Plant Protection Act (Cap 31)
- The National Agricultural Research Act, 2005
- The National Environment Act, Cap 153
- Local Governments Act, Cap 243
- Access to Information Act No. 6 of 2005
- The Public Health Act Cap. 281
- Occupational Safety and Health Act No. 9, 2006
- External Trade Act, Cap 88 77
- Uganda National Bureau of Standards Act, Cap 327 77
- Water Act, Cap 152

International Conventions

- Basel Convention
- Rotterdam Convention
- The International Maritime Dangerous Goods (IMDG) Code
- The FAO International Code of Conduct on the Distribution and Use of Pesticides 78
- The Safety and Health in Agriculture Convention
- International Plant Protection Convention

World Bank Safeguard Policies

The Project has been assigned Environmental Category B and triggers Environmental Assessment (OP 4.01), Natural Habitats (OP 4.04), Pest Management (OP 4.09), Physical Cultural Resources (OP 4.11), Involuntary Resettlement (OP/BP 4.12) and OP 7.50 on International Waters.

Crop Pest and Disease Problems in Uganda

Food and cash crops in Uganda are constantly threatened by epidemic pests and diseases and weeds. Both foreign and indigenous pests, weeds and diseases are a threat to the country's agricultural sector. Climate change, modern means of travel, trade liberalization, and agricultural intensification could trigger the occurrence of new pest problems. Future outbreaks of existing or new pests, weeds and diseases are a certainty, and although all outbreaks will result in losses, the

key risk is that badly and ineffectively managed responses to new outbreaks in the country will significantly raise the scale and impact of the losses. With the onset of climate change, which has extended warm temperatures to new regions, Uganda is bound to see pest-related problems spread to even wider areas since warmer temperatures due to climate change are expected to both encourage the spread of pests into new areas as well as render some plants more susceptible to their effects. The key pests and diseases are summarized below:

Crop	Key Pests	Key Diseases
Coffee	Coffee Twig Borer, Coffee Meal bug, and the Berry Borer	Coffee Wilt Disease and Coffee Leaf Rust Disease (Fungus).
Maize	Stalk Borer, Armyworm and Maize Weevil	Maize streak disease, Maize lethal necrosis, Grey leaf spot, and Maize smut.
Beans	Cutworms and Aphids	Bean Root Rot (fungal), Bean anthracnose, Bean wilt, and the Bean Rosette, Bean common mosaic (viral),
Rice	Quelea Quelea birds, Termites, Aphids, Rice Stem Borers	Rice Yellow Mottle Virus (RYMV), Rice Bright and Rice Blast
Cassava	Mealy Bug, Cassava White Fly	Cassava Mozaic and the Cassava Brown Streak Diseases

Economic Losses due to Pests and Diseases

Average crops losses, due to pests, diseases, and weeds in Uganda are estimated at 10-20% during the pre-harvest period and 20-30% during the post-harvest period. At times, losses up to 90% occur; caused by epidemics or diseases in perishable horticultural crops. The economic costs associated with a biological problem such as crop pests and diseases comprise the direct losses from predation or competition for resources and the expenditure incurred to control the pests and diseases. The full economic (monetary) cost of crop pests and diseases in Uganda is difficult to assess because the cost varies from region to region, and also requires intensive efforts to collect the necessary values. Expenditures continually change due to factors that influence the status of a pest or disease and the current and expected importance of such pests and diseases. Much as data on losses caused by pests and diseases on specific crops is scarce, below is a sample of estimation of losses for different crops cultivated in Uganda due to pests and diseases.

Crop	Estimated Annual Loss ($ million)
Bananas	35 - 200
Coffee	8
Cotton	10
Cassava	60 - 80

Key Pests and Pesticides Management Challenges in Uganda

The key bottlenecks and challenges faced by Uganda in regard to pest management and use of pesticides are as follows:

- The Country has very few researchers and crop pest and disease specialists especially epidemiologists, crop breeders, weed scientists critical for pest and diseases control;
- Limited budget for agricultural research which hinders continuity in research as well as weak collaborative linkages of NARO with tertiary universities;

- Proliferation of illegal imports by unscrupulous private companies and the presence of unlicensed dealers who are unlikely to have the requisite knowledge to correctly inform farmers what the appropriate pesticides to use are and how to use them safely;
- No food safety routine tests conducted on the food grown under pesticide use to check on contamination;
- The proportion of farmers using recommended personal protective equipment while handling pesticides is very low and exposure to hazards is amplified given that some farmers allow their children to do the spraying;
- There is widespread re-use of pesticide containers for storing food or water for humans or livestock;
- There is an overlap or lack of clarity on the responsibilities of NEMA, UNBS, NDA, GAL, and MAAIF as regards pesticides monitoring and management, a cause for ineffective monitoring due to unclear responsibilities.

ACDP IPM Plan

In complement to on-going research and extension activities, ACDP will further strengthen: (i) the development of integrated pest and disease management guidelines for targeted commodities, including tolerant varieties, good agricultural practices and reasonable use of pesticides; (ii) pest & disease identification tools and services based on modern Information and Communication Technologies (ICT) networks, involving district Subject Matter Specialists (SMS) and ZARDIs (plant clinic services); and (iii) technical training of extension workers and agro-dealers on pest & disease symptoms and adapted treatment recommendations.

Key Elements - The elements of the ACDP IPM will include the following:

(a) Preventing pest problems;
(b) Monitoring for the presence of pests and pest damage;
(c) Establishing the density of pest population, which may be set at zero, that can be tolerated or corrected with a damage level sufficient to warrant treatment of the problem based on health, public safety, economic or aesthetic threshold;
(d) Treating pest problems to reduce population below those levels established by damage thresholds using strategies that may include biological, cultural, mechanical and pesticidal control methods and that shall consider human health, ecological impact, feasibility and cost effectiveness; and
(e) Evaluating the effects and efficacy of pest treatments.

Decision Making - Detecting a single pest under the Project will not always mean control is needed. A decision to use pesticides will be taken only as the very last resort and will also be based on conclusions reached from an agro-ecosystem analysis and trials. The decision under ACDP will also depend on the number of pest and diseases found in the respective crop and the level of damage they are doing. If it is absolutely necessary to spray crops with pesticides, use of selective rather than broad-spectrum pesticides shall be strictly observed.

Pest Monitoring and Surveillance - A process for the reporting and identification of unusual plants, animals and pests will be established to track and document all pest cases, be it minor or major in a pest inventory register. Pest surveys will be conducted on a regular basis to detect new infestations and will include the types, abundance, location of pest plants, date when first spotted or seen, and date when reported. This information will be gathered from surveillance or monitoring

system to be put in place, periodic surveys to be conducted and feedback from farmers/farm assistants. The data will be managed in a standardized way so that trends can be established. A rapid response process for the management of new infestations will be established to treat and manage new pest infestations as soon as they are identified. The potential to exploit mobile phones to enhance field surveillance of disease outbreaks and the efficacy of recommended control options is massive and will help to bridge the current gap between science and practice. Furthermore, enhanced field surveillance through interventions such as this will permit the project to recognize risks due to disease earlier and to deploy control measures to prevent catastrophic disease epidemics.

Procurement of Pesticides

The following criteria will apply to the selection and use of pesticides in activities under ACDP:

- Pesticide financed under ACDP must be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards that, at a minimum, comply with the FAO's guidelines on pesticides.

- Consistent with World Bank OP 4.09, ACDP financing will not be used for formulated products that fall in WHO classes IA and IB, or formulations of products in Class II, if (a) the country lacks restrictions on their distribution and use; or (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly.

- ACDP financing will not be used for any pesticide products which contain active ingredients that are listed on Annex III of the Rotterdam Convention (on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade), unless the Country has taken explicit legal or administrative measures to consent to import and use of that active ingredient.

- ACDP financing will not be used on any pesticide products which contain active ingredients that are listed on Annex A & B of the Stockholm Convention on Persistent Organic Pollutants, unless for an acceptable purpose as defined by the Convention, or if an exemption has been obtained by the Country under this Convention.

- ACDP financing will not be used for any pesticide products which contain active ingredients that are listed on Annex III of the Rotterdam Convention (on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade), unless the Country has taken explicit legal or administrative measures to consent to import and use of that active ingredient.

Procurement Challenges by Farmers

Challenges associated with direct procurement of pesticides by smallholder farmers in Uganda include the proliferation of illegal imports by unscrupulous private companies and the presence of unlicensed dealers. There are many fake or adulterated pesticides on the market. However, purchase of pesticides through ACEs presents a solution to this problem.

Distribution of Pesticides

Cluster Stores - Pesticides will be stored at one Cluster Store and will then be dispersed to each District Store when need arises. The stores will have to be maintained in good condition with all the required facilities for proper storage as detailed in the next Chapter. Storage facilities in each District will help alleviate the crowding at the Cluster Store and to reduce the travel distances to the Parish facilities.

Distribution downstream - To help facilitate the accounting of specific stock of pesticides and other logistics, record for each type of stock (i.e. pesticides, gloves – number and date bought, number and date dispersed to each Parish, number and date returned at end of spray cycle, etc.). This will ensure good accountability and record keeping of pesticide at the Parish level, from dispersal to collection of empty containers at the end of the day. Each Parish store manager or Distributor will have to count out and document the required number of sachets or bottles to be distributed to the Spray Leaders, who in turn will count out and document the sachets and bottles allocated to each spray operator. At the end of the day, the process will be repeated and the used and unused sachets or bottles will be collected and recorded.

Pesticides Usage Records - Under circumstances where MAAIF will directly procure pesticides for distribution to the farmers, it will be required to maintain records of all pesticides annually applied under the project.

Pesticide Use Issues - Farmers are likely to misuse pesticides in at least six different ways:

- Spraying too close to harvest, thus contaminating the crop after harvest;
- Applying the wrong dosage, often over-applying. Farmers often spray hazardous insecticides like organochlorines over five times in a season when two or three times can be sufficient;
- Applying pesticides intended for cash crops to growing food crops;
- Spraying pesticides intended for growing crops on stored crops;
- Using obsolete or expired pesticides;
- Mixing different chemical pesticides together.
- Inadequate or non-use of required PPE in handling and applying pesticides.
- Insufficient or lack of knowledge on pesticides use and management by most farmers.
- No use of PPE

Overall Impact on Pesticide Use

The fast growing population in Uganda has put more pressure on the agricultural sector as demand for food increases. Due to the limited arable land, there is or will be a need for productivity increases on the existing lands, including increased pesticide usage. With credit programs almost absent, farmers have in the past had little economic incentive to use pesticides particularly on subsistence crops. However, with increased access to credit as envisaged by the ACDP, the farmers may have more incentive to purchase pesticides and therefore the overall pesticide use may increase.

Disposal of Expired Pesticides and Containers

Occasions will arise when it will be necessary to dispose of agro-chemicals concentrates, either because the stock is outdated or has been found to be unusable or because the product is no longer

registered for the original purpose. The other issue is the empty containers. The management of pesticides containers is currently under the responsibility of resellers and farmers because of the retail sales system. They find themselves with the most important share of the empty containers which are differently managed. There is widespread re-use of containers for storing food or water for humans or livestock. Indeed, this may well be the most hazardous practice associated with pesticide use in Uganda. Many farmers wash the containers before re-use, but often less thoroughly than is needed. Under the ACDP, a scheme will be put in place to collect empty containers. ***MAAIF will engage Luwero Industries to explore the possibility of upgrading the facility to the standard required for pesticide disposal. As part of local solutions, MAAIF shall engage local fabricators to fabricate small-scale incinerators to help smallholder farmers to safely dispose obsolete pesticides.*** But for the long-term, it is certainly time for MAAIF to consider investing in a pesticide incinerator.

Pest Management Plan Implementation

Key Strategies

The project will adopt the following programmes and strategies to achieve an effective pest and pesticide management process:

- Formation of a Safeguard Team
- Registration and training of all interested pesticide distributors/resellers under the Project
- Education and awareness creation on safe pesticides use
- Pests Monitoring and Surveillance Measures
- IPM Capacity Building
- Institutional Capacity Building and Training
- Training of farmers in IPM and safe pesticide use
- Participatory Monitoring and Evaluation

Key Recommended Interventions

- Pest surveillance systems need to be urgently established or bolstered in Uganda to avert the socio-economic disasters that can be caused by plant pests and diseases;
- Smallholder farmers need to have more reliable and timely access to agricultural advisory and extension services to provide them with the knowledge on how to identify and deal with pests and diseases;
- Registration of pesticide distributors and resellers and to train them in safe pesticides management;
- Setup Collection Centers where farmers across the Districts can return empty pesticides container for onward transmission for safe handling and disposal. The collections of empty containers will be a direct responsibility of the Local Government Authority;
- Need for MAAIF to consider construction of a pesticides disposal facility in Uganda.

Safeguards Team - The Project Coordinators/PIU will form a Safeguard Team to oversee the monitoring of pests and pesticide use under the project to ensure that the project complies with national laws, relevant safeguard policies as well as meeting of the country's international obligations.

Implementing Agencies

Institution	Role/Responsibility
MAAIF Crop Protection Department	MAAIF will be the focal point for implementation of the PMP and shall coordinate its implementation through a harmonized information management system, financial mechanism and a monitoring and evaluation framework. The PIU will communicate the content of the Pest Management Plan to all project actors or stakeholders including ACB, NAADS, NARO, DAOs, UNBS, NDA, GAL, NEMA etc. at the national and relevant regional levels (i.e. within project clusters). MAAIF will • create awareness among downstream project actors or participants (pesticide distributors/resellers, farmers, farm assistants) of the importance of pest and pesticide management in the framework of this PMP; • Ensure that all downstream actors or participants have access to information on relevant crop pests/diseases, ACDP IPM strategies regarding pest control, declared pest plants, current ACB list of registered pesticides etc. MAAIF will also: • Liaise with statutory bodies including URA, NDA and UNBS to ensure the importation of quality pesticides; (Already contacted UNBS for PVOC which starts May 31 2014). MAAIF has constructed a laboratory to test the pesticide ingredients if in harmony with the label at Namarele. • Liaise with NEMA and GAL to monitor pesticide contamination; • inspect the conditions of pesticide storage and transport; • Together with LGs collect empty pesticide containers; • Inspect pesticide shops to ensure that they are registered or licensed by ACB and trained by the College of Agricultural and Environmental Sciences at Makerere University together with UNADA, on safe use of pesticides. Inspectors will also be required to take samples of pesticides that are expired or suspected of being adulterated for laboratory testing. • Collect agricultural statistics through its Agricultural Statistics Division
NARO	NARO will coordinate all integrated agricultural research activities initiated under the ACDP. The institutions will include National Agricultural Research Laboratory at Kawanda, Coffee Research Center at Kituuza, National Crops Resources Institute - Namulonge and other tertiary institutions. When pest problems occur that are novel or beyond the scope of NAADS in-house experts and the UCDA Extension Staff at the district level, advice will be obtained from NARO.
UBOS	UBOS will conduct agricultural censuses to generate data on agricultural production, cropped area, and yields of the crops produced by smallholder farmers. These agricultural statistics will be important in project evaluation.
CCU	The Climate Change Unit will have to implement the NAPA on pests and diseases and inform MAAIF on its findings.
LGs	Actual implementation of a large proportion of ACDP activities will take place at district level and will fall under the responsibility of local governments. The LGS will: • Conduct surveillance of pests and diseases • Mobilize farmers for training

	• Distribute pesticides as well as collection of empty containers
GAL	GAL will play a role in inspection to verify via analysis the content of agrochemicals sold to the farmers and to control adulteration. In addition, GAL and other laboratories will be useful in testing of samples to monitor pesticide contamination and food safety issues.
MWE	The MWE through its Water Resources Department will collaborate with GAL in monitoring pesticide contamination of water bodies.
MoWT	Ensure that transportation, distribution and storage of pesticides is done in such a manner that will protect the public health and environment. The MoWT will have to work closely with MAAIF Inspectors and the respective District Local Governments.
NEMA	Role of NEMA will be to review and approve ESIA reports for the different ACDP Subprojects in addition to monitoring of pesticide use. Monitoring pesticides use and disposal of resultant waste, including expired pesticides.
MoH	MoH will be supported to collect and keep accurate statistics on pesticide poisonings events. In addition, it will create awareness raising actions that will target the different pesticide users in order to avoid such accidents and incidents.
ACB (This is established as part of MAAIF)	The ACB will: • Register any new pesticides required under the project. • License any new pesticides suppliers • Development of the project specific IPM Pesticides List • Work with MAAIF inspectors to enforce the pertinent laws
UNBS	UNBS will work hand in hand with ACB, NDA, URA and MAAIF to address issues of pesticides quality. It will have to ensure that the fertilizers and pesticides imported to Uganda for the ACDP meet standards as per guidance of the ACB, NDA and UNBS.
URA	Will ensure that revenue from the products that are taxable is remitted to Government.
UCDA	UCDA will work together with MAAIF and NARO to ensure that extension services specifically for coffee are adequate and also to promote research as well as distribution of resistant varieties.
UNADA	UNADA to work with MAAIF and UNBS to address the issue of fake and adulterated pesticides as well as to train more UNADA members in safe agrochemical use so as to effectively advise farmers.
NOGAMU	NOGAMU will collaborate with MAAIF to advise farmers on how to reduce reliance on pesticide use under the ACDP since it has vast knowledge of organic agriculture.
NGOs	NGOs with collaborate with MAAIF and will work with farmers to: • Raise awareness among the smallholder farmers about the dangers of poor pesticide handling and use; • Work with extension staff to teach farmers about safe pesticide use and storage; • Work with farmers to develop community monitoring of the use and impacts of pesticides in order to alert the authorities as to the health and environmental impacts of pesticide use; • Empower the smallholders through training and other support to engage with the

	local government to address their concerns on pesticides use; • Do more to publicize to the public the environmental and health impacts of pesticide use • Work with Government to identify and support necessary policy changes.

National Capacity to Monitor Pests and Pesticide Use

Pests Management - Like many developing countries, at present, Uganda has insufficient enabling legislation and resources allocated to carrying out:

- Pest Surveillance and monitoring
- Border control and inspections
- Expertise in risk assessment
- Diagnostic tools for early Pest, weed and disease detections
- Expertise in diagnosis (taxonomy)
- Data collection and access to information
- Tools for rapid response to entry, establishment and spread of pests and diseases

Pesticides Management - There is limited or no budget for chemicals management in most government ministries/agencies. Most Line Ministries have restricted themselves to policy issues without putting in place adequate structures to monitor and implement the policies they put in place. In some ministries/sectors where the technical staff is available, there is inadequate funding; weak policies; lack of a pesticides inventory and lack of equipment which has led to poor service delivery. The capacity for regulation has not kept pace with the liberalization of the pesticides market. Just as there is no systematic testing for the impacts of pesticides on farmers, there appears to be no routine food safety tests conducted on the food available in Ugandan markets. If any, it could only be 'scattered studies'. Government extension services which can provide vital training and advice on pesticides to farmers are still inadequate to reach farmers regularly. Very little of the extension officers' time is spent on pesticides, even though the majority of the smallholder farmers use pesticides. Below is a summary of overall capacity of Uganda to handle the different pesticide risks.

Nature of Problem	**Scale of Problem**	**Level of Concern**	**Ability to control problem**
Public health	Local	High	Low
Drinking water contamination	Local and national	High	Low
Air Pollution	Local	Low	Low
Pollution of Inland Waterways	National	Medium	Low
Pesticide residues in food	National and Regional	Medium	Low
Occupational Health agricultural	Local	High	Low
Ground water pollution	Local	Medium	Low
Storage/Disposal of expired pesticides	National	High	Low
Soil contamination	Local	Medium	Low
Unknown pesticide importation	National	Medium	Medium
Pesticide accidents transport	Local and national	Medium	Medium

Training Needs and Strategy

Training Needs - There is need for training of Agricultural Extension Agents in IPM to become better at providing practical and research-based knowledge of crop production and protection strategies, including non-chemical alternatives. All existing extension workers will be trained in IPM and safer pesticide use who will in turn train the farmers and those directly below them.

Approach - Training farmers in IPM will be through using farmer field school (FFS) type of participatory learning and research programs, jointly with farmers, extension workers, and researchers. The FFS approach will involve a growing season-long informal learning experience in the farmers' own fields. There will also be training abroad to find out how their Pest Management Plans are implemented (like in the European Union, our biggest trade partners)

Pesticides Use Training - The key training needs that have been identified among others include post harvest handling of crops, storage, disposal as well as safe use and handling of pesticides. Training for "safer pesticide use" is a common approach to mitigate the potential negative health and environmental impacts of pesticides. This conventional approach will promote reducing health risks of pesticides by safer use of the products through training, use of protective equipment and technology improvements, as well seeking to reduce pesticide hazards via regulations and enforcement in addition to the training. A well-illustrated booklet on safe pesticide use designed for self-learning will be developed and distributed to farmers, Extension staff, stockists and their staff.

PMP Budget

The Consultant estimates about $4.7 million as the budget to implement the PMP during a 5 - year period. It includes project coordination, training of farmers in IPM and safe pesticide use, building capacity of the different stakeholders to monitor pests and diseases and to ensure safe storage, use and disposal of pesticides among others.

Monitoring and Evaluation

An annual report on the progress of pest and pesticide management in the clusters will be prepared. The report will indicate the pest cases identified and treated using IPM approaches, location of pests, level of success of treatment, the amount and type of herbicide/pesticide used, level of cooperation from farmers and other relevant information (e.g. training programmes organized, farmer field schools held etc.). The project management will undertake annual pest and pesticide control and management reviews to confirm the implementation of the various control measures or programmes or actions outlined in the IPM. Recommendations from the reviews will help MAAIF to refocus and plan effectively towards achieving planned targets. The management review team will include, NARO, UCDA, NAADS, NEMA and MAAIF Crop Protection Department. Any other required additional technical guidance may be provided by the World Bank.

1 INTRODUCTION

1.1 Preamble

Providing sufficient, affordable, and safe food for the increasing world population is one of the biggest challenges the international agricultural community faces. According to FAO, food demand will double by 2050 and to meet this, cereal yields in developing countries will have to increase by 40% and an additional 100-200 million hectares of land may be needed. Other estimates predict that already before 2030, the world cereal production will have to increase by 50%. Nowhere will the need to sustainably increase agricultural productivity in line with increasing demand be more pertinent than in resource poor areas of the world, especially Africa, where populations are most rapidly expanding (Nicol et al. 2008). The increase in production has to happen at the same time as land and water resources are shrinking or deteriorating. The provision of additional agricultural land is limited, as it would have to happen mostly at the expense of forests and the natural habitats of wildlife, wild relatives of crops, and natural enemies of crop pests. Increasing productivity on existing land is by far the better choice and can be achieved.

1.2 Agriculture Cluster Development Project (ACDP)

1.2.1 Project Objective

The objective of the proposed project is to raise productivity, production, and commercialization of selected agricultural commodities in specified clusters of districts across the country. This will raise farm and agribusiness incomes while substantially lowering transactions costs in markets for agricultural commodities. Special attention will be given to raising productivity and marketed production on small-scale farming operations in the project clusters. Special attention will also be given to proactively ensure inclusion within project activities of farming households (and agribusiness firms) in which women and youth play a prominent role in the management of the farm (and/or agribusiness) enterprise. Five focus commodities (maize, beans, rice, cassava and coffee) have been selected according to the priorities articulated in the operationalization framework for the non-ATAAS components of the DSIP.

1.2.2 Target Areas

The ACDP will be specifically implemented in the Districts of Masaka, Mpigi, Rakai, Iganga, Bugiri, Namutumba, Pallisa, Tororo, Butaleja, Kapchorwa, Bukwo, Mbale, Soroti, Serere, Amuru (including Nwoya), Gulu, Apac (including Kole), Oyam, Lira (including Dokolo), Kabarole, Kamwenge, Kasese, Kyenjojo (including Kyegwegwa), Mubende, Kibaale, Hoima, Masindi, Kiryandongo, Ntungamo, Kabale, Bushenyi, Isingiro, Nebbi, Arua (including Nyadri), and Yumbe.

1.2.3 Project Components

The activities and investments to be supported under the proposed project are organized into four components. Component 1 would support activities related to expanding access to and use of key agricultural inputs. Component 2 would support the rehabilitation and expansion of existing small irrigation schemes for rice, assist formation of water user groups and look at water management and conservation. Component 3 would support activities and investments to improve post-harvest handling of the selected commodities and to improve the efficiency of output markets for these commodities and would also support measures to eliminate bottlenecks and trouble spots in rural

access roads and market places. Component 4 would support capacity building and operations of the key institutional actors (particularly MAAIF, District governments, farmer organizations, and cluster committees). Component 4 would also support activities to develop, improve, and implement policies and regulatory frameworks for the production and marketing of the 5 selected commodities.

1.2.4 Beneficiaries

Core beneficiaries of the project will be farmer and other value chain actors at local, district and national level, in particular national cooperative alliances, unions and federations, Area-based Cooperative Enterprises (ACEs), as well as their primary members such as Rural Producer Organizations (RPOs), cooperatives and producer associations. Private agribusiness firms will also benefit through greater volume and lower transactions cost. The involvement of some wholesale buyers, input dealers, rural banks, service providers and commercial farmers will be crucial to organize linkages to ensure effective access to productive assets, capital, services, know-how and markets. These categories would have relatively large but mainly indirect benefits. The project will work with approximately 300 ACEs, which represent about 3,000 RPOs, or about 450,000 farming households, of which 180,000 producers of maize (of which at least 50% also producers of beans), 40,000 producers of irrigated and lowland rice, 110,000 producers of Robusta and Arabica coffee, and 25,000 producers of cassava. Through the irrigation component, the project will further benefit about 16,000 rice farmers (one acre per farmer on average) which will improve their food security, nutrition (vegetable production) and income. The project will support about 30 Water Users' Associations in better organizing water management and maintenance of their facilities.

1.2.5 Implementation Mechanism

For the purpose of focusing on required services in the upstream and downstream of production, twelve (12) production clusters will be established for selected strategic commodities/crops as growth poles within targeted agro-ecological zones. *A commodity cluster* is a coherent area comprising of 2-3 districts, where there is already a proven potential for a specific commodity/crop, as well as the presence of value chain actors (e.g., producers, traders, processors and service providers), a multi-stakeholder innovation platform (MSIP) and basic market infrastructure. The cluster approach enhances delivery of essential services, exploitation of economies of scale, development of required infrastructure, bulking of produce, agro-processing and reduction of transaction costs.

Through a value-chain approach, the project will support access to and utilization of yield enhancing technologies (improved seeds, fertilizers, mechanization and water for agricultural production) as well as infrastructure for marketing and value addition. The capacity of private sector actors, including farmers' organizations and cooperatives, will be strengthened to improve stakeholders' access to the required inputs, marketing and agro-processing services. Supporting improved input use to complement research and advisory services is a cost-effective response for increased productivity and farm income, but also a means to prevent potential risks from climate change and land degradation. Broader access to adapted varieties and seeds, integrated soil fertility management and timely land preparation will also help farmers to move towards sustainable agriculture and overcome climate risks. Gradual adoption of appropriate mechanization technologies for production and post-harvest operations will not only increase rural labor productivity but also attract young entrepreneurs in the sector.

1.3 Need for a PMP

One of the most logical steps to increase food production is the reduction of current yield losses caused by pests, pathogens, and weeds in the field and during storage. The activities funded under the ACDP may lead to the increased use of agricultural pesticides, inter alia, in the agricultural sector. To ensure these issues are managed in an integrated manner and are mainstreamed nationally across the sector and also to comply with national legislation and World Banks Safeguard Policies, it is imperative to have in place an effective and sustainable Pest Management Plan. The goal of this Pest Management Plan is to reduce the impact of pests to crops, create a list of options based on location and types of crops, and to create a plan that will provide agricultural practices which can reduce problems associated with pesticide usage.

1.4 Objectives

The objective of the Pest Management Plan is to:

- Promote the use of environmentally friendly practices (hygienic, cultural, biological or natural control mechanisms and the judicious use of chemicals) in pest control designed to minimize potential adverse impacts on human health and the environment and to advance ecologically based Integrated Pest Management (IPM).;
- Effectively monitor pesticide use and pest issues amongst participating farmers;
- Provide for implementation of an IPM action plan in the event that serious pest management issues are encountered, and/or the introduction of technologies is seen to lead to a significant decrease in the application of pesticides;
- Assess the capacity of the country's regulatory framework and institutions to promote and support safe, effective, socially and environmentally sound pest management and to provide for appropriate institutional capacity support recommendations;
- Ensure compliance with national laws, regional standards, and regulations;
- Ensure compliance with World Bank safeguard policy OP 4.09

1.5 Scope

The Pest Management Plan is meant to enhance IPM within Uganda to ensure a guided pesticides-use planning, acquisition/procurement, storage, handling and application of pesticides. The plan includes development of comprehensive strategies for handling, transportation and application of pesticides in compliance with national and international requirements relating to different agrochemicals. The PMP addresses relevant stakeholder concerns about pests and pesticides. It stresses the need to monitor and mitigate negative environmental and social impacts of the ACDP (which includes the use of pesticides) and emphasizes the need for an integrated approach to the management of pests in line with Uganda's strategies on IPM adoption as well as World Bank requirements on pest management and makes provision for adequate measures to enable the Project sustain the adoption of IPM techniques. The scope of this Pest Management Plan includes:

- A history of pest problems, present pest problems and crop history;
- Analyzes the vulnerability of Uganda to pest attacks;
- Quantifies the losses attributed to these pests and diseases;
- Identifies the key pests and diseases of the major crops in Uganda;
- A review of the impact of the current pest control measures;
- Proposes appropriate integrated pest management strategies for the pests and diseases in Uganda;

- Defines an appropriate implementation strategy for the proposed measures;
- Comprehensive strategies for handling, transportation and application of pesticides in compliance with national and international requirements relating to the different chemicals;
- The safe transport, storage and disposal of pesticides and monitoring aspects;
- Identifies capacity building and training needs;

1.6 Preparation of the PMP

1.6.1 Literature Review

A comprehensive literature review was conducted to obtain information on:

- History of pests in Uganda
- Economic losses due to pests
- Common pesticides and their environmental and health impacts
- Environmental, occupational health and safety legislation
- World Bank Safeguard Policies, and
- International Best Management Practices (BMPs) related to agricultural projects and the use of pesticides.

The following key documents were reviewed amongst others:

- ACDP Project Appraisal Document
- Vision 2040 and the National Development Plan 2010/2015;
- Plan for Modernization of Agriculture, 2004;
- World Bank Safeguard Policy on Pesticides

1.6.2 Capacity Assessment

Capacity is defined as the ability of people, organizations and society as a whole to manage their affairs successfully; and capacity development is understood as the process whereby people, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time. The capacity assessment of the different institutions determined capacity needs by comparing desired capacities against existing capacity assets. A number of approaches were used to gather information on capacity assets and needs and included one-on-one interviews, focus groups, and surveys. The institutional mandates of MAAIF, MWE, NAADS, NEMA, MWT, NARO, MoH, URA, UNBS, DAOs and DPOs, and National Laboratories were reviewed to understand their role and specific responsibility in the management of pests in Uganda including the procurement, storage, use, disposal, and monitoring of pesticides. The capacity of the above institutions and agencies was assessed in terms of:

- Institutional management systems specifically for managing pesticides right from planning, documentation, use and handling, monitoring systems, reporting and evaluation practices;
- Competence/qualifications and experience of staff to supervise all aspects of pests and pesticide use;
- Resources (personnel and funds) in place;
- Equipment for laboratories.

The above served as a basis to develop an appropriate monitoring framework for the management and monitoring of crop pests and diseases as well as the distribution, use and general management of pesticides including environmental monitoring of pesticide contamination in Uganda.

1.6.3 Field Studies and Stakeholder Consultations

Consultative meetings and interviews were held with the key stakeholders and institutions including: National Environment Management Authority, Uganda Coffee Development Authority, Wetlands Management Department, Local Government Officials especially the DAO, Makerere University College of Agriculture, The Integrated Pest Management Collaborative Research Support Program (IPM CRSP) and Agricultural Extension Workers.

Figure 1: Consultations with Agriculture Officer, Kiryandogo District

Current pest control knowledge, attitudes, and practices of farmers were ascertained by undertaking field reconnaissance visits to the cluster districts. Wholesalers and retailers as well as open markets were surveyed in Kampala and rural areas to assess availability of pesticides and protective equipment and clothing. Farmers were randomly selected for interview. An informal group discussion was held with the DAOs and Extension Officers in order to obtain general farming information. Some of the questions asked during the study included the farmer characteristics, farmers' identity, the crop enterprise grown, the acreage, the common pests, methods of controlling the pests in the field and the estimated losses due to pests and diseases. Also gender roles at household level in field pest management were established. Identification of field pest species and common pesticides used against them was also done.

Figure 2: Consultations with framers in Lira

Figure 3: Consultations with framers in Kabale District

Person Consulted	Issues and Recommendations Raised
Dr. Mark Erbaugh – IPM CRSP in Uganda and Prof. Samuel Kyamanywa of Makerere University College of Agriculture	• **Vulnerability to Pests/Diseases** - Uganda is very highly vulnerable to pests and diseases; virtually every crop requires some form of pest management for its cultivation. • **Ongoing Studies** – the CRSP is currently conducting studies on the economic thresholds for crops based on different ecological zones including coffee. • **Need for IPM** – The ACDP is considering 5 crops i.e. coffee, beans, rice, cassava and maize; each requires different priorities and pest management styles. Therefore, there is need for IPM to address all of the problems. • **Information** – Agricultural information management in the country is still poor and investment is required to have such a system in place. • **Constraints to IPM Adoption** – The farmers have been ignored for a longtime and don't know what to do. There is need for MAAIF or Government to show interest in what they (farmers) do. The farmers need to be trained to build their confidence. • **Knowledge of Extension Staff** – Extension workers need training in areas of pest and disease identification, IPM and alternatives to pesticide use as well as in-service training i.e. new areas of science to help them do their job. In addition, there is need to redefine the role of extension workers. • **Pesticides Misuse** – There is need to sensitize the masses. An interesting example is the practice of spraying harvested tomatoes with fungicides to preserve tomatoes sold in markets in Uganda. **Research areas**: 1. There is need to conduct economic losses assessment to have a basis for prioritizing and targeting a particular pest or disease. 2. Economic Action Thresholds for the different crops. 3. Genetically Modified Organisms (GMOs) might be a solution to the existing pest problems and should be considered. 4. There is need for IPM packages for specific crops.
NEMA Laboratory Officer 16/1/2014	• Overall, NEMA as an institution has limited laboratory capacity to test for pesticides contamination but has working relationships with other national labs that have the necessary equipment.
Edmund Kananura Quality and Regulatory Services Manager at Uganda Coffee Development Authority (UCDA) 16/1/2014	• **Pests and diseases** – The sector is recovering from the shock impact of the Coffee Wilt Disease (CWD) that destroyed nearly 50% of the Robusta coffee in Uganda. • **Research** - UCDA has a working relationship with the Coffee Research Center at Kituza and 10% of the UCDA budget goes to the Center for coffee research purposes; • **Pests** – The biggest threats in the Country are the Coffee Wilt Disease and the Twig Borer. The twig borers used to be in low lands but due to climate change, they are everywhere and now attack either types of coffee. • **Varieties** – UCDA has been working with the Coffee Research Center at Kituza and over the years, 7 Coffee Wilt Resistant strains were developed. However, they had to be assessed for their commercial viability and aroma/taste. Only 1 strain met the two criteria which will proceed to the next stage of multiplication. UCDA intends to finance the production of 2 million seedlings of the resistant strain through tissue culture.

	• **Management of pesticides** – UCDA does not supply pesticides to coffee farmers. However due to issues of fake agrochemicals in the country, UCDA usually identifies a distributor of genuine pesticides in the region and advises the farmers to procure their agrochemicals from him or her. **Challenges faced by UCDA** • Funding – UCDA has limited funding to address all coffee issues across the country. **Recommendations by UCDA** • **Funding** – Extension services are currently very inadequate; UCDA recommends that Government to support and fund coffee extension services to fulfill the objectives of the national coffee policy. Every Sub County should have a coffee extension officer. UCDA currently has only 28 Coffee Extension Officers! • **Pest and Diseases** – UCDA recommends that Government intervenes to address coffee diseases which should be timely. Where possible, the Government should provide free fertilizers and agrochemicals to the farmers. • **Quality of inputs** – Government should urgently address the issue of quality of fertilizers and pesticides as many on the market are fake or adulterated making fighting of pests and diseases a challenge.
Ongol Joseph Wetlands Management Department 16/1/2014	• Agrochemicals – Communities downstream of wetlands utilize water for drinking and for livestock; how do we ensure food safety e.g. of beef for consumers? Contamination of the food chain has to be considered; • If the project affects water quality, what action will be taken and who takes it? Analysis and monitoring – at what period or frequency? Who takes action on the results? • Capacity – The Wetlands Department has human resource constraints especially as regards field compliance monitoring and enforcement; it requires more staffing.
Richard Kyambadde – Wetlands Department	• The challenge with pesticide use in crops cultivated in wetlands is that you are dealing with water-logged; so there is potential of direct contact between the pesticides and a threat of accumulation of these agrochemicals and therefore toxicity and pollution issues may arise; • There is high risk of contamination of ecosystems and related systems i.e. lakes and rivers;
Gift Grace- Agro-Chemical Shop operator (Mo-AgroLinK-Kiryandongo) Opio Sam Oceng – Cassava farmer	• There is no supervising authority and the sale of fake chemicals is not checked in any way. The town council issues trading license to the drug shop but is not bothered of what is sold. • Expired drugs are taken back to the supplier but only when picked by the supplier, hence they continue to be displayed in as long as they have not been picked by the supplier. • PPE are available in the shop but are hardly bought by the farmers, farmers rarely use them while applying the chemicals.
Ojok George Johnson – District NAADS Coordinator, Apac	Training needs identified for the district staff include; • Training in post-harvest handling of cassava • Training in agronomic practices • Training in value addition • Soil and water conservation/management

2 VULNERABILITY OF UGANDA TO CROP PESTS AND DISEASES ATTACKS

2.1 Introduction

Uganda is among the major producers of coffee, banana, cassava, tea, tobacco, maize, rice, groundnuts, and other important crops suitable for food security. These food and cash crops are constantly threatened by epidemic pests and diseases. Both foreign and indigenous pests and diseases are a threat to agriculture. In the recent past, the country has been fighting outbreaks of a number of crop pests and diseases. Coffee, an important income-generating crop to the small-scale farmers, was attacked by the Coffee Wilt Disease (CWD in 1990s, destroying more than 10 million Robusta coffee trees countrywide, in a period of less than 20 years, making the country lose billions of shillings. When all looked promising for the coffee industry, due to discovery of the resistant varieties to CWD, the Coffee Twig Borer (CTB, Lepidoptera) and the Coffee Leaf Rust Disease (Fungus) broke out into the plantations. All farmers are now battling with the pests.

2.2 Vulnerability to Pests and Diseases

2.2.1 Present Situation

Uganda is vulnerable to pest and disease attack especially since the country is crossed by the equator where the environmental conditions favour availability of crops in most parts of the region. Dr. Mark Erbaugh and Prof. Samuel Kyamanywa also observe that Uganda is very highly vulnerable to pests and diseases as virtually every crop requires some form of pest management for its cultivation. They add that one of the reasons is the country's location in the tropics which has a lot of food for pests in addition to the weather that favours the pests and diseases. They cite the Coffee Wilt Diseases which was a big problem recently. However, as it is being managed, the Twig Borer has broken out. For cassava, the problem has been the cassava mosaic disease. Now the new challenge is the Brown Streak diseases. Therefore pests and diseases problems are endless.

2.2.2 Vulnerability in the Future

Climate change, trade liberalization, and agricultural intensification (introduction of irrigation farming, increased fertilizer use, introduction of new crops and varieties, changes in land use etc.) could trigger the occurrence of new pest problems. Future outbreaks of existing (or new) pests and diseases are a certainty, and although all outbreaks will result in losses, the key risk is that badly and ineffectively managed responses to new outbreaks will significantly raise the scale and impact of the losses (FAO, 2011).

2.3 Factors contributing to Vulnerability

2.3.1 Human movements and Cross border trade

Human beings are mobile most of the time and since some of the border entry points are porous, obnoxious weeds and pests are likely to enter the country. This is compounded by wars and famine and natural disasters such as droughts, landslides, and heavy rains, which sometimes makes some parts of the country to rely on food aid. Transport of food aid and cross border trade is a sure way for entry of alien but noxious pests like the larger grain borer – *Prostephanus truncatus* which has become an endemic pest in the entire East African region.

Indiscriminate exchange of planting materials and stocking materials by farmers across borders without following proper plant/livestock quarantine regimes is considered a big threat to ensuring crop and livestock health within Uganda. Cassava mealy bug entered Uganda in 1992 via the Democratic Republic of Congo. Likewise the Cassava green mite – *Mononychellus tanajoa* is rumoured to have escaped from a scientific laboratory in Uganda but later became a devastating

pest of cassava. It is projected that pests and diseases may become a bigger problem as more trade and aid flourish in the region.

2.3.2 Inadequate Resources

Surveillance of Emerging Infectious Diseases (EIDs) is crucial for developing countries' agricultural self-sufficiency and wider social economy, but these technologies are often expensive and require technical preparation, economic investment and personnel. Given the cost, many developing countries do not have adequate control systems; nor can they acquire and update lists of emerging pathogens within their borders (Vurro, 2010). The consequence is that many diseases in developing countries simply spread without being recognized and monitored (Vurro, 2010). The limited resources of the Ugandan coffee sector affecting research and extension (e.g., the inability to identify and monitor infestations in a timely manner, insufficient research capacity to evaluate and respond to problems, insufficient extension services to promote good agricultural control practices, and limited access to inputs) suggest that the sector is presently not sufficiently prepared to address pest and disease risks in an effective manner that would adequately mitigate potential losses (World Bank, 2011).

2.3.3 Role of Climate Change

Climate risk is understood as the probability of negative impacts on farmers, the environment and crop production resulting from the interaction of climate hazards and conditions of vulnerability (UNDP, 2013). Currently, the main impacts of climate hazards on crop production include increased susceptibility to pest and diseases and occurrence of new pests and diseases (UNDP, 2013). It is evident that pests and diseases will also change and mutate under climate change. Like plants, they will be subject to natural selection and mutation to adapt to the new conditions.

Climate change promises to have major – if uncertain – effects on the interactions between crops and pests. The changing climate is likely to affect different pests in different ways. This may result, for instance, in changes to pest growth rates and the number of generations they achieve per year; pest mortality due to low temperatures (or lack of it); or host susceptibility (SP-IPM, 2008). The effects of these changes are likely to include the expansion of some pests' ranges and higher pest pressures within their existing ranges, together with the development of new pest problems where, for instance, secondary pests become primary pests, or new alien invasive species become widespread. Climate change is likely to have profound impacts on pest–crop and pest–beneficial interactions and may substantially increase the pressure on farmers to use pesticides in response (SP-IPM, 2008). Climate change will result in a higher probability of entry, establishment and spread of pests of plants and invasive alien aquatic species for the following reasons:

- For some animal and plant pests and diseases and invasive alien aquatic species, the climate will become more conducive and for others the meteorological conditions will become less favourable. This will result in unstable situations with a high probability of entry and establishment in areas that are presently protected by unsuitable conditions.
- Meteorological and related environmental circumstances may change the geographical distribution of host species, putting them in contact with animal and plant pests and diseases of related hosts to which they do not possess resistance.
- New animal and plant pests and diseases may emerge due to evolving selection and adaptation to new situations.

2.3.4 Uganda's Adaptive Capacity

In global change, the concept of vulnerability goes beyond the estimation of impacts to identifying the capacity of stakeholders to implement adaptation options. Adaptation may be either natural, including ecological and genetic adaptations, or managed as in the case of policy or local management interventions. Vulnerability is defined thus:

Vulnerability = Impacts x Adaptation, where
Impacts = Exposure x Sensitivity

The *adaptive capacity* of any given agricultural system will depend on a number of biological, economic and sociological factors. While some crop species have high phenotypic or genetic plasticity and will be able to respond to climate change, others with a narrow genetic base will fail and need human intervention in terms of species switching or selective breeding (FAO, 2008). The extent of potential impacts and adaptive capacity determines the *vulnerability* of a species, agricultural enterprise or other local or regional system to climate change. The capacity of local communities to adapt their agricultural enterprises will depend upon their physical, social and financial resources, as measured by 'triple-bottom line' accounting methods. Resource-poor societies will be more vulnerable to climate change if their agricultural production systems are not biologically resilient to potential impacts (FAO, 2008). ***Based on the above, it can be concluded that Uganda's adaptive capacity to climate change impacts especially control of emerging pests and diseases is very low. The pest complexes associated with the crops are a big challenge as the Country has also to deal with outbreak migratory pests as well as non-migratory outbreak pests and alien invasive species.***

2.4 Risk Levels of Particular Crops

Disease epidemics are strongly linked to climatic conditions and therefore some diseases may disappear or lose their predominance in a given production system and new pathogens or new strains may become more important. Climate variables control the geographical distribution of pests and diseases, and therefore expand their distributions to new areas. Temperature rise in cold mountain areas enables vector and pests to increase their ecological range to areas where they would otherwise be limited by low temperatures (GoU, 2007). Pest and disease pressure is likely to continue in many regions of Africa, moving into some new regions, as well as reducing pressure in other regions (Jarvis et al. 2012). This causes more infestation during the following production season, as the new hosts will not have had immunity. Altered wind patterns also change the spread of wind-borne pests, vectors and pathogens for crops (GoU, 2007). Plant pests and diseases could potentially deprive humanity of up to 82% of the attainable yield in the case of cotton and over 50% for other major crops and, combined with postharvest spoilage and deterioration in quality, these losses become critical, especially for resource-poor regions (Chakraborty and Newton, 2011). The introduction of diseases and pests will result in higher costs to national food industry in relation to inspection, treatment and compliance with obligations of the importing trading partners (FAO, 2008).

2.4.1 Cassava

Of the few studies which have quantified the impacts or responses of cassava to climate change, all have found cassava to be the least affected crop when compared with other major staples such as maize, sorghum and millets. Jarvis et al. (2012) examined the impacts of climate change on cassava production in Africa, and questions whether cassava can play an important role in climate change adaptation. They examined the impacts that climate change will likely have on cassava

itself, and on other important staple food crops for Africa including maize, millets, sorghum, banana, and beans based on projections to 2030. Their study was based only on environmental niche based approaches, which use the present distribution of the pest or disease to train a statistical model that describes the climate conditions likely to harbor the pest or disease. According to Jarvis et al. (2012), Whitefly is the most widely distributed pest under current conditions but its distribution is predicted to shrink in 2030. For cassava brown streak disease, the suitable climate conditions for the pathogen across the continent are predicted to decrease by 2030, but new areas will be affected with **notable increases in Uganda of 3.4%**.

Cassava mosaic disease represents one of the primary constraints to cassava production in Africa. The only alternative for its control is with host plant resistance, appropriate crop management, and through management of the vector (*Bemisia tabaci*). Two particularly aggressive strains can produce mixed infestations in the crop, making its management highly complex. With climate change, and the predicted shift in geographic distributions this could bring into contact multiple strains which previously have not been in contact, causing more virulent strains and contributing to greater losses (Jarvis et al. 2012).

2.4.2 Coffee

Stakeholders, including the Coffee Research Centre (COREC), argue that changes in weather patterns (drought, unpredictable and varied rains, temperature changes) are causing alterations in the appearance and severity of newer pests (e.g., black twig borer), while existing diseases are migrating to ecological zones where they previously did not exist (World Bank, 2011). Consultations with UCDA indicate that the biggest threats in the Country are the Coffee Wilt Disease and the Twig Borer. UCDA also notes that the Twig Borers used to be in low lands but due to climate change, they are everywhere and now attack either types of coffee as mentioned by the World Bank (2011). Currently, CWD is no longer seen as a major threat, as it is now viewed as controlled. However, there remains the risk that the disease will begin to spread again because CWD-tolerant varieties are not yet available for large-scale release (World Bank, 2011). The UCDA revealed during consultations that commercial distribution of the CWD-resistant and commercially viable variety to farmers is expected to commence in 2015.

The possibility of renewed outbreaks of CWD and the unchecked spread of other pests and diseases could potentially devastate the entire coffee sector, causing greater losses than those from CWD to date or even causing farmers to abandon coffee production and subsequent loss of Uganda's share of the global market (World Bank, 2011). An already high prevalence of disease and pest outbreaks, together with the historic failure of the sector to adequately manage such outbreaks in a timely manner, suggests that future losses from pests and disease are highly probable and likely to generate high industry losses (World Bank). The coffee berry borer only appeared a few years ago and it is becoming worse (Oxfam, 2013).

2.4.3 Rice

Rice is also susceptible to considerable disease stress. Three major rice diseases (Rice Blast, Rice Yellow Mottle Virus and the Bacterial Leaf Blight) are significantly aggravated by adverse weather conditions that affect temperature, air humidity, and soil moisture status, posing a threat to the crop (ARCC, 2013).

2.4.4 Maize and Beans

According to ARCC (2013), maize and beans can both be produced under a wide range of climatic conditions and are not likely to be significantly affected by predicted temperature changes. The greatest impact of climate change on these crops is due to continued high inter-annual variability and amount of precipitation. Maize is greatly affected by short-term water stress or hail, while beans in particular develop significant fungal and viral diseases in the event of excessive rainfall during critical periods. Declining soil fertility and structure greatly exacerbate the problem by reducing the capacity of soil to retain water, thus making nutrients less available to the plants.

Farmers typically sun dry their crops, often on the bare ground. Post-harvest storage losses are high due to pests and decomposition. The maize export market is particularly threatened by the presence of aflatoxin contamination, and the problem will likely be greatly exacerbated if the predicted increases in the traditional dry season precipitation materialize. The presence of precipitation during this period means that traditional sun drying of grains may result in degraded grains/seeds for storage and an increase in diseases/fungi such as aflatoxin (not a fungus but a product), which thrive in moist conditions (ARCC, 2013).

2.5 Adaptation Strategy

To understand how best to control plant diseases to improve food security in the context of climate change, plant protection professionals must work with societal change, defining its key processes and influencers to effect change (Chakraborty and Newton, 2011).

2.5.1 National Action Plans for Pests and Diseases

NAPAs were designed as part of the National Adaptation Plan to Climate Change for Uganda to address specific urgent and immediate problems faced by communities. As one of the NAPAs, "**PROJECT 7: Vectors, Pests and Disease Control Project**" aims at understanding the linkages of these outbreaks to climate change for more cost-effective management with special emphasis on vulnerable communities and gender dimensions (GoU, 2007). The objectives of the project are:

- To strengthen the national programmes on prevention, control and effective management of disease vectors and pests;
- To enhance the protection of the vulnerable communities against climate change related diseases and pests outbreaks;
- To strengthen community awareness on health impacts due to climate change;
- Identify communities and extent of damage to communities that are vulnerable to climate change related diseases and pests outbreaks;
- Investigate the relationships between climate change and, disease vectors, pests, other biodiversity including the use of herbal plants;
- To assess the impact of risky occurrences of climate change related diseases and pests outbreaks on the welfare of the victimized farmers;
- To enhance the protection of the vulnerable communities against climate change related diseases and pests outbreaks;
- To assess the impact of interventions proposed by the project and associated with the control of climate change related diseases and pests outbreaks on reduced health and income risks of the farmers.

Therefore, the CCU has a big role to play to ensure that the smallholder farmers adapt to the impacts of climate change by increasing their resilience mechanisms.

2.5.2 Use of Varieties

In recent years, part of the debate on climate change and agriculture focused on how farmers will adapt to climate change. This included the need to shift varieties and crops and to develop models that will tell which varieties will be adapted to future climate. The same applies for pests and diseases. Key priorities for research in ensuring that cassava adapts to climate change lie in increasing resistance to these key pests and diseases, as well as further developing management practices to address greater pest or disease pressure (Jarvis et al. 2012). The idea is that different varieties have different sources of resistance to different pests and diseases and therefore identifying these differences can be very useful to develop mixtures that will include varieties that differ in their resistance to pests and diseases.

MAAIF is aware that this will take time and research and the results might not reach the smallholder farmers in immediately and therefore focus will be on a wise use of agricultural biodiversity. However, since the farmers are the custodians of this diversity, they should be able to manage production systems that are rich in agricultural biodiversity. Several Integrated Pest Management (IPM) approach can be strengthened and used to control pests and diseases through environmental manipulation that put in benign equilibrium host and pathogen. More breeding can be used to develop resistant varieties.

2.5.3 Capacity Development and Improvement

The top priority for dealing with plant pests and diseases is strengthening national extension services and plant health systems through capacity building. This will include improvement of infrastructure, border control, better legislation and enforcement, and better surveillance. Other priorities include improving the ability to respond to movements of plant pests and diseases through increasing preparedness, ensuring maintenance of expertise and adopting rapid diagnostic tools and forecasting models. Investment in capacity building will contribute to reduction of emerging plant pests and diseases at source. Basic sciences such as climate change science, taxonomy, modeling, population ecology and epidemiology will be given highest priority by Government as recommended by FAO (2008). It will be essential to build the capacity of the CCU and other supporting agencies (NARO, Department of Meteorology, and universities and national research organizations) to research the intersections between climate and agriculture (ARCC, 2013).

At the national and district levels, agricultural extension and advisory services help farmers respond to and address some of the underlying issues; ultimately aiming to increase farmers' adaptive capacity (UNDP, 2013). ***Agricultural extension and service delivery institutions should be strengthened to institutionalize, apply, and replicate evidence-based management practices and technologies that have been developed through research efforts.*** Examples include the development of climate-adapted varieties, provisioning of inputs and information to farmers, and development of climate change monitoring and early warning systems (ARCC, 2013). Through support by MAAIF, the respective local governments will provide advice on varieties, methods, pest and disease management, pre- and post-harvest approaches to avoid losses, and soil and water conservation techniques.

2.5.4 Investment in Research

As world agriculture responds to challenges of securing sufficient, safe and nutritious food for the ever-expanding human population under changing climate, no doubt pesticide usage will increase even more. Identifying key constraints to food security, primarily from a production perspective,

this overview highlights how improving plant disease management can enhance global food security (Chakraborty and Newton, 2011).

Given Uganda's bio-physical and cultural diversity, a priority institutional development strategy would be to support the mandate and ability of research institutions to develop—through innovation and research—applied solutions to the impact of climate change specific to the Ugandan and subnational context. The potential research areas are elaborated in Chapter 18. The respective National research institutes coordinated by NARO, community-based organizations and local governments will work with farmers to develop new crop varieties (maize, beans and coffee) through research and on-farm trials. NARICA and K5 Resistant varieties have been developed against the Rice Blast and Rice Yellow Mottle Virus respectively. Research on maize has focused on controlling diseases, increasing yields and developing early-maturing varieties, while UCDA and the Coffee Research Centre are focusing on breeding and selecting hybrid coffee varieties for disease resistance and drought tolerance (UNDP, 2013). 12 nursery operators were supplied with the CWD lines to establish CWD resistant mother gardens in 2010 (MAAIF, 2011).

3 LOSSES AND COSTS ASSOCIATED WITH PEST ATTACKS IN UGANDA

3.1 Key Pests and Diseases

According to literature sources as well as consultations with DAOs and NAADS Coordinators as well as the smallholder farmers interviewed, the following is a summary of the key common pests and diseases of beans, rice, cassava, maize, and coffee:

Crop	Key Pests	Key Diseases
Coffee	Coffee Twig Borer, Coffee Meal Bug, and the Coffee Berry Borer Antestia bugs and lace bugs.	Coffee Wilt Disease and Coffee Leaf Rust Disease (Fungus).
Maize	Stalk Borer, Armyworm and Maize Weevil	Maize streak disease, Maize Leaf necrosis, Grey leaf spot, and Maize smut. Maize Lethal Necrosis disease
Beans	Cutworms and Aphids	Bean Root Rot (fungal), Bean anthracnose, Bean wilt, and the Bean Rosette (viral), Bean Common Mosaic Disease
Rice	Quelea Quelea birds, Termites, Aphids, Rice Stem Borers	Rice Yellow Mottle Virus (RYMV), Rice Bright and Rice Blast
Cassava	Mealy Bug, Cassava White Fly	Cassava Mozaic and the Cassava Brown Streak Disease

3.2 Definition of Losses

Subsistence farmers throughout Uganda continue to have problems of protecting their crops in the field against pests, diseases, and weeds. As a result field losses of crops are common and pose a big threat to food security and household incomes (Mugisha-Kamatenesi et al. 2008). The economic costs associated with a biological problem such as crop pests and diseases comprise the direct losses from predation or competition for resources and the expenditure incurred to control the pests and diseases. When pests and diseases cause agricultural losses, they reduce welfare.

Net cost = Losses in agricultural production + expenditures on control and management by government and farmers.

Losses due to insect infestation include the following:

- Loss of weight to the grain due to feeding.
- Loss in quality due to:
  - ✓ Impurities like droppings, cocoons and parts of insects, which may also lead to microbial infestation as a result of increased temperature and moisture,
  - ✓ Reduction of nutritional value,
  - ✓ Reduction in germination ability for seeds.
- Creating localized hot spots within the grain that may initiate wet heating, causing stack collapse due to weakening of bag fibre.
- Processing machinery may be blocked by webbing, and at times milling machinery may be totally damaged.
- Costs of disposal
- Mycotoxin contamination

3.3 Impact of Losses

The attacks of major pests and diseases invariably result into quantitative, qualitative, food insecurity, economic loss and environmental damage. There are several ways in which diseases

and pests affect crop production but primarily their effects is through reduced yields whose knock-on effects include diminished food availability, access and utilization (FAO, 2009). There is direct monetary loss as a result of expenditures on acquisition and application of pesticides, buying foods at later date more expensively as a result of short-term storage.

3.3.1 Household Level

Crop failures due to disease and attack also reduce households' income and evidence shows that income loss is indeed significant.

3.3.2 Beyond the Household

Crop diseases have impacts beyond households. The impact of these outbreaks is not limited to immediate and local food shortages, but can destabilize markets, both locally and overseas over extended periods of time. The shock event of a pest outbreak also undermines confidence in the farming and food sectors to risk investment that may otherwise realize a more resilient and profitable cropping and food system (Smith, 2013). The upstream as well as downstream impacts of disease-induced crop failures are significant and can have profound consequences on the survival of poor households. Losses due to crop pests and diseases are not only felt in terms of volume lost, and potentially the most significant impacts due to pests are not in the main felt around the scale of these norms, but in the extremes of unusual events. Examples include impacts on food security when produce is scare, or on price when in excess, or when a pest outbreak triggers a quarantine and trade embargo on an exporting nation.

At the district level for example, resources have to be shifted from planned activities to containment of a disease outbreak. Extension workers, as well as other technical and political staff, are often mobilized and sent to affected areas. Diseases have also become an emergency phenomenon. Accordingly, funds are diverted to cover these emergency expenses. Resources are also needed in terms of equipment, procurement of new planting materials and procurement and distribution of relief food (FAO, 2009). Therefore, addressing the effects of pests on Uganda's agricultural production captures a lot of attention from both local and international bodies. Not surprisingly, a number of agricultural research efforts are currently underway aimed at reversing the trend of pest damage to Uganda's agricultural produce.

3.4 Typical Pest Specific Yield Losses

It is estimated that pests and diseases cause a 27 percent loss to annual harvests worldwide - a problem that is becoming increasingly difficult to fight as climate change results in changes in insect behaviour and new pest and disease combinations. According to MAAIF, in Uganda, average crops losses due to pests and diseases in Uganda are 10-20% during the pre-harvest period and 20-30% during the post-harvest period. In Uganda, although literature does not provide quantitative losses, it is estimated that crop losses due to pests are larger than those causes by drought, soil infertility, or poor planting material (Kyamanywa, 1996). At times, losses up to 90% occur; caused by epidemics or diseases in perishable horticultural crops. The intensity of damage that may result in 100-% loss depends on the stage of growth, variety, season, type of pest/disease, type of crop management method employed. Although a crop may recover from field damage, the losses in storage are irreversible and infinite. Other epidemics include the coffee wilt, locusts, armyworm, quelea birds, variegated hoppers, whitefly, cassava mosaic, and cassava brown streak virus. Endemic/pandemic pests and diseases include aphids, Banana weevil, nematodes, potato blights, Bacterial wilts and viral infections that seriously reduce crop yields (MAAIF, 2013).

Table 1: Losses levels of some major crops

Crop	Pest/Disease	Typical Loss level
1. Banana	i. Black Sigatoka ii. Bacterial wilt iii. Fusarium wilt iv. Banana streak virus v. Banana weevil vi. Nematodes	i. 30-50% ii. up to 100% for affected field iii. up to 100% for susceptible varieties iv. 40% v. 60% in 4 years vi. 51% in 4 years
2. Coffee	Coffee wilt	Up to 100%
3. Cassava	i. Brown streak ii. Mosaic virus disease	i. 100% ii. 80%
4. Cereal and legume grains	Post-harvest losses due to insects, microbes, rodents and birds	5-15%
5. Roots and tuber crops	Post-harvest losses due to intrinsic, physiological and biochemical deterioration, and microbial decay	20-35%
6. Horticultural crops	Post-harvest losses due to intrinsic physiological deterioration, microbial decay	35-100%
7. Beans	i. Bean stem maggot: *Ophiomyia* spp. *ii.* Black bean aphid: *Aphis fabae* iii. Flower thrips: *Megalurothrips sjostedti* *iv.* Common bacterial blight: *Xanthomonas campestris* pv *phaseoli* var *fuscans* v. Angular leafspot: *Phaeoisariopsis griseola*	i. 53-74% ii. 10-58% iii.1-3 kg/ha per thrip iv. up to 60% on susceptible varieties v.40-55%

3.5 Estimated Monetary Value of Losses

Much as data on losses caused by specific pests and diseases on specific crops is scarce; below is a sample of estimation of losses and cost of mitigations for different crops in Uganda due to pests and diseases. The data below provides a good basis to understand the magnitude of the problem.

3.5.1 Banana Losses

In 2001, an outbreak of banana bacterial wilt (BBW) broke out in Uganda leaving in its wake a trail of crop destruction and utter misery among affected farms. As a result, a 50% decline in household incomes from banana sales and a corresponding increase in banana prices were observed during 2001 and 2004 in Uganda. There is no doubt that BBW is the most devastating disease to hit banana production in the Greater Lakes region (AATF, 2009). It changed crop production patterns, income sources and means of livelihoods. In Mukono and Kayunga districts, for example it was reported that banana production for certain varieties declined by between 80% and 100%, with the most affected being *gonja*, *kayinja* and *ndiizi* (AATF, 2009).

Overall, the banana programme in Uganda estimates that bananas valued at over US$ 35 million were lost due to BBW in 2005 alone (AATF, 2009) and a staggering US$ 200 million overall (AATF, 2009). This was despite a heavy campaign to control the spread and effects of the disease

in the country. Some scientists estimate that the loss could be as high as UGX 500 billion worth of bananas every year. The economic costs of the disease include labour used in debudding and removal of affected plants, and value of affected plants (AATF, 2009). ***It is also estimated that the disease can only be contained if funding of up to US$1 million per year is secured for the fight against its spread to save bananas worth over $200 million annually.*** However, the losses have decreased after interventions by government including introduction of resistant varieties.

3.5.2 Cotton Losses

Cotton in Uganda is produced mostly by small-scale farmers and contributes to the income of an estimated 10% of the country's population mainly in eastern, northern and western Uganda (IFPRI, 2004). Uganda's National Agricultural Research Organization (NARO) estimates cotton yield losses in Uganda due to insect pests to be about 40%. Annual total cotton yield losses due to insect pest pressure therefore, may reach close to 50,000 bales which is equivalent to ***US$10 million*** export value.

3.5.3 Coffee Losses

Coffee plays a central role in the economy of Uganda, accounting for approximately 20% of total annual export earnings. The livelihoods of an estimated 1.5 million households in Uganda depend on coffee and it is therefore a key commodity in the fight to eradicate poverty. 70% of the coffee growing areas were affected by coffee wilt and production declined from 4.4 million bags in 1996-97 to 3.6 million bags in 1997-98. The UCDA estimated that the disease caused a financial loss per coffee growing household of approx. 63US$ compared to a per capita income in Uganda of 190 US$ (World Bank, 1996). Hence a significant proportion of income was lost in Uganda due to that disease. ***Due to spread of Wilt Disease, up to half of Uganda's Robusta trees were killed which caused a sharp decline in yields with an estimated $800m loss over 10 year period ($8 million per year) i.e. year 2000 – 2012 (World Bank, 2010).*** According to UCDA, the coffee sector is still recovering from the shock impact of the Coffee Wilt Disease (CWD) that destroyed nearly 50% of the Robusta coffee in Uganda.

3.5.4 Rice Losses

Birds cause damage by eating the rice grains and yield losses in the range of 30 -100 % depending on time of planting (late planted rice suffers great damage), whether rice field is in isolation or not and whether bird are controlled or not. Rats cause yield loss in the range of 10-30%. Farmers control rats through field hygiene and baits containing rat poison. In 1997 the rice yellow mottle virus (RYMV) disease caused 100 % loss at TILDA rice scheme and Rice Blast disease was reported to cause 100 % yield loss for the old Bungala upland variety.

3.5.5 Cassava Losses

A new and highly virulent strain of the Cassava Mosaic Disease (CMD) virus appeared in Uganda in 1988, which subsequently spread to epidemic proportions from 1989 to 1999 over much of Africa. It was estimated that losses of about 60,000ha of cassava were incurred, equivalent to over 600,000 metric tonnes (US$60 million) of fresh cassava roots. ***The estimated annual cassava loss to pests and diseases has also been estimated at about UGX 200 billion ($ 80 million).***

3.5.6 Losses by Quelea Birds

With an estimated adult breeding population of at least 1.5 billion, FAO estimates the agricultural losses attributable to the quelea in excess of US$50 million annually in Africa alone. There has been an upsurge of Quelea birds in eastern Uganda that eat and destroy cereals such as sorghum and rice resulting into massive food losses and hunger. ***It was reported that while in Kween***

District in 2013, the birds destroyed over 1,000 acres of sorghum leading to a loss of over UGX 1 billion. In June 2013, the Crop Protection Department of the Ministry of Agriculture conducted an aerial bird control operation at Tilda Uganda Limited in Kibimba, Bugiri district in which a large number of quelea birds were wiped out. ***It was reported that Tilda had been losing over 1.5 tonnes of rice per day to the birds valued at UGX 40-45 million per day.***

3.6 Limitations in Estimations

3.6.1 Lack of Reliable Information

One of the functions of MAAIF is to establish a sustainable system to collect, process, maintain and disseminate agricultural statistics and information. At the moment, the agricultural sector is faced with a problem of increasing demand for data whereas there is lack of regular surveys and an infant system for collection, analysis and storage of agricultural data. There are issues that need to be resolved on methodology, manpower and funding. There are many uncoordinated producers of agricultural data; some existing agricultural data and information are not harmonized or consistent between sources and scattered among institutions collecting them. Additional constraints/ challenges include i) Limited awareness; ii) inadequate manpower; limited infrastructure. As a result the national agricultural statistics system is unable to meet the statistical needs of different users (MAAIF, 2011).

Among the most important statistics for which there is no regular and current information are crop area, yield, and production. According to Prof. Samuel Kyamanywa of Makerere University College of Agriculture, there is no latest literature on the economic losses caused by pests and diseases in Uganda. The only existing work was done by Peter Walker during the colonial days up to 1967. After that, there has not been a serious need of doing serious loss assessment as effort has moved from understanding the pests and diseases to managing them i.e. if the stalk borer is there, go and kill it. However, the IPM CRSP is currently conducting studies on the economic thresholds for pesticide use for crops based on different ecological zones including coffee. ***There is need to conduct economic losses assessment to have a basis for prioritizing and targeting a particular pest or disease.***

3.6.2 Regional Differences

The characteristics of the agricultural systems in Uganda makes data collection more difficult due to mixed crop and livestock farming systems, continuous planting and harvesting, use of non-standard units of measure of output, few farmers recording their production, and nomadic pastoral livestock production in some areas, among others. The full economic cost of crop pests and diseases in Uganda is therefore difficult to assess because the cost varies from region to region, and also requires intensive efforts to collect the necessary values. Expenditures continually change due to factors that influence the status of a pest or disease and the current and expected importance of such pests and diseases.

3.7 Institutional Interventions

3.7.1 MAAIF Interventions

MAAIF set up a Crop Diseases and Pests Control Project under the Department of Crop Resources from 2006-2012 to minimize crop losses, effectively control these pests and diseases, with the following interventions:

- Rapid response to control the epidemics whenever they break out.

- Equipping staff with the necessary knowledge and skills;
- Setting up mechanisms for pest and diseases surveillance, forecasting, diagnosis and prompt control.

The objectives of the project included:

- To reduce the crop losses from the current 50% to 10%.
- To equip staff with the up-to-date knowledge and skills to control pests and diseases effectively and in an environmental safe manner.
- To establish a surveillance, forecasting and diagnostic system to enable timely and effective control of the pests and diseases.
- To set up an effective Plant Quarantine System to protect Uganda's Agriculture against foreign pests and diseases.
- To strengthen the inspection and certification services to assure quality and safety of Agricultural exports.

3.7.2 Pest Management Procedures by UCDA

As regards management of pests and diseases, the UCDA says that assessment studies are always done including field trials before full-scale operations against pests and diseases are conducted. When there is an attack, UCDA through collaboration with MAAIF and NARO conduct checks to establish the pest or disease's mode of attack, habitat among others and then laboratory trials are conducted to identify the most suitable options. After that, demonstrations are then conducted to farmers in every coffee growing area on how to deal with the particular pest or disease. According to the UCDA, the areas of focus relevant to pests and diseases for the coming years include:

1. Generation of clean planting materials through Elite seed and Vegetative propagation of the CWD resistant lines.
2. Management of diseases and pests - Black twig borer, Coffee leaf rust, Coffee berry disease, Antestia bugs and lace bugs, Stem borers.
3. Supporting research in the development of varieties for adaptation to climatic change.
4. Provide both technical and general extension to coffee stakeholders- farmers and processors.

4 HISTORY OF PESTS AND DISEASES AND THEIR MANAGEMENT IN UGANDA

4.1 Definition of Pest

While pests are commonly considered to be insects, mites, rodents, nematodes, birds, snails, slugs, etc., FAO defines them more broadly as: "Any form of plant or animal life or any pathogenic organism that is injurious or potentially injurious to plants, plant products, livestock or people". This definition covers a wide range of organisms (plants, animals and micro-organisms) that reduce the productivity of agriculture, destroy produce or render it unfit for human use, and also includes organisms (vectors) that transmit diseases causing debilitating conditions in agriculture or public health.

4.2 Maize Pests and Diseases

4.2.1 Field Pests

Armyworm (*Spodoptera exempta*)

Armyworms are leaf-eating caterpillar pests of many cereal crops. They usually feed heavily leaving only stems and mid-rib of leaves. They make sudden outbreaks when large numbers of moths migrate into the country. They first appear as large numbers of minute green caterpillars feeding on the leaves. Fully grown armyworms are velvet black with fine yellow lines, and are about 35 cm long.

Control

- ✓ Spray botanicals such as neem and pyrethrum extracts. Spray when caterpillars are small. Once caterpillars are mature (about 3 to 3.5 cm long) they may have already caused serious damage and it may no longer be economical to treat the crop.
- ✓ Conserve and encourage natural enemies.
- ✓ Practice field sanitation.

Cutworms *(Agrotis spp)*

Cutworms are greasy-looking, grayish caterpillars, which feed on green plant material. They grow up to 40 mm long and tend to curl into a 'C' shape when disturbed. They eat the maize plants soon after germination at ground level reducing the stand considerably.

Control

- ✓ Leave the land weed free for about six weeks prior to planting.
- ✓ Apply pyrethroid sprays in bands over the rows.

Leaf Hoppers (*Cicadulina spp.)*

Leaf hoppers are small (about 3 mm long), pale, yellow and wedge-shaped insects, which suck sap from the maize plants. They are important because they are the vectors of maize streak virus. Control is by the following:

- ✓ Plant maize well away from grassland or previously irrigated cereals; in particular, avoid planting downwind of such areas. The numbers of leafhoppers generally increase in irrigated cereals and grasslands - or in wild grasses during rainy seasons. Leafhoppers disperse away from these areas when dry.

- ✓ Plant early - and if possible planting in an area should be carried out at the same time. Staggered planting of crops will favour multiplication of leafhoppers and increase the risk of virus transmission to later plantings.
- ✓ Keep the fields free from weeds, in particular grasses.
- ✓ Leave a barrier of 10 m of bare ground between maize fields and previously infested crops. This is reported to reduce virus incidence, by restraining movement of leafhoppers.
- ✓ Remove residues of cereal crops since they serve as infection sources.
- ✓ Use resistant varieties where available.

Termites

Termites are becoming important maize pests in Uganda. Various species of termites attach maize and damage is particularly noticeable during drought seasons or in areas with erratic rainfall. They destroy the roots and the base of the stem leading to lodging. Destruction continues even on fallen plants. In extreme cases, damage can lead to almost 100% yield loss especially if it occurs at an early stage. Damage after physiological maturity will lead to grains of poor quality because after lodging, cobs are exposed to contamination.

Control

- Dusban (Chloryrifos): Dusban kills by contact. Apply 20-40 ml using 10-20 litres of water per termite mound/ anti-hill. Other chemicals include terminator, dusban, pyrinex, troban, endosulphan, malataf.
- Regent 3-G (Fipronil): This is used where there are no mounds in the garden. Mix 50 gm with two litres of water and apply to locations of feeding termites. Apply to several locations of the field. The Fipronil kills the worker due to excitement, leading to over working and exhaustion, then eventually death. The queen stops feeding and dies of starvation.
- Imidacloprid systemic insecticide.

4.2.2 Vertebrate Pests

Rodents

Although rodents are generally considered important pests of stored grains, they are also important pests of maize in the field.

Damage

- Rodents (squirrels and rats) dig out maize seed plants in the ground and feed on them reducing the crop stand.
- Destroy seedlings as they struggle to feed on the remains of the endosperm after germination. This also reduces the plant population.
- Feed on cobs. In addition to reducing yield, this leads to reduction in quality of the grains.

Control

Control of rodents in the field is difficult.

- To avoid the reduction in stand, farmers usually plant 3-4 plants per hill and thin to 2 seedlings in the third week. This may not be done in the entire field, it could be done for the area notorious for rodent damage e.g. near a bush.
- Where possible, maintain clean surroundings by weeding or slashing. Rodents usually invade maize fields from nearby bushes and garbage, but may fear to cross open ground.

Wild Pigs and Monkeys
Wild pigs destroy maize at all growing stages. Monkeys will destroy the maize mainly after tussling equally when cobs are already formed. The pigs feed on seedlings, stems, leaves, green cobs and dry cobs. They usually invade the fields in large numbers.

Control

- They are usually controlled by groups of hunters who net them and kill them with the help of trained dogs.
- Scaring is done by children; this is difficult because its success depends on the faithfulness of the children. Some families also lack children to do the job.
- Shooting: Although shooting monkeys is effective in controlling them, it is illegal.

Birds
Birds can dig out seeds from the ground before germination, reducing plant stand. They also feed on the grains as soon as the grain filling stage begins. This reduces yield but perhaps even more important, their damage opens avenues for pathogens, leading to reduced quality. Queleas - often referred to as "feathered locusts"—are probably the most destructive birds in Uganda. Quelea birds are common in the districts of Iganga, Mayuge, Bugiri, Busia, Tororo, Butaleja, Budaka, Pallisa, Kumi and Lira.

Losses Due to Birds

- Loss in grain weight due to feeding
- Loss of grain quality due to contamination with droppings and pathogenic agents.
- Damage to storage bags.

Control – Control is by bird scaring, which is limited by lack of labour. Use of scare crows and other locally improvised noise making devices stationed in different points of the field reduces damage. The most common way of controlling the pest is by large-scale spraying of infested areas, "usually with a chemical called Fenthion - also known as quelea-tox - where they breed or roost"

4.2.3 Storage Pests

Maize Weevil *(Sitophilus zeamais)*
The maize weevil is an important storage pest constraining maize production in Uganda. It is a cylindrical black-brown insect of 3-4 mm length, with a well-defined snout, and an elbowed and clubbed antennae. The overall life cycle takes 24-60 days depending on temperature and humidity. Eggs are deposited within the grains where the larva and pupa stages are completed. It is a primary pest and damage is caused by adult feeding and larvae tunneling within the grains. Both adults and larvae feed on internally on maize grains and an infestation can start in the field (when the cob is still on the plant) but most damage occurs in storage.

Control –

- ✓ Cultural practices – The severity of a maize weevil infestation can be reduced by good store hygiene: cleaning the store between harvests, removing and burning infested residues, fumigating the store to eliminate residual infestations and the selection of only uninfected material for storage. Harvesting the maize as soon as possible after it has reached maturity will reduce the chances of attack by maize weevil and other storage pests. The use of resistant cultivars may also reduce the severity of an infestation.

- ✓ Physical control – The removal of adult insects from the grain by sieving can reduce populations but this is very labour-intensive. The addition of inert dusts such as ash and clay to the grain can reduce insect numbers by causing the insects to die from desiccation.
- ✓ Chemical control – Maize weevil populations build up the longer the maize is kept in store so it is important to inspect the stock regularly. If the pest is found then some form of treatment will be required. Synthetic pyrethroid insecticides such as permethrin and deltamethrin are not very effective against maize weevils which are more susceptible to organophosphorus insecticides such as fenitrothion and pirimiphos-methyl. Fumigation with phosphine or methyl bromide is very effective in large-scale stores. Also grain stocks may be fumigated with phosphine. Pesticides are poisons so it is essential to follow all safety precautions on labels.
- ✓ Neem shows considerable potential for controlling pests of stored products. Jute sacks are also treated with neem oil or neem extracts to prevent pests - particularly, weevils and flour beetles- from penetrating for several months.

Larger Grain Borer or LGB *(Prostephasnus truncates)*

The LGB, also known as Greater Grain Borer, "Scania", "Dumuzi" or "Lugimba Nsigo", can bore and live in wood, and on maize. It is cylindrical, dark brown and 3-5 mm in length. Its elytra are apically flattened and look like cut off. Its life cycle takes about 27 days under favourable conditions. Its infestation can occur both in the field and in storage. It is a primary pest and damage is by both adults and larvae. The beetle feeds on the most nutritious part of the maize kernel that is endosperm. They attack stored maize grains. Both the adults and the larvae (grubs) of these beetles feed in the grains. Adults come from infested cobs in the field or from an infested maize store and lay eggs in the grains. They attack maize both in the field and after harvest. Attacked maize grains lose all their contents and are not fit to eat. These pests become a serious problem in short time if no control measures are applied. The larger grain borer also attacks dried cassava roots and even the wooden structures of the stores.

Control –

- ✓ Spray using Italec Super
- ✓ When maize is ready for harvest, do not leave it for too long in the field; the larger grain borer or other storage pests could attack it.
- ✓ Treat the grain with a botanical pesticide (Neem or Pyrethrum; a mixture of neem and pyrethrum known as ("**Nimpyr**") seems as a better option to protect stored maize).
- ✓ Where feasible, use brick stones to construct the granaries; wood and grass would encourage breeding and multiplication of the larger grain borer.
- ✓ Where feasible, sell the maize within 3 months since the extent of larger grain borer infestation during the first 3 months of storage is generally low.
- ✓ Good store hygiene is very important in limiting infestation
  - ➢ Clean store thoroughly between harvests.
  - ➢ Remove and burn infested residues before the new stock is stored.
  - ➢ Immerse used sacks in boiling water to eliminate residual infestations.
  - ➢ Eliminate residual infestation in the wooden structure of the store by removing timber or by fumigating the whole store.

4.2.4 Diseases

Maize Streak Virus

The disease was reported first from East Africa, and has now extended to other African countries. The virus is transmitted by *Cicadulina spp.* Leahoppers. *Cicadulina mbila* (Naude) is the most prevalent vector, and will transmit the virus for most of its life after feeding on an infected plant. Early disease symptoms begin within a week after infection and consist of very small, round, scattered spots in the youngest leaves. The number of spots increases with plant growth; they enlarge parallel to the leaf veins. Soon spot become more profuse at leaf bases and are particularly conspicuous in the youngest leaves. Fully elongated leaves develop chlorosis with broken yellow streak along the veins, contrasting with the dark green color of normal foliage. Severe infection causes stunting, and plants can die prematurely will not develop cobs. Many cereals crops and wild grasses serve as reservoirs of the virus and vectors.

Management of maize streak virus

- Cultural Control – Certain cultural control methods can reduce the incidence of MSV in crops. Often, high rainfall during the wet season correlates with a large migration of infected vectors as the dry season approaches. Planting downwind of covered crops should be avoided, and close attention should be given to management and rotation practices in irrigated areas. A 10-m barrier of paved ground has been shown to reduce the number of immigrant vectors, and removing the remnants of previous crops is advised.
- Grow resistant varieties like Longe 1, Longe 4, Longe 5, Longe 2H, Longe 3H.
- Chemical insecticides can be effective and should be chosen for moderate persistence in order to cover the peak period of immigration when emerging crops are at greatest risk.

Maize Smut

Maize smut is a disease caused by the pathogenic plant fungus *Ustilago maydis.* Smut can cause significant economic damage in dry, hot maize growing areas, as well as in mid hill zones and under temperate conditions. The infection is systemic: the fungus penetrates the seedlings and grows inside the plant without showing symptoms, until the tasseling and silking stages. The most conspicuous symptoms are (a) abnormal development of the tassels, which become malformed and overgrown; (b) black masses of spores that develop inside individual male florets; and (c) masses of black spores in place of the normal ear, leaving the vascular bundles exposed and shredded. The smutted ear develops no grains.

Management of Maize Smut Host resistance

Maize varieties that are resistant to common smut are widely available and offer the most cost-effective and practical means of disease management.

Fungicide

Efforts to control common smut through the application foliar fungicides and seed treatments have not been highly successful.

Cultural control

- Avoiding mechanical damage to plants will reduce plant injury, which is the primary means of infection by the fungi.
- Controlling insect damage (e.g. controlling maize borers) will also limit plant injury.
- Removing galls before they rupture will limit the spread of teliospores but is not practical in large-scale maize cultivation.

- A well-balanced fertilizer regime will reduce disease severity. High levels of nitrogen fertilization increase disease severity, although application of phosphorous reduces disease incidence.

Gray Leaf Spot (GLS)
The disease is caused by *Cercospora zeae-maydis, C. sorghi var maydis.* This disease, also known as *Cercospora* leaf spot, may occur in subtropical and temperate, humid areas. Lesions begin as small, regular, elongated brown-gray necrotic spots growing parallel to the veins. Occasionally, lesions may reach 3.0 x 0.3 cm. Minimum tillage practices have been associated with an increased incidence of GLS. Development is favored by extended periods of leaf wetness and cloudy conditions, and can result in severe leaf senescence following flowering and in poor grain fill.

Management of Grey Leaf Spot

- Use of resistant cultivars
- Because moisture on leaf surfaces is important throughout the disease cycle, efforts should be made to avoid practices that extend dew periods. Therefore, irrigation should not be scheduled during late afternoon or early evening, especially after outbreaks have already occurred. Other cultural practices appear to have little effect on gray leaf spot development. Fungicides are important for gray leaf spot control.

Turcicum Leaf Blight (TLB)
The disease is caused by *Exserohilum turcicum,* an early symptom is the easily recognized, slightly oval, water-soaked, small spots produced on the leaves. These grow into elongated, spindle-shaped necrotic lesions. They may appear first on lower leaves and increase in number as the plant develops, and can lead to complete burning of the foliage. *Turcicum* leaf blight (or northern leaf blight) occurs worldwide and particularly in areas where high humidity and moderate temperature prevail during the growing season. When infection occurs prior to and at silking and conditions are optimum, it may cause significant economic damage. Development of the disease later in the season might not cause heavy yield losses.

Control

- Plant resistance maize varieties. Currently, no varieties are immune, hybrids like SC627, Longe 2H, Longe 6H, Longe 7H and Longe 8H have higher levels of resistance.
- Rotate diseased fields to non-cereal crops (like sunflower, soybean) for at least one year. Never plant maize after a diseased maize crop.
- Bury infected debris soon after harvest to enhance break-down of the residue so that the fungus dies in a short period of time.

Management of Turcicum Leaf Blight

Host resistance
Host resistance is the most efficient and cost effective means of disease resistance.

- Four genes offering major resistance to Turcicum leaf blight have been identified and are incorporated in many commercial hybrids. However, success of disease management using qualitative resistance will depend on the race of the pathogen present.
- Quantitative levels of host resistance are also available that restrict lesion development and sporulation.

Cultural control

- Rotating maize with non-host crops can reduce disease pressure.
- Management of overwintering infected crop residue will reduce the amount of available inoculum at the onset of the subsequent growing season.

Fungicides

- Fungicide application can effectively control Turcicum leaf blight when applied at the right time. Fungicide should be applied when lesions first become visible on the lower leaves.
- In seasons not favorable to Turcicum leaf blight (cool and dry seasons), fungicide application may not be cost effective particularly for grain production.

Ear Rot

Ear rots are commonly found in hot, humid maize-growing areas. Maize ears show characteristic development of irregular bleached areas on husks. These areas enlarge until the husks become completely dried, although the plant is still green. If husks are removed, ears appear chaffy and bleached, with a white, cottony growth between the kernels. Late in the season, many small, black pycnidia form on kernels and cob tissues. These pycnidia serve as sources of inoculum for the following season's crop. Microscopic observation of the spores is the only way to identify which pathogen is present. Severely infected ears are very light. Infection more frequently occurs through the shank and moves from the cob to the kernels. Stem borer injury in the ear often increases incidence of this disease. *Stenocarpella maydis* produces the mycotoxin diplodiatoxin and S. *macrospora* produces diplodiol, both harmful to birds.

4.3 Beans Pests and Diseases

The information below is adapted from Buruchara et al. (2010):

Cutworms: Several species belonging mostly to the genera Agrotis and Spodoptera

Attack by cutworms is usually sporadic: they appear to suddenly invade a young field and cut young seedlings at the base, near the ground. On digging into the soil near the cut plants one may find a dull, plump, hairless brown, charcoal gray, or black larva about 3 cm long. The larva curls up tightly when disturbed.

Control/management - Cutworms are minor pests of beans and often their management does not warrant control efforts beyond digging about 5 cm into the soil where the damage is observed and crushing the culprit. However, in situations where the population is high and damage is threatening, the larvae can be baited with straw mixed with an insecticide such as carbaryl (or other stomach poisons) and molasses and spread within the field.

Bean Stem Maggots or Bean Fly, three species: *Ophiomyia phaseoli, O. spencerella, O. Centrosematis*

Severe damage is indicated by wilting and dying of seedlings. The attack disrupts nutrient transportation, causing the tap root to die. The plant attempts to recover by forming adventitious roots above the damaged area. Young seedlings under stress wilt and die within a short time. Older and more vigorous plants may tolerate the damage but become stunted and will have reduced yield. Bean flies are especially active following the peak of the rainy season. Bean fly damage is aggravated by environmental stresses such as infertile soils, drought or moisture stress, the presence of soil borne diseases and other causes. Repeated planting of beans in the same plot, which leads to pest population build up, also worsens bean fly damage. Bean stem maggot

populations tend to peak late in the season: Sowing beans early in the season will hence help to avoid high maggot populations. Chemical seed dressing with systemic insecticides such as Endosulfan, Acephate, etc. before planting will protect young seedlings, which are the most susceptible, from attack.

Management

- Formulations such as "Murtano" combine insecticides and fungicides to protect against bean stem maggots and root rot pathogens.
- Growing beans in more healthy and fertile soils (for example through the use of farmyard manure and others), to improve tolerance to infestations
- Use resistant varieties such as EXL 55, G11746, G22501 and other resistant varieties, where available.
- Mulching with materials such as rice straw enhances adventitious root formation and recovery tolerance to damage.

Bean Foliage Beetle: *Ootheca bennigseni* and *O. mutabilis*

Early sign of trouble is the presence of large swarms of foliage beetles on young beans in the field. This often follows the early rains. They feed voraciously and may cause total defoliation of the crop. Continuous planting of beans on the same field without rotation is a key factor that promotes bean foliage beetle population build-up.

Management

- Post-harvest tillage exposes the dormant adults in the soil to the heat of the sun and increases mortality.
- Crop rotation with non-hosts (e.g. maize or sunflower) breaks the development cycle and reduces the emerging adult population.
- Delayed sowing of beans also helps to avoid susceptible stages of the crop coinciding with peaks in the pest population cycle.
- Application of botanical pesticides such as neem (*Azadirachta indica*) seed extracts deter infestation and reduces the damage.
- Where applicable various combinations of these strategies will help control the foliage beetle problem even further.

Flower and Pollen Beetles: Several species of *Mylabris* and *Coryna*

Flower and pollen beetles that attack beans are large (1.5 to 3 cm long) and are often brightly colored with red or yellow spots on black wing cases. They feed on petals and pollen of flowers and a large infestation can reduce pod setting and yield drastically. Eggs are laid in the soil and the early instar larvae feed on grasshopper eggs; high populations may follow high grasshopper populations. The adults may exude a yellowish fluid that can irritate or cause blisters to the skin.

Management - Insecticides are not known to be effective against the adult pollen beetles and the more susceptible immature forms do not appear on crops. On small fields hand picking with a pair of tongs may be more practical.

Pod Borers: *Helicoverpa (Heliothis) amigera*

The bollworm is cosmopolitan, widely distributed and causes damage to beans and several other horticultural crops in the tropics and subtropics. The older larvae feed from outside and characteristically leave part of the body exposed. The feeding hole is usually clean and circular

with fecal frass usually deposited away from the hole. Conditions that favor infestation and attack: Because the bollworm develops on many alternate hosts, it can switch easily and sporadically attack a new bean crop grown in the neighborhood of another host.

Management

- Avoid relay cropping of beans into established alternate hosts such as tomatoes, cotton, okra, etc.
- Encourage beneficial plant habitats that support natural enemies such as parasites and predators. The presence of predatory ants also reduces pest populations as they feed on small larvae and pupae.
- Botanical products, such as extracts of neem seed kernel, Tephrosia or tobacco leaves, chili, garlic, and others may be applied as foliar sprays to control bollworms.

Aphids (*Aphis fabae, A. craccivora*)

The black bean aphid is the main aphid pest of beans and causes direct damage wherever the crop is grown in Africa. The cowpea aphid may also colonize bean plants especially in low altitudes. Aphid infestations are usually more important in dry conditions. In humid weather, large aphid colonies can be wiped out by fungi that attack insects.

Management - A combination of natural enemies, including green lacewings (Chrysopidae), various lady beetles, the minute pirate bug, syrphid flies, and parasitic wasps, are the main natural enemies that keep aphids in check in the field. Certain insecticides have been found effective against aphid colonies but they may also eliminate the natural enemies, aggravating the problem.

Bean Bruchids: Common Bean Weevil: *Acanthoscelides obtectus* and Mexican Bean Weevil: *Zabrotes subfasciatus*

Bean bruchids are widely distributed in Africa. Two species: *Zabrotes subfasciatus* [Mexican bean weevil (MBW)] and *Acanthoscelides obtectus* [Common bean weevil (CBW)] are known. CBW is more common in high altitude or cool environments, while MBW prevails in warmer environments. In eastern Africa CBW is more frequently encountered. The larvae of both weevils can stay undetected in the seed until the adult emerges. They can be seed borne and spread by seed movement.

Conditions that predispose harvest to attack

- Storage under poor, unhygienic conditions such as stores already infested with bruchids
- Poorly dried beans

Management Strategies

- Early harvests before splits appear in pods to avoid field infestation by CBW
- Drying seeds thoroughly before storage
- Tumbling of seeds in a sack or rolling of seeds in a drum crushes eggs and stops new larvae from penetrating the seed
- Use of MBW resistant varieties reduces infestation from this species
- Boil used storage sacks in hot water and dry in the sun before reuse
- Inspect stored seeds for signs of infestation and take action to stop its development.

4.4 Pests and Diseases of Coffee

4.4.1 Key Nursery pests

A number of insect pests may attack clonal robusta cuttings while still in the nursery. Serious insect infestations may render the cuttings unfit for planting out in the field. The most common pests found on cuttings are leaf eating caterpillars discussed below:

Leaf Miners *(Leucoptera* spp.)

Status: Can be severe sporadically and are troublesome. Two species of miners are found in Uganda.

Symptoms of attack: Affected leaves develop brown irregular blotches on the upper leaf surfaces. If a mine is opened by bending the leaf across the mine, small white caterpillars may be seen. Leaves with mines are usually shed prematurely.

Control

Chemical: In nurseries a full cover spray of 70 ml. of Fenitrothion 50% E. C. in 20 litres of water is recommended. The mines should contain active larvae before deciding to spray, since the miner itself may have disappeared leaving just old damage.

Leaf Skeletonizer *(Epiplema dohertyi* (Warr.))

Status: Severe outbreak may occur in the nurseries, which can be troublesome and cause defoliation.

Symptoms of attack: The caterpillars feed on the under surfaces of leaves, usually close to the mid-rib. They devour all the leaf tissues leaving only the main veins and upper epidermis, resulting in irregular patches on the leaves.

Chemical control: 70 ml. of Fenitrothion 50% E. C. in 20 litres water applied as a cover spray.

Tailed Caterpillar *(Epicampoptera andersoni(Tams)*)

Status: Occurs occasionally in large numbers and can cause defoliation of coffee in the nursery.

Symptoms of attack: The caterpillars feed on the under surface .of the leaf, about halfway between the mid-rib and the edge, leaving the upper surface intact. The older caterpillars, however, feed at the leaf margin, sometimes devouring everything except the mid-rib.

Control

Cultural - In a small number of plants, the pupae can be collected by hand and destroyed.
Chemical - Spraying can be done when the caterpillars are small and are in large numbers, using Fenitrothion 50% E.C. 70 ml. in 20 litres of water.

4.4.2 Major Coffee Field Pests

Coffee Berry Borer *(Hypothenemus hampei)*

Status: This tiny beetle is the most serious pest of robusta coffee. It also damages arabica coffee growing at lower altitudes, but is uncommon above 1,500 m.

Symptoms of attack: One or more small round holes near the apex, of a large coffee berry and into one of the two beans. Hard beans are preferred. Soft young berries are not generally attacked. Both adults and larvae feed on the berry and can turn the bean into a dusty mass of frass. Even slightly bored beans have distinctive blue-green staining which lowers quality.

Control

Cultural: Heavy shade from shade trees or through neglect of pruning will encourage the borer because this condition does not favour the natural enemies of the pest. Pruning to reduce shade is essential. Regular picking of ripe cherries (at least once fortnightly) is recommended. Use sacks or Hessian cloth spread on the ground during picking to prevent loss of infested cherries in the mulch. Dry or over-ripe cherries should be stripped and burnt.

Coffee Twig Borer (CTB) (*Xylosandrus spp*)

The Coffee Twig Borer is known to have spread to the rest of the world from Asia. It's a small black beetle which mostly bores into primary branches and kills them before attacking the main branches. In Uganda, CTB was first reported in Bundibugyo district in 1993. Second record was in Rukungiri, Kanungu and Bushenyi districts in 2002 and the third report was in Mukono district in 2007. At the moment, almost all Robusta growing districts are affected, the most severe hit being: Mukono, Kayunga, Buikwe, Mpigi, Butambala, Luwero, Nakaseke, Masaka, Lwengo, Kalungu, Mityana and Mubende. It is also reported in Bushenyi, Ibanda, Hoima, and Kibale Districts.

Very small black spots/holes (about the size of a needle) or bicycle spoke appear at the point where the pest bores to enter the twig/plant. The female beetle bores into the twigs/primary branches and causes them to wilt and eventually die in a few weeks. Female cultivates ambrosia (Fusarium solani), a fungus in the infested coffee galleries for feeding its larvae. The leaves of the infected twigs start turning yellow followed by wilting and eventually die without yielding coffee berries. When the affected part is broken at the pin-hole point and split apart, small back beetles and white larvae can be seen inside the tunnel. If no control measure is undertaken, death may occur to the entire coffee tree, resulting in total loss of berries.

Field Hygiene (Phytosanitary)

- ✓ Daily field inspection to detect any new infections and/or symptoms;
- ✓ Clean weeding and burying all weeds. Weeds should not be allowed to thrive as they may act as a bridge between the individual plants.
- ✓ Reduction of heavy shade tree cover in the coffee field.
- ✓ Pruning and burning infected twigs and branches.
- ✓ Good plant nutrition, including manure or fertilizer application, soil and water conservation provision and mulching for good plant health and vigor.
- ✓ Maintain the recommended spacing between individual plants to minimize humidity levels and cross contamination.

Chemical Control:

- ✓ Coffee Twig Borer (CTB) can effectively be controlled by using a combination of good field hygiene practices and spraying regime using systemic pesticides such as Monocrotophos, Chlorpyrifos and Permethrins.
- ✓ Spray using IMAX (Imidacloprid), Thionex (Endosulfan), and Malathion

Brown Scale (Helmet scale) (*Saissetia coffeae (Walker)*
Status: Minor pest though occasionally severe outbreaks may occur.
Symptoms of attack: Immobile insects, which are oval shaped and 1 brown in colour. They are found clustered on green shoots, leaves and berries and often arrange themselves along the edge of the leaf 4 blade.

Control:
Cultural: Badly infested branches should be trimmed and left on the ground to allow the parasites to emerge from the scales. Trees should be given optimum quantities of fertilizer and mulch.

Chemical: Insecticide banding. If ants are attending the insects, stem banding with a suitable insecticide is done as for green scale.

Common Coffee Mealy bug *(Kenya Mealy bug) (Planococcus kenyae* (Le Pelly))
Minor pest of robusta and arabica coffee.
Symptoms of attack: Mealy white masses of insects found especially between flower buds, berries and on young shoot tips, sooty mould on the upper surface of leaves is a frequent sign of infestation. They are attended by ants.

Control:
Cultural: Prompt *striping* of unwanted sucker growth.
Chemical: Chemical banding indirectly controls the bug. Banding stumps/stems of trees with recommended insecticides keeps off the attendant ants and allows natural enemies to clean up infestation. Chemical used are the same as for Green scales etc.

Coffee Root Mealy bug *(Planococcus preneus* (De Lotto))
Status: It is a minor pest of both arabica and robusta coffee, but potentially serious.

Symptoms of attack: The insects are found at the base of the stem below soil level and on the roots. Trees attacked by coffee root mealy bug typically have yellow drooping leaves and become unproductive, as if affected by drought. Roots become stunted. The roots of old trees are often covered by a whitish rubbery fungal tissue, *Polyporus* sp. Seedlings and very young trees are usually free of the fungus. The fungal layer and the sucking of the insect kill off the coffee roots, leading to death of the whole tree. Al If the fungus layer is peeled off the white J mealy bugs can be seen. The white colour of the mealy bug is due to a waxy secretion.

Infested trees with yellowish of brown leaves or have been growing poorly over a number of years should be replaced. Infested trees still exhibiting a healthy appearance should be treated with insecticides.

Chemical control: Soil is scraped away from the roots and 10 g/tree of Furadan, Dursban or Mashal10% granules applied, before replacing the soil.

Coffee Ants
Ants are not normally direct pests of coffee in Uganda, but because of their habit of biting and stinging anyone disturbing the coffee trees, they can hinder harvesting, pruning and cultivation within the crop. Some species of ants encourage infestations of scales and mealy bugs by cleaning honeydew from them and thus protecting them from their natural enemies.

Biting Ants *(Macromischoides aculeatus* (Mayr))
Status: Common in most robusta coffee areas.
Symptoms of infestation: A small black and extremely aggressive ant which makes papery nests between the leaves. It can prevent picking, pruning or other management activities in the coffee by its fierce attacks upon the field workers. They do not generally encourage infestation by scales and mealy bugs.

Control:
Spot treatment of the nests with 40 ml of Fenitrothion 50% E. C. in 20 litres of water can "" contain the situation.

Tailor Ant *(Oecophylla longinoda* (Latr:))
Status: Less common than the biting ant but more troublesome in some robusta areas than the biting ant. They also nest on other trees such as C*ashew, citrus and mango.*

Symptoms of infestation: It is a yellowing red insect about 10 mm long (Adult worker). The insects fasten leaves together to contain their nests. Leaves are held together by fine web of white silk produced only by the larvae. They are the most aggressive and ferocious insects which attack workers in the field. They also attend some scales.

Control
Spot spraying as in the case of biting ants. , If the ants are attending scales an insecticide band should be applied to the stem, e.g. Dursban 48%; E.C. 700 ml in 20 litres of water with 15 g. Methylene Blue added.

4.4.3 Coffee Diseases

Coffee Wilt Disease (*Fusarium xylarioides*)
In 1992 a new devastating disease of Robusta coffee appeared in Uganda by the end of 2000 it had spread to all Robusta zones of the country. This was identified as *Fusarium xylarioides* (telomorph which also has a sexual stage (*Gibberella xylarioides*). Coffee wild disease established itself in all Robusta growing districts of Uganda destroying approximately 52% of the Robusta coffee trees by the year 2005. The declining trend of plant population has been reversed by the replanting program and overall reduction in the severity of the epidemic.

Management - One of the first recommendations for controlling coffee wilt disease was to uproot and burn affected plant parts as soon as the first symptoms were observed. The effectiveness and feasibility of the method was known. Infected plants form 1992-2000 were uprooted and burnt as soon as the first symptoms were observed. Results revealed that at initial stages, this practice controlled the disease. However later there was a severe upsurge of the disease and the situation became impossible to control. In the long run, the method became labor intensive and ineffective.

Coffee Leaf Rust: *(Hemileia vastatrix)*
Status: Potentially serious disease of robusta coffee. However, the effect of premature leaf fall on the yield of clonal coffee has not yet been determined.

Symptoms: The first symptoms are pale yellow spots on the lower leaf surfaces. The spots enlarge and develop into yellowing-orange, powdery, round, blotches, as spore production takes place.

Mode of spread and attack: The spores are dispersed mainly by wind, and rain. Spreading by insects has been reported. Germination of spores takes place in the presence of liquid water and under favourable temperature conditions. Only spores germinating on the under surface can penetrate the leaf through the stomata and cause infection. The fungus occurs in a number of physiologic races.

Control
Well managed clonal coffee does not succumb to rust. Chemical control is not recommended.

Red Blister Disease *(Cercospora coffeicola (Berk et Cooke)*
Status: A serious and widespread berry disease on the old seedling coffee. It occurs in robusta coffee and arabica coffee in the robusta areas. Occasionally seen on arabica coffee at high altitude but is not serious. Symptoms include small red spots appear on both green and ripening berries and are slightly raised. The spots increase in size and coalesce forming unsightly blisters.

Control
The 6 clones are resistant to the disease, and control measures are not warranted. It is not economical to use chemical sprays on the old robusta seedling coffee.

Root Rot (Collar Crack) *(Armillaria mellea*)(Vahl ex Fr.) Kummer
Status: Can be a serious disease in various localities especially in coffee planted on land cleared from forest. The fungus attacks many forest trees and other tree crops besides coffee.

Symptoms: Affected trees slowly decline. Leaves turn yellow, followed by wilting and eventual death of leaves, branches and the whole tree. The root system is rotten, and just beneath the bark of the root, white mycelia growth of the fungus can be seen. At an advanced stage of the disease, the wood of the affected tree is decomposed into a white wet mass with characteristic black lines running through the tissue. Vertical cracks may occur at the base of the stem.

Mode of spread and attack: The spread from one tree to another may be by root contact. Spread can also be effected over short distances by root-like fungal growths (rhizomorphs*)* under the bark along the surface of infected roots into the soil. The source of infection to coffee trees can usually be traced to affected shade trees, or old stumps left in the ground when land is cleared prior to planting.

Control
Ring barking trees prior to felling. This has the effect of depleting the carbohydrate reserves in l the root system. The fungus *(Armillaria)* cannot grow in roots deprived of carbohydrates. Ring barking should be done correctly by removing the bark, but leaving the tissue of the~ wood alive. The removal of the bark prevents downward movement of carbohydrates to the root. The tree continues to live using the reserves in the roots, which with time are exhausted. The aim of ring

barking is to exhaust the reserves in the roots, which may take two to three years. By that time the top of the tree would be dead, and felling of the trees can be done. The stump and as much as possible of the root system should be removed and burnt after the trees have been felled.

Drenching: Affected coffee trees cannot be treated or saved. The tree and as much as possible of its root system should be removed. Replanting on the site should be delayed for 24 months. The area can be drenched with a copper fungicide to reduce infection of future transplant.

Separation of healthy and infected root systems: .A ring of apparently healthy trees adjacent to the one removed, may already be infected by .the fungus. A trench 60 cm (2ft) or more external to them and surrounding the affected site may help in preventing further spread by root contact.

4.5 Pests and Diseases for Rice

4.5.1 Pests

A participatory rural appraisal (PRA) was carried out by Musiime et al. (2005) to identify the major constraints to rice production which have led to the increased rice yield gap in Bugiri district. The constraint due to pests and diseases as assessed as well. According to their results, Weaver birds (*Quelea quelea*) and rice field rats (*Rattus argentiventer*) were reported as the most serious pests. Rats cause damage by cutting down seedlings, mature plants or eating of mature grains. The affected rice plants normally fail to develop panicles. Unlike the birds, rats lead to both poor and decreased plant stands. Others include the Stem borers - the larvae of different species bore into the rice plants causing white heads and Control is by spraying with Fenitrothion 50% EC.

4.5.2 Diseases

According to Musiime et al. (2005), most common diseases are rice yellow mottle virus (RYMV) and Rice Blast for wetland and upland rice respectively. Rice Blast is a serious fungal disease which develops brown or reddish spots with grey centers on the leaves. The heads are empty and often droop. Control is by use clean of seed of resistant varieties. Also remove affected plants or spray with fungicide. The Rice Blast was reported to cause 100 % yield loss for the old Bungala upland variety.

RYMV vector is transmitted by leaf hopper and causes rice plants to get stunted. In 1997 the disease caused 100 % loss at TILDA rice scheme. Rice blast attacks seedling (seedling blast), leaf (leaf blast) and stem (neck blast) by forming spindle shaped lesions that lead to reduction of both photosynthetic leaf area and stem support. NARICA and K5 Resistant varieties have been developed against blast and RYMV respectively.

4.6 Pests and Diseases for Cassava

4.6.1 Cassava Pests

Cassava pests represent a wide range of invertebrate and vertebrate organisms most of which are minor and sporadic in terms of their economic importance. Considering their economic importance, the following are recognised pests of cassava in Uganda (NARO, 1994):

Cassava Mealybug (*Phenacoccus Manihoti*)

Cassava mealybug attacks only the growing points of the plant producing curving of the shoot, bunched effect in terminal shoots results in stunted crop. A toxin present in its saliva contributes to this leaf and shoots deformation. Further symptoms include: shortened internodes, little or no leaf

growth and curling leaves. The presence of mealybug infestation under field conditions can be noticed by a swarm of dipteran files looking for their honey dew secretions and the shooty mould growth on the stems and leaves. Very young plants may be killed and any infested plants are significantly weakened. Severe damage can result in tuber quality deterioration which eventually rots as carbohydrate root reserves are immobilised to sustain the crop and the pest complex. This pest always prefers stressed plants i.e. environmental stresses like: water shortage, nutrient deficiency and other pests and cassava diseases. Such preference explains reasons for the extensive damage they do during dry weather conditions i.e. June - July and January - March.

Control - This exotic pest was introduced without its natural enemy complex. The exotic natural enemy (Epidinocarsis lopezi) is an effective control agent. It parasitizes 2^{nd}-3^{rd} instar stages. The natural enemy was first imported in 1992 and released in Tororo, Iganga, Apac, Masindi and Nebbi Districts. In all these release sites, the E.lopezi has established and is beginning to make some impact on the mealybug.

1. The use of chemicals on mealybug is not recommended in cassava crops. However, it is restricted to the treatment of infested stems of improved varieties for distribution to distant non-infested areas only. Treatment using dimethoate (Rogor) a systematic insecticide at 0.25 mg ai/100 water as a dipping solution has been proved very effective.
2. The use of mealybug-free stems also helps reduce disseminating the pest to non-infested areas.
3. Free movement by personnel and workers in a mealybug infested field be restricted as they are able to stick on clothes and be transported to the next cassava field.
4. For mealybug-free areas enforcing quarantine measures on the movement of stems into the area is of paramount importance as to delay or eliminate artificial infestation.
5. The possibility of using mealybug resistant cassava varieties is being explored. However, preliminary field observations indicate that Nase 1 (TMS 60142) appears resistant to the mealybug.
6. Crop rotation to reduce mealybug population is encouraged.

Cassava Green Mite (Mononychellus tanajoa):
This exotic pest was accidentally introduced from South America to East Africa (Uganda) probably in 1971. Within a decade, it had expanded its range across the entire cassava growing belt of Africa imposing a constraint in cassava production. The CGM is a sucking pest and deprives the plant of assimilates manufactured during photosynthesis. This leads to reduced growth, scorching of leaves, tiny leaf production, leaf fall, shortened internodes, which during dry weather, aggregated by water stress, can leave shoot tips as mere twigs. Yield loss determination by measuring the difference in biomass between mite-free and naturally infested cassava at Serere reported 6.3-35% loss in B8, B II and Ebwanateraka varieties. Yield loss is however very severe on late planted cassava as the most vulnerable stage corresponds with mite peak populations during the dry spell.

Control - Considering the pest range and the various domesticated and wild host for CGM, an integrated approach is the most suitable and sustainable.

1. Use resistant cassava varieties such as Nase I. In areas where mosaic is not a problem, Ebwanateraka can also be grown as the variety is resistant to the pest.

2. Biological control using predatory mites i.e. the phytoseiids. This has been very successful especially with genotypes which have shown field resistance to mites.
3. Crop rotation is encouraged.
4. Plant at the beginning of main rains so that by the onset of dry season, the crop will have matured.
5. Grow early maturing varieties when available.

Termites

There are a range of termite species attacking crops and crop products in store. No quantitative assessment has been done to determine the effects of these pests on crop establishment and yield. However, there is evidence that termites are a problem to newly planted cuttings, more so if dry planting is done. Under water stress conditions, termites have been reported infesting cassava tubers as a source of food and water causing heavy and extension yield losses. These infestations also expose stems and tubers to attack by fungal and bacterial pathogens causing rotting.

Control –

1. Termite damage can be remedied through insecticidal treatment of termite mounds in areas where cassava is to be planted.
   a) Cypermethrin (Ripcord) 40% 5c at 100 ml/20 lts water.
   b) Lambola Cyhalothrin (Karate) 40 w.p at 1 pack/20 lts water.
   c) Dimethoate (Rogor) 25% Sc at 200/20 lts water.
   d) Lindane 20% wp at 0.125 g ai/200 lts water.

2. Completely destroy, physically by digging-up mounds and removing the primary reproductives (Queen + King) leading to slow death of the colony.
3. Use the above chemicals excluding synthetic pyrethroids at the above rates as dipping solutions to protect the cut- ting from attack.
4. Avoid dry planting in areas where termites are a problem.

Vertebrate Pests

The most important of which are: wild and domestic pigs, rats, and mole rats, baboons, monkeys etc. In places where these pests are a problem farmers have self-initiated control methods to check the extent of damage and their population including hunting, pit and wire trapping etc.

Cassava Scales

White scales used to be minor although it is becoming important in some areas now. No quantitative measures have been taken to assess scale damage to yield loss.
However, sanitary measures such as:

- Use of white scale free planting materials
- Restricted movement of unauthorised vegetative plant material
- Chemical disinfestation as for mealybug. Dimethoate 20% wp. at 0.125 g ai/200 lts.
- Crop rotation is encouraged.
- Early planting.

Variegated Grasshoppers

This pest has of recent been a problem in West Nile, Soroti and Kumi Districts. In Uganda, no quantitative yield loss assessment has been conducted on this sporadic pest. However being a

defoliator especially on young tender and the most efficient food manufacturing leaves always lead to some yield losses especially on young cassava. Being on the migratory group, strategies for locust control can be used with success.

Use chemicals such as:

- Fenitrothion 40% Sc at 200-250 mg ai/ha
- Lambda Cyhalothrin (Karate) 40% wp at 60 mg ai/ha.

Nematodes

These have assumed economic importance in cassava production especially where continuous cassava production has been a practice. These pests destroy the rooting system on which they cause knots hampering water and nutrient uptake and transport. The knots also interfere with tuber development and storage leading to yield losses.

Cassava Whiteflies

The pest status of whiteflies on cassava production is very minimal. It is important as a vector of cassava mosaic virus.

4.6.2 Cassava Diseases

According to NARO (1994), the following are the key diseases affecting cassava in Uganda:

The African Cassava Mosaic Disease (ACMD)

Cassava Mosaic Disease was first reported in East Africa in 1894 and later found widespread in Uganda. Over the years, the disease became serious in the country and by 1933 -1944 serious epidemic similar to what now is widespread in Eastern and Northern Uganda.

Symptoms - The typical symptom is reduced leaf size, malformed and twisted leaves, with yellow areas separated by areas of normal green colour. Severely affected plants are stunted.

Yield Loss - The magnitude of yield loss depends on the stage which the plant is infected and the degree of symptom severity. Plants infected as cuttings sustain highest (80-100%) yield loss. Plants infected after 5 months from planting may sustain very minimal or no yield loss. Similarly plants with very severe symptoms sustain highest yield loss and vice versa. Repeated planting of infected materials eventually results in no yield at all.

Transmission and Spread - The African cassava mosaic is transmitted by ineffective, whitefly Bemisia tabaci. The whitefly acquires the virus from infected plants from within the field and outside sources. Once infected, it retains the virus for along time and can transmit it to distant plants. Under favourable conditions all healthy plants of susceptible varieties become infected within five months from planting. The virus remains in infected stems indefinitely and planting such stems can disseminate the disease.

Control Measures

- Roguing of infected plants
- Planting ‘clean’ planting materials
- Use of resistant varieties
- Crop disposition and isolation

- Avoid planting cassava towards the end of the rains. This is the time when transmission of mosaic by the whitefly is rapid.
- Do not gather planting materials from cassava stems lying on the ground. You will not know the status of the stems or else you may transfer mosaic to your field.
- Never allow goats to break cassava during the dry season. This reduces the quality of planting materials and makes it difficult to select mosaic-free stems as the leaves would be absent.
- Seek for advice and learn now ideas on mosaic control from neighbours. Relatives, nearest extension staff or any nearby Government Institution.

Leaf Spot: Round brown spot (1 cm in diameter) with grey spores on lower surface. This is common but not serious.

Bacterial Blight: Is serious in parts of Northern and Eastern Uganda. Use resistant varieties and plant clean cuttings.

Anthracnose and Root Rot: Anthracnose and root rot infect the stems and tubers respectively. However the severity of the diseases has not been correlated to yield loss and sanitary measures have been practised with success. It has been found that tuber rot is prevalent in heavy poorly drained soils more so in newly opened woodland where there are decaying stumps. For these reasons well drained soils are recommended and avoid newly opened woodlands where rotting stumps are because they share the same pathogen.

4.7 Management Practices for Pests and Diseases in Uganda

4.7.1 Use of Resistant Species

Over centuries of crop production, breeding has been continuously practiced to improve crops by generating new varieties with resistance to pests and diseases as well as various physical constraints like drought. In Uganda, for example, more than 60 varieties of common bean grown by farmers were observed and documented for their resistance to diseases such as Angular Leaf Spot, Anthracnose and pests such as bean fly. Scientists are currently experimenting with different mixtures of these varieties to see if certain combinations prove to be more effective in controlling pests and diseases. Awareness raising materials have also been developed and shared with farmers and extension workers. According to the 2011-2012 Annual Report by UCDA, in terms of research, emphasis has been on dissemination of technologies for sustainable control of pests and diseases. There was continued propagation of 7 CWD resistant Robusta varieties by tissue culture and nodal cuttings where 29 Nursery operators were allocated plantlets to establish mother gardens for subsequent generation of clones. This brings the cumulative number of nursery operators to 45, with a total of 15,750 mother bushes established which will generate at least 472,500 trees in the first season.

4.7.2 Examples of Existing Crop Specific Management Practices

4.7.3 Coffee

Intercropping with coffee is also done to control coffee wilt disease. Another initiative for those cultivating organic coffee is the use of *Tephrosia vogelii* leaves that are crushed and mixed with water and sprayed to fight the common coffee pests.

Figure 4: Intercropping, coffee and bananas, note mulching for both the coffee and banana and the shed provided by the banana plants

Figure 5: Tephrosia vogelii used to control pests at organic coffee farms in Sironko District

4.7.3.1 Rice

Scare crows and bird chasing (typically by children) are the methods jointly used to keep birds off the rice fields. On big farms like Tilda rice scheme, the first rows of rice at the edge of each field are poisoned and the method has been reported effective against birds.

Figure 6: A young boy on duty to chase birds at Doho Rice Scheme

Figure 7: Another initiative to scare away birds at Bwirya Rice Farm

Figure 8: Scare crows at Bwirya Rice Farms in Butaleja District

4.8 Proposed ACDP Interventions

In order to address some of the above constraints, the ACDP includes particular components to solve the some of the above bottlenecks as discussed below:

Component 1: Agricultural inputs

(Seeds & planting materials, fertilizers, pest & disease management, coffee rejuvenation and stakeholder training) (USD 65 million)

The objective of this component is to increase farmers' access to and use of improved seeds, integrated soil fertility management technologies (soil fertility and water management) and pest and disease management (IPM) as well as coffee rejuvenation for sustainable growth of productivity, production and return of selected commodities (maize, rice, beans, cassava and coffee) in the targeted districts/clusters.

The overall approach is to simultaneously strengthen the demand and supply systems for technologies and quality inputs. Proposed activities will enable scaling-up farmers' use of agricultural research outcomes and advisory services, provided through ATAAS and EAAPP projects, in support of the intensification of market-oriented smallholder farming systems. Main challenges to kick start sustainable farmer productivity and income growth are: (i) access to improved seeds adapted to local farming systems and markets; (ii) in-time availability and access to quality inputs for intensification; (iii) updated information on pest/disease prevalence and location-specific soil fertility status for efficient input use; and (iv) improved management of market and climatic change induced risks and their mitigation.

Proposed support activities will promote access to and use of quality inputs through four main activities: (i) availability of improved seeds and planting materials by organizing farmers demand and strengthening the seed production and planting material production capacity; (ii) access to and use of quality inputs (seeds, planting material and fertilizers) facilitated through temporary targeted/smart subsidies (voucher scheme); (iii) integrated pest and disease control/management for targeted commodities; and (iv) training of trainers in improved production, processing and marketing of targeted commodities.

Activity 1.1: Availability of improved seeds (maize, rice and beans) and planting materials (cassava and coffee).

Complementing other programmes, the aim of this activity is to support the development of Uganda's seed industry in order to accelerate the availability and farmers' use of improved varieties and quality seeds. Proposed activities will respond to farmers' demand in targeted value chains by: (i) promoting and bulking farmers' demand/use of quality seeds and planting material; and (ii) enhancing seed availability through strengthened capacities for production and distribution of quality seeds and planting materials by private seed industry and farmer organizations. This will involve working with the Uganda Seed Trade Association (USTA), member seed companies, farmer organizations and cooperatives, as well as agricultural research and extension systems.

Organize and bulk farmers' demand for improved seeds. Farmers' demand for improved planting materials will be boosted by: (i) scaling-up of on-farm trials and demonstrations in close collaboration with ATAAS programmed activities towards identifying farmer preferences (on top of market studies component 3); (ii) ATAAS is distributing starter packs (0.2-0.5 kg per beneficiary) to allow for farmer participating at field days organized around demonstrations to test new technologies in their own fields; and (iii) bulking farmers' demand for improved seeds (maize,

rice and beans) and planting material (cassava and coffee) through their local agricultural cooperative enterprises (ACE) and other active farmer organizations and private producers..

Consolidate the seed demand information system. A public-private partnership between the Uganda Seed Trader Association (USTA) and the seed section of MAAIF will establish and manage an efficient seed marketing information system (demand, offer and prices of quality seeds). This will inform stakeholders about seed demand and availability for targeted commodities and varieties to allow for better medium term planning of seed (maize, rice and beans) and planting material (cassava, coffee) production. An annual stakeholders' forum for the seed sector will be organised by USTA, to discuss key issues and prospects of the Ugandan seed market among stakeholders while adjusting seed demand and offer projections by species and variety.

Enhancing seed and planting material availability by strengthened capacity for its production and distribution. The aim is to up-scale the capacities of the private seed industry and farmer organizations for quality seed and planting material multiplication and distribution. ACDP will complement on-going support to Uganda's seed industry and accelerate the adoption of improved varieties for targeted species. Proposed activities will include:

a. strengthening the capacities of the private seed industry for hybrid and OPV production by: (i) improved access of the private sector to public (NARO license/royalties) and private sector varieties for local multiplication; (ii) NARO technical assistance and training for seed companies based on their identified needs and demand; (iii) training for farmers' seed groups to graduate into the formal seed sector and improve traceability; and (iv) upgrading specialized scientific and technical capacities in the national seed sector by tailored short-courses in seed technology for seed company staff and relevant government staff.

b. Enhanced farmer production of quality OPV seeds (rice and beans) and planting materials (cassava and coffee).

For cassava, decentralized production of quality planting material (tolerant/resistant to ACMV and CBSD) by farmers' organisations at district, sub-county, parish and village levels will be promoted to deliver improved cassava cuttings. Trained district crop SMS will ensure quality control and follow-up at district level. The distribution of planting material to beneficiaries will be limited to maximum 20 m to allow for wide distribution and self-multiplication.

For coffee (robusta and arabica) seedling production of improved/tolerant and high yielding varieties by coffee farmer associations and producer cooperatives. The project will aim to deliver some 100 million seedlings (over 5 years) for coffee farmers to replant and gradually expand their production. In the target area, about 1500 existing certified nurseries will be supported and their number increased, as required by local demand for seedlings, to produce plantlets from elite seed. The aim is to ensure that in the targeted area, every coffee parish has a nursery capable of producing on average 10,000 coffee seedlings per annum and to create a cadre of skilled village nurserymen who can promote the planting of this elite material and function as a conduit for disseminating agronomic advice. Support will involve training of the nursery person, and provision of key inputs to launch nurseries (e.g. Certified seed, plant containers, specialized plant fertilizer, shade cloth).

To ensure quality seeds, the Uganda Seed Trade Association (USTA) and member seed companies will be supported to strengthen their internal seed quality control systems (in collaboration with the National Seed Certification Service –NSCS) , apply their code of conduct for internal regulation, and to participate at seed fairs and regular stakeholder meetings with agricultural research, the

national agro-dealer association (UNADA), and farmers' organizations, such as Uganda Co-operative Alliance (UCA).

Activity 1.2: Access to and use of quality inputs (seeds and fertilizers).

The aim is to increase farmers demand and use of appropriate inputs by implementing a time-limited partial subsidy to kick start sustainable productivity growth and enhanced input-output marketing. Furthermore the intensification of input use will be put on sustainable footing by accompanying activities for adapted fertilizer recommendations and bulking input demand and imports.

Time-limited smart e-voucher scheme – To trigger the necessary increase in supply, as well as to generate demand for inputs (seeds and fertilizers) and to create a foundation for their sustainable delivery, a time limited, diminishing e-voucher scheme for inputs will be implemented for eligible members of RPOs and ACEs. The selection of the ACEs and farmers' groups will be based on membership, good governance and management and financial performance. The beneficiary selection criteria will target those not yet using inputs and being able to significantly increase their marketable surplus. The proposed package will be sufficient to plant one (1) acre of the target crop and cover 50% and 25% of input costs for 2 consecutive seasons respectively. The access to this matching grant is triggered when the farmer provides the top-up to purchase selected inputs, either from an ACE, or form an accredited input supplier (agro-dealer). No direct cash will be involved as beneficiaries top-up by Mpesa transfer and agro-dealer will be redeemed by electronic transfer. Thus producer access to inputs can be tracked in real time by the project management.

Proposed electronic input vouchers (e-vouchers) will target specific groups of farmers with potential for intensifying their production systems and increasing their marketable surplus for the targeted commodities (maize, rice, beans, cassava and coffee) as per support plan in Annex 7. Care will be taken to avoid displacement of commercial input sales: specific packages for seeds, fertilizer and agro-chemical packages for maize, rice, beans, cassava and coffee will be considered for support. This will allow for knowledge practice, but also capital build-up for farmers to access commercial inputs.

For grain crops (maize, rice and beans) vouchers will target improved seeds and adapted fertilizer packages. For cassava, the production of improved planting material will be promoted under activity 1.1 and one fertilizer voucher will be provided for farmers intercropping their cassava with maize. For coffee, one of the most cost effective interventions is the rejuvenation of existing coffee plantations, involving pruning back of old plants, applying fertilizer and filling gaps in the stand with new plants as required. Growers will be eligible for vouchers to cover partially the fertilizer costs for one acre after verification of the effective pruning of the coffee stand or (re)planted area, while plant production by producer groups are supported under activity 1.1.

About a total of 450,000 farmers will benefit from this arrangement: average subsidies of 75-80$ per commodity/household will allow them to jump start significant input use and increase in productivity and production, create demand and profitably opportunity for input suppliers and de-risk farmers' financial commitment and create positive cash flow for access to inputs at commercial prices. The efficiency of this approach will be evaluated after the first year.

Activity 1.3: Integrated pest and disease control/management

In well managed sustainable farming systems, crop losses to pests & diseases can be kept at acceptable levels by integrated management practices, including use of resistant/tolerant varieties, good agricultural practices, managing crop nutrient for plant health and reasonable levels of pesticide use, when necessary, conserving predators. Recommended measures against diseases

include use of clean planting material, crop rotations to suppress/reduce soil-borne pathogens and eliminating infected host plants. Effective weed management entails timely manual weeding, minimum tillage and permanent soil coverage. When necessary, lower risk synthetic pesticides should be used for targeted control, in the right quantity and at the right time. Integrated pest management promoted through participatory extension (e.g. farmer field schools - FFS), local production of bio-control agents, farmer information on alert thresholds and strict application of pesticide regulations. While key elements of this strategy are already integrated in the support programmes for agricultural research and extension, ACDP will further strengthen:

(i) farmers use of integrated pest and disease management for considered commodity value chains in targeted districts/clusters;
(ii) farmers' access to pest & disease identification services and early warning system on alert thresholds
(iii) The availability of adapted quality pesticide and upgraded technical knowledge of the agro-dealer network.

To professionalize and intensify farmer production, ACDP will complement and upscale on-going support activities, including:

i. the development and diffusion of recommended IPPM production guidelines (paper leaflets and internet publications), summarizing the recommended agronomic practices, integrated pest & disease management and improved post-harvest handling methods in targeted AEZ – using local languages and drawings;

ii. Pest & disease identification tools and services based on ICT networks involving district SMS and ZARDIs (plant clinic services). ACDP will support the development of pest & disease identification tools for targeted commodities, including full picture guided pest & disease identification system on internet/smartphone, early warning system on alert thresholds and related treatment recommendations. Zonal networks coordinated by ZARDIs will be supported by toll free phone access, analytical and field visit costs as required; and,

iii. Technical training of extension and agro-dealers on identification of biological (pests and diseases) and non-biological (mineral deficiency) symptoms and adapted treatment recommendations (2 sessions per year for 25 persons per cluster).

Activity 1.4: Stakeholder training

This part of the project is closely linked to NAADS and NARO through the World Bank supported ATAAS project and coordinated with the upcoming World Bank supported Skilling Uganda project. The project aims through training of trainers (ToT) to equip outstanding farmers, farmer group leaders and agro-dealers with the up-to-date knowledge on agronomy (soil fertility management, use of improved seeds, pest and disease management, water management and conservation agriculture), processing/value addition and market information on the selected commodities. This information is then relayed to farmers through training and enhanced service delivery by agro-dealers. The ToT training will be provided by private and/or public institutions based upon a competitive bidding process and transparent and acceptable procurement procedures.

5 LAWS, POLICIES AND PLANS FOR PEST MANAGEMENT IN UGANDA

5.1 Policies and Plans

5.1.1 The 2003 National Agricultural Research (NAR) Policy

The 2003 National Agricultural Research (NAR) Policy, guided by the principles of the Plan for Modernization of Agriculture, has a vision based on a market-responsive, client oriented and demand-driven national agricultural research system comprising public and private institutions working in tandem for the sustainable economic growth of Uganda. The NAR Policy calls for decentralization of research on the basis of agro-ecological zones and seeks to implement different mechanisms of funding research on a sustainable basis. The aspects of research and marketing of agricultural products mentioned in this Policy are of relevance to pesticides management in the country.

5.1.2 Plan for Modernization of Agriculture (PMA)

The Plan for the Modernization of Agriculture (PMA) has seven pillars. These include research and technology, national agricultural advisory services, agro-processing and marketing, sustainable natural resource utilization, and management and physical infrastructure. The broad strategies for achieving the PMA objectives are, among others; supporting the dissemination and adoption of productivity-enhancing technologies; and ensuring the coordination of the multi-sectoral interventions to remove any constraints to agricultural modernization.

5.1.3 The National Environment Management Policy, 1994

In 1994, Uganda developed the National Environment Management Policy aimed at promoting intergenerational equity and sustainable development. It seeks to enhance health and quality of life of the people of Uganda and the integration of good environmental practice and behavior into development policies, plans and activities. The policy also aims at conservation and restoration of the environment, raising public awareness, and ensuring individual and community participation in environmental and development activities. It provides the tenets of sustainable environmental management nationally. The strategies to achieve the above objective include the establishment of environmental standards for permissible levels of pollution, encouraging better understanding of the effects of hazardous materials through provision of information in a form understandable to users; and strengthening of institutional and technical capacities for waste management and enhancement of institutional co-ordination.

5.1.4 The National Trade Policy, 2006

The National Trade Policy (2006) is aimed at poverty reduction, promoting employment, economic growth and promotion and diversification of exports, particularly nontraditional exports. The guiding principles of the Policy that have a linkage with the pesticides management are highlighted in the need to mitigate any adverse effects of practices by the country's trading partners. The concerns are dealt with by invoking and implementing trade defense measures as and when appropriate, and taking into account multilateral disciplines in the area. The policy also notes that the country ought to be mindful of the negative social and economic effects that might come with growth in trade, and ensure that mitigating measures and policies are put in place.

5.1.5 Draft Uganda Organic Agriculture Policy, July 2009

On the policy side, in 2004 the Uganda Organic Standard was adopted, while in 2007, as part of the East African Community, Uganda adopted the regional standard, the East African Organic Products Standards (EAOPS) developed under a joint UNEP-UNCTAD initiative. In July 2009,

the government released a Draft Uganda Organic Agriculture Policy. The draft policy describes the vision, mission, objectives and strategies to support the development of organic agriculture as "one of the avenues for delivering self-sustaining growth as it provides mechanisms for individual farmers to improve productivity, add value and access markets which are keys to achievement of the Poverty Eradication Action Plan objectives".

The strategy put in place to implement the policy is based on interventions in nine policy areas: the promotion of organic agriculture as a complementary agricultural production system; the development of a system of standards, certification and accreditation; the promotion of research, to enable technology development and dissemination; support to the development of local, regional and international markets for organic products; the generation of information, knowledge and skills through education and training; the improvement of post-harvest handling practices, preservation, storage and value addition; the sustainable use of natural resources; and participation of the special interest groups such as women, youth, and the poor and vulnerable.

5.1.6 World Bank Safeguard Policy 4.09 on Pest Management

World Bank Safeguard Policy 4.09 on Pest Management is triggered and therefore applicable to the proposed ACDP because it will involve procurement and/or use pesticides directly by the project, or indirectly through on-lending, co-financing, or government counterpart funding. The project may lead to substantially increased pesticide use and subsequent environmental and health risks. OP 4.09 supports integrated approaches to pest management, identifies pesticides that may be financed under the project and develop appropriate pest management plan to address risks. It requires that the procurement of any pesticide in a Bank-financed project is contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users. With respect to the classification of pesticides and their specific formulations, the Bank refers to the World Health Organization's *Recommended Classification of pesticides by Hazard and Guidelines to Classification*. The following criteria apply to the selection and use of pesticides in Bank-financed projects:

(a) They must have negligible adverse human health effects.
(b) They must be shown to be effective against the target species.
(c) They must have minimal effect on non-target species and the natural environment. The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies. Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them.
(d) Their use must take into account the need to prevent the development of resistance in pests.

The Bank requires that any pesticides it finances be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards acceptable to the Bank. The Bank does not finance formulated products that fall in WHO classes IA and IB, or formulations of products in Class II, if:

(a) The country lacks restrictions on their distribution and use; or
(b) They are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly.

In agriculture operations, pest populations are normally controlled through Integrated Pest Management approaches such as biological control, cultural practices and the development and use of crop varieties that are resistant or tolerant to pests. Use of pesticides proposed for financing under the project is justified under an IPM approach. In order to comply with the OP 4.09 requirements, a Pest Management Plan (PMP) has been prepared.

5.2 Laws

5.2.1 The Constitution of the Republic of Uganda, 1995

In its National Objectives and Directive Principles of State Policy, the Constitution provides in paragraph 13 on protection of natural resources that the State shall protect important natural resources including land, water, wetlands, minerals, oil, fauna and flora on behalf of the people of Uganda. In paragraph 22 it provides that the state shall promote sustainable development and public awareness of the need to manage land, air, water resources in a balanced and sustainable manner for the present and future generation. The state is also required to take all possible measures to prevent or minimize damage and destruction to land, air and water resources due to pollution, degradation and other causes.

The National Constitution under article 39 further states that everyone has a right to a clean and healthy environment. Under Article 17(1) (j) every citizen, has a duty to create and protect a clean and healthy environment. Article 245 stipulates that parliament shall by law provide measures intended to protect and preserve the environment from abuse, pollution and degradation and to manage the environment for sustainable development. These constitutional provisions provide the basis for legal and policy action on pesticides management in Uganda.

5.2.2 The Agricultural Chemicals (Control) Act, No. 1 of 2006

This Act was enacted to control and regulate the manufacture, storage, distribution and trade in, use, importation and exportation of agricultural chemical and other related matters save in accordance with regulations made under the Act, and the National Environmental Act, Cap 153 (section 3). Under this Act, the requirement of packaging, labelling or advertisement of agricultural chemicals is relevant in pesticides management to prevent illegal activities related to mislabelling and mis-packaging. In addition, section 13(2) provides for the period in which the seized agricultural chemicals can be detained and the power to dispose them off. The person in whose possession the chemicals were got has to consent in writing for these chemicals to be destroyed by the Government. It is therefore important to put in place an effective and efficient mechanism for disposal of the seized chemicals.

5.2.3 The National Environment Act, Cap 153

This is the framework legislation on environment. The Act provides for the control of pollution through mechanisms to establish Environmental Standards and criteria for environmentally acceptable behaviour and phenomena. It prohibits the discharge of hazardous substances into any part of the environment except in accordance with the guidelines of the National Environment Management Authority and prohibits pollution contrary to established standards (sections 24-27, 30, 32 53, 55, 56, 57, and generally Part VI of the Act). The Act prohibits the illegal traffic in hazardous wastes (section 54); and obliges the generator of waste to manage such wastes (section 52) in a manner that does not endanger human health and the environment. The National Environment (Waste Management) Regulations, S.I. 153-2 expound on management of hazardous wastes; while the National Environment Standards (Discharge of Effluent into Water or on Land) Regulations, S.I. 153-3, provide standards for effluent and waste discharge. The Act also provides

for Environmental Impact Assessment and Audits for projects likely to have a negative impact on the environment (sections 19, 20-23). Projects likely to introduce pesticides into the environment can thus be regulated under the Act, and in accordance with the Environmental Impact Assessment Regulations, 1999 and the National Environment (Audit) Regulations, 2006. Further, the Act provides for environment restoration orders, improvement notices, and environmental inspectors (section 67-71, 80).

5.2.4 Local Governments Act, Cap 243

The Act provides for a system of local government based on the district as an administrative unit. It further provides for the functions of government that the district council is responsible for. This includes protection of streams, lakeshore, wetlands and forests; and environment and sanitation. Under this Act, therefore, district and lower councils may make ordinances and byelaws for the management of the environment under their jurisdiction. These councils may, for instance, legislate on pesticides related matters/issues.

5.2.5 Access to Information Act No. 6 of 2005

This Act provides for the right of access to information pursuant to Article 41 of the Constitution of Uganda. It also prescribes the classes of information referred to in that article, the procedure for obtaining access to that information and for related matters. The information and records to which a person is entitled to have access under this Act shall be accurate and up-to-date so far as it is practicable (section 5(2). For the purposes of this Convention, information on health and safety of humans and the environment shall not be regarded as confidential except in cases where the release of the information is likely to prejudice the security or sovereignty of the State or interfere with the right to the privacy of any other person.

5.2.6 The Public Health Act Cap. 281

The Act provides for preservation of human health and gives local authorities powers to prevent any pollution dangerous to the water supply, to which the public has access. The Act is relevant in cases where water bodies have been exposed to pesticides.

5.2.7 Occupational Safety and Health Act No. 9, 2006

The Act operationalizes Articles 34(4) and 40(1) (a) of the Constitution and provides for the safety and health of persons in workplaces such as in factories, plantations and other places where hazardous work may be found. The Act obliges the employer to ensure, as far as is reasonably practicable, that the working environment is kept free from any hazard due to pollution (section 13). It further states that where there is major handling of chemicals or any dangerous substances which are liable to be airborne or released into rivers, lakes or soil and are a danger to the animal and plant life, it shall be the duty of the employer to arrange for equipment and apparatus used to monitor the air, soil, and water pollution and arrange for actual monitoring of these mediums, with a view to rendering them safe from the dangerous undertaking" (section18). The employer is also obliged to take all preventive measures including administrative and technical measures to prevent or reduce contamination of the working environment (section 95). Such preventive measures include the keeping of chemical data sheets containing essential information regarding the identity of the chemical, its hazards, safety precautions, emergency procedures and its supplier (sections 96 and 97). The above mentioned provisions of the Act are clearly relevant to pesticides management as far as the life cycle of pesticides is concerned.

5.2.8 External Trade Act, Cap 88

This Act restricts certain imports (section 3) and empowers the Minister to prohibit the importation or exportation of any goods (section 8). This Act provides Uganda the opportunity to restrict or prohibit the importation of highly hazardous pesticides, especially as the provisions of the Customs Management Act can only be amended through the East African Community.

5.2.9 Uganda National Bureau of Standards Act, Cap 327

The relevant provision of this Act prohibits any person to import, distribute, sell, manufacture or have in possession for sale or distribution any commodity for which a compulsory standard specification has been declared unless such commodity conforms to the compulsory standard or unless the commodity bears a distinctive mark (section 21(1). This Act could be read together with the National Environment Act on chemical standards in developing standards for pesticides use in the country.

5.2.10 Water Act, Cap 152

The Water Act vests all rights to investigate, control, protect and manage water in the Government of Uganda (section 5). The Act penalizes pollution of water or the causing of risk of pollution of water works, unless the activity is licensed by the Act (section 31). The implementation of this Act therefore needs to be cognizant of possible pollution of water sources by pesticides.

5.2.11 The National Agricultural Advisory Services Act, 2001

The major objective of this Act was to establish the National Agricultural Advisory Services (NAADS) for the promotion of market oriented agriculture and in particular to support and regulate provision of advice and information services to farmers. Among the stated objectives of the Organization include: the promotion of food security, nutrition and household incomes through increased productivity and market oriented farming, empowerment of farmers to access and utilize contracted agricultural advisory services, and the creation of funding options for delivery of agricultural advice to farmers especially subsistence farmers, particularly women, youth and the people with disabilities.

5.2.12 The Agricultural Seeds and Plants Act (Cap 28)

This Act provides for the promotion, regulation and control of plant breeding and variety release, multiplication, conditioning marketing, importing and quality assurance of seeds and other planting materials. It establishes the National Seed Certification Services (NSCS) and a Variety Release Committee. The Act also establishes the National Seed Certification Service which is responsible for the design, establishment and enforcement of certification standards, methods and procedures, registration and licensing of all seed producers, auctioneers and dealers, advising the Authority on seed standards and providing the Authority with technical information on any technical aspects affecting seed quality. The Act imposes stringent requirements for variety testing. All imported and domestic varieties of seeds or breeding materials are required be tested for a minimum of three generations before their releases.

5.2.13 The Plant Protection Act (Cap 31)

The Act provides for the prevention of the introduction and spread of disease destructive to plants. Section 4(i) states "*Every occupier or, in the absence of the occupier, every owner of land shall take all measures as he or she may be required to take by virtue of any rules made under section 3 and, in addition, such other measures as are reasonably necessary for the eradication, reduction or prevention of the spread of any pest or disease which an inspector may by notice in writing order him or her to take, including the destruction of plants, whether the plants are infected with*

disease or not; but no order for the destruction of any living plants shall be made by an inspector under this subsection without the approval in writing of the senior agricultural officer of the area."

Section 5 states "*Subject to any rules made under section 3, any inspector and his or her assistants may enter any land or building, other than a dwelling house, at all reasonable hours for the purpose of discovering pests or diseases in any plant, and of ascertaining whether any order of an inspector or any rules made under section 3 have been complied with, and of causing measures to be taken under section 4(3); but before entering upon any land or building under the provisions of this section, the inspector shall first inform the owner or occupier, if present, of the intention so to enter.*"

5.2.14 The National Agricultural Research Act, 2005

The National Agricultural Research ACT, 2005 provides for the development of an integrated agricultural research system for Uganda for the purpose of improving agricultural research services delivery, financing and management. According to Section 3 of the Act, the purpose of the enactment is to among other things facilitate the achievement of sustainable increases in economic, social and environmental benefits from agricultural research services and products, to provide for a market-responsive and client oriented national agricultural system that generates knowledge and information, and disseminate demand driven problem solving, profitable and environmentally sound technologies on a sustainable basis, and provide linkages, partnerships and collaboration among various categories of agricultural research service providers whether public, private, local, regional, or international in the conduct, financing and development of agricultural research in Uganda.

The overall goal of the National Agricultural Research System (NARS) is to address challenges presented in the Plan for Modernization of Agriculture (PMA) strategy and the National Agricultural Research Policy (NARP) principles to provide research services that address in a sustainable manner, the needs and priorities of the majority poor. In this respect, the major objective of agricultural research in Uganda as provided for in Section 4 of the Act is to transform agricultural production into a modern science-based market oriented agriculture capable of greater efficiency, profitability and of sustaining growth in the agricultural sector while contributing to poverty eradication.

The National Agricultural Research System provided for in the Act includes all stakeholders whether in public or private sector. The Act establishes the National Agriculture Research Organization (NARO) as the principal institution for the coordination and oversight of all aspects of agricultural research in Uganda, including providing strategic direction for publicly funded agricultural; research and coordination and oversight of implementation of the agricultural research policy. In addition to NARO, the system comprises of public agricultural research institutes, universities and other tertiary institutions, farmer groups, civil society organizations, private sector and any other entity engaged in the provision of agricultural research services. Research is under the ATAAS.

5.3 International Conventions and Treaties

5.3.1 International Plant Protection Convention

The International Plant Protection Convention (IPPC) is an international agreement on plant health to which 181 signatories currently adhere. It aims to protect cultivated and wild plants by

preventing the introduction and spread of pests. The Secretariat of the IPPC is provided by the Food and Agriculture Organization of the United Nations. The Convention makes provision for the application of measures by governments to protect their plant resources from harmful pests (phytosanitary measures) which may be introduced through international trade. The IPPC came into force in 1952, superseding previous international plant protection agreements. The Convention was revised in 1979 and the amendments came into force in 1991.

The revision of the IPPC agreed in 1997 and which entered into legal force on 2 October 2005 represents an updating of the Convention to reflect contemporary phytosanitary concepts and the role of the IPPC in relation to the Uruguay Round Agreements of the WTO, particularly the SPS Agreement. The SPS (Sanitary and Phytosanitary) Agreement identifies the IPPC as the reference organization developing international standards for plant health (phytosanitary) measures. IPPC work includes standards on pest risk analysis, requirements for the establishment of pest-free areas, and others which give specific guidance on topics related to the SPS Agreement.

5.3.2 International Treaty on Plant Genetic Resources for Food and Agriculture

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), adopted in 2001, is a global response to promote the conservation of plant genetic resources and to protect farmer's rights to access and have fair and equitable sharing of benefits arising out of their use. Sustainable use of plant genetic resources is fundamental for achieving food and nutrition security and for a progressive realization of the right to food.

The International Treaty on Plant Genetic Resources for Food and Agriculture is crucial in the fight against hunger and poverty and essential for the achievement of Millennium Development Goals 1 and 7. No country is self-sufficient in plant genetic resources; all depend on genetic diversity in crops from other countries and regions. International cooperation and open exchange of genetic resources are therefore essential for food security. The fair sharing of benefits arising from the use of these resources has for the first time been practically implemented at the international level through the Treaty and its Standard Material Transfer Agreement.

5.3.3 Stockholm Convention

The Stockholm Convention is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife. POPs circulate globally and can cause damage wherever they travel. In implementing the Convention, Governments will take measures to eliminate or reduce the release of POPs into the environment. The Stockholm Convention established an initial list of 12 key POPs chemicals (the socalled dirty dozen) for which signatories are required to reduce the risks to human health and the environment arising from their release. Enlisted parties are required to take measures (legal and/or administrative) to eliminate or heavily restrict the production and use of POP pesticides and PCBs, and to minimise the unintentional production and release of POPs. The Convention covers pesticides, and industrial chemicals and by-products i.e. Aldrin, Chlordane, DDT, Dieldrin, Dioxins, Endrin, Furans, Hexachlorobenzene, Heptachlor, Mirex, PCBs and Toxaphene. 15 of the 22 Chemicals listed under the Stockholm Convention are Pesticides or pesticide production by-products. Obsolete pesticide disposal must be in compliance with the Basel Convention.

5.3.4 Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal was concluded in Basel, Switzerland, on March 22, 1989, and entered into force in May 1992. Now ratified by 149 countries including 32 of the 53 African countries, the focus of this convention is to control the movement of hazardous wastes, ensure their environmentally sound management and disposal, and prevent illegal waste trafficking (UNEP, 2006). The parties to this convention recognize the serious problems posed by stockpiles of unused and unwanted chemical products which, as a result of their obsolescence, are now considered wastes.

5.3.5 Rotterdam Convention

Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and pesticides in International Trade: This convention came into force on 24th February 2004 and Uganda acceded to the convention early 2007. The Rotterdam Convention aims to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use. Governments began to address the problem of toxic pesticides and other hazardous chemicals in the 1980s by establishing a voluntary Prior Informed Consent procedure. PIC required exporters trading in a list of hazardous substances to obtain the prior informed consent of importers before proceeding with the trade. In 1998, governments decided to strengthen the procedure by adopting the Rotterdam Convention, which makes PIC legally binding. The convention establishes a first line of defense by giving importing countries the tools and information they need to identify potential hazards and exclude chemicals they cannot manage safely. When a country agrees to import chemicals, the convention promotes their safe use through labelling standards, technical assistance, and other forms of support. It also ensures that exporters comply with the requirements.

5.3.6 The International Maritime Dangerous Goods (IMDG) Code

The International Maritime Dangerous Goods (IMDG) Code was developed as a uniform international code for the transport of dangerous goods by sea. It covers such matters as packing, container traffic and stowage, with particular reference to the segregation of incompatible substances. The Code lays down basic principles; detailed recommendations for individual substances, materials and articles; and a number of recommendations for good operational practice, including advice on terminology, packing, labeling, storage, segregation and handling, and emergency response action. The Code has become the standard guide to all aspects of handling dangerous goods and marine pollutants in sea transport. The Code will ensure compliance to international law in the event that Uganda decides on sea transport for its pesticides destined for disposal.

5.3.7 The FAO International Code of Conduct on the Distribution and Use of Pesticides

It establishes voluntary standards for public and private institutions involved in the distribution and use of pesticides. The revised version of the Code, adopted in 2002, has become the globally accepted benchmark for pesticide management and has enabled many countries to establish and strengthen their pesticide management systems. The Code sets out a vision of shared responsibility between the public and private sectors, especially the pesticide industry and government, to ensure that pesticides are used responsibly, delivering benefits through adequate pest management without significant adverse effects on human health or the environment. It aims to promote practices that reduce the risks of handling pesticides, prevent accidental poisoning, ensure pesticides are used effectively and efficiently, and encourage IPM and Integrated Vector

Management (IVM). The 2002 revision of the Code puts greater emphasis on promoting IPM than the previous version and also specifically incorporates a focus on active food-sector participation in developing and promoting IPM.

5.3.8 The Safety and Health in Agriculture Convention

The Safety and Health in Agriculture Convention (Convention C184) adopted by the conference of the International Labour Organization (ILO) addresses the protection of workers in the agricultural sector. More people work in agriculture than in any other sector, more workers are injured in agriculture than in any other sector, and pesticides are a major cause of injury and death. In addition more children work in agriculture than in any other sector and they are differently and particularly vulnerable to the toxic effects of chemicals such as pesticides. A specific section of the convention deals with the sound management of chemicals and advises governments to adopt good management practices for chemicals, to inform users adequately about the chemicals they use and to ensure that adequate mechanisms are in place to safely dispose of empty containers and waste chemicals. Application of the Convention is an important step in improving pesticide management and preventing some of the problems that arise from pesticide distribution and use in developing countries in particular.

5.4 Other Initiatives

5.4.1 Strategic Approach to International Chemicals Management (SAICM)

Uganda UNEP/UNDP Partnership initiative for the implementation of SAICM is intended to assist the Government, through the National Environmental Management Authority (NEMA), to take up the strategic priorities of SAICM Quick Start Program (QSP), namely: develop and strength national chemicals management institutions, plans, programs and activities to implement the Strategic Approach, building upon work conducted to implement international chemicals-related initiatives; and undertake analysis, interagency coordination, and public participation activities directed at enabling the implementation of Strategic Approach by integrating the sound management of chemicals in national development priorities and strategies. The main objectives of SAICM required to strengthen measures for sound management of chemicals (SMC) are:

1) Risk reduction: To implement comprehensive, efficient and effective risk management strategies, including risk reduction, risk elimination and pollution prevention strategies, to prevent unsafe and unnecessary exposures to chemicals.
2) Knowledge and information: ensure that knowledge and information on chemicals and chemicals management, and chemical safety is adequate, appropriate, accessible and user-friendly to enable chemicals to be dealt with safely throughout their life cycle by all actors.

6 INTEGRATED PEST MANAGEMENT FRAMEWORK

6.1 Integrated Pest Management (IPM)

6.1.1 Definition

IPM is the coordinated use of pest and environmental information with available pest control methods to prevent unacceptable levels of pest damage by the most economical means with the least possible hazard to people, property, and the environment. In the revised International Code of Conduct on the Distribution and Use of Pesticides, FAO (2002) defines IPM as follows: "*IPM means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption of agro-ecosystems and encourages natural pest control mechanisms.*"

6.2 History of IPM in Uganda

According to Bonabana-Wabbi (2002), early IPM practices were focused on coffee and cotton. This was probably because of these crops' importance as major cash crops and foreign exchange earners for the country and hence the urgent need to protect them from devastating yield loss due to pests. Post-harvest systems were also developed under these early Uganda IPM efforts by various agricultural research institutes in the country. Both cultural and chemical methods were used to control pest populations on these crops. The system was based on a careful analysis of pest populations and pest patterns and determining a suitable strategy for their control. However, the period of political and civil strife saw the collapse of this otherwise effective IPM system. However, this was not the end of IPM efforts in Uganda. According to Kyamanywa (1996), efforts to rejuvenate IPM were pursued in 1994 under funding from the IPM CRSP that the Uganda IPM Network was formed. Its initial focus was directed towards raising knowledge and awareness of fundamental IPM concepts. Subsequently, efforts to develop pest management alternatives for priority pests with an added emphasis on environmental quality were incorporated and more aspects of agricultural production were considered.

6.3 Existing IPM Adoption Projects

6.3.1 The NAADS Program

Given that NAADS is a long-term program, its implementation was planned to take place in phases. The NAADS is a 25-programme system covering the entire country that aims to promote food and nutrition security and household incomes through increased productivity and market-oriented farming. The approach is demand-driven, bottom-up and decentralized (UNDP, 2013). The overall development objective of the NAADS extension system was to assist poor male and female farmers to become aware of and be able to adapt to improved technology and management practices in their farming enterprises so as to enhance their productive efficiency, their economic welfare and the sustainability of farming operations. In particular, according to the legal act that established NAADS, the program was to pay more attention to women, people living with disabilities (PLWDs) and young people who were considered to be those most affected by the economic reforms of the 1990s (Okoboi et al. 2013). The NAADS program was initially designed to build the capacity of farmers to form and operate farmer associations, demand advisory services and adopt improved agricultural technologies and practices—through demonstration of the technologies by model farmers in the community. The first phase of its implementation was

originally designed to last seven years (2001-2007), at a cost of $108 million, but the project stretched on to June 2010. The second phase of NAADS (July 2010-June 2015), under the Agricultural Technology and Agribusiness Advisory Services (ATAAS) project, will cost at least $450 million. Technology demonstration sites were managed by six model farmers per parish. Revisions of the NAADS implementation guidelines in 2005/6, however, mandated program administrators to distribute free or subsidized inputs to more beneficiaries per parish. Besides NAADS, the ATAAS project has another component focusing on agricultural research as well as joint activities on research and extension, and the whole project is estimated to cost $666 million (Okoboi et al. 2013).

6.3.2 IPM CRSP in Uganda

The Integrated Pest Management Collaborative Research Support Program (IPM CSRP) is one of nine collaborative research support programs, or CRSPs, set up to leverage the expertise found at American land grant universities in developing countries around the world. The Regional IPM CRSP for East Africa (Kenya, Tanzania, and Uganda) aims at developing a shared IPM strategy to improve the productivity of higher value marketed horticultural crops in the region using a specialized program that is dedicated to ecologically based IPM research on horticultural crops. The IPM CRSP is being implemented by a consortium of U.S. and East African institutions, with The Ohio State University (OSU) serving as the lead university and Virginia Tech as the management entity. A coordinating unit is headquartered at Makerere University School of Agriculture in Uganda which co-ordinates IPM research, training, extension and technology dissemination activities in Uganda and the East African region. The IPM CRSP has been applying a farmer participatory IPM strategy at on-farm research sites in Eastern Uganda since 1995.

The IPM CRSP crop focus has expanded to include key food crops many of which were grain crops - Beans, Maize, Cowpeas, Sorghum and Groundnut. Other additions to IPM CRSP trials in Uganda included disease and pest control strategies on two horticultural crops i.e. tomatoes and potatoes. Mold incidence on stored maize and groundnuts and coffee wilt incidence are currently being investigated. Among the crops the IPM CRSP has had active programs on a long-term basis include sorghum, groundnuts and cowpeas.

6.4 World Bank Policy Requirements

1. In assisting borrowers to manage pests that affect either agriculture or public health, the Bank supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. In Bank-financed projects, the borrower addresses pest management issues in the context of the project's environmental assessment.
2. In appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components to strengthen such capacity.
3. The Bank uses various means to assess pest management in the country and support integrated pest management (IPM) and the safe use of agricultural pesticides: economic and sector work, sectoral or project-specific environmental assessments, participatory IPM assessments, and investment projects and components aimed specifically at supporting the adoption and use of IPM.
4. In Bank-financed agriculture operations, pest populations are normally controlled through IPM approaches, such as biological control, cultural practices, and the development and

use of crop varieties that are resistant or tolerant to the pest. The Bank may finance the purchase of pesticides when their use is justified under an IPM approach.

5. In Bank-financed public health projects, the Bank supports controlling pests primarily through environmental methods. Where environmental methods alone are not effective, the Bank may finance the use of pesticides for control of disease vectors.

6.5 ACDP Integrated Pest Management Plan

6.5.1 Overall Guiding Framework

In complement to on-going research and extension activities, ACDP will further strengthen: (i) the development of integrated pest and disease management guidelines for targeted commodities, including tolerant varieties, good agricultural practices and reasonable use of pesticides; (ii) pest & disease identification tools and services based on modern Information and Communication Technologies (ICT) networks, involving district Subject Matter Specialists (SMS) and ZARDIs (plant clinic services); and (iii) technical training of extension workers and agro-dealers on pest & disease symptoms and adapted treatment recommendations.

6.5.2 Goal

The goal of IPM under the ACDP will be to manage pests and the environment so as to balance costs, benefits, public health, and environmental quality. The IPM system will use all available technical information on the pest and its interactions with the environment and because the IPM program will apply a holistic approach to pest management decision-making, it will take advantage of all appropriate pest management options, including, but not limited to pesticides.

6.5.3 Key Elements

The elements of the ACDP IPM will include the following:

(f) Preventing pest problems;
(g) Monitoring for the presence of pests and pest damage;
(h) Establishing the density of pest population, which may be set at zero, that can be tolerated or corrected with a damage level sufficient to warrant treatment of the problem based on health, public safety, economic or aesthetic threshold;
(i) Treating pest problems to reduce population below those levels established by damage thresholds using strategies that may include biological, cultural, mechanical and pesticidal control methods and that shall consider human health, ecological impact, feasibility and cost effectiveness; and
(j) Evaluating the effects and efficacy of pest treatments.

6.5.4 Key Principles to Follow

IPM strategies will be applied according to the local circumstances. The smallholder farmers will be encouraged to find specific solutions to the pest problems they encounter in their fields based on understanding of agro-ecological principles, monitoring interactions among crops, pests and natural enemies of pests, and selecting and implementation of adequate control measures. The World Bank sets the following principles for IPM and will serve as guiding principles for IPM implementation:

- **Grow a healthy crop**. The focus will be on cultural practices aimed at keeping the crop healthy. Selection of varieties that are resistant or tolerant to pests will be an important aspect. Attention to soil, nutrient and water management is part of growing a healthy crop

and therefore a wider range of agro-ecological parameters related to crop production will be considered.

- **Manage the agro-ecosystem** in such a way that pests remain below economic damaging levels, rather than attempt to eradicate the pest. Prevention of pest build up and encouragement of natural mortality of the pest is the first line of defense to protect the crop. Non-chemical practices are used to make the field and the crop inhospitable to the insect pest species and hospitable to their natural enemies, and to prevent conditions favorable to the buildup of weeds and diseases.

- **Decisions to apply external inputs as supplementary controls are made locally, are based on monitoring of pest incidence and are site-specific**. External inputs may include predators or parasites (bio-control), labor to remove the pest manually, pest attracting lures, pest traps, or pesticides. The choice of external input will vary for each situation. Pesticides will only be used if economically viable non-chemical pest control inputs are not available or have failed to control the pest. They will be applied only when field monitoring shows that a pest population has reached a level that is likely to cause significant economic damage and the use of pesticides is cost-effective in terms of having a positive effect on net farm profits. Selection of products and application techniques shall aim to minimize adverse effects on non-target species, people and the environment.

6.5.5 Key IPM Steps

The four key steps to be followed under the IPM strategy of the ACDP will be as follows:

Set Action Thresholds

Before taking any pest control action, the IPM will first set an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. Sighting a single pest will not always mean control is needed. The level at which pests will either become an economic threat be a critical criterion to guide future pest control decisions.

Monitor and Identify Pests

Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. The IPM program will work to monitor pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification will remove the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

Prevention

As a first line of pest control, the ACDP IPM program work to manage the crop to prevent pests from becoming a threat. This will include using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods are expected to be very effective and cost-efficient and will present little to no risk to people or the environment.

Control

Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, the IPM program will then evaluate the proper control method both for effectiveness and risk. Effective, less risky pest controls will be

chosen first to disrupt pest mating, or mechanical control, such as trapping or weeding. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods will be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides will only be conducted as a last resort.

6.5.6 Activities

The Project will assist and train farmers to be able to develop their IPM approaches to the management of pests and diseases. This will be done holistically from seed selection, land preparation, through planting and farm maintenance to harvesting and post harvesting issues. Farmers will be trained and encouraged to make detailed observations in their fields regularly so that they can detect early infestations and make the appropriate management decisions using agro-ecosystem analysis (AESA). In this way, it will be ensured that pest and disease problems do not escape notice and are not allowed to develop to the extent that they cause very severe damage and heavy crop losses. The decision to use chemical pesticides will be taken only as the very last resort as already indicated in the IPM principles above.

Pesticide use in general and pest issues amongst downstream project actors or participants (such as farmers, farm assistants, agro-chemical dealers, resellers, local communities, etc.) will by surveyed regularly by MAAIF, NEMA and other relevant lead agencies and stakeholders. Decision making on pest management strategies and measures at the Project implementation level will be influenced by suggestions and recommendations from the downstream project actors. Communicating any decision on pest management strategy or measure from the project implementation level will be undertaken by educated or experts or trained and well informed project actors.

6.5.7 IPM Pest Management Practices

The following measures will be adopted by all farmers where feasible:

6.5.7.1 Pest Preventive Measures

Diseased plants or affected portions of the plant will be removed and burned. Phytosanitary measures, such as physical removal of pests, affected plant parts, infected plants (virus-infected plants, severely disease-infected or pest-infested plants should be undertaken. It may also be possible for farmers to minimize pest attack through good timing.

6.5.7.2 Use of Host Resistance and Early Maturing Varieties

Choice of crop and variety can help to reduce pest problems. An important result consistent across countries and crops is that growing more varieties of the same crop within the farm, leads to a decreased variance of pest and disease damage. This means that even though certain pests and diseases might affect crops on a farm, overall, the risk of having a severe infection or pest outbreak is lower, e.g. they might just have a few spots, lesions or bites. In general, it is much better to farm 'with nature' than against it. This means choosing a crop that is naturally suited to the soil type and environmental conditions of the farm, rather than trying to adapt the farm to suit the chosen crop.

Crop genetic diversity has the potential to curb epidemics and outbreaks to save farmers from high yield losses and is overall a more resilient system, where crops are unlikely to suffer significant damage when and if a new pest or disease comes around. Traits needed by plants to adapt to pathogen threats following climate change generally come in the categories of resilience and durable resistance. In addition, 'early maturing' varieties of crop reach maturity and are ready for harvesting sooner than normal varieties. If pests only become a problem later in the growing season, choosing an early maturing variety may be a good idea.

Some varieties of crop have been developed that have resistance to certain pests and the Project will ensure that the smallholder farmers plant them if pests are a major cause of lost harvest. Every effort will be made by the Project to select and use crop varieties resistant or tolerant to disease and pests in an attempt to check on regular usage of agro-chemicals. The Project will collaborate with NARO and other research institutions to get information and varieties resistant to disease and pests for their usage. This strategy is one of the measures the project hopes will render usage of agro-chemicals to be very minimal or unnecessary.

However, it is also important to note that the use of agricultural improved inputs remains low generally and particularly among women farmers. This is due to lack of access to or non-availability, of inputs lack of knowledge about inputs and the cost barriers. Increased use of improved inputs is very important to enhancing yields and production at farm level and ultimately increasing individual and household incomes (FOWODE, 2012). This is to be addressed by the ACDP by distributing quality seeds and resistant varieties to the smallholder farmers.

6.5.7.3 Biological Control

This tactic takes advantage of the fact that organisms depend or even feed on each other for survival. Thus biological control method tries to ensure that pests are reduced by organisms which are their natural enemies. These natural enemies can be conserved by taking care with farming practices so that they are not killed but are actually encouraged. Under ACDP, biological control will be considered by the Project as the first line of control for pests and diseases, when incidence is noticed and where an appropriate biocontrol agent is available. In this case, the project will adopt measures such as ensuring existence of an environment conducive to the proliferation of pests' bio-control agents is to be maintained in the crop areas in the project and these include regular application of *Trichoderma s*pp., *Pochonia chlamydosporia*, *Pseudomonas fluorescens* and other antagonistic microorganisms. For insect pests, the project will engage in planting of biocontrol agents such *Neem* trees which can be planted along the plots of crops. For successful introduction of biological control agents the Project will consider the following:

- The environment must be suitable for the population to flourish.
- Be certain the control agent will virtually feed only on the weed or pest species itself, and not on crop plants.
- The control agents must not be native to the area.

6.5.7.4 Cultural Practices

Cultural control methods will include:

- Crop rotation - Crop rotation helps to prevent pest populations building over a number of years.
- Inter-cropping,
- Field sanitation and seed bed sanitation,
- Use of pest-resistant crop varieties,
- Managing sowing, planting or harvesting dates;
- Water/irrigation management,
- Practices to enhance the buildup of naturally existing predator populations;
- Hand-picking of pests or hand-weeding;
- Use of traps or trap crops.

6.5.7.5 Chemical Control

With the above measures for control pests and diseases, chemical control will therefore be an addition and its application will be undertaken with utmost care as per applicable standards governing safe applications of agrochemicals (e.g. FAO Guidelines) to ensure safety of the environment and the farmers. Agro-chemicals to be used should be registered for use in Uganda as well as acceptable for procurement under World Bank Safeguard Policies. In all, the application of agro-chemicals shall follow recommended practices by FAO.

6.5.8 Specific Criteria for Choosing a Pest Management Method

When choosing a pest management method or pesticide material under the ACDP, MAAIF will have to consider a number of factors. At a minimum, farmers and extension staff shall consider the following factors during the selection of management methods and products.

6.5.8.1 Nature of the site or region

- The feasibility of the method given the area and scope of the problem;
- Site conditions such as soil type, grade, drainage patterns, and presence of surface water;
- Erosion susceptibility and potential movement of soil through runoff.

6.5.8.2 Possible health and safety effects

- Consider both short and long term toxicological properties and any other related potential health effects of the materials or methods, both to the applicator and the public;
- Equipment operation safety issues for both the operator and the public;
- Farmer safety and injury issues involved with carrying out the method.

6.5.8.3 Possible environmental effects

- Consider both acute and chronic toxicity and any other related potential effects of the material or method to non-target organisms;
- Environmental effects from potential bioaccumulation;
- Potential impacts to non-target plants and other organisms from materials or methods;
- Potential impacts to threatened or endangered species;
- Possible introduction or establishment of invasive plants;
- Water pollution.

6.5.8.4 Costs

Both short and long term costs as they relate to:

- Costs of the material or method;
- Application and labor costs;
- Length and quality of pest control;
- Feasibility of using a particular method or product;
- Costs associated with not treating, or delaying treatment

6.5.8.5 Characteristics of the product

- Target pests and target sites of the product being used;
- Possible residual effect, decomposition pathways, rates, and breakdown products;
- Volatility and flammability;
- Product formulation and package size;
- Leachability, solubility, and surface and soil bonding characteristics of the product;
- Ease of cleaning equipment after use;

- Positive and negative synergistic effects of pesticide combinations;
- Post-harvest interval.

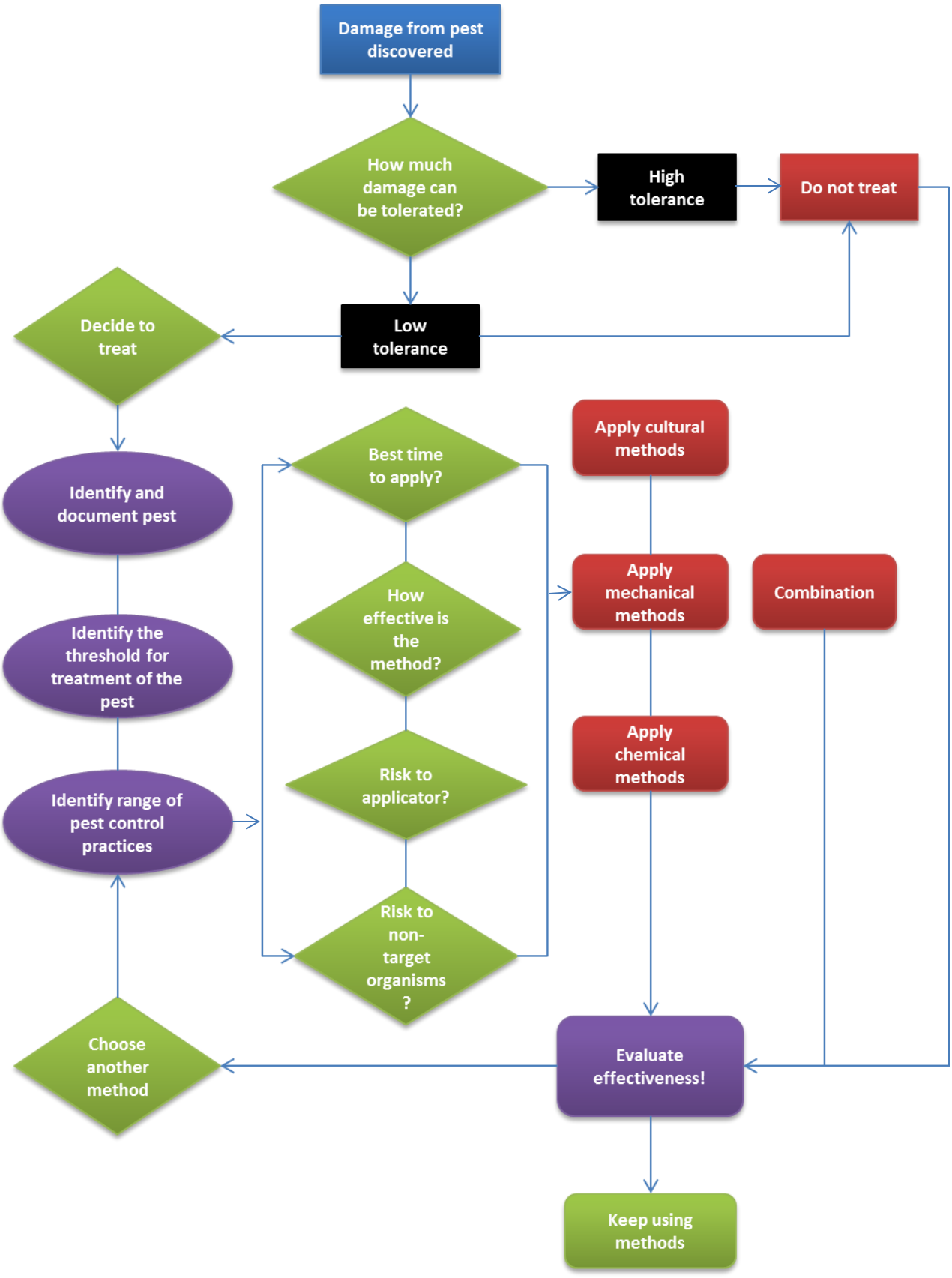
6.5.8.6 Other special considerations

- Application equipment availability;
- Method of delivery;
- Current and anticipated weather conditions;
- Previous pesticide applications to the site and the interval between treatments;
- Possible development of pest resistance to a particular management method or material.

6.5.9 ACDP Integrated Pest Management Decision Tree

IPM is based on the life cycles of pests and their interactions with the environment, and manages pest damage while limiting the hazard to people, property, and the environment. The IPM approach sets thresholds, conducts evaluations and makes decisions that may result in the use of physical, cultural, mechanical, biological and chemical controls or a combination of means.

Monitoring programs along with action thresholds have to be conducted to quantify pest abundance as a guideline to initiate pesticide usage. Knowing when to act includes an explanation of the thresholds that farmers need to know, in order to decide whether or not to use a pesticide. ***Action Threshold*** is the point at which pest populations or environmental conditions can no longer be tolerated, necessitating that pest control action must be taken based on economic, human health, aesthetics, or other effects. Once the "action threshold" has been reached, spraying a pesticide may be warranted to protect the crop. However, once levels of damage reach a certain point, it will no longer be cost effective for a farmer to spend more money on spraying the crop. This is known as the 'economic injury level'. ***Detecting a single pest under the Project will not always mean control is needed. A decision to use pesticides will be taken only as the very last resort and will also be based on conclusions reached from an agro-ecosystem analysis and trials. The decision under ACDP will also depend on the number of pest and diseases found in the respective crop and the level of damage they are doing. If it is absolutely necessary to spray crops with pesticides, use of selective rather than broad-spectrum pesticides shall be strictly observed. The following decision-tree will guide decision making of pesticide use under the ACDP:***


Damage from pest discovered
How much damage can be tolerated?
High tolerance
Do not treat
Low tolerance
Decide to treat
Identify and document pest
Identify the threshold for treatment of the pest
Identify range of pest control practices
Best time to apply?
How effective is the method?
Risk to applicator?
Risk to non-target organisms ?
Apply cultural methods
Apply mechanical methods
Apply chemical methods
Combination
Evaluate effectiveness!
Choose another method
Keep using methods

6.6 IPM Adoption Strategy

6.6.1 Factors to consider in IPM Adoption

Among the socio-economic factors, income, farming experience, gender, education, amount of land owned, and age among others have been found to significantly influence the adoption of IPM technologies in Uganda (Kirinya et al. 2013). Other factors include access to necessary resources, such as land or extension services, individual perception of effectiveness or safety of pest management methods, gender, type of crop being grown, market characteristics, physical geography, and infrastructure conditions Montgomery (2011). Also, lack of labor can be a significant constraint in IPM adoption as IPM is often labor intensive.

6.6.2 Dissemination Strategy

The agricultural innovation literature suggests that knowledge only translates into adoption if a set of enabling factors and conditions exist, including farmers' positive perception of the technology's benefits, access to complementary inputs (e.g. seed, fertilizer), tenurial arrangements and labor availability. When a new innovation is introduced, farmers go through periods of becoming knowledgeable about the new technology, to forming positive or negative attitudes toward the technology, and ultimately to deciding whether to adopt the technology or not. Adoption process can be classified into three phases namely, information collection, whether or not to adopt and how much to adopt (Kirinya et al. 2013). Numerous household, community, and institutional factors affecting the farmer influence this decision process. Adoption at the farm level describes the realization of farmers' decision to apply a new technology in the production process. On the other hand, aggregate adoption is the process of spread or diffusion of a new technology within a region (Kirinya et al. 2013).

Since the majority of farmers under ACDP are smallholders who have poor access to information, knowledge and technologies, it important their capacities are built on the application of the different IPM strategies. This requires proper communication channels through production of user friendly dissemination materials on IPM, on-farm demonstrations, agricultural shows, farmer-field schools and as incorporation of IPM methods in the training curriculum in schools.

6.6.2.1 Increasing Extension Services

Contact with extension services has consistently been identified throughout the literature as highly influential in small farmer pest management practices and knowledge. The most important factors influencing the adoption of IPM is the amount of satisfaction farmers have with the quality of IPM information and explanation. IPM is complex and difficult to implement without auxiliary information about how the farm ecosystem works and site specific variables, such as the type of crop and pest. Extension officers are therefore challenged to provide farmers with access to resources as well as demonstrations necessary for IPM adoption (Montgomery, 2011). ***Under the ACDP, development of IPM packages for beans, rice, coffee, maize, and cassava will be done and the IPM packages developed will be transferred to farmers by organizing farmers' field schools (FFS), workshops and meetings. Funding will be provided to ensure that every Sub County has a competent Extension Officer.***

6.6.2.2 Area Specific IPM Packages and Booklets

IPM is an information-intensive means of managing pests and diseases: farmers need information and appropriate support to understand, how IPM works and what they should do to make it work for them. For over two decades, attempts have been made to develop and disseminate IPM

strategies to small farmers in sub-Saharan Africa and around the world. However, these efforts have met with limited success, particularly among small farmers. Despite appearances of homogeneity, smallholder farmers have different production practices, needs and constraints. One unavoidable lesson over the past 50 years of agricultural research and development is that one-size does not fit all and that recommendations must be tailored to the needs of the end-user (Erbaugh et al. 2002). A one-size-fits-all approach to the dissemination of IPM may have underestimated small farmer heterogeneity and impeded its adoption. Targeting particular groups who share similar production practices and problems has proven to be a cost-effective, efficient way to design and disseminate agricultural technologies (Erbaugh et al. 2002).

Key information on crop pests/diseases, IPM strategies regarding pest control as well as pesticide use toolkits will be provided in easy to read and understand format/pictorial presentations and translated into local languages for easy understanding and use by illiterate beneficiary farmers. The IPM package will be region or cluster-specific and MAAIF will ensure that every smallholder farm household receives a free copy of the booklet.

6.6.3 Location of IPM Knowledge Centers

Extension services involving transfer of agricultural recommendations and advice must therefore be directed outward to more remote rural areas where agriculture is the primary source of income (Montgomery, 2011). According to Montgomery (2011), the spatial pattern of distance decay from the sub-county headquarters, which acts as the main hub for IPM information, suggests that IPM should explore different vehicles for disseminating information across longer distances. It may not be feasible for farmers to travel to the headquarters. Past extension strategies targeted innovative or progressive farmers, however, these approaches fell out of favor because they benefited elites and exacerbated rural socio-economic inequality. Participatory agricultural research and extension approaches attempted to counter this bias by advocating that resource poor farmers and disadvantaged groups, such as women or minority ethnic groups, be specifically targeted (Erbaugh et al. 2002).

Women are responsible for the majority of food production in sub-Saharan Africa; therefore, an understanding of women's issues is critical for the success of agricultural projects in Uganda (Montgomery, 2011). Agricultural extension has traditionally been focused on cash crop activities, which have been dominated by men. Also, women are burdened by a heavy workload at home, including child-care, and are less likely to attend training programs far from their homes (Montgomery, 2011). Women also experience limited access to many social networks that expand beyond their own village, partly due to transportation constraints. Social hubs, such as bars and recreational halls, which are more often frequented by men than women, provide occasion to listen to news and other information, such as that concerning market conditions and prices (Montgomery, 2011).

The use of village-level demonstration plots (model farms), farmer-to-farmer discussion groups, and other small farmer organizations will be adopted under the project. Numerous sources of information about IPM shall be placed at destinations common to men and women farmers across the sub-county. Additionally, efforts shall be made to extend extension services to those who are less visible in the community than the farmers who regularly attend events at the sub-county headquarters.

6.6.4 Building Capacity of Farmers

The complexity and difficulty of implementing IPM require a shift away from extension efforts based on "transfer of technology" in which farmer perspectives are not taken into account and farmers are expected to follow recommendations without understanding the reasons for them. The need to accurately identify and diagnose pests and pest problems and understand ecosystem interactions could enable farmers with biological and ecological control opportunities and in making pragmatic pest control decisions. Knowledge transfer should happen in both directions between farmer and extension services to provide adequate knowledge for farmers to make decisions in coping with everyday problems that arise. According to Dr. Mark Erbaugh of the IPM CRSP in Uganda, farmer participatory research and farmer field schools are two approaches that have largely developed around the needs for better understanding of IPM techniques by farmers, and better understanding of farmers' priority problems by researchers. He adds that learning to recognize pest species and non-pest species is an important part of Integrated Pest Management. For example, a field may have more than a hundred species of insect living in it, but only a few of these may be a problem for crops. Some insects actually feed on pest species, which is one reason why broad-based insecticides are discouraged by IPM.

Thus the IPM strategy will largely focus on developing and sustaining institutional and human capacity to facilitate experiential learning for making informed decisions in integrating scientific and indigenous knowledge to solve cluster, district, ward and village specific problems. Farmer participatory research will include a wide variety of activities, such as the facilitation of farmers' experiments, farmer participation in plant breeding and testing, farmer testing of 'best-bet' options for IPM, and other approaches involving interactive participation, action research, and social learning. Such research will emphasize the role of farmers in setting the research agenda as well as in co-developing and applying IPM solutions.

6.6.5 Hierarchy of Information Flow

The PMP implementation will be anchored at the MAAIF regional level with field action by farmer groups which will receive training and advisory services from MAAIF and appropriate NGOs, who would have graduated from Training of Trainers (ToT) sessions. Training at all levels will be based on participatory learning modules for capacity building in IPM information delivery. The participants will be equipped with skills in facilitation, group dynamics, and non-formal education methods to encourage adult learning. Farmer training will focus on farmers' group learning for informed decision making on IPM issues. Group learning will be experimental through farmer-led field trials and discussions on practical aspects of crop production and pest management including indigenous and traditional knowledge/technologies. Farmer group learning will be facilitated by ToT trained men and women extension agents.

6.6.6 Collaborating with Research and Academic Institutions

Beyond the direct empowerment of farmers, a wide range of expertise is required at many levels for the successful development and promotion of IPM. This demands a comprehensive human resources development program to build or strengthen national research and development capacities. Such a program should aim to create a cadre of local IPM experts – including those who are active in participatory research and learning approaches – who also push forward public awareness campaigns to highlight the importance of IPM for food and agricultural production.

Manpower and capacity are two factors that are very vital in conducting research in pests and diseases. In this context, tertiary Agricultural Colleges are important in spinning out the technical

staff vital in data collection and analysis. Example of such institutes includes Arapai and Bukalasa Agricultural Colleges. At University level, curricula are being developed that spin out graduates versed in IPM application and research. Makerere University, Busitema University and Gulu University are some of the institutions that produce graduates with academic and practical skills of IPM. Regionally, institutions such as the International Centre of Insect Physiology and Ecology (ICIPE) has the African Regional Postgraduate Program in Insect Science (ARPPIS) that has sun out world class Doctorate Entomologists that have made great impact in Africa in the field of Plant Protection. The International Institute of Tropical Agriculture (IITA) has also been crucial solving many pest problems especially in the field of Biological control. Internationally, the Commonwealth Institute of Scientific and Industrial Research Organization (CSIRO) have also been collaborating with E. African countries in the field of aquatic weed control. In general, IPM research activities in Uganda are conducted by NARO in collaboration/networking national, regional and international institutions. Prof. Samuel Kyamanywa observes that there is need for MAAIF to engage MUK more in research and that NARO should build clear collaborative research linkages with MUK to ensure stronger synergies.

6.7 Monitoring of Pests and Diseases

6.7.1 Need for Monitoring and Surveillance

On several occasions, Uganda has had pest outbreaks in some parts of the country causing destruction of crops that lead to mass economic loss and even famine in some areas. For example the outbreak of armyworms, caterpillars, coffee bores etc. This happens because there is no monitoring mechanism for pest forecast and pest outbreaks. Usually, when a crop disease is reported in a given area, experts from the respective research institutes take time to reach the reported location to carry out investigations. In many cases, the farmers never get to know the disease that has attacked their crops for weeks or even months. This happens because there is no monitoring mechanism for pest forecast and pest outbreaks. In Western countries, pest surveillance systems exist. Similar systems must be urgently established in and bolstered in Uganda to avert the socio-economic disasters that can be caused by plant diseases. Pest outbreak monitoring and forecast mechanisms will enable the country to clearly identify the particular pest, numbers that cause economic loss, seasonal and weather variability that favor or deter the pest build-up.

6.7.2 Strategies and Plan

6.7.2.1 Overview

A process for the reporting and identification of unusual plants, animals and pests will be established to track and document all pest cases, be it minor or major in a pest inventory register. Pest surveys will be conducted on a regular basis to detect new infestations and will include the types, abundance, location of pest plants, date when first spotted or seen, and date when reported. This information will be gathered from surveillance or monitoring system to be put in place, periodic surveys to be conducted and feedback from farmers/farm assistants. The data will be managed in a standardized way so that trends can be established. A rapid response process for the management of new infestations will be established to treat and manage new pest infestations as soon as they are identified.

6.7.2.2 Potential Monitoring Technologies

A pilot study in collaboration with IITA is underway in Uganda to train rural community members in the use of mobile phones to collect and disseminate information on disease outbreaks and methods for their control. The survey system developed at Makerere University uses camera-phone

input to provide timely data on the health of staple crops (Quinn et al. 2011). Survey workers (with GPS enabled devices) and agricultural extension workers or farmers (with basic camera phones) can provide data in the form of images taken of the leaves of their crops. Applying computer vision techniques to large sets of such uploaded images, the researchers can automatically classify the state of health of plants, and then map the extent of the disease in a district or country. In this way, more data can be collected, more rapidly and at lower cost, than is possible with traditional survey methods. Once geotagged observations are collected, prediction of the disease spread across the entire area of interest is then conducted. Where experts are present, they give the team a diagnosis of the health of the plant to accompany the image and position data.

Ultimately such maps are used to plan the way in which limited resources can best be used to limit the spread of disease, for example by starting training programs for farmers in high risk areas, or calculating the best places to take healthy planting material to replace the crops in the most affected areas. ***The potential to exploit mobile phones to enhance field surveillance of disease outbreaks and the efficacy of recommended control options is massive and will help to bridge the current gap between science and practice. Furthermore, enhanced field surveillance through interventions such as this will permit the project to recognize risks due to disease earlier and to deploy control measures to prevent catastrophic disease epidemics.***

7 PROCUREMENT, DISTRIBUTION, USE AND DISPOSAL OF PESTICIDES

7.1 Major Classifications of Pesticides

Since pesticides varies in identity, physical and chemical properties, it`s therefore logical to have them classified and their properties studied under their respective groups.

7.1.1 Classification of pesticides based on the chemical composition

Based on chemical classification, pesticides are classified into four main groups namely; organochlorines, organophosphorous, carbamates and pyrethrin and pyrethroids. Organochlorines pesticides are organic compounds with five or more chlorine atoms. Organochlorines were the first synthetic organic pesticides to be used in agriculture and in public health. Most of them were widely used as insecticides for the control of a wide range of insects, and they have a long-term residual effect in the environment. Organochlorine insecticides act as nervous system disruptors leading to convulsions and paralysis of the insect and its eventual death.

7.1.2 Classification of pesticides based on the targeted pest species

In this type of classification, pesticides are named after the name of the corresponding pest in target as shown in the table below:

Type of pesticide	**Target organism/pest**
Insecticides	Insects
Herbicides	Weeds
Rodenticides	Rodents
Fungicides	Fungi
Acaricides and Miticides	Arachnids of the order Acarina such as ticks and Mites
Molluscicides	Mollusks
Bactericides	Bacteria
Avicides	Bird pests
Virucides	Virus
Algicides	Algae

7.1.3 Mode of formulation

Emulsifiable concentrates (EC) - are fine suspensions of oil droplets in water and appear milky in colour. They do not require constant agitation prior to each application.

Wettable Powders (WP) - are suspensions of fine particles suspended in water. These suspensions require constant agitation prior to each application.

Granules (G) - Granules are obtained by mixing the active ingredient with clay for outdoor applications.

Baits - These are obtained by mixing the active ingredient with food base especially used for the control of rodents.

Dusts (D) - Dusts cannot be mixed with water and they must be applied dry. The common carriers for dusts are clay, talc, silica gel or diatomacious earth.

Fumigants - These are gaseous insecticides usually packaged under pressure and stored as liquids. Some are tablets or pellets that release gas when mixed with water.

7.1.4 Toxicity

The toxicity of a pesticide is its capacity or ability to cause injury or illness. The toxicity of a particular pesticide is determined by subjecting test animals to varying dosages of the active ingredient (a.i.) and each of its formulated products. The active ingredient is the chemical component in the pesticide product that controls the pest. The two types of toxicity are acute and chronic. Acute toxicity of a pesticide refers to the chemical's ability to cause injury to a person or animal from a single exposure, generally of short duration.

Acute toxicity is measured as the amount or concentration of a toxicant— the a.i.—required to kill 50 percent of the animals in a test population. This measure is usually expressed as LD_{50} (lethal dose 50) or LC_{50} (lethal concentration 50). LD_{50} and LC_{50} values are useful in comparing the toxicities of different active ingredients and different formulations containing the same active ingredient. ***The lower the* LD_{50} *or* LC_{50} *of a pesticide product, the greater is its toxicity to humans and animals.*** Pesticides with a high LD_{50} are the least toxic to humans if used according to the directions on the product label. The chronic toxicity of a pesticide is determined by subjecting test animals to long-term exposure to the active ingredient.

The WHO bases its ratings on the lowest published rat oral LD_{50}, the lethal dose (in milligrams of substance per kilogram of body weight) that kills 50% of the test animals in a standard assay (WHO, 2010). WHO gives a hazard ranking of Ia (Extremely Hazardous) to the most hazardous pesticide active ingredients. While the WHO ratings generally reflect acute toxicity, they also take into account other toxic effects such as reproductive and developmental toxicity. WHO does not evaluate the fumigants, a class of gaseous pesticides that are generally extremely hazardous, nor does it evaluate pesticides believed obsolete or discontinued (WHO, 2010).

WHO Toxicity Classification		**Rat LD_{50} (mg of chemical per kg of body weight)**			
Class	**Description**	**Solids (oral)**	**Liquids (oral)**	**Solids (dermal)**	**Liquids (dermal)**
Ia	Extremely hazardous	‹ 5	‹ 20	‹ 10	‹ 40
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	200-2,000	100-1,000	400-4,000
III	Slightly hazardous	› 500	›2,000	›1000	› 4,000
Table 5	Unlikely to present acute hazard in normal use	› 2,000	› 3,000	---	---
Table 6	Not classified: believed obsolete				
Table 7	Fumigants not classified by WHO				

It is highly desirable that, whenever practicable, toxicological data for each formulation to be classified should be available from the manufacturer. However, if such data are not obtainable, then the classification may be based on proportionate calculations from the LD50 values of the technical ingredient or ingredients, according to the following formula (WHO, 2010):

$$\frac{LD_{50}\ active\ ingredient \times 100}{Percentage\ of\ active\ ingredient\ in\ formulation}$$

If the formulation contains more than one ingredient (including solvents, wetting agents, etc.) of significant toxicity-enhancing properties, then the classification should correspond to the toxicity of the mixed ingredients (WHO, 2010).

7.2 Status of Pesticide Importation, Distribution and Use in Uganda

7.2.1 Main Brands in Uganda

There are no agricultural pesticides manufactured or formulated in Uganda. Suppliers of imported pesticides come mainly from India, China, Taiwan, Israel, Europe or branch offices of international companies in Kenya. The market is dominated by generic companies which manufacture pesticides that have gone off patent (> 20 years). Over 300 products are registered in Uganda. Many active ingredients have been on the world market for 30-50 years. These are less expensive but are more hazardous and include organo-phosphates, carbamates, and synthetic pyrethroids. There are some newer pesticides (e.g. Polo, Tordon, Milraz) but these are much more expensive and mostly aimed at and used by the floriculture industry or vegetable exporters. Some shops also have a selection of biological and botanicals imported from India (*Beauveria*, *Metarrhizium*, neem, etc.).

7.2.2 Variations in Quantities Used

Plantation farmers tend to import a greater bulk of their chemical requirements. They have better storage facilities than most of the private agricultural chemical importers and distributors. Most of these farms also provide chemical protective gear to their employees, reducing the health risks from agricultural chemical use to some extent. However, because they apply chemicals in bulk, the risks of environmental contamination are higher from these farms. The small holder farmers, however, often satisfy their agricultural chemical demands by purchasing from many of the registered and unregistered distributors, which poses its own risks. Increased use of chemicals in small farms has resulted in significant expansion in output, but it has also created a number of problems for both the farmers and the regulators in chemical management.

7.2.3 Distribution

There are a number of wholesalers, who distribute to small scale stockists (dealers), mostly in Kampala but also in the interior. Nakivubo, a section near the Balikuddembe (formerly called Owino) market in Kampala, is the site of more than 50 small shops that sell either agricultural, public health, or veterinary supplies. The area is commonly called, "Container Village". The business is thriving in Kampala for agricultural pesticides. There is an abundant supply of pesticides in Kampala but once in the rural areas the number of products greatly diminishes. There are stockists in the rural areas maintaining store sites, but much pesticide is sold in public markets sometimes in unlabeled containers such as beverage bottles. This is in part due to the inability of farmers to purchase a liter or even a half liter, as they want an amount for one sprayerload. Due to the ignorance of the farmers there are new brand names being introduced each year, most of which are the same as existing pesticides, but as the farmer thinks they are a new product he is willing to give it a try. Many products offered are in small sizes, some as small as 50 ml much in demand by farmers but most are 1 liter or kg packing.

Figure 9: Agro-chemical shop in Ntungamo District

7.2.4 Quantities Used

In Uganda, widespread pesticide use is due to an equally widespread occurrence of insects and diseases on many crops and livestock, facilitated by a warm humid climate throughout the year. In order to control these pests, many farmers spray their crops with pesticides as they are regarded as a fast-acting alternative to cultural pest control methods (Bonabana-Wabbi and Taylor, 2008). Figures on pesticide use are not readily available, and where available, they are mostly rough estimates. Reasons for this situation are varied: it is costly to establish active ingredients used, as most chemicals are mixed into concoctions to provide a formulation known only to the applicator; many chemicals are stored for long periods such that any inventory estimation would be inaccurate; and the illegal trade and sale of banned pesticides means that that portion of the market is not documented (Bonabana-Wabbi and Taylor, 2008). Missing information about pesticide use in most cases translates into under-estimates.

7.3 Pesticide to be procured and used under ACDP

7.3.1 Overall Standards

The World Bank has been a longtime partner in the agricultural sector. Given its safeguard policies, it has to ensure that the procurement/use of pesticides is done as cautiously as practicable, with proper safeguards in place, and through the use of the least toxic means of effective pest control. In

that regard, the following criteria will apply to the selection and use of pesticides in activities under ACDP:

- Pesticide financed under ACDP must be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards that, at a minimum, comply with the FAO's Pesticide storage and stock control manual (FAO, 1996), Revised guidelines on good labeling practice for pesticides (FAO, 1995), Guidelines for the management of small quantities of unwanted and obsolete pesticides (FAO, 1999), Guidelines on Management Options for Empty Pesticide Containers (FAO, 2008), and Guidelines on personal protection when using pesticides in hot climates (FAO, 1990).

- Consistent with World Bank OP 4.09, ACDP financing will not be used for formulated products that fall in WHO classes IA and IB, or formulations of products in Class II, if (a) the country lacks restrictions on their distribution and use; or (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly.

- ACDP financing will not be used for any pesticide products which contain active ingredients that are listed on Annex III of the Rotterdam Convention (on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade), unless the Country has taken explicit legal or administrative measures to consent to import and use of that active ingredient.

- ACDP financing will not be used on any pesticide products which contain active ingredients that are listed on Annex A & B of the Stockholm Convention on Persistent Organic Pollutants, unless for an acceptable purpose as defined by the Convention, or if an exemption has been obtained by the Country under this Convention.

- ACDP financing will not be used for any pesticide products which contain active ingredients that are listed on Annex III of the Rotterdam Convention (on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade), unless the Country has taken explicit legal or administrative measures to consent to import and use of that active ingredient.

7.3.2 IPM Pesticides List

The selective use of pesticides will be based upon pest ecology (including mode of reproduction), the size and distribution of its populations, site-specific conditions (e.g., soils, topography), known efficacy under similar site conditions, and the capability to utilize best management practices (BMPs) to reduce/eliminate potential effects to non-target species, sensitive habitats, and potential to contaminate surface and groundwater. MAAIF will maintain an IPM Product List, which will include all pesticides approved for use under this project. To be included on the IPM Product List, a pesticide will be reviewed for efficacy, public health and safety concerns, potential impacts to water resources and wildlife, and tendency to move or persist in the environment.

Cost shall not be the primary factor in selecting a pesticide for use under the project. If the least expensive pesticide has more potential to harm natural resources or people, then a different product on the IPM List will have to be selected. The most efficacious pesticide available with the least potential to degrade environment quality as well as least potential effect to native species and

communities of fish, wildlife, plants, and their habitats will be acceptable for use in the context of an IPM approach. ***It will be important to continuously update the IPM List to maintain only pesticides that are effective in destroying pests. Monitoring will be conducted to determine whether treatments are efficacious (eradicating, controlling, or containing the target pest).***

7.4 Challenges in Direct Pesticide Procurement by Farmers

7.4.1 Adulterated and Expired Pesticides

7.4.1.1 The Challenge

Challenges associated with direct procurement of pesticides by smallholder farmers in Uganda include the proliferation of illegal imports by unscrupulous private companies and the presence of unlicensed dealers. While it is illegal to sell unregistered pesticides, some pesticides are being sold without an ACB registration. Similarly, there are cases of pesticides being re-packaged, and sold in smaller amounts without any, or at least proper, labels.

Figure 10: Inside the agrochemical shop in Kiryandongo, some chemicals are locally packed in used mineral water bottles (Arrow)

The label on the pesticide container tells what the pesticide is, what it is used for, how to mix it, what pests it will control, what plants and animals may be particularly harmed if one is careless, protective equipment needed for proper handling and use, hazard statements, environmental hazards and compatibility with other pesticides or fertilizers.

7.4.1.2 Cause of the Problem

Lack of sufficient human resources and lack of facilities to inspect and enforce the regulations are the main causes of non-compliance of many pesticide dealers. It is estimated that almost 30 percent of pesticides sold in 2008 were substandard, and pesticide poisoning remains a big problem (NEMA, 2009). Extension workers are often unaware that counterfeits exist, while farmers and agro-dealers are unaware of the problems fake products cause. According to Mr. Sekamatte Stephen, the DAO of Kiryandongo District, Agrochemicals used by the farmers are supplied by the local drug dealers in the towns and trading centers. They are licensed by the respective lower local governments. Regulation of fake agrochemicals on the market is not done since the district does not have the expertise to do so.

Figure 11: Expired drugs are still displayed, and can easily be sold to unsuspecting farmers

According to Opio Sam Oceng, a Cassava smallholder farmer in Kiryandongo District, there is no supervising authority and the sale of fake chemicals is not checked in any way. The Town Council issues trading license to the drug shop but is not bothered of what is sold. Mr. Sekamatte Stephen, the DAO of Kiryandongo District, acknowledges that farmers have complained about fake seeds and agrochemical on sale in the district and that some drug shop operators are not trained or completely illiterate, they instruct farmers wrongly. In response to the farmers' outcry, he says that the district has embarked on formulating an ordinance for controlling the sale of agrochemicals and other farm inputs. The draft ordinance is out and will be sent to the solicitor general for review before it is passed by the district council.

UCDA does not supply pesticides to coffee farmers. However due to issues of fake agrochemicals in the country, UCDA usually identifies a distributor of genuine pesticides in the region and advises the farmers to procure their agrochemicals from him or her. So, in principle, UCDA only tells the farmer, go to Shop X, he has the genuine pesticide. No direct involvement in the purchase of agrochemicals.

7.5 Interventions

7.5.1 Proposed Interventions under ACDP

Component 4: Project Management and Regulation *(USD 15million)*

Fertilizer and agricultural inputs quality control – In accordance with the Agricultural Chemicals (Control) Act (2006), the project will support the Agricultural Chemicals Board through the Secretariat, Department of Crop inspection and Certification, to develop guidelines for fertilizer handling and use and the control of fertilizer quality (protocol, laboratory).

The Agricultural Chemicals Board (ACB) and its secretariat will be supported to create an enabling environment through better coordination and to tackle policy issues (management of the withholding tax, harmonizing regulatory framework) affecting the performance and transparency of the fertilizer market and to oversee the implementation of input market development strategies. A fertilizer Market Development Team based in MAAIF –Department of Crop Inspection and Certification will: (i) implement decisions of the ACB; (ii) provide a forum for public private dialogue for policy reforms and program implementation for fertilizer market advancement; (iii) collect and disseminate fertilizer market information; and (iv) coordinate activities related to the fertilizer sector.

Pesticide regulatory framework – In line with the Agricultural Chemicals Control Act (2006) and international guidelines and conventions, Uganda has developed - regulations for pesticide registration and control, including for application equipment and fertilizer control. On this basis, -pesticides, bio-fertilizers, dealers and premises that are handling pesticides or fertilizers -are registered and imports/exports of pesticides/fertilizers controlled. Surveillance to enforce that products are conform to standards will be upgraded by strengthening the inspection capacity through inspector training, updating of inspection guidelines and manuals, effectively implementing pesticide and fertilizer regulatory system to ensure that products supplied to the market meet high quality standards. The system calls for licensing of agro-dealers as well as regular inspection, sampling and analysis of Fertilizers/pesticide at importation points and along the distribution chain.

Institute quality control of agro-inputs traded by equipping and installing the laboratory with modern analytical facilities and instruments, and the implementation of a pesticide residue monitoring plan. Finally, the project will contribute to create awareness of professionals and the large public on safe use, handling and disposal of pesticides and fertilizers, including support to a pesticide poison information facility.

Building the Capacity of Agro-Dealers and distributors on the appropriate storage and handling of pesticide and fertilizer products as well as their physical and chemical properties; doing so will contribute to reducing the effect of physical attributes of pesticide and fertilizer on product quality.

7.5.2 Other Ongoing Initiatives

Licensing by MAAIF - As counterfeited agro-inputs float on the Ugandan market, MAAIF in collaboration with the Uganda National Agro Dealers Association (UNADA) resolved to train all agro dealers countrywide to detect fake inputs. The trainees are taught to identify fake inputs at purchasing point before passing them on to the final users -the farmer. MAAIF and the association is then supposed to make abrupt visits to agro dealers in to find out whether the trainees are practicing what they were taught before they are issued with new licenses.

7.5.3 Other Recommended Interventions

7.5.3.1 Registration and training of pesticide distributors/resellers under the Project

Emphasis shall be laid on training and certifications of all personnel involved in application and storage of pesticides including stockists. The stockists are retail traders who deal in chemicals; some are licensed but many are not. Some of their scrupulous activities include repackaging chemicals in unlabeled containers, adulteration of chemicals and sell to unsuspecting customers (NUPAWU, 2005). MAAIF will notify pesticide distributors and resellers though UNADA to register with the Project by providing specific requested information which will include but not limited to the following:

- Certificate of registration or incorporation with the Register General's Department of Uganda;
- License or permit to operate from ACB;
- Locations of company; and
- Type of activities or services or products to be provided.

The Project will also organize an orientation workshop for all registered pesticide distributors/resellers under the Project on the following but not limited to these:

- Registered and banned pesticides
- World Bank requirements on purchase, supply and safe distribution of pesticides
- World Bank list of pesticides products recommended
- IPM Pesticides List

7.5.3.2 Other Ongoing Initiatives

Campaigns by CropLife - CropLife Uganda launched an intensive campaign in northern Uganda to spread awareness among farmers, agro-dealers and extension workers about the risks of counterfeit pesticides. Through the use of radio jingles and videos, the campaign aims to educate the target audience on the types of counterfeit products found in the market and how they can harm humans, crops and the environment. Activities focus on the area's main crops, including sunflower, maize and beans. Elements of the campaign include a 15-minute movie, screened in rural villages by video vans, which details the consequences of using fake products and includes representatives from the Ugandan Ministry of Agriculture and CropLife Uganda. The movie also makes the link between the sales of empty containers and local production of counterfeit pesticides using those containers. Radio jingles, aired twice a week in both English and a local language, warn farmers against fake products. Widely disseminated stickers and posters carry similar warnings. The project also includes training for 75 agro-dealers and extension workers on the safe and responsible use of pesticides, Integrated Pest Management (IPM), and counterfeit and illegal pesticides. These training sessions are facilitated by field coordinators for CropLife Uganda. The awareness campaign,

expected to run through March 2013, is funded by the Agro Business Initiative Trust, a group sponsored by several donor agencies to support activities in Uganda's agricultural sector. ***MAAIF will partner with CropLife to booster its activities in that regard to ensure safe use of pesticides under the ACDP.***

Licensing by UNDA - As counterfeited agro-inputs float on the Ugandan market, the Uganda National Agro Dealers Association (UNADA) resolved to train all certified agro dealers countrywide to detect fake inputs. The trainees are taught to identify fake inputs at purchasing point before passing them on to the final users -the farmer. The association is then supposed to make abrupt visits to agro dealers in to find out whether the trainees are practicing what they were taught before they are accredited and issued with new licenses.

Figure 12: Typical certificate of a trained Agro-Dealer

7.6 Envisaged Impact of Project on Overall Quantities of Pesticide Use

There is not much published information on pesticide usage in Uganda either from importation statistics or on a crop basis as GoU statistics derived from surveys. From the information at hand, it is evident that usage is highly variable depending on the crop and the size of the farm. GoU was once the largest importer of pesticides in Uganda until the early 1990s when the economy was liberalized. Now the private sector is the leading importer. With the decline of subsidies, pesticide usage is slowly increasing to former times. Pesticide prices are high as they are unsubsidized and taxed and transportation costs are high as manufacturers are overseas. Highest usage is by large farms and commercial estates growing cash crops (cotton, cowpeas, groundnut, tomato, Irish potato

and sweet potato) and flower farms. ***The fast growing population puts more pressure on the agricultural sector as demand for food increases. Due to the limited arable land there may be a need for productivity increases on the existing lands, including increased pesticide usage. With credit programs almost absent, farmers have had little economic incentive to use pesticides particularly on subsistence crops. Small farmers tend to use the least expensive pesticides (generics) and select the smallest packings (100-250 ml/g containers). However, with increased access to credit as envisaged by the ACDP, the farmers may have more incentive to purchase pesticides and therefore the overall pesticide use may increase.***

7.7 Transport, Distribution, Storage and Application of Pesticides

7.7.1 Key Challenges

7.7.1.1 The misuse of pesticides

Farmers are likely to misuse pesticides in at least six different ways in Uganda:

- Spraying too close to harvest, thus contaminating the crop after harvest;
- Applying the wrong dosage, often over-applying. Farmers often spray hazardous insecticides like organochlorines over five times in a season when two or three times can be sufficient;
- Applying pesticides intended for cash crops to growing food crops;
- Spraying pesticides intended for growing crops on stored crops;
- Using obsolete or expired pesticides;
- Mixing different chemical pesticides together.

7.7.1.2 Insufficient training and advice

Most of these problems result from a lack of knowledge among farmers, which in turn arises from lack of sufficient training and advice provided to them. A related problem, however, is reliance on often unqualified, sometimes unlicensed dealers who sell the wrong pesticides for the wrong crops. Farmers also generally underdose to save money but this is a sign that they do not understand the nonlinear dosage-mortality relationship. There is a critical mortality threshold for pesticides below which no control occurs. For organo-phosphorous insecticides, it is usually around 0.3-0.4 kg active ingredient/ha.

Many problems associated with the unsafe use of pesticides result from insufficient training and advice provided to farmers by MAAIF and its extension service. Training and advice is especially critical given that most farmers are unable to read and write. More training and advice needs to be done by the extension service, but that little is currently taking place due to lack of resources. Even if farmers have attended a workshop, also critical is follow-up through and implementation of what they have learnt; even after basic training, some bad habits can persist.

7.7.1.3 Failure to use protective equipment

Pesticide users are generally advised to wear an overall, a hat, gloves, eye protection or a respirator, and good quality boots made of rubber with socks. Yet these recommendations highlight the practical difficulties of expecting poor farmers in hot countries like Uganda to comply, and indeed most do not. The proportion of farmers using all the recommended protective equipment is very low. The hazards to health are amplified given that some farmers allow their children to do the spraying.

According to field visits and briefings by many resource staff, outside of demonstration plot activities, few farmers normally use even the bare minimum of appropriate pesticide protection clothing and equipment. Farmers generally mix chemicals (where the pesticide is most toxic) without rubber gloves, a bucket of water to wash off spills, or goggles and spray while walking through the spray path without rubber boots, goggles, rubber gloves, a plastic sheet between the sprayer and the back, and with only every-day clothing. This behavior is common among farmers even though they generally believe that pesticides pose danger to their health.

7.7.1.4 Unsafe Storage

Many farmers are less aware than they need to be that pesticides are truly dangerous. Storing pesticide containers near or even in food stores has contributed to several recent deaths in Uganda and an untold number of illnesses since there are no official figures. Pesticides also pose health problems to those that handle them during the supply chain from stores to farms. Some of the pesticide stockists shops in Kampala are converted metal shipping containers (hence the name 'Container Village') while the majority are small wooden constructed shops. The average store is about 3-4 m wide and 5-6 m deep and pesticides are displayed openly on shelves with up to six staff seated behind counters. Very few stores have glass encased shelves or ventilators.

7.7.2 Pesticide Poisonings

7.7.2.1 Magnitude of the Problem in Uganda

The Pesticides Use, Health and Environment (PHE) Uganda Project is being carried out by Uganda National Association of Community and Occupational Health (UNACOH) and Dialogos (Denmark) in collaboration with Makerere University School of Agricultural Sciences (MUSA) and Makerere University School of Public Health (MUSPH) with an intent of making the use of pesticides safer for human health, more friendly to the environment, while maintaining and improving agricultural productivity. The main goal of this project is to reduce the negative health effects of pesticides in humans and to prevent pesticide pollution of the environment.

A survey conducted by UNACOH in Pallisa and Wakiso Districts, in the year 2011 revealed that more than half of the health workers (55%) said that they had ever received cases of pesticide poisoning at their work stations in the previous year. The largest number of reported cases was for people in the 21-39 and 1-5 year age categories. 63.6% of health workers mentioning that the leading causes of pesticide poisoning were suicide-related. Only 9% of health workers believed that pesticide poisoning experienced in the village was through occupational exposure. Other pesticide poisoning exposure is believed to be accidental. Health workers in general were not aware of the different classes of pesticides, although they had various ways of telling how toxic a pesticide was. (Source: UNACOH at: http://www.unacoh.org/projects/pestcide-health-and-environment-phe/) ***The above data reveals that the problem of pesticide poisonings remains a big challenge in Uganda that has to be addressed under the ACDP to ensure sustainability.***

7.7.2.2 Pesticides of Concern

There is a scarcity of information in Uganda on the magnitude of both intentional and unintentional poisoning, as well as on the relative importance of different pesticides. Health centers, that would need to be identified and supported, could provide this information. The locally available pesticides will also determine how many poisoned people survive to hospital presentation. In areas where highly toxic fast acting WHO Class I organophosphorus (OP) pesticides are used, the onset of poisoning can be so fast that many people die before they can be taken to hospital. By contrast, where slower acting pesticides are used, more patients will survive to reach hospital and medical

care. The case fatality for different pesticides also varies markedly, from around 70% for both aluminium phosphide and paraquat, to close to 0% for many of the newer lower toxicity pesticides. Therefore, hospital statistics, whether from primary or secondary hospitals, must be interpreted in light of this difference.

7.7.3 Risks of Poor Storage and Misuse of Pesticides

Uganda is a country laced by rivers and lakes. Such aquatic features act as a sink for eroded material and effluent, and great care should be taken when using pesticides adjacent to, or on hillsides leading to, such aquatic environments. The contamination of water bodies with pesticides can pose a significant threat to aquatic ecosystems and drinking water resources. With its extensive wetlands and lakes there is a risk that uncontrolled pesticide usage can contaminate economically important resources such as Lake Victoria. In 1999 the lucrative export market for fish to Europe was stopped due to endosulfan residues found in fish. Therefore, there is need for proper safeguards on the use of pesticides in the Project.

Figure 13: Safe application of pesticides in waterlogged areas especially the rice schemes in wetlands will present an enormous challenge to the project

Another challenge will be in regard to pesticides entering the food chain as some of the wetlands used for rice cultivation are also used for livestock grazing. There is therefore a risk of these livestock drinking contaminated water from the fields as well as eating from fields contaminated with pesticides. This calls for management of the schemes to avoid contamination of the food chain in addition to routine food safety tests to check on contamination. There is also a risk of people eating birds killed by pesticides especially in Northern and Eastern Uganda!

Figure 14: Residents fetching water from R. Manafwa; use of pesticides in rice grown in wetlands will be critical as these wetlands are part of the catchment areas of aquifers and wells used by the local communities.

Figure 15: Goats grazing at Doho Rice Scheme

Nature of Problem	Brief description of problem
Public health	• Through ground water pollution • Through food contamination • Through air pollution • Through occupation • Through drinking contaminated water
Drinking water contamination	• No water treatment in villages • Inadequate treatment in towns • Most water ways/bodies are source of drinking water • Using chemical containers for drinking water
Air Pollution	• Through generation of fumes • Through burning of pesticide • Through spraying • Through dusting
Pollution of Inland Waterways	• Use of pesticides near water ways • Washing containers in water ways • Direct discharge of agrochemicals into water bodies
Pesticide residues in food	• Improper post harvest handling • Extent of food contamination not known • Excessive and frequent use of pesticides • Pesticides discharged into water bodies accumulate in fish
Occupational Health of agricultural workers	• Lack of awareness of dangers associated with pesticides • Most rural users Lack safety gears • Lack of adequate information • Safety gears are expensive, uncomfortable hence reluctant to put on
Ground water pollution	• Through infiltration of contaminated water
Storage/Disposal of Obsolete pesticides and containers	• Lack of adequate storage facilities • Lack of adequate logistics in distribution of pesticides • Importation of excess than needed • Lack of adequate disposal facilities
Soil contamination	• Through spraying • Through dusting • During transportation • Disposal of obsolete chemicals • Pesticide residues • Through disposal of packaging materials
Unknown pesticide importation and distribution	• Varieties are too many to monitor • Due to locally re-packed pesticides • Lack of quality control guide lines on packaging
Pesticide accidents during transport	• Due to spills on board • Careless driving/riding • Transport with other products

7.7.4 Distribution of Pesticides

7.7.4.1 Cluster Stores

Pesticides will be stored at one Cluster Store and will then be dispersed to each District Store when need arises. The stores will have to be maintained in good condition with all the required facilities

for proper storage as detailed in the next Chapter. Storage facilities in each District will help alleviate the crowding at the Cluster Store and to reduce the travel distances to the Parish facilities.

7.7.4.2 Distribution downstream

To help facilitate the accounting of specific stock of pesticides and other logistics, record for each type of stock (i.e. pesticides, gloves – number and date bought, number and date dispersed to each Parish, number and date returned at end of spray cycle, etc.). This will ensure good accountability and record keeping of pesticide sachets at the Parish level, from dispersal to collection of empty containers at the end of the day. Each Parish store manager will have to count out and document the required number of sachets or bottles to be distributed to the Spray Leaders, who in turn will count out and document the sachets and bottles allocated to each spray operator. At the end of the day, the process will be repeated and the used and unused sachets will be collected and recorded.

7.7.4.3 Pesticides Usage Records

Under circumstances where MAAIF will directly procure pesticides for distribution to the farmers, the PIU will be required to maintain records of all pesticides annually applied under the project. The following usage information will be reported:

- Pesticide trade name(s)
- Active ingredient(s)
- Total acres treated
- Total amount of pesticides used
- Total amount of active ingredient(s) used
- Target pest(s)
- Efficacy (percent control)
- Total number of containers returned to the stores where chemicals are purchased

7.7.5 Use of Pesticides

7.7.5.1 General Criteria for Pesticide Use

An approved list by the Agricultural Chemicals Board exists (see Annex 1) will be used according to their labeled uses when all of the following criteria are met:

- The activity is part of an IPM strategy that seeks to minimize pesticide use or use pesticides as a last resort;
- Best technology-based practices are followed, leaks or spills are reduced, and application equipment is maintained in good working order;
- Timing of pesticide application corresponds to the life cycle of the pests to be treated, and the life cycle is monitored appropriately;
- Pest population action thresholds are determined, and monitoring ensures treatment only when the threshold is exceeded;
- Weather conditions are appropriate for the application;
- Applicators adhere to all of the label requirements concerning the safe and effective use of the pesticide(s);
- Persons applying the pesticide are fully trained or are under instructions from MAAIF, UCDA or NAADS or any other competent Extension Staff;
- Activity minimizes pesticide application within 50 meters buffer of streams or other water bodies;

7.7.5.2 Pesticide Application Decisions and Procedures

Pesticides should be applied by directed, low volume, single wand sprayers, wiping, daubing and painting equipment, or injection systems. Boom application shall be limited to large scale (>5 acres) natural resources enhancement or farming activities. It is important to manage pesticide drift when surface waters or beneficial plants are nearby. Control nozzle size, pressure and droplet size to minimize drift. Application checklist shall include the following procedures:

1. Read pesticide label.
2. Check and calibrate application equipment for safety and efficiency.
3. Check the weather conditions. Unless otherwise indicated on the product label, avoid pesticide use it is raining or expected to rain within 24 hours, or wind speed is very high
4. Post notification signs at all entrances to sites associated with pesticide applications.
5. List re-entry specifications on the signs if required by the label.
6. Apply material according to the label.
7. Record pesticide application on application forms.
8. Remove signs when the liquid pesticide has dried, unless indicated otherwise on the label.

7.7.5.3 Rules and Procedures for Application of Pesticides

It is virtually impossible to train all small-scale farmers in Uganda in the safe and responsible use of pesticides. The solution, therefore, is the concept of Spray Service Providers (SSPs) as part of an initiative to promote the safe and responsible use of pesticides and timely control of outbreaks and occurrence of new pests, or to manage regular pests, to benefit small-scale farmers. This approach will recruit trained and certified lead farmers in the application of pesticides and they will hire out their services to fellow farmers to spray their lands/crop. This implies that untrained farmers will no longer handle pesticides and that this application will only be undertaken by those who are properly trained and certified.

7.7.5.4 Safety and Protection

There are certain measures which should always be undertaken by pesticide operators to help protect against contamination during the handling and application of pesticides. These measures should always be followed.

Reading and Understanding Labels - The first principle is to always read and follow the label recommendations on the pesticide container. If the label information cannot be read or understood for any reason, then the operator should find someone who can explain the instructions to him. Apart from the written instructions, the operator should also look for pictorial information on the label which will indicate the degree of hazard presented by the pesticide formulation. Similarly warning symbols, such as skull and crossbones, give information on the type of chemical hazard.

Avoiding Contamination - Direct exposure of the skin, nose, mouth or eyes should be avoided or minimized when working with pesticide products to reduce the chances of personal contamination.

When pouring and mixing the concentrated product, every effort should be made to avoid splashing or spilling onto skin or clothing. If any product falls on the skin, or into the eyes, then this should be washed off as soon as possible. Heavily contaminated clothing must be removed and washed with detergent and water. The likelihood of contamination can be greatly reduced by using suitable equipment for measuring out and transferring the product. In particular the hands must never be used as scoops nor should the hands or arms be used to stir liquids.

The most appropriate application technique should be selected to control the pest problem. It is very important that the application equipment is in a good state of repair and that it is properly maintained and calibrated. When spraying the diluted product the applicator should always work upwind of the spray to avoid coming into contact with it. He should also avoid contact with freshly sprayed foliage as far as possible.

Personal Hygiene - Another basic principle of personal protection is good hygiene when working with pesticides. This is to ensure that if any contamination occurs then it is removed in good time. In addition personal habits will help avoid direct contamination in itself.

Operators should not eat, drink or smoke during work and should not touch their face or other bare skin with soiled hands or gloves. They should always wash their hands and face after handling pesticides and before eating, drinking, smoking or going to the toilet. When they have finished work for the day they should then wash themselves thoroughly. Their work clothes should also be washed after work, separately from other clothing, and then dried.

Safety Gear - For the effective safety and protection of the workers handling agro-chemicals, the provision of the following is deemed necessary.

- Helmet or cloth cap
- Safety spectacles, goggles or face shield (attached to helmet)
- Dust or light fume masks
- Emergency vapor masks or half-face respirators with organic vapor cartridges
- Nitrile rubber or neoprene gloves or gauntlets
- Overalls
- Nitrile rubber or neoprene aprons
- Strong rubber or neoprene boots

Selection, care, and maintenance of work clothing and protective equipment will be paramount given the hot conditions in some parts of Uganda. This is because the wearing of additional protective clothing and other equipment can cause severe discomfort and even physical distress due to heat stress if they are made of inappropriate materials. In addition, because of the discomfort, operators may dispense with protective apparel and become subject to greater exposure and possible contamination. There are certain measures which can help reduce this problem, namely:

a) Where possible using a pesticide formulation which does not require the wearing of additional items of protective clothing;
b) Applying the pesticide in the cooler hours of the day when it is more comfortable to wear protective equipment.

Instructions on Wearing of PPE

Wear protective equipment as described in the chart to reduce exposure.

EQUIPMENT	PROTECTION	HOW TO WEAR IT
Coveralls	There are two types of coveralls: disposable and reusable. Disposable coveralls are lightweight and comfortable on warm days. They can be worn for mixing and applying pesticides, and then discarded at the day's end. If they become contaminated, they should be discarded at once. The second type of coverall is made of washable fabric and may be reused many times. These fabric coveralls are adequate for use with all but the most highly toxic and concentrated pesticides.	Button (or zip) right up to the neck. Loose coveralls around the neck will suck and blow pesticide in and out of the interior of the coveralls as you bend and move. Wear coveralls over a long-sleeved shirt and pants.
Aprons	When pouring or otherwise handling concentrated pesticides, it makes good sense to wear protection in the form of an apron. The apron protects the front of your body from spills or splashes of the concentrate. The apron should be made of rubber or synthetic liquid-proof material that will resist the solvents used in formulating the pesticide.	Make sure the apron covers your body from your chest to your boots.
Gloves	Protect your hands by wearing chemical- resistant gloves. Neoprene gloves provide the best protection. Natural rubber gloves may be used when handling organo-phosphorus or carbamate pesticides. Be sure that they are designed for use with solvents and pesticides. Never use lined gloves, gloves with wristbands or leather gloves.	Put gloves on and roll up the first inch or two of the cuff. That way when you lift your hands, any liquid on the gloves won't drip down your arms.
Hats	Use a chemical-resistant hat, preferably made of washable plastic. The hat may be a hard hat or made of flexible plastic. In either case, it should have a plastic sweatband. Wash and dry entire hat after each use and before storing. Ordinary baseball caps with cloth sweatbands are dangerous as they absorb the pesticide and recontaminate the forehead each time you wear them. Even small amounts of moderately or slightly toxic pesticides may cause severe skin irritation or other illness if exposure continues for several days.	
Boots	Wear chemical-resistant, unlined boots. These boots are available in a variety of styles and materials. Neoprene boots are the best. Knee-length boots offer greater protection because they extend above the lower end of the apron. Avoid leather or fabric boots and shoes because these will absorb pesticides and cannot be cleaned effectively.	Wear your trouser legs outside the top of your boots. This will prevent spills and splashes from running into the boot and onto your leg.
Goggles	Chemical-resistant goggles keep your eyes safe from both splashing and, if using dry formulations, dusts or granules. Don't use goggles with cloth or elastic headbands as these will absorb pesticides.	Wear goggles snugly on your face so that the sides of your head are protected from splashes. If you wear glasses, make sure you purchase goggles that fit snugly over them. Never wear contact lenses when working around pesticides.
Respirators	Only approved respirators should be used. Do not exchange parts of different respirators. (For example, do not use a cartridge produced by Company "A" with a respirator produced by Company "B" as the combination may not provide adequate protection to the user). Dust masks are ineffective in protecting against herbicide vapours. Similarly, the filters on tractor cabs are intended to remove dust and are not designed to protect against herbicide	When carrying out operations, change filters each day. The cartridge should be replaced when chemical odour becomes apparent or when breathing becomes difficult. New cartridges should always be installed at the beginning of the spray season.

	vapours or mists. Chemical cartridge respirators are recommended for outdoor use when mixing and applying herbicides.	Prior to commencing work, check the face seal while the respirator is on the wearer's face. Regardless of design, respirators cannot be worn securely by people wearing beards, moustaches or sideburns.
Face Shields	Goggles offer some protection, but frequently full-face protection is advised or required according to the pesticide label. It is especially important to protect your eyes and face when pouring or mixing liquid concentrates. Effective face shields are made of clear plastic.	Since the shield attaches to the hard hat, you can raise or lower it as needed.

Note: The key danger times are during mixing and when walking through the spray path. Eye and feet protection are the greatest priority. Goggles, long pants, and rubber boots are most needed. Due to the use of knapsack sprayers by small-scale farmers and being unaccustomed to wearing protective equipment, only pesticides which meet World Bank standards of minimum mammalian toxicity ("least toxic"), yet still effective, will be recommended for use under the project.

7.7.5.5 Post-application Visual Assessment

All operators must conduct visual assessments of application sites. Visual assessments will consist of spot checks in the area in and around where pesticides are applied for possible and observable adverse impacts caused by an application of pesticides. Possible and observable adverse impacts include, but are not limited to, the unanticipated death or distress of non-target organisms, disruption of fish and wildlife habitat.

7.7.5.6 Records Keeping

All records will have to be documented as soon as possible but no later than 14 days following completion of each pesticide application in a treatment area. On or before the 14th day after any pesticide application, a copy of the below information will need to be on file with the Extension Workers. Information for each treatment area to which pesticides are discharged as follows:

- Surveillance methods used, dates of surveillance, and findings of surveillance
- Target pest(s) and explanation of the need for pest control
- Pest or site-specific action thresholds prior to pesticide application
- Description of pest management measures implemented prior to the first application
- Company name and contact information for pesticide applicator
- Pesticide application dates and time of day of application
- Description of treatment area, including location and size of treatment area and identification of any waters
- Name of each pesticide product used including ACB registration number
- Quantity of pesticide applied
- Concentration (%) of active ingredient
- Effective concentration of active ingredient
- Any unusual or unexpected effects identified to non-target organisms
- Was a visual assessment conducted? Was it done during or post pesticide application, if not explanation why not
- Assessment of environmental conditions relating to proper pesticide use

7.7.6 Proposal for Public Health Initiatives under ACDP

7.7.6.1 Justification

The national situation analysis for the agricultural sector puts the figure of reported human pesticide contamination (acute poisoning) cases at 300,000 per annum and an estimate of 4000 fatal cases per annum (Kateregga, 2012). Note that estimated annual damages could be higher due to the fact that some effects from exposure may be evident only in the long run, and because the impacts of some pollutants on the food chain and on the environment may not be immediately detected (Kateregga, 2012).

7.7.6.2 Objectives

Under the ACDP, an initiative regarding the Impact of Pesticides on Health will be done to prevent intentional and unintentional deaths from pesticide poisoning in Uganda. The objectives of the initiative will be as follows (WHO, 2006):

- Review and recommend improved pesticide policies.
- Implement sustainable epidemiological surveillance and monitoring of pesticide poisoning in clinical settings and communities.
- Develop or strengthen community programmes that minimize risks of intentional and unintentional pesticide poisoning.
- Improve the medical management and mental health care of people with pesticide poisoning in health care facilities at different levels.
- Provide training at different sectors and levels.

7.8 Disposal of Expired Pesticides and Empty Containers

7.8.1 Key Challenges

7.8.1.1 Re-use and poor storage of pesticide containers

The management of pesticides containers is currently under the responsibility of resellers and farmers because of the retail sales system. They find themselves with the most important share of the empty containers which are differently managed. There is widespread re-use of containers for storing food or water for humans or livestock. Indeed, this may well be the most hazardous practice associated with pesticide use in Uganda. Many farmers wash the containers before re-use, but often less thoroughly than is needed.

7.8.1.2 Limited Capacity to dispose Expired pesticides

Occasions will arise when it will be necessary to dispose of agro-chemicals concentrates, either because the stock is outdated or has been found to be unusable or because the product is no longer registered for the original purpose. The only thermal processes that are able to destroy plastics and pesticides are high temperature incinerators and cement kilns with effective emission controls (WHO, 2008). However, Uganda has only one incinerator fit for safe pesticide disposal whose cost of UGX 1500 per kg of pesticide is highly prohibitive for large quantities.

7.8.2 Possible Interventions and Options under ACDP

7.8.2.1 Empty Container Collection

A collection and disposal system and cleaning of pesticide containers need to be put in place by MAAIF under the ACDP. Involving the distributors and Local Governments in the collection and

disposal of empty containers and obsolete stocks of pesticides is paramount. There is need for a program to provide farmers and municipalities with a management system for disposing of empty pesticide containers. There needs to be collection centers where farmers can take empty and rinsed non-returnable plastic and metal pesticide containers across the Districts for safe handling and disposal. The safe and environmentally sound management of containers at the end of their life is an external cost to the marketing and use of pesticide products. The proposed scheme will require adequate funding to support all its operations and it is the responsibility of the administrative body to develop:

- the logistical infrastructure to collect the empty containers;
- the processes to treat the containers to facilitate easier handling (e.g. shredding or baling) and to separate the materials into fractions according to the intended recycling or disposal route; and
- the appropriate technologies for the sound environmental management of the materials, or establish contracts with external organizations to undertake the recycling and disposal.

For the scheme to be effective in attracting back empty containers, it must be easy for the users to return them to the scheme. Designing the appropriate infrastructure for logistics is crucial. Reverse distribution system could be used that involves using the infrastructure that has been established to distribute products to users as a mechanism to receive material back from them or creating Network of collection centers. As an alternative to the reverse distribution model is one where the users are able to deliver empty containers themselves. The location, opening times and staffing of the collection centers must be convenient to users. Inconvenient locations and opening times will discourage users from returning containers. The collection centers may be used to undertake segregation of container materials and pre-treatment such as baling and shredding to increase the density and improve the efficiency of the onward transportation. Shredding may also improve the value of the materials for recycling. ***Under the ACDP, the collection of empty containers and obsolete pesticides will be a direct responsibility of the Local Government Authority and MAAIF will handle all disposal issues.***

7.8.2.2 Utilization of Luwero Industries

One incinerator thought to meet the required pesticide incineration standards is Luwero Industries located at the Nakasongola Military Base (Luweero Industries) but its specifications were not ascertained due to issues of access to a military facility. Although MAAIF had been allowed to utilize the facility for pesticide disposal, the UGX 1500/= per Kg incinerated was too expensive for MAAIF to afford! There have also been concerns over access to the facilities by NEMA to monitor its operations. ***NEMA licensed Waste Disposal service providers that have access to the incineration facilities at Nakasongola and MAAIF will work with these licensed service providers. MAAIF should engage Luwero Industries to explore the possibility of upgrading the facility to the standard required for pesticide disposal.***

7.8.2.3 Utilization of Hospital Incinerators

Hospital incinerators have been identified as potential solutions but they do not meet the required standards. It is recommended that such incinerators SHOULD NOT be used for solid pesticides, agro-chemicals containing chlorine, sulphur or nitrogen, agro-chemicals containing metals and large quantities of agro-chemicals in general (FAO, 1996). They should only be considered for relatively small quantities of liquid pesticides, provided that the design, temperature and residence time are adequate; they have the necessary air pollution control devices; expert advice is sought in advance; and if regulations permit such use of hospital incinerators. However, such incinerators can

be utilized to incinerate other wastes such at masks and empty sachets, though the capacity is limited and would require incineration of small batches. Burning using those incinerators may be dangerous as the temperatures obtained by wood fires may not be hot enough to prevent poisonous smoke from occurring. ***More research and tests need to be carried out to ascertain their suitability for disposal of pesticide packaging materials.***

7.8.2.4 Utilization of Locally Fabricated Incinerators

A local company Technology for Tomorrow Technology Ltd (T4T) www.T4Tafrica.com manufactures batch type incinerators with a trade name MAK. They come in three sizes: small (20 kg/hour), medium (30 kg/hour) and large (40 kg/hour). When considered over an operating period of say 12 hours, the destruction would be: small (240 kg), medium (360 kg) and large (480 kg). One great advantage is that they do not require fuel; by design they are self-fueling only requiring 3 kg of wood or paper as startup fuel. Their operating temperature ranges from 850 to 1,080 ^{o}C. The incinerators normally have smokeless gas emissions, with a small percentage of carbon dioxide at startup and run down. The target of these incinerators has been disposal of medical waste and many of such incinerators are being used at major hospitals in Uganda.

Figure 16: Medical waste incinerator used at Kabale Municipality Composting Site

A good example is the MAK IV incinerator that has been specially invented for the burning of medical waste such as used cotton, syringes and safety boxes. The stainless steel machine uses waste paper as fuel and burns at up to about 1200 degrees Celsius. The top of the incinerator is

covered with sand, to stop air leakage but also work as refractory powder, to prevent heat loss. It can burn 5 kilos of waste in about 25 minutes.

Therefore, MAAIF will engage local fabricators to fabricate small-scale incinerators to help smallholder farmers to safely dispose obsolete pesticides.

7.8.2.5 Working with Cement Industries

The temperature of 2000^{o}F of the cement plant flame can fully vaporize pesticides. It is far cheaper to add on an incineration capability to a cement plant than to export it to another country or build a specialized incineration plant within the country. Consultations with cement plants in Uganda will be pursued to determine if obsolete pesticides could be incinerated in their furnaces.

In terms of a sustainable solution, a detailed feasibility study will be commissioned to select the most feasible option for safe disposal of obsolete pesticides in the country. However, in the long-term, MAAIF should think of investing in a pesticide incinerator.

8 PMP IMPLEMENTATION FRAMEWORK

8.1 Roles and Responsibilities for Pests Management and Research

The Government of Uganda and other stakeholders are responsible for ensuring that the pesticides used nationally are safe; are marketed, applied, handled and disposed of appropriately; and, if used judiciously, do not leave harmful residues on agricultural produce and in the environment.

8.1.1 Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)

Component 1: Agricultural Inputs. Subcomponent 1.1 Availability of seeds and planting materials fall within the mandate of the Director – Crop Resources (DRC). It will be coordinated by the Department of Crop Inspection and Certification (DCIC).

Subcomponent 1.2 Access to and use of quality inputs (seeds and fertilizers) will be coordinated by DCIC in close cooperation with retailers at town and village level. Software development and management for the voucher scheme will be outsourced. Farmer driven fertilizer trials and test will be organized.

8.1.1.1 Responsibility

The Crop Protection Department is in charge of all matters related to plant health, including issuance of import and export phytosanitary certificates for live plant material and horticultural crops, as well as for plant pest prevention or eradication programmes. The department is also responsible for enforcing regulations on registration and the use of pesticides and other agrochemicals. The Pesticide and Fertilizer Control Unit (PFCU) under Crop Protection Department has the following functions:

- Initiate formulation and review of policies, laws, regulations strategies and plans related to agro-chemicals and their use in Uganda
- Inspection, monitoring and enforcement of regulations and standards for compliance and to take the necessary action in cases of non-compliance
- Equip, operate and build capacity to operate the Pesticide Analytical laboratory to establish accurate pesticide residues in plants used for food and other food and feed items
- Develop and participate in pesticide residue monitoring plan to ensure adherence to the official Maximum Residue Levels (MRLs)
- Conduct tests and efficacy field trials on agricultural chemical formulations to compliance to approved specifications and quality the registration process
- Participate in National, regional and international fora to promote sound management of agricultural chemicals
- Secretary to the National Agricultural Chemicals Board and its subsidiary body, the Agricultural Chemicals Control Technical Committee Build capacity for inspection and certification of agro-chemical trade in Uganda and assessing and seeking solutions to the trade constraints and use of the agro-chemicals
- Establishing a database of registered and approved products, dealers, and premises
- Ensure that the public and the farming communities and dealership communities have access to information on safe and responsible use of agricultural chemicals and that the necessary training programs are in place

The Control of Crop Epidemics Section (CCES) has the following functions:

- Surveillance for weeds, pests and diseases that are of epidemic proportions;

- Mobilizing and organizing researchers, Local Government Staff, Local NGOs, and farmers to control weeds, epidemic pests (including migratory pests) and diseases;
- Purchasing Equipment, agro-chemicals and mobilizing stand-by funding to intervene in case of outbreaks of a weeds, pests or diseases;
- Forecasting, and providing an early warning on epidemic pests and diseases and sending alert messages to the stakeholders to be ready for outbreaks;
- Liaising with regional and international organizations in weed, pest and disease forecasting, monitoring and management;
- Training and building capacity for the Department, Local Governments and farming communities in pest and disease epidemic control;
- Creating awareness for weeds, crop pests and diseases, their management and follow up
- Keeping and updating a database of information on epidemic pests and diseases and their control;
- Formulating guidelines based on the Crop Protection act 1962, to guide lower administrative units to make by-laws to improve pest and disease control strategies in the affected districts.

MAAIF will be the focal point for implementation of the PMP and shall coordinate its implementation through a harmonized information management system, financial mechanism and a monitoring and evaluation framework. The ministry will:

- Liaise with statutory bodies including URA and UNBS to ensure the importation of pesticides allowed for use in Uganda and to ensure they are of high quality
- Liaise with NEMA and GAL to monitor pesticide contamination
- Through its inspectors monitor condition of pesticide storage and transport
- Together with NAADS link-up with the district to collect empty pesticide containers

All pesticide shops will be inspected regularly by MAAIF inspectors to ensure that they are registered or licensed by ACB and that they follow safety regulations. Inspectors will also be required to take samples of pesticides that are suspected of being adulterated.

8.1.1.2 Capacity of MAAIF

MAAIF has inspectors around the country but they do not focus just on pesticides but also on seeds and plants, among other areas. But it lacks the capacity to work in the rural areas among farmers, a major problem when numerous unregistered dealers sell directly to farmers by visiting villages. It also has little capacity to pounce on unregistered dealers who set up stalls in local markets in urban centers.

8.1.2 Role of NARO and Research Institutes

Agricultural research is carried out by the MAAIF regional research stations under NARO. The three largest stations include National Agricultural Research Laboratory - Kawanda (horticulture and post-harvest) and Namulonge Agricultural and Animal Research Institute (NAARI) (root crops) both outside Kampala as well as Serere Agricultural and Animal Research Institute (SAARI) (dry land crops) in the northern zone of lower rainfall. There is also the Kituza Coffee Research Institute (CORI) also near Kampala and a few smaller ones elsewhere. Also important is the Crop Science Department of Makerere University which has support from the USAID IPM-CRSP.

NARO will coordinate all integrated agricultural research and development (R&D) activities required under the ACDP. The R&D institutions will include National Agricultural Research

Laboratory - Kawanda, Coffee Research Center, National Agricultural Research Institute - Namulonge and Makerere University all under the coordination of NARO. When pest problems occur that are novel or beyond the scope of NAADS in-house experts and the UCDA Extension Staff at the district level, advice will be obtained from NARO.

8.1.3 Role of UBOS

The Uganda Bureau of Statistics (UBOS) is responsible for supplying up-to-date agricultural statistics. Under the ACDP, ***UBOS will continue to carry out agricultural censuses to generate data on agricultural production, cropped area, and yields of the crops produced by Ugandan smallholder farmers.***

8.1.4 Climate Change Unit

Uganda's National Adaptation Programmes of Action (NAPA) was developed under the leadership of the Department of Meteorology as the UNFCCC National Climate Change Focal Point. The formal objectives of the NAPAs are to provide a process for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change – those for which further delay would increase vulnerability and/or costs at a later stage. NAPAs were designed as part of the National Adaptation Plan to Climate Change for Uganda to address specific urgent and immediate problems faced by communities. As one of the NAPAs, "**PROJECT 7: Vectors, Pests and Disease Control Project**" aims at understanding the linkages of these outbreaks to climate change for more cost-effective management with special emphasis on vulnerable communities and gender dimensions (GoU, 2007). ***Therefore, the Climate Change Unit will have to implement the NAPA on pests and diseases and inform MAAIF on its findings.***

8.1.5 Ministry of Water and Environment

The Directorate of Water Resources Management is responsible for managing the water resources of Uganda in an integrated and sustainable manner in order to secure and provide water of adequate quantity and quality for all social and economic needs for the present and future. The directorate has two departments the Rural Water Supply (RWSD) and Urban Water and Sewerage Department (UWSD). The directorate is responsible for ensuring that water used for domestic, industrial and other production purposes is free of harmful substances including pesticides. ***The MWE through its Water Resources Department will collaborate with GAL in monitoring pesticide contamination of water bodies.***

8.1.6 Ministry of Works and Transport

The mandate of this Ministry is to promote an adequate, safe and well-maintained transport infrastructure, an efficient and effective communications system, safe housing and buildings, and to contribute to the socio-economic development of the country. Part of this mandate is supposed to extend to providing for regulations/provisions for the safe transportation of chemicals, which obviously caters for pesticides. ***The role and involvement of the Ministry is very important and will have to ensure that transportation, distribution and storage of pesticides is done in such a manner that will protect the public health and environment. The ministry will have to work closely with MAAIF Inspectors and the respective District Local Governments.***

8.1.7 National Environment Management Authority

One of the key institutional mandates of NEMA include among others ensuring the observance of proper safeguards in the planning and execution of all development projects including those already in existence that have or are likely to have significant impact on the environment. NEMA is also charged with review and approval of EIA reports as provided for by the National Environment Act,

Cap. 153. ***Therefore the key role of NEMA will be to review and approve ESIA reports for the different ACDP Subprojects.*** It is also critical to understand that NEMA has a monitoring and compliance team and Environmental Inspectors under NEMA's Department of Monitoring and Compliance, who are expected to ensure compliance with permits, standards, regulations and all approval conditions. Therefore, where MAAIF fails to put in place measures to ensure compliance with national environment laws and regulations, Environmental Inspectors may issue improvement notices and/or commence criminal or civil proceedings against MAAIF as laid out in the National Environment Act Cap 135.

8.1.8 Ministry of Health

In the absence of systematic data collection related to pesticide poisoning (accidental or intentional), it is difficult to understand and tackle the problem. The Ministry of Health is expected to keep records on pesticide poisoning and accidents. The Ministry needs to be supported for the collection and keeping of accurate statistics on these events. The district hospitals and Health Centers in the cluster districts will set up databases on incidence of pesticide poisoning, effect of pesticides on human health and environmental contamination. Currently, the data on pesticide poisoning and accidents resulting from pesticides use or disposal is fragmented and still remains in the various newspapers that have reported such cases, and various hospital cases. There is the need to create awareness raising actions that will target the different pesticide users in order to avoid accidents and incidents. ***Under the ACDP, the Department of Environmental Health in the Ministry of Health will be supported to collect and keep accurate statistics on pesticide poisonings events. In addition, it will create awareness raising actions that will target the different pesticide users in order to avoid such accidents and incidents.***

8.1.9 Agricultural Chemicals Control Board (ACB)

8.1.9.1 Roles and Responsibilities

This is a statutory body established under the Agricultural Chemical Control Act 2006 and charged with overseeing, deciding or advising the Minster on the registration and control of agricultural chemicals and exercising responsibility for all policy matters affecting agricultural chemicals However, the bulk of the enforcement, monitoring and technical capacity infrastructure rests in the hands of the staff in the directorates for crop and in particular department of crop inspection and certification. Apart from the ACB, the other agencies are likely to play enforcement and monitoring roles for chemicals use. However, the bulk of the technical capacity infrastructure rests in the hands of the ACB and staff in the directorates for crop and livestock protection. This body regulates: (i) herbicides; (ii) pesticides; (iii) fungicides; (iv) fertilizers; (v) insecticides; (vi) plant growth regulators; (vii) seed treatment chemicals; (viii) bio pesticides; (ix) chemicals for wood industry (petroleum and wood treatment); and (x) vector control-the Board also handles chemicals for the control of epidemic pests and diseases. The Agricultural Chemicals Board also gives permits to suitable and approved importers of agrochemicals. The Board also maintains a statistical database of these chemicals. The responsibilities of the Agricultural Chemicals Board include:

- Registration and regulations of use of agricultural chemicals.
- Regulations of quality, importation and distribution.
- Licensing.
- Advisory role to MAAIF.

The responsibilities of the Agricultural Chemicals Board under the ACDP will include:

- ***Registration of new pesticides required under the project.***
- ***Licensing on new pesticides suppliers***
- ***Development of the project specific IPM Pesticides List***
- ***Work with MAAIF inspectors to enforce the pertinent laws***

8.1.9.2 Capacity of ACB

MAAIF has a low laboratory staff capacity with only one or two fully qualified staff and no laboratory equipment for assessing pesticides chemicals. In addition, the ACB is unable to regularly sit to assess the chemicals imported in the country and make decisions; and there are no regular field inspections and surveillance due to a limited budget. ***The ACDP will set aside resources for laboratory and technical capacity enhancement for the key stakeholders and a plan to harmonize activities and share resources where capacity is higher. Also, this Plan has highlighted the need to train key staff at ACB.***

8.1.10 The Uganda Revenue Authority (URA)

The Customs Department is one of the departments under the Uganda Revenue Authority which was found to be relevant to pesticides through its mandate. Section 9 of the External Trade Act gives powers to customs officers to refuse to allow:(i) the import of any import restricted goods or any goods the import of which has been limited until an import license is produced and he or she is satisfied that the import of goods in question in no way contravenes any of the conditions of the license; (ii) the export of any export restricted goods or any goods the export of which has been limited until an export license is produced to him or her and he or she is satisfied that the export of the goods in no way contravenes any of the conditions of the license; and (iii) the import or export of any goods whose import or export has been prohibited or if under such provisions the import or export of goods has been made subject to any conditions until he or she is satisfied that the conditions have been fulfilled. ***URA will have to ensure that the all applicable taxes are remitted to Government of Uganda.***

8.1.11 Uganda National Bureau of Standards (UNBS)

The UNBS is mandated to develop and promote standardization; quality assurance; laboratory testing; and metrology to enhance the competitiveness of local industry and to strengthen Uganda's economy and promote quality, safety and fair trade. UNBS also ensures quality imports through implementation of the Import Inspection and Clearance Regulations 2002 by carrying out inspection of imports to:

- Safeguard the health and safety of the consumers and the environment against imported substandard, shoddy and hazardous products;
- Safeguard our industries from cheap counterfeit imports that can be a threat to our infant industries;
- Ensure that Uganda's hard-earned foreign exchange is not wasted on shoddy, substandard and sometimes dangerous products, which may not only further impoverish the people but also cause ill health sometimes resulting in death.

UNBS will work hand in hand with ACB, NDA, URA and MAAIF to address issues of pesticides quality.

8.1.12 Government Analytical Laboratory (GAL) and other Laboratories

8.1.12.1 Role of Laboratories

Currently, the main functions of Government Analytical Laboratory can be broadly categorized as follows:

- Provision of Forensic science services as back up in assuring national internal security, trans-boundary activities, law and order to all interested parties;
- Statutory testing for enforcement of public health, environmental standards and regulations;
- Advisory and investigative services, important in assuring national internal security, trans-border activities, business competitiveness, health and environmental protection.

This Pesticide Residue Laboratory (PRL) was set up under the GAL by the Government of Uganda as a result of fish poisoning saga in 1997. It was a requirement by the European Union for any fish exporting country to establish and build capacity for a pesticide residue laboratory. PRL is mandated to analyze pesticide residues in water, food and environmental samples for both local consumption and export. It further undertakes the examination of residues of agricultural and veterinary drugs in food and food animals that are of health and public concern. For instance, during fish poisoning as indicated above, the laboratory carried out analysis on the fish samples from the market and identified the poison as endosulfan. Environmental analysis for pollution monitoring purposes will be performed by the laboratories. The following will be tested:

- Groundwater to check for contamination
- Pesticide residues in food
- Soil contamination

Under the ACDP, the Government Chemist in the Ministry of Internal Affairs (MIA) will play a role in enforcement to verify via analysis the content of products sold to the public and to control adulteration. In addition, GAL and other laboratories will be useful in testing of samples to monitor pesticide contamination and food safety issues.

8.1.12.2 Testing Capacity of Laboratories

There are many qualified well-trained personnel in different institutions widely spread in many parts of the country although most equipped laboratories are located in and around Kampala the capital city. In general, Makerere University and the Government Chemist have partial capacity for conducting formulation and residue analysis. This potential needs to be developed further if aspects of pesticide pollution and residues are to be addressed appropriately. Makerere University will be supported in developing this analytical capacity, and will used for training, and collaboration of research on pesticide quality, and monitoring of residues in the environment.

Government Agencies	**Capacity**
Government Analytical Laboratory (GAL)	• Has capacity (equipment and competent personnel) to test for pesticide contamination.
NEMA Laboratory	• No capacity (limited competent personnel and no required equipment) to analyze pesticide contamination.
Department of Chemistry - MUK	• The department of Chemistry can also analyze pesticide contamination and residues in soils, water and agricultural produce.
Department of Soil Science -	• Department of Soil Science has capacity to analyze pesticide

MUK	contamination and residues.
The Institute of Public Health - MUK	• Institute of Public Health has capacity for research still in infancy at the other universities.
DWR Lab in Entebbe	• No capacity for pesticides; existing equipment can only test for heavy metals and other organics.
Kawanda National Research Laboratory	• No equipment specifically for pesticide residue analysis but competent personnel in place.
Chemiphar (U) Ltd	• Chemiphar is an accredited laboratory and equipped with the recommended type of equipment that can be used for monitoring of pesticides in the environment and food.

8.1.13 Uganda Coffee Development Authority (UCDA)

The UCDA was established by the Uganda Coffee Development Authority Act, 1991under the Ministry of Agriculture Animal Industry and Fisheries to be the apex body for promoting, overseeing and regulating the coffee sub-sector, including, control of quality and safety. The Coffee Regulations of 1994 support the Act. ***UCDA will work together with MAAIF and NARO to ensure that extension services specifically for coffee are adequate and also to promote research as well as distribution of resistant varieties.***

Capacity **–** UCDA currently has limited capacity of 28 Extension Workers to manage the entire country.

8.1.14 District Local Government

The district technical teams ordinarily consist of the District Production Coordinator (who provides oversight of the work of the NAADS District Coordinator), the District NAADS Coordinator, the District Agricultural Officer, the District Fisheries Officer, the District Planner, the Internal Auditor, the District Information Officer, and the District Community Development Officer among others. The Production Department typically has a number of divisions: Entomology, Crops, Livestock, Commerce, Fisheries and, in some cases, Forestry. Actual implementation of a large proportion of project activities will take place at district level and will fall under the responsibility of local governments. In order for surveillance and monitoring of plantation activities to be effective, the overall monitoring work needs to be broken down into smaller management units i.e. unit, block, sub cluster, cluster etc. The Leader of each unit, block, sub-cluster and cluster will be responsible for the surveillance and monitoring of their area with regards to pests management and pesticide use chain.

Surveillance will be initiated by MAAIF, NAADS, UCDA, Local Government, Political leadership in addition to farmer to farmer surveillance. The surveillance will involve visits to smallholder farmers' homes to train them on pest and diseases control, printing and disseminating information materials (posters, brochures), running jingles and spot messages and phone-in programmes on local radio. District initiated pest and disease control will be under the District NAADS office and the District Agricultural Officer who will conduct the training of farmers on pests and disease identification. The advantage of this approach is that they will be able to reach farmers at the grass root which will have a far reaching impact. Political leadership of the respective Districts especially the LC 5 Chairpersons will have to initiate surveillance by mobilizing the people at a venue, and inviting the MAAIF, NAADS, and NARO staff to address them.

In order for surveillance and monitoring of plantation activities to be effective, the overall monitoring work needs to be broken down into smaller management units i.e. unit, block, sub

cluster, cluster etc. The Leader of each unit, block, sub-cluster and cluster will be responsible for the surveillance and monitoring of their area with regards to pesticide use chain.

Capacity – A significant part of the project will be carried out at district level. Most districts have District Agricultural Officers but inadequate extension staff. Local Governments already carry out projects and programs, in line with the decentralized nature of government in Uganda. However, they are often not properly briefed, trained nor properly funded. As the first step in the project preparation and implementation, a series of training workshops/sessions will be held in the respective clusters, bringing together the key government senior staff, as well as the key stakeholder representatives. To the degree possible awareness raising and sensitisation at district and cluster level should be carried out prior to project start. However, the district staff will work together with the NAADS team to implement the project.

8.1.15 Uganda National Agro-Input Dealers Association (UNADA)

The Aims and Objectives of UNADA are as below:

a) To represent all agro-input dealers in the country, and act as a negotiating body that speaks with one voice to support the interests of all members.
b) To provide professional support and networking among agro-input dealers, encourage and support the business development of individual members, and promote the exchange of ideas and skills in order to improve services to farmers.
c) To establish and enforce a code of fair business conduct for members and keep members informed of the legal codes regulating the industry.
d) To actively contribute to the modernization of Uganda's agriculture, and participate in projects aimed at bringing development to the agricultural sector.

As a pre-requisite before registration, a dealer must attend, pass examination and obtain a certificate on safe use and handling of pesticide. The training is done on behalf of ACB by Makerere University (Crop Science Department). UNADA only mobilizes their members to be trained. ***Under ACDP, funding will be provided to strengthen MAAIF to work with UNADA to address the issue of fake and adulterated pesticides as well as to train more UNADA members in safe agrochemical use.***

8.1.16 National Organic Agricultural Movement of Uganda (NOGAMU)

The NOGAMU started in 2001 as a result of demand by all stakeholders to have a national umbrella body in organic agriculture. It comprises producers, processors, exporters, trainers and other stakeholders. It markets and promotes local and export organic products; trains and coordinates research and extension; undertakes development of standards and promotion of application of organic standards; and carries out lobbying and advocacy on organic agriculture. NOGAMU is a member of the International Forum for Organic Agriculture Movement (IFOAM). It has already developed the Uganda Organic Standard with the guidance and participation of UNBS and is coordinating with the East African Community through the East African Bureau of Standards to formulate the East African Organic Standards. ***NOGAMU will collaborate with MAAIF to advise farmers on how to reduce reliance on pesticide use under the ACDP.***

8.1.17 Role of NGOs

The role and commitment of NGOs is significant in all the stages of the pesticides life-cycle right from the importation, use to waste disposal. NGOs will be fully recognized and brought on board as serious partners in all efforts to ensure safe use of pesticides. In terms of capacity, NGOs in Uganda

lack the financial and technical resources required to adequately manage pesticides and related issues. Therefore, there is need for a concerted effort to develop their capacity and other interested players to undertake public awareness on the hazards associated with pesticides and how to safely handle them. ***Under the ACDP, the NGOs working with farmers will:***

- Raise awareness among the smallholder farmers about the dangers of pesticide use;
- Work with extension staff to teach farmers about safe pesticide use and storage;
- Work with farmers to develop community monitoring of the use and impacts of pesticides in order to alert the authorities as to the health and environmental impacts of pesticide use;
- Empower the smallholders through training and other support to engage with the local government to address their concerns on pesticides use;

8.2 Key Challenges in Pests Management and Pesticides Monitoring

8.2.1 Overall Constraints

Like many developing countries, at present, Uganda has insufficient enabling legislation and resources allocated to carry out:

- Surveillance and monitoring
- Border control and inspections
- Expertise in risk assessment
- Diagnostic tools for early detections
- Expertise in diagnosis (taxonomy)
- Data collection and access to information
- Tools for rapid response to entry, establishment and spread

8.2.2 Limited Capacity and Funds to conduct Research

The responsibility for safeguarding plants against invasive pathogens is held officially by MAAIF. In addition to its regulatory functions, MAAIF conducts pathogen surveillance and pest risk analyses. The quality of plant disease diagnostic services depends on the availability and quality of human capital, infrastructure, and technology. Although all three are not necessary for many routine diagnoses in which symptoms or signs are obvious, at least one must be of high quality to solve all but the simplest diagnostic problems (Miller et al. 2009). However, unlike human and veterinary medicine, trained practitioners in plant pathology are a relatively rare commodity, and clinicians with appropriate training and access to necessary infrastructure and technology to diagnose the broad range of pathogens afflicting plants are particularly scarce (Miller et al. 2009). The country currently has very few specialists to conduct research to address the existing challenges posed by crop pests and diseases and there is therefore need to build capacity of people capable of conducting quality agricultural research.

The above was proved by the Coffee Wilt Disease that demonstrated its ability to spread fast. The disease killed all the affected trees and the control of the disease was frustrated by lack of information on all aspects of the disease including epidemiology, environmental and cultural conditions favouring epidemics. Long-term solutions to the disease depended on generation of new information and technologies on the disease. It was with this intention that research activity to generate the needed information was initiated in 1997.

Prof. Samuel Kyamanywa of Makerere University College of Agriculture estimates that there are only about 6-7 Agricultural Entomologists at PhD level (2 Entomologists and 1 Nematologist at MUK) in the whole country. He points out that the key priority areas in regard to pest management and research include entomology, plant pathologists and weed scientists among others. The same issue was echoed by Dr. Mark Erbaugh of the IPM CRSP who points out that based on experience from a number of IPM studies in Uganda under the CRSP, weeds has been mentioned by smallholder farmers as a big production constraint to farmers yet the country has 1 or no weed scientists.

According to Mrs. Atwine Esther, the District Agriculture Officer of Ntungamo District, there is no laboratory for crops but there is a mobile plant clinic operated by the district. The clinic operates in the weekly markets (auctions). The clinic comprises of a plant pathologist and 2 assistants. Farmers who come to the markets carry samples of diseased plant parts to the pathologist who in turn identified the disease and also recommends the appropriate intervention. The clinic is a very effective way of advising farmers on diseases control and management but it also has its own challenges. There are only 3 trained pathologists, and yet many markets operate on the same days, hence the clinic cannot be in all markets at the same time. This indeed echoes the issue of limited number of experts in the country! They all don't have a vehicle to carry their equipment (Tent, chair, seats, microscope etc.). Hence their movement is limited to only those nearby markets.

8.2.3 Limited Statistical Capacity

Under the Statistics Act 2008, UBOS is to lead and coordinate all data collection activities in the country and is involved, therefore, in Food and Agricultural Statistics (FAS) data collection and oversight. To improve the production of agricultural statistics in the country UBOS has among other initiatives included an agricultural module as a core element of the Uganda National Household Survey (UNHS) programme. Also, it is now launching the Uganda National Panel Survey (UNPS) programme with a strong agricultural component and also created an Agricultural Statistics Section within the Directorate of Business and Industry Statistics.

While UBOS is the coordinating agency for statistical activities in Uganda, MAAIF is also an important stakeholder in all agricultural statistics activities. The main source of FAS data in MAAIF is the Statistics Unit under the Monitoring and Evaluation Section within the Department of Agricultural Planning. ***The statistical capacity within MAAIF has not been developed to the required degree. There are other ministries, agencies, and institutions that also collect statistics pertinent to agriculture. These agencies also do not have sufficient financial and human resources for effective data collection and analysis.***

8.2.4 Lack of Resources for Effective Monitoring

Uganda has significant national regulation in place and international regulation to which it is a signatory to ensure the safe use of pesticides. However, the legislation is not being implemented adequately largely due to the insufficient allocation of resources. There is limited budget for chemicals management in most government ministries/agencies. Most Line Ministries have restricted themselves to policy issues without, putting in place adequate structures to monitor and implement the policies they put in place. In some ministries/sectors where the technical staff is available, there is inadequate funding; weak policies; lack of a pesticides inventory (pesticide inventory is available) and lack of equipment which has led to poor service delivery. The capacity for regulation has not kept pace with the liberalization of the pesticides market. The inability of governments to enforce existing legislation can create major pesticide-related risks. These include risks associated with uncontrolled importation (importation is controlled through the issuance of

import permit and inspection at border point before customs clearance) and misuse of hazardous pesticides, a lack of information and training among suppliers and users, dangers due to improper disposal of containers, and lack of awareness about pesticide residues on crops.

8.2.5 Limited Extension Services

Extension is carried out by a wide range of institutions and local entities. The traditional extension service under MAAIF in Entebbe was decentralized. Farmers mostly depend upon their neighbors or agricultural suppliers for advice and technical assistance. There is no national compilation of recommended production practices and the many sources of advice (chemical companies/stockists, agricultural extension service, various NGOs, private plantations and estates, and various projects) result in inconsistent messages confusing farmers. According to Dr. Mark Erbaugh, the Coordinator of the IPM CRSP in East Africa, the smallholder farmers have been ignored for a longtime and don't know what to do. He stresses that there is need for MAAIF or Government to show interest in what they (farmers) do. He adds that the farmers need to be trained to build their confidence. There is need to demonstrate to them and to make them participate. This can be done through village schools that can be run by extension staff to teach the farmers.

The NAADS program has overall improved upon extension services. In practice, however, implementation, supervision and monitoring of NAADS are limited, due partly to limited funds. In addition, poor coordination and lack of harmonization of programs in the study areas is a big challenge, leading to duplication and escalating the dependency syndrome among communities (UNDP, 2013). Overall, the research-extension-farmer links remain weak (UNDP, 2013). Despite the fact that the NAADS program has had a commendable impact on participants' access to extension services, the quality of extension services is still a major challenge due to the large pool of unqualified ASPs, the limited attention that agricultural services providers (ASPs) give farmers and the theoretical nature of their training. This is perhaps the main reason for the program's limited impact on increasing the technology adoption, productivity and output commercialization of its beneficiaries (Okoboi et al. 2013).

Due to limited extension by MAAIF, the various commodity organizations such as UCDA and Cotton Development Organization (CDO) hire their own extension workers, as do Agro-chemical companies among others. UCDA has a production department and has divided up the country into 5 regions (Central, Eastern, Western, South-Western and Northern) with each headed by a Principal Agricultural Officer. Each region has a number of Regional Coffee Extension Officers in the field that interact with farmers, carry out sensitizations and training and also gather information on coffee pests and diseases as needed by UCDA. In total, UCDA has only 28 Extension Officers for the whole country! According to Mr. Sekamatte Stephen, the DAO of Kiryandongo District, the ratio of extension workers to farmers in the district is 1:1000. There are 7 NAADS extension workers (Crop), 1 DAO and 1 Animal Officer. Lack of transport is the biggest challenge face by the extension workers in Kiryandongo. According to Mr. Ojok George Johnson, the NAADS Coordinator, Apac District, there are 11 sub counties in the district and 33 NAADs extension workers. Only 11 of these have means of transport (Motorcycle). According to Mrs. Atwine Esther, the District Agriculture Officer of Ntungamo District, the biggest challenges include inadequate facilitation to the extension workers in terms of allowances, transport and field kits, especially for disease control and monitoring.

Government extension services which can provide vital training and advice on pesticides to farmers are still inadequate to reach farmers regularly. Very little of the extension officers' time is spent on pesticides, even though the majority of the smallholder farmers use pesticides. According to a

survey by Erbaugh et al. (2003) in the Districts of Kumi and Iganga, the most important source for information on pesticide usage was extension agents. The increase in pesticide imports has been accompanied by an increase in the number of private importing companies. A major problem with unlicensed dealers is that they are unlikely to have the requisite knowledge to correctly inform farmers what the appropriate pesticides to use are and how to use them safely.

8.2.6 Overall Capacity for Specific Risks

Below is a summary of overall capacity of Uganda to handle the different pesticide risks

Nature of Problem	Scale of Problem	Level of Concern	Ability to control problem
Public health	Local	High	Low
Drinking water contamination	Local and national	High	Low
Air Pollution	Local	Low	Low
Pollution of Inland Waterways	National	Medium	Low
Pesticide residues in food	National and Regional	Medium	Low
Occupational Health agricultural	Local	High	Low
Ground water pollution	Local	Medium	Low
Storage/Disposal of expired pesticides	National	High	Low
Soil contamination	Local	Medium	Low
Unknown pesticide importation	National	Medium	Medium
Pesticide accidents transport	Local and national	Medium	Medium

8.3 Training Needs and Strategy

8.3.1 Overview

Farmers should have the capacity to accurately identify and diagnose pests and pest problems, understand trophic relationships that underpin biological control opportunities, and use such knowledge to guide pesticide and other kinds of interventions. Through the participatory approaches, the Project will build local capacity to ensure rapid spread and adoption of ecologically sound and environmentally friendly management practices among the smallholder farmers. They will learn cultural, biological and ecological processes underpinning IPM options, and use the newly acquired knowledge to choose compatible methods to reduce losses in production and post-harvest storage.

Training will be provided to targeted farmers organizations and retailers within the project area through a training of trainers (ToT) scheme. Development and implementation of ToT courses will be outsourced through competitive bidding processes with MAAIF providing technical backstopping and securing transparency and compliance with procurement procedures. Component 1 is complementary with ATAAS and EAAPP and requires consultation with NAADS and NARO on programming and implementation of activities, in particular those at district level. Most activities of Component 1 at district level will be implemented by NAADS, which will be represented in the DCT.

8.3.2 Strategies and Steps

8.3.2.1 Needs Assessment

Before training begins, a training needs assessment survey will be undertaken for each crop both to learn what technologies farmers already know but more importantly what technologies farmers

should but don't know. Training activities will then be focused on the key concepts that farmers should know. This will reduce the training load and will make the training more interesting to the farmers. At the same time before each training activity, a short quiz will be given on questions relating to the main extension messages of existing demonstrations at the time.

8.3.2.2 Farmer Field Schools

Training farmers in integrated pest management will be through use of farmer field school (FFS) types of participatory learning and research programs, jointly with farmers, extension workers, and researchers. The FFS approach will involve a growing season-long informal learning experience in the farmers' own fields. The farmers will be trained on how to apply integrated pest management concepts in practice, to give them an understanding of basic diagnostics, biology of crop and agro-ecosystems, and an introduction to alternatives to synthetic chemicals. Emphasis will be made on reducing the need for pesticides by being able to recognize and distinguish pests and their natural enemies; practicing cultural control (e.g., crop rotation, correct planting dates); cover crops; and agro-ecosystem diversity, and monitoring and decision criteria. Each IPM training programme will be adapted to the particular crop and local growing situation. This means that Extension Workers have to go into a field to teach the farmers how to grow a healthy crop and how to protect it from pests, diseases and weeds by non-chemical means.

8.3.2.3 Evaluations

After the extension activities, a quiz will be given to measure understanding. This will tell if they understood the information. After each season, small adoption surveys will be carried out with a small sample of 30 or so farmers and extension workers to measure adoption rates. This will be another measure of the benefit of the extension activity. In general, more adoption is expected to follow demonstrations where farmers are not lectured to but follow exercises where they take observations in the field and then discuss the implications of those observations and draw conclusions. One activity would be for farmers to assess the pest populations in the field and then make decisions themselves on whether and what corrective measure to undertake.

8.3.2.4 Multiplication of Knowledge

Trained farmers and leaders of farmers' associations will be expected to promote secondary adoption of proven options. For example, leaders of farmers' associations trained will be expected to assist in training new farmers through demonstrations and farm visits. Additionally, the trained farmers will organize field days to train other farmers and explain new/improved IPM practices they have learnt. Field day participants will include representatives of the PIU, local community leaders, NGOs, local community FM stations, researcher institutes, and national extension services.

8.3.2.5 Training Content

Training and education will emphasize the use of alternative (non-chemical) tactics in an IPM approach but will be designed to accommodate the needs and requirements of the differing strata of users, including crop protection specialists, extension staff, applicators, field workers etc. in order to ensure flow of information from the specialists to the farmers.

8.3.2.5.1 Training for Trainers of Trainers

Target Audience: Field officers of ACDP, District Agriculture Officers designated as subject matter specialists in crop protection.

Justification: The ACDP will be implemented by field officers recruited by the project who will be responsible for various production activities, including use of pesticides. In the process of

implementing various development projects, field officers act as extension agents as they come in contact with the farmers. There is, therefore, a need to equip the field officers with sound information on pest management strategies and safer pesticide use. They will in-turn train assistant field extension officers. The assistant field officers will then be responsible for training farmers at the grassroots level.

Course content – The course would consist of two main parts: (I) Principles of Pest Management and (II) Pesticide Management. The Principles of Pest Management course will emphasize pest management decision tools (including concepts of sampling and pest monitoring), ecological/cultural management, biological control, host plant resistance, genetic control, and a theoretical approach to integrated pest management, differentiating between IPM approaches for resource-poor farmers and resource-rich farmers. The Pesticide Management Course will emphasize various types of pesticides, pesticide formulations, active ingredients, pesticide application, calibration of sprayers, calculation of application rates, pesticide fate and toxicology, safety in pesticide handling, impact of pesticides on the environment, non-target organisms, and human beings, pesticides as part of integrated pest management, and pesticide regulations.

8.3.2.5.2 **Resource persons** – This course is for a high-caliber audience, aimed at imparting both theoretical and practical skills to prospective trainers. It is therefore recommended that at least one consultant, who is an expert in pesticide use, be involved in the training. The course should be hosted by Makerere University or other agricultural institute that has the resource persons and facilities to mount the course.

8.3.2.5.3 Extension Agents

Target group – Assistant agricultural field extension officers

Justification – There is need for training of public sector extension agents to become better at providing objective and research-based knowledge of crop production and protection practices and strategies, including non-chemical alternatives. Field extension agents at sub-parish levels are concerned with advising farmers on all aspects of agricultural production, including pest management. Consequently, if field extension officers are to effectively advise on judicious use of pesticides, they need to be well-equipped with sound information on pesticides use and pest management systems. All Extension Staff will be trained in integrated pest management and safer pesticide use who will in turn train the farmers and those directly below them.

Recommended Course Content

According to Dr. Mark Erbaugh, extension workers need training in areas of pest and disease identification, IPM and alternatives to pesticide use as well as in-service training i.e. new areas of science to help them do their job. The following is recommended:

- General introduction to causes of pest problems,
- Introduction to use of participatory methods in understanding pest problems.
- Introduction to insect pest sampling/monitoring and use of action thresholds.
- Overview on use of cultural, biological, host plant resistance methods in control of crop pests.
- Introduction to elements of pesticide control tactics
- Impact of pesticides on the environment and

- Integrating pesticides in an IPM program.

Resource Person - This course is for a high-caliber audience, aimed at imparting both theoretical and practical skills to prospective trainers. It is therefore recommended that at least one consultant, who is an expert in pesticide use, be involved in the training. The courses will be conducted at District farm institutes, and organized by the subject matter specialist in collaboration with project officers.

8.3.3 Pesticides Use Training

8.3.3.1 Need for Training

It is one thing to have pesticide regulations in place, and another to have them adhered to. The only way of raising the population's awareness of problems associated with pesticides, and how those problems can be avoided, is through continuous training. Training for "safer pesticide use" is a common approach to mitigating the potential negative health and environmental impacts of pesticides. This conventional approach will promote reducing health risks of pesticides by safer use of the products through training, use of protective equipment and technology improvements, as well seeking to reduce pesticide hazards via regulations and enforcement.

8.3.3.2 Training Aspects and Levels

There is therefore great need for capacity building and human resource training in almost all areas of pesticides management. However, the key training needs that have been identified among others include the following with respect to pesticides management: storage; disposal as well as safe use and handling of pesticides. Not all workers need the same level of training since the intensity and length of exposure varies with different types of jobs. All individuals who may come in contact with pesticides as part of their work should receive a certain basic level of training, increasing in direct proportion to the exposure use level. Certainly there is much useful information available, but until it is transmitted to the users, it is of little value.

8.3.3.3 Training of Trainers in Safer Pesticide Management

In the process of implementing various development projects, field officers act as extension agents as they come in contact with the farmers. There is, therefore, a need to equip the field officers with sound information on safer pesticide use. One of the most common problems with pesticide use is over-dosing, with farmers failing to mix the correct amounts of pesticide and water. This can cause damage to the crop and the environment, and increases the risk to human health, both for farmers and consumers. It is also a waste of money. Safe and appropriate use of pesticides requires the farmer to have a good understanding of the pest problem. For example, what kind of insect pest is present, what level of damage is it doing, and how is that damage likely to worsen if left untreated?
All NAADS Extension Staff will be trained in safer pesticide use who will in turn train District Model Farmers and those directly below them.

The Pesticide Management Course will emphasize various types of pesticides, pesticide formulations, active ingredients, pesticide application, calibration of sprayers, calculation of application rates, pesticide fate and toxicology, safety in pesticide handling, impact of pesticides on the environment, non-target organisms, and human beings, pesticides as part of integrated pest management, and pesticide regulations.

Resource Person - This course is for a high-caliber audience, aimed at imparting both theoretical and practical skills to prospective trainers. It is therefore recommended that at least one consultant, who is an expert in pesticide use, be involved in the training.

8.3.3.4 Pesticide management training of pesticide dealers

Recommended Course Content - The target group is mainly business persons, whose main interest is making money. Consequently, this group has minimal interest in theoretical background and needs to be introduced to the practical aspects of pesticide management. Therefore, the course recommended here include types of pesticides, pesticide formulations, toxicity classification, types of pesticide labels, concentration mixing, fate of pesticides in the environment, safer use of pesticides (including selection, handling, application, storage, and protective clothing), and combining pesticides with non-pesticide methods.

8.3.3.5 Booklet/Manual on Safe Pesticide Use

In addition to the above training, a well illustrated booklet designed for self learning will be developed and distributed to stockists and their staff. The booklet will contain information on how to read pesticide labels as well as general information about safe pesticide use and first aid practices. In addition, MAAIF will assemble the recommended pest control practices in summary form for major crops that will also be very useful to stockists when advising farmers. This same booklet will also be used by extension workers.

8.3.4 Training Responsibilities

The PIU at MAAIF with input from NAADS, UCDA and NARO and other interested stakeholders will standardize training needs assessment across the clusters and organize appropriate workshops to develop more detailed learning modules. The Crop Protection Department with input from the NAADS, will liaise with appropriate farmers' associations to:

- plan training implementation
- provide technical support such as in preparing and delivering specific training materials and evaluating resource materials,
- identify and select suitable local training resource persons and materials, and
- Prepare training progress reports.

The respective District Agricultural Officers will collaborate with farmers' associations to:

- identify and organize farmers groups for training (i.e. use of farmer field school to teach farmers on the efficient and responsible use of pesticides),
- prepare, organize and supervise training implementation plan,
- verify reports of persisting pest problems and farmers training needs,
- monitor performance of farmer trainers and post-training assignments, and
- Prepare training progress reports.

Farmers/local communities as the principal beneficiaries will be organized into farmer groups for training and adoption of IPM practices. The farmers will be facilitated to set up Community IPM Action Committees to coordinate IPM activities in their areas.

9 MONITORING AND REPORTING OF PMP

There will be regular monitoring and evaluation of control programs to determine the level of progress being made with regard to pest management and control issues identified in the PMP. The following performance indicators will be incorporated into a participatory monitoring and evaluation plan.

9.1 Monitoring Indicators

9.1.1 Indicators for Training and awareness creation

- Types and number of participatory training modules (PTM) delivered;
- Category and number of extension agents and farmers trained and reached with each PTM;
- Category and number of participants reached beyond baseline figures;
- Practical skills/techniques most frequently demanded by extension agents and farmers; and
- Crop management practices preferred by farmers.

9.1.2 Indicators for Technology acceptance/field application

- Category and number of farmers who correctly apply the skills they have learnt;
- New management practices adopted most by farmers;
- Category and number of other farmers trained by project trained farmers;
- Types of farmer-innovations implemented;
- Level of pest damage and losses;
- Rate of adoption of IPM practices;
- Impact of the adoption of IPM on production performance of farmers

9.1.3 Indicators for impact of IPM

- Increase in crop production;
- Increase in farm revenue;
- Low incidence of pests and diseases
- Social benefits: e.g., improvement in the health status of farmers;
- Level of reduction of pesticide purchase and use; and
- Number of project co families using preventive mechanisms against diseases.

9.2 Reporting

An annual report on the progress of pest and pesticide management in the clusters will be prepared. The report will indicate the pest cases identified and treated using IPM approaches, location of pests, level of success of treatment, the amount and type of herbicide/pesticide used, level of cooperation from farmers and other relevant information (e.g. training programmes organized, farmer field schools held etc.).

9.3 Management Reviews

The project management will undertake annual pest and pesticide control and management reviews to confirm the implementation of the various control measures or programmes or actions outlined in the IPM. Recommendations from the reviews will help MAAIF to refocus and plan effectively towards achieving planned targets. The management review team will include the World Bank Country Specialists, NAADS, and MAAIF Crop Protection Department.

Table 2: Pest Management and Monitoring Plan

Potential Impacts and Risks	Mitigation Measures	Implementation tool	Expected result	Monitoring indicators	Responsibility
Threat from other crop pests and diseases	Educate and train farmers to adopt good agricultural practices (GAP)	Adoption of IPM techniques/ approaches	Farmers trained in IPM techniques and GAP	1. Number of farmers trained, Training records 2. Incidence of crop pests 3. Production losses from crop pests	UCDA, NAADS, MAAIF
	Apply ACB approved or recommended pesticide if necessary	Inspection of pesticides at farm/storage gate prior to use (Project Policy)	Applied pesticides registered and approved by key stakeholders and in conformity with IPM principles	Records of pesticides applied at each farm	UCDA, MAAIF, NAADS
Impact on post harvest losses due to pests	1. Provide adequate and proper storage facilities	Post-harvest loss reduction plan based on IPM techniques in place	a.) Post harvest losses avoided or minimized b) Applied pesticides registered and approved by key stakeholders and in conformity with IPM principles	Number of farmers trained in IPM techniques for post harvest storage; Number and condition of storage facilities in use	MAAIF, NAADS, UCDA
	2. Monitor incidence of post harvest pests			Number of cases of post harvest pests	UCDA, NAADS, MAAIF
	3. Confirm status and integrity of pesticides at storage gate prior to use	Inspection of pesticides at farm/storage gate prior to use (Project Policy)		Records of pesticides applied at storage sites/ rooms	NAADS, MAAIF

Table 3: Pesticides Management and Monitoring Plan

Potential Impacts and Risks	Mitigation Measures	Implementation tool	Expected result	Monitoring indicators	Responsibility
Improper use of pesticides by farmers and extension staff	Educate farmers and extension staff on proper use of pesticides and pesticide use hazards	Pesticide hazards and use guide manual or leaflet for the project (include simple pictorial presentations)	Proper use of pesticides by farmers and farm assistants	Number of cases of pesticide poisoning occurring under the project	MAAIF, NAADS
	Control and supervise pesticide use on farms	Adoption of IPM approaches/ techniques	Farmers trained in IPM techniques	Number of farmers trained, Training records	MAAIF, NAADS
	Monitor pesticide residue in crops	Random sampling procedure for crops and storage products	Pesticide residue in crops within acceptable limit/MRL	1. Levels and trend of pesticide residue in sampled crops 2. Number of times exported crops are rejected due to pesticide residues	MAAIF
Pollution of water resources and aquatic life	Control and supervise pesticide use by farmers	Adoption of IPM approaches/ techniques	Farmers trained in IPM techniques	Number of farmers trained, Training records	MAAIF
	Proper disposal of pesticide containers by resellers/farmers	Pesticide container collection and disposal plan	Pesticide container disposal plan developed and implemented	1. Number of farmers/ resellers aware of pesticide container disposal plan 2. Number of containers collected	MAAIF
	Monitor pesticides in water resources	Environmental quality monitoring plan (linkage with Project ESMP)	Pesticide concentration in water resources (boreholes, streams etc.)	Levels of pesticides in water resources	NEMA, GAL, MAAIF
Abuses in pesticide supply and sales	Identify all pesticide distributors and resellers interested in providing services and products to farmers under the Project	Registration policy for all interested distributors and resellers under project	Only approved and licensed dealers and resellers supply pesticides under project	a) Company registration documents b) Evidence of license/permit to operate in pesticides c) Evidence of location and contacts of suppliers/resellers	ACB, UNBS, MAAIF, NAADS
	Confirm status and	a.) All pesticides are to be in	a) Only approved and	a) List of pesticides supplied	

	integrity of pesticides supplied under project Ban big pesticide containers to minimize decanting cases	the original well labeled pesticide containers prior to use b.) No decanting of pesticides under this project c) Inspection of pesticides at farm gate prior to use Decanting policy (No decanting of pesticides under project)	registered pesticides used under project b)Banned pesticides avoided c) Fake and expired pesticides avoided d) Integrity of pesticide guaranteed at farm gate level All pesticides delivered for use are in the original containers	and used in line with Agricultural Chemicals Board b) Cases of pesticides found in non-original containers c) Inspection records for pesticides at farm gate prior to use Cases of pesticides found in non-original containers	
Poisoning from improper disposal of pesticide containers	1. Educate farmers, extension staff and local communities on health hazards associated with use of pesticide containers	1. Pesticide hazards and use guide manual or leaflet for the project	Farmers, extension staff, local communities educated on pesticide health hazards	Number of cases of pesticide poisoning through use of pesticide containers; Number of farmers returning empty pesticide containers at collection points; Number of farmers, extension staff, and resellers trained in proper cleaning of pesticide containers	DLG, NAADS, NEMA, MAAIF
	2. Properly dispose pesticide containers	2. Pesticide container cleaning and disposal plan	Pesticide container cleaning and disposal		
General health and safety of farmers/crops and environmental hazards	Educate farmers to adopt Best Practices based upon IPM techniques; and do not use chemical pesticides unless advised by MAAIF	IPM techniques with emphasis on cultural and biological forms of pest control	Compliance with national laws and WB policy on Pest/ pesticide management	Number of farmers trained in IPM techniques; Number of farmers implementing IPM on their farms Frequency of chemical pesticides usage	MAAIF, NAADS

	Provide PPEs to farmers/extension staff for pesticide use in the fields	Health and safety policy for farm work	Farmers and accompanying dependants (children) protected against pesticide exposure in the fields	Quantities and types of PPEs supplied or made available under the project	MAAIF and NAADS
	Educate farmers/ farm assistants in the proper use of pesticides	Pesticide hazards and use guide manual or leaflet for the project (include simple pictorial presentations)	Farmers know and use pesticides properly; pesticide hazards and use guide leaflet or flyers produced	Number of farmers trained in pesticide use; Number of farmers having copies of the pesticide hazard and use guide flyers;	MAAIF and NAADS
	Properly dispose obsolete and unused pesticides	Obsolete and unused pesticide disposal plan	obsolete and unused pesticide disposal plan prepared and implemented	Relationship between pesticide supply and usage	MAAIF, NEMA
	Educate farmers to obtain or purchase quantities of pesticides required at a given time and to avoid long term storage of pesticides	Pesticide use policy/plan	Only pesticides needed are purchased; long term storage of pesticides by farmers avoided	Relationship between pesticide supply and usage	MAAIF, NAADS
	Provide emergency response to pesticide accidents and poisoning	Emergency response plan	Pesticide accidents and emergencies managed under the project	Number of pesticide accidents and emergencies	MAAIF, NAADS, DLG

10 ESTIMATED PMP BUDGET

The Consultant estimates the budget below to implement the PMP during a 5- year period.

Activity/Programme		**Budget, USD**					
		Year 1	Year 2	Year 3	Year 4	Year 5	Total
1.0 Capacity Building							
1.1	Orientation workshops (on PMP, IPM, and for project registered agro-input dealers)	40,000	40,000				80,000
1.2	Training of trainers	40,000	40,000				80,000
1.3	Farmers' groups and extension staff training in IPM	200,000	150,000	150,000	150,000	150,000	800,000
1.4	Capacity building of ACB	40,000	30,000	20,000	20,000	20,000	130,000
Subtotal		320,000	260,000	170,000	170,000	170,000	**1,090,000**
2.0 Support/Advisory services							
2.1	Registration of pesticide suppliers	20,000	20,000				40,000
2.2	IPM Booklets, Guides + other materials (4 million copies)	200,000	150,000	150,000	150,000	150,000	800,000
2.3	Public awareness/sensitization campaigns	150,000	100,000	100,000	100,000	100,000	550,000
2.4	Pest/disease surveillance	60,000	40,000	40,000	40,000	40,000	220,000
2.5	Laboratory analysis support	30,000	20,000	20,000	20,000	20,000	110,000
2.6	Emergency response support	60,000	50,000	50,000	50,000	50,000	260,000
2.7	Collection of agricultural statistics	40,000	25,000	25,000	25,000	25,000	140,000
Subtotal		560,000	405,000	385,000	385,000	385,000	**2,120,000**
3.0 Public Health and Environmental Management							
3.1	Pesticide monitoring in surface water bodies in or around project areas	20,000	20,000	20,000	20,000	20,000	100,000
3.2	Collection of pesticide containers and expired pesticides	50,000	40,000	40,000	40,000	40,000	210,000
3.4	Disposal of expired pesticides and empty containers	100,000	80,000	80,000	80,000	80,000	420,000
3.5	Food safety tests	40,000	20,000	20,000	20,000	20,000	120,000
Subtotal		210,000	160,000	160,000	160,000	160,000	**850,000**
4.0 Project management							
4.1	PMP coordination	100,000	50,000	50,000	50,000	50,000	300,000
4.2	Monitoring and evaluation	60,000	40,000	40,000	40,000	40,000	220,000
4.3	Reviews and reporting	40,000	30,000	30,000	30,000	30,000	160,000
Subtotal		200,000	120,000	120,000	120,000	120,000	**680,000**
GRAND TOTAL/USD							**$4,740,000**

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12 ANNEX

Annex 1: List of Pesticides Registered for Use in Uganda

PERIOD OF REGISTRATION	THE REGISTRATION NUMBER	TRADE NAME/COMMERCIAL NAME	NAME OF THE ACTIVE INGREDIENT(S) AND CONCENTRATION	NAME OF THE REGISTRANT
03/10/2013	Ugc/2013/001040/FuIn/R	PILARSTIN 500SC	Carbendazim 500g/lSC	PILARQUIM SHANGAI Co. LTD
03/10/2013	Ugc/2013/001040/FuIn/R	PILARICH	Chlorothalonil 720g/l	PILARQUIM SHANGAI Co. LTD
03/10/2013	Ugc/2013/001040/FuIn/R	PILAR-2,4-D	2,4-Dimethylamine salt 720g/l	PILARQUIM SHANGAI Co. LTD
03/10/2013	Ugc/2013/001040/FuIn/R	PILARKING	Imidacloprid 20% SL	PILARQUIM SHANGAI Co. LTD
03/10/2013	Ugc/2013/001040/FuIn/R	PILARXIL-MZ	Metalaxyl 8%+Mancozeb 64%	PILARQUIM SHANGAI Co. LTD
03/10/2013	Ugc/2013/001040/FuIn/R	ROVER 72WP	Cymoxanil 8%+Mancozeb 64%	WILLOWOOD LIMITED HONG KONG
03/10/2013	Ugc/2013/001039/In/R	DYNAMO 1.9%EC	Emamectin Benzoate 1.9%WG	WILLOWOOD LIMITED HONG KONG
03/10/2013	Ugc/2013/001038/In/R	RAZOR 70WG	Imidacloprid 70%WG	WILLOWOOD LIMITED HONG KONG
03/10/2013	Ugc/2013/001037/In/R	DICLO 100EC	Dichlorvos 1000g/l EC	WILLOWOOD LIMITED HONG KONG
03/10/2013	Ugc/2013/001036/In/R	CYCHLOR 55%EC	Chlorpyrifos 50%+Cypermethrin	WILLOWOOD LIMITED HONG KONG
23/08/2013	Ugc/2013/001035/In/R	ACTARA 25WG	Thiamethoate 25%WG	SYNGENTA AGRO CROP PROTECTION, BASEL SWITZERLAND
22/08/2013	Ugc/2013/001034/Fu/RRRR	EMTHANE M45	Mancozeb 80WP	SABERO ORGANIC GUJARAT, INDIA
22/08/2013	Ugc/2013/001033/In/RRR	ROCKET 44EC	Profenofos 40%+Cypermethrin4%	PI-INDUSTRIES INDIA
22/08/2013	Ugc/2013/001032/In/RRRR	MALATAF 57EC	Malathion 57%EC	RALLIS INDIA LTD
22/08/2013	Ugc/2013/001031/In/RRRR	CYPERLACER 5EC	Cypermethrin 5%EC	ISAGRO ASIA PUT INDIA
22/08/2013	Ugc/2013/001030/In/RRRR	TAFGOR 40EC	Dimethoate 40%EC	RALLIS INDIA LTD

22/08/2013	Ugc/2013/001029/Fu/RR	TATA MASTER 56	Metalaxyl 100g/Kg+Mancozeb 480g/Kg	RALLIS INDIA LTD
16/08/2013	Ugc/2013/001028/He/RR	LB-2,4-D AMINE	2,4-D Amine 720g/l	HONBOR CHEMICAL Co., CHINA
16/08/2013	Ugc/2013/001027/Fu/RR	LANCOZEB 80WP	Mancozeb 80%WP	HONBOR CHEMICAL Co., CHINA
16/08/2013	Ugc/2013/001026/In/RR	LINEX 48%EC	Chlorpyrifos 480g/l	MODERN INSECTICIDES INDIA
16/08/2013	Ugc/2013/001025/In/RR	LB-DICHLORVOS 100EC	Dichlorvos 1000g/l	MODERN INSECTICIDES INDIA
16/08/2013	Ugc/2013/001024/In/RR	LB-AMBUSH 5%EC	Cypermethrin 5EC	MODERN INSECTICIDES INDIA
16/08/2013	Ugc/2013/001023/He/RRR	NO-WEED 36%SL	Glyphosate 36%SL	HOCKEY INTERNATIONAL LTD, UK
09/08/2013	Ugc/2013/001022/He/R	GREEN-2,4-D	2,4-D Amine 860g/l	CHANGZHOU WINTAFONE CHEMICAL Co. LTD CHINA
09/08/2013	Ugc/2013/001021/He/R	GREEN MASTER	Glyphosate 48%SL	ZHEJIANG XINAN CHEMICAL GROUP CO. LTD, CHINA
30/07/2013	Ugc/2013/001020/Fe/R	GNLD SUPER GLO (Wetting agent and adjuvant)		DOW CHEMICAL MIDRANG GOUTENG SOUTH AFRICA
26/07/2013	Ugc/2013/001910/Fe/R	GIBBROVA 2%SL	Gibberellic acid 2%W/V	VETERINARY AND AGRICULTURAL PROPERTIES MFG.Co.LTD (VAPCO LTD)
26/07/2013	Ugc/2013/001018/Fu/R	MANCOTHANE 88%WP	Mancozeb 88WP	VETERINARY AND AGRICULTURAL PROPERTIES MFG.Co.LTD (VAPCO LTD)
26/07/2013	Ugc/2013/001017/He/R	GROUND-UP	Glyphosate IPA 48%SL	VETERINARY AND AGRICULTURAL PROPERTIES MFG.Co.LTD (VAPCO LTD)
26/07/2013	Ugc/2013/001016/In/R	FLORATON SL	Deltamethrin 98.5%SL	VETERINARY AND AGRICULTURAL PROPERTIES MFG.Co.LTD (VAPCO LTD)
26/07/2013	Ugc/2013/001015/In/R	BLAST 44.1% SL	Bentazon 44.1%SL	VETERINARY AND AGRICULTURAL PROPERTIES MFG.Co.LTD (VAPCO LTD)
26/07/2013	Ugc/2013/001014/In/R	CHLOROFET-5%DP	Chlorpyrifos 5% W/V	VETERINARY AND AGRICULTURAL PROPERTIES MFG.Co.LTD (VAPCO LTD)
24/07/2013	Ugc/2013/001013/Fu/R	UNIZEB 80WP	Mancozeb 80%WP	UNITED PHOSPHORUS INDIA
24/07/2013	Ugc/2013/001012/In/R	ULTRAPHOS 56	Aluminium phosphide 56%	UNITED PHOSPHORUS INDIA
23/07/2013	Ugc/2013/001011/Fe/RRRR	VEGIMAX	Micronutrient/plant nutrient suppliment	BOON VANIT INTERNATIONAL

				LTD, BANGKOK THAILAND
16/07/2013	Ugc/2013/001010/In/R	DICHLOBEX 1000EC	Dichlorvos 1000EC	NANJING LIMIN CHEMICAL Co. LTD JIENGAU CHINA
10/07/2013	Ugc/2013/001009/Fu/RR	UGONALL 580WP	Metalaxyl 100g/Kg+Mancozeb 480g/Kg	HANGZHOUS CHEM. IND LTD CHINA
10/07/2013	Ugc/2013/001008/He/RR	Ametrex	Ametryne 500g/lSC	HANGZHOUS CHEM. IND LTD CHINA
10/07/2013	Ugc/2013/001007/In/RR	DUDU ALL	Cypermethrin 10g/l+Chlorpyrifos 35g/l	HANGZHOUS CHEM. IND LTD CHINA
10/07/2013	Ugc/2013/001006/In/RR	HANGTHOATE 40EC	Dimethoate 400g/l	HANGZHOUS CHEM. IND LTD CHINA
10/07/2013	Ugc/2013/001005/He/RR	WEED ALL 480SL	Glyphosate 480g/l	HANGZHOUS CHEM. IND LTD CHINA
10/07/2013	Ugc/2013/001004/He/RR	HURROW	Diuron 800g/lSC	HANGZHOUS CHEM. IND LTD CHINA
10/07/2013	Ugc/2013/001003/He/RR	HASUNIL 60EC	Thiobencarb 40%+Propanil 20%	HANGZHOUS CHEM. IND LTD CHINA
10/07/2013	Ugc/2013/001002/He/RR	HANGZHOU 2,4-D AMINE 720SL	2,4-Dichlorophenoxy acetic Acid 720SL	HANGZHOUS CHEM. IND LTD CHINA
12/06/2013	Ugc/2013/001001/In/RR	AGRITHOATE 40EC	Dimethoate 400g/L	WILLWOOD LTD, HONGKONG
12/06/2013	Ugc/2013/001000/He/RR	WILLOSATE 36%	Glyphosate 360SL	WILLWOOD LTD, HONGKONG
12/06/2013	Ugc/2013/000999/In/RR	AGRILLIC SUPER DP	Pirimiphos-methyl 16g/Kg+Permethrin 3g/Kg	WILLWOOD LTD, HONGKONG
12/06/2013	Ugc/2013/000998/Fu/RRR	ASCOZEB 80WP	Mancozeb 80%WP	WILLWOOD LTD, HONGKONG
12/06/2013	Ugc/2013/000997/In/RRR	ASCORIS48%EC	Chlorpyrifos 480g/L	BHAGIRADHA IND. LTD, CHINA
12/06/2013	Ugc/2013/000996/He/RRR	ASCOMINE 2,4D		HANGZHOUS YILONG CHEM IND, CHINA
12/06/2013	Ugc/2013/000995/Fu/RR	EUREKA 72WP	Metalaxyl 60g+Mancozeb640g/Kg	INVECTOR AGROV CYPRUS
12/06/2013	Ugc/2013/000994/In/RR	MAGIC	Malathion 50%EC	BHATI INSECTICIDE LTD INDIA
15/05/2013	Ugc/2013/000993/Fu/RRRRRRR	SANCOZEB 80WP	Mancozeb 80WP	DOW AGROSCIENCE FRANCE
08/05/2013	Ugc/2013/000992/In/RRR	TROGAR 40%EC	Dimethoate 400g/l	RALLIS LTD INDIA
07/05/2013	Ugc/2013/000991/In/RRRRRRRR	DURSBAN 48EC	Chlorpyrifos Ethyl 48%EC	DOW AGROSCIENCE LTD
07/05/2013	Ugc/2013/000990/In/RRR	RALOTHRIN	Cypermethrin 50g/L	RALLIS LTD INDIA

06/05/2013	Ugc/2013/000989/In/RRRRRR	QUICKPHOS	Aluminium Phosphide 56%	UNITED PHOSPHOROUS LTD INDIA
06/05/2013	Ugc/2013/000988/Fu/R	MILSTIN 50%WP	Carbendazim 50%WP	MEGHAMI INDUSTRIES LTD CHINA
06/05/2013	Ugc/2013/000987/In/R	DOOM 100EC	Dichlorvos 100EC	UNITED PHOSPHOROUS LTD INDIA
24/04/2013	Ugc/2013/000986/In/RRR	CYPERCAL P720EC	Cypermethrin 120g/+Profenos 600g/L	CALLIOPE GROUPE (AYSTA LIFE SCIENCE FRANCE)
24/04/2013	Ugc/2013/000985/He/RRRR	SATUNIL 60%EC	Thiobencarb 40%+ Propanil 20%EC	TOMEN CORPORATION JAPAN
05/04/2013	Ugc/2013/000984/He/RRR	GLYWEED	Glyphosate 41%SL	SABERO ORGANICS LTD INDIA
05/04/2013	Ugc/2013/000983/He/RRR	PIN-UP48%SL	Glyphosate 48%SL	AGSIN SINGAPORE-PTE LTD
05/04/2013	Ugc/2013/000982/He/RRRRRR	MAMBA	Glyphosate 36%SL	DOW AGRISCIENCE FRANCE
05/04/2013	Ugc/2013/000981/Fu/RRRRR	MANCOFIL-M45	Mancozeb 80WP	INDOFIL CHEMICAL LTD INDIA
05/03/2013	Ugc/2013/000980/He/RRR	GLYCEL 41%SL	Glyphosate 410g/L	EXCEL INDUSTRIES LIMITED INDIA
05/03/2013	Ugc/2013/000979/In/RRR	CELPHOS	Aluminium Phosiphide 56%	EXCEL INDUSTRIES LIMITED INDIA
05/03/2013	Ugc/2013/000978/In/RRRR	CRUISER350FL	Thiomethoxam 350FL	SYNGENTA CROP PROTECTION
05/03/2013	Ugc/2013/000977/In/RRRRR	SICORIN 5%EC	Cypermethrin 50g/L	THE SCIENTIFIC FERTILIZER CO INDIA
14/02/2013	Ugc/2013/000976/In/RR	GREEN HAMMER CYPER	Cypermethrin 5%EC	LIMIN CHEMICAL CO LTD CHINA
14/02/2013	Ugc/2013/000975/In/RR	GREEN HAMMER THOATE	Dimethoate 40%EC	LIMIN CHEMICAL CO LTD CHINA
14/1/2013	Ugc/2013/000974/He/R	SWEEP ALL	Glyphosate IPA 41%	ESINOCHEM SHANGAI CO LTD CHINA
17/12/2012	Ugc/2012/000973/He/R	NYO 2,4-D AMINE	2,4-D Amine 720g/L	CROPSTAR CHEMICAL INDUSTRY CO. CHINA
5/12/2012	Ugc/2012/000972/He/R	SUGUARD	Ametryn 50% SC	GSP CROP SCIENCE PRIVATE LTD
5/12/2012	Ugc/2012/000971/He/R	RUNOUT	Glyphosate 48%SL	GSP CROP SCIENCE PRIVATE LTD
5/12/2012	Ugc/2012/000970/He/R	CYCLONE	2,4-D 720g/l S.C	GSP CROP SCIENCE PRIVATE LTD
23/11/2012	Ugc/2012/000969/He/RRR	PILARSATO	Glyphosate 41%WW	PILARQUIM CORPORATION BOX

				7777 TAIPEI, TAIWAN
16/11/2012	Ugc/2012/000968/In/R	KOHINOR 200g/l	Imidacloprid 200g/l	MAKHTESHMAGAN, ISRAEL
16/11/2012	Ugc/2012/000967/Fu/RRRRR	ANTRACOL 70WP	Propineb 70%WP	BAYER EAST AFRICA
14/11/2012	Ugc/2012/000966/In/RRRRR	DECIS 2.5%EC	Deltamethrin 2.5%EC	BAYER EAST AFRICA
14/11/2012	Ugc/2012/000965/He/RR	BUTANIL 70SL	Propanil 350g/L +Butalachlor 350g/l	KINGTECH CORPORATION SHENZHEN-CHINA
14/11/2012	Ugc/2012/000964/In/RR	DUDUCYPER	Cypermethrin 50g/L	KINGTECH CORPORATION SHENZHEN-CHINA
14/11/2012	Ugc/2012/000963/He/RR	WEEDMASTER 50% SL	Glyphosate 500g/L SL	KINGTECH CORPORATION SHENZHEN-CHINA
14/11/2012	Ugc/2012/000962/In/RR	NIMBECIDINE	Azadirachitin 0.03%EC	T.stones and company LTD, INDIA C/O BUKOOLA CHEMICAL INDUSTRY
12/11/2012	Ugc/2012/000961/In/RRR	CONFIDOR	Imidacloprid 20%	BAYER E.A
12/11/2012	Ugc/2012/000960/In/RRR	GAUCHO	Imidacloprid 70%	BAYER E.A
8/11/2012	Ugc/2012/000959/Fu/RR	RODAZIM	Carbendazim	ROTAM LTD, HONGKONG
5/11/2012	Ugc/2012/000958/In/RR	ROCHLOP	Chlorpyrifos 480g/lEC	ROTAM LTD, HONGKONG
5/11/2012	Ugc/2012/000957/In/RR	ELECTRA	Lufenuron 50EC	ROTAM LTD, HONGKONG
5/11/2012	Ugc/2012/000956/Fu/RR	VOLAR	Dimetormorp+Mancozeb 690WP	ROTAM LTD, HONGKONG
5/11/2012	Ugc/2012/000955/In/RR	JACKPOT	Lambdacyhalothrin 50gEC	ROTAM LTD, HONGKONG
5/11/2012	Ugc/2012/000954/In/RR	IMAXI	Imidacloprid 200SC	ROTAM LTD, HONGKONG
5/11/2012	Ugc/2012/000953/Fu/RR	MILOR 72WP	Metalaxyl 80g/Kg+Mancozeb 640g/Kg	ROTAM LTD, HONGKONG
5/11/2012	Ugc/2012/000952/In/RR	COOPERTHIOATE	Dimethoate 40%EC	HOCKEY INTERNATIONAL LTD
5/11/2012	Ugc/2012/000951/Fu/RR	COOPERZEB	Mancozeb 80WP	HOCKEY INTERNATIONAL LTD
5/11/2012	Ugc/2012/000950/He/RR	COOPERSATE 36%SL	Glyphosate 36%SL	HOCKEY INTERNATIONAL LTD
31/10/2012	Ugc/2012/000949/Fu/R	SEKMANCOZEB	Mancozeb 80%WP	SHANGAI AGROCHINA INTERNATIONAL TRADING CO. LTD
31/10/2012	Ugc/2012/000948/He/R	SEK CYPERMETHRIN 5% EC	Cypermethrin 5%EC	SHANGAI AGROCHINA INTERNATIONAL TRADING CO. LTD
31/10/2012	Ugc/2012/000947/He/R	SEK GLYPHOSATE	Potassium salt of glyphosate 360g/l	SHANGAI AGROCHINA INTERNATIONAL TRADING CO.

				LTD
31/10/2012	Ugc/2012/000946/He/R	SEK2,4-D Amine	2,4-Dimethyl amine	SHANGAI AGROCHINA INTERNATIONAL TRADING CO. LTD
24/10/2012	Ugc/2012/000945/He/R	ROUNDUP READY PLUS	Potassium salt of N-phosphonomethyl glycine 540g/l	MONSANTO EUROPE SA
24/10/2012	Ugc/2012/000944/He/R	MON79632	Glycine 360g/l (Potassium salt of N-phosphonomethly)	MONSANTO EUROPE SA
17/10/2012	Ugc/2012/000943/He/RR	METRIX	Metribuzin 480 EC	FLUENCE MIDDLE E.A LTD CYPRUS
17/10/2012	Ugc/2012/000942/In/RR	GOLAN	Acetamiprid 200g/l	FLUENCE MIDDLE E.A LTD CYPRUS
17/10/2012	Ugc/2012/000941/In/RR	BIRD SHIELD	Methyl Anthranilate	BROR CEDERSTROM IMPEC, INC, USA
17/10/2012	Ugc/2012/000940/Fu/RR	NORDOX 75WG	Cuprous oxide	NORDOX INDUSTRIES AS, NORWAY
17/10/2012	Ugc/2012/000939/In/RR	OXYMATRINE 2.4SL	Prosular oxymatrine	FLUENCE MIDDLE E.A LTD CYPRUS
17/10/2012	Ugc/2012/000938/Fu/RR	AGRIFOS 600	Phosphorus acid 600g/l	FLUENCE MIDDLE E.A LTD CYPRUS
17/10/2012	Ugc/2012/000937/In/RR	ABAMECTIN	*Abamectin* 18g/l	AGRIPHAR SA BELGIUM
17/10/2012	Ugc/2012/000936/In/RR	ROGAN 40%	*Dimethoate 40%*	AGRIMORIL LTD, ISRAEL
17/10/2012	Ugc/2012/000935/In/R	KINYVERT	*Verticillium lecannii*-Vl7	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000934/In/R	KINYMET	*Metarrhizium anisopilae*-Ma4	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000933/In/R	KINYBEAU	*Beauveria bassiana* Bb-5a	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000932/Ba/R	KINYMONAS	*Pseudomonas flourescens* PF-19	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000931/Fu/R	KINYDERMA	*Trichorderma viride* Tv-6	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000930/Fe/R	KINYBIUM	*Rhizobium sp* Ks3	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000929/Fe/R	KINYPOTASH	*Fracteuria aurentia* Fa3	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000928/Fe/R	KINYACETO	*Gluconoacetobacter diazotropicus (*Biofert1)	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000927/Fe/R	KINYAZOTO	*Azotobactor chroococcum* AC1	KINYARA SUGAR LIMITED
12/10/2012	Ugc/2012/000926/Fe/R	KINYSPIRILLUM	*Azospirillum sp* SP7	KINYARA SUGAR LIMITED

12/10/2012	Ugc/2012/000925/Fe/R	KINYPHOS	*Bacillus megaterium* var *phoshaticum* PB1	KINYARA SUGAR LIMITED
03/10/2012	Ugc/2012/000924/Fu/R	FUNGOZEB 80WP	Mancozeb 80WP	DVA AGRO GmbH, GERMANY
03/10/2012	Ugc/2012/000923/In/R	DEVACYPER 5%EC	Cypermethrin 5%EC	DVA AGRO GmbH, GERMANY
03/10/2012	Ugc/2012/000922/In/R	DEVALAN 20SP	Aceptamiprid 20% SP	DVA AGRO GmbH, GERMANY
03/10/2012	Ugc/2012/000921/He/R	RONDO 480SL	Glyphosate 480g/l SL	DVA AGRO GmbH, GERMANY
03/10/2012	Ugc/2012/000920/He/R	HERBIX PLUS 720SL	2,4-Dichlorophenoxyacetic acid 720g/l SL	DVA AGRO GmbH, GERMANY
27/09/2012	Ugc/2012/000919/He/RRRR	KALACH 360SL	Glyphosate 360g/l	CALLIOPE GROUPE ABYSTA LIFE SC. FRANCE
31/08/2012	Ugc/2012/000918/Fu/R	MANCOBEX 80WP	Mancozeb 80WP	NANJING LIMIN CO. LTD SHANGAI
31/08/2012	Ugc/2012/000917/In/R	CYMEBEX 5%EC	Cypermethrin 50g/l	NANJING LIMIN CO. LTD SHANGAI
31/08/2012	Ugc/2012/000916/He/R	GLYPHOBEX 360SL	Glyphosate 360g/lSL	NANJING LIMIN CO. LTD SHANGAI
31/08/2012	Ugc/2012/000915/In/R	PYRIBEX 48%EC	Chlorpyrifos 480g/lEC	NANJING LIMIN CO. LTD SHANGAI
31/08/2012	Ugc/2012/000914/In/R	DIMETHOBEX 40EC	Dimethoate 400g/l	NANJING LIMIN CO. LTD SHANGAI
1/08/2012	Ugc/2012/000913/In/R	THUNDER 145 OD	Betacyfluthrin 45g/l+ Imidaclopid 100g/l	BAYER EAST AFRICA, KENYA
10/07/2012	Ugc/2012/000912/In/RRR	TWIGATHIOATE 40EC (FAMGOR 40%EC)	Dimethoate 40%EC	THE NATIONAL Co FOR CHEMICALS PRODUCTION, ALEXANDRIA EGYPT
10/07/2012	Ugc/2012/000911/In/RRRRR	SUMITHION 50EC	Fenitrothion 50%EC	SUMITOMO CORPORATION JAPAN
03/07/2012	Ugc/2012/000910/In/R	UTHOATE 40EC	Dimethoate 400g/l	UNITED PHOSPHORUS INDIA
03/07/2012	Ugc/2012/000909/In/R	UCHLORVOS 100EC	Dichlorvos 100EC	UNITED PHOSPHORUS INDIA
03/07/2012	Ugc/2012/000908/He/R	UPHOSATE	Glyphosate 41%SL	UNITED PHOSPHORUS INDIA
03/07/2012	Ugc/2012/000907/In/R	UMETHRIN	Cypermethrin 5%EC	UNITED PHOSPHORUS INDIA
03/07/2012	Ugc/2012/000906/Fu/R	UNILAX 72WP	Metalaxyl+Mancozeb 72WP	UNITED PHOSPHORUS INDIA
15/06/2012	Ugc/2012/000905/Fu/RRR	TRIDEX 80WP	Penncozeb 80WP	CEREXAGRIC FRANCE
22/05/2012	Ugc/2012/000904/Fu/RR	APRON STAR	Difenoconazole 2%+Thiamethoxam 20%+Metalaxyl-M 20%	SYNGENTA CROP PROTECTION BASEL EAST AFRICA LTD
22/05/2012	Ugc/2012/000903/He/RRRR	TOUCHDOWN 48%SL	Glyphosate Trimesium 48%SL	SYNGENTA CROP PROTECTION
22/05/2012	Ugc/2012/000902/Fu/RRR	MAXIMXL 035FS	Fludioxonil+Metalaxylon	SYNGENTA CROP PROTECTION BASEL, SWITZERLAND
22/05/2012	Ugc/2012/000901/He/RR	FUSILADE FORTE	Fluazifop-p-butyl 150g/l	SYNGENTA CROP PROTECTION BASEL, SWITZERLAND

22/05/2012	Ugc/2012/000900/He/RR	LUMAX	S.metolachlor 375g/l+Terbuthylazine 125g/l+Mesotrion 37.5g/l	SYNGENTA CROP PROTECTION BASEL, SWITZERLAND
22/05/2012	Ugc/2012/000899/In/RRRRR	ACTELLIC SUPER 25EC	Primiphos methyl 1.6%+ Permethrin 0.3%	SYNGENTA CROP PROTECTION EAST AFRICA
22/05/2012	Ugc/2012/000898/Fu/RRR	THIOVIT JET	Sulpher 80%WG	SYNGENTA CROP PROTECTION BASEL, SWITZERLAND
30/03/2012	Ugc/2012/000897/In/R	SEKAPYRIFOS	Chlorpyrifos 48%EC	SINOCHEM SHANGAI CO. LTD
30/03/2012	Ugc/2012/000896/Fu/R	SEKAZEB	Mancozeb 80WP	SINOCHEM SHANGAI CO. LTD
30/03/2012	Ugc/2012/000895/He/R	SEKASATE	Glyphosate 360g/l	SINOCHEM SHANGAI CO. LTD
30/03/2012	Ugc/2012/000894/He/R	SEKA 2,4-D AMINE 720SL	2,4D Amine 720SL	SINOCHEM SHANGAI CO. LTD
28/03/2012	Ugc/2012/00089/He/RR	LASSET GD	Acetochlor 41%+ Terbuthylazine 19%	MONSANTO EUROPE NV
28/03/2012	Ugc/2012/000892/He/RR	ROUND UP-TURBO	Glyphosate 450SL	MONSANTO EUROPE NV
28/03/2012	Ugc/2012/000891/Fe/RR	AGROLEAF/AGROBLEN	Nitrogen 19.89%+ Phosphorus 20.29%+ Potassium 19.51%+ Trace elements	THE SCOTTS CO KENYA LTD, ALPHA CENTER, UNIT8, NAIROBI, KENYA
28/03/2012	Ugc/2012/000890/Fu/RRRRR	GREENZEB 80WP	Mancozeb 80WP	LIMIN CHEMICALS LTD, JIANSU, CHINA
23/03/2012	Ugc/2012/000889/In/RR	STA 1.8EC	Abemectin 18g/l	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000888/In/RRR	AGRO-DELLIC GRAIN DUST	Pirimiphosmethyl 16g/kg+Permithrin 3g/kg	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000887/In/RRRRR	AGRO-CYPRO 440EC	40g/l Cypermethrin+ 400g/l Profenofos	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000886/In/RRRRRRR	AGRO-CHLORDI 500EC	278g/l Cypermethrin+ 222g/l Dimethoate	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000885/In/RRRRRRRR	AGRO-THOATE 40EC	Dimethoate 400g/l	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000884/He/RRRRRRR	AGRO-SATE 360SL	Glyphosate 36%SL	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000883/In/RRRRRRR	AGRO-CYTHRIN 5EC	Cypermethrin 50g/l	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000882/Fu/RRRRRRR	AGRO-ZEB 80WP	Mancozeb 80%WP	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000881/In/RRRRRR	AGRO-PYRIFOS 48EC	Chlorpyrifos 480g/l	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE

23/03/2012	Ugc/2012/000880/In/RRRRRR	AGRO-MALON 57EC	Malathion 57%EC	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000879/Fu/RRRRRR	AGRO-LAXYL MZ 72WP	Metalaxyl 80g/kg + 640g/kg Mancozeb	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/03/2012	Ugc/2012/000878/He/RRRRR	AGRO2,4D AMINE 720SL	Dimethylamino salt 720g/L	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
02/03/2012	Ugc/2012/000877/In/R	ORTHENE 97% PELLET	Acephate 97%P	TOMEN CORPORATION, JAPAN.
02/03/2012	Ugc/2012/000876/In/R	LAVA 100%EC	Dichlorvos 100%EC	SABERO ORGANICS LTD GUJARAT, INDIA
02/03/2012	Ugc/2012/000875/Fe/R	D.I.GROW-GREEN ORGANIC FERTILIZER		DIAMOND INTEREST SOLN BUS, MALAYSIA. C/O MS DYNAPHARM GROUP OF COMPANIES
02/03/2012	Ugc/2012/000874/Fe/R	D.I.GROW-RED ORGANIC FERTILIZER		DIAMOND INTEREST SOLN BUS, MALAYSIA. C/O MS DYNAPHARM GROUP OF COMPANIES
23/02/2012	Ugc/2012/000873/He/R	MILSATE 41%SC	Glyphosate 41%SL	HANGZHOU WEIYUAN CHEMICAL CO LTD
23/02/2012	Ugc/2012/000872/In/R	MILCYPER 5%EC	Cypermethrin 5%EC	HANGZHOU WEIYUAN CHEMICAL CO LTD
23/02/2012	Ugc/2012/000871/He/R	MIL-2,4D AMINE	2,4D Amine 720g/l	HANGZHOU WEIYUAN CHEMICAL CO LTD
23/02/2012	Ugc/2012/000870/In/RRR	PHOSTOXIN 66%	Aluminium Phosphide 66%	DETIA DEGESCH Gmbh, GERMANY
23/02/2012	Ugc/2012/000869/In/RR	DERA BLUE CROSS	Malathion 2% Dust	DERA CHEMICALS INDUSTRIES NAIROBI-KENYA
21/02/2012	Ugc/2012/000868/Fu/RRRRRR	RIDOMIL GOLD MZ 68WG	Mancozeb 64% + Metalaxyl-M 4%	SYNGENTA CROP PROTECTION Ag BASLE
21/02/2012	Ugc/2012/000867/He/RRRRR	PRIMAGRAM GOLD 660SC	Atrazine 37% +S- Metolachlor 29% SC	SYNGENTA CROP PROTECTION Ag BASLE
17/02/2012	Ugc/2012/000866/In/RR	DRAGNET FT	Permithrin 36.8%	JUANCO SPS LTD NAIROBI-KENYA
17/02/2012	Ugc/2012/000865/In/RR	MARSHAL 25EC	Carbosulfan 25EC	JUANCO SPS LTD NAIROBI-KENYA
17/02/2012	Ugc/2012/000864/In/R	PYGAR 35EC		JUANCO SPS LTD NAIROBI-KENYA
17/02/2012	Ugc/2012/000863/In/R	PYNEEM 20EC		JUANCO SPS LTD NAIROBI-KENYA
17/02/2012	Ugc/2012/000862/He/RR	AUTHORITY 48%SC	Sulfentrazone 48%SC	JUANCO SPS LTD NAIROBI-KENYA
03/02/2012	Ugc/2012/000861/In/RR	DIVIPAN 100EC	Dichlorvos 1000g/l	MAKHTSHM-AGAN ISRAEL

23/11/2011	Ugc/2011/000860/In/RRRR	AGRO-LAMBDA 2.5EC	Lambda Cyhalothrin	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000589/In/RRRR	TERMINATOR 480EC	Chlorpyrifos 480g/l	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000858/In/RRRR	AGRO-FURAN 5%G	Carbofuran 5%G	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000857/In/RRRR	FENDAGRO 6SC	Alpha-Cypermethrin 6%SC	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000856/In/RRRRR	AGRO-DETRIN2.5EC	Deltamethrin 2.5%EC	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000855/Ro/RR	SYNPHOS	Zinc phosphide 800g/kg	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000854/In/RR	SYNFUME	Aluminium Phoside	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000853/He/RR	AGRO-SUPANIL 60EC	Thiobencarb 400g/l + Propanil 200g/l	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000852/He/RR	AGRO-STUMP 330EC	Pendimethalin 330EC	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000851/In/RR	VALUE	Cypermethrin 5g/l	ASIATIC AGRICULTURAL INDUSTRY,SINGAPORE
23/11/2011	Ugc/2011/000850/In/RR	AGRO-LAMBACIN 3.5 EC	Lambd-cyhalothrin 15g/l+profenos 300g/l	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/11/2011	Ugc/2011/000849/In/RR	AGRO-ALPHACYPER 10EC	Alpha-cypermethrin 100g/l	ASIATIC AGRICULTURAL INDUSTRY, SINGAPORE
23/11/2011	Ugc/2011/000848/Fe/RRRR	Vegimax		Boon Vanit International LTD
01/11/2011	Ugc/2011/000847/He/RR	LIPHOSATE	Glyphosate 41% SL	HONBOR CHEMICALS CO LTD, CHINA
01/11/2011	Ugc/2012/000846/In/RR	LICYPER	Cypermethrin 50g/l	HONBOR CHEMICALS CO LTD, CHINA
11.10.2011	Ugc/2011/000845/He/RRR	Glyphogan 480g/l	Glyphosate 480g/l	Makhteshm Agan, Isreal
11.10.2011	Ugc/2011/000844/He/RR	Glyphosate	Glyphosate 480g/l	Tivochem, Isreal
11.10.2011	Ugc/2011/000843/Fu/RR	Rodazim	Carbendazim 50% SC	Rotam LTD, Hongkong
26.09.2011	Ugc/2011/000842/He/RR	2,4 –D - Amine	Amine Salt of 2,4 – dichlorophenoxy 720g	Agromol IL LTD, Isreal

11.08.2011	Ugc/2011/000841/He/RR	Invectra 720g/l	Amine Salt of 2,4 – dichlorophenoxy 720g/l	Hangzhous Yilong Chem. Ind., China
11.08.2011	Ugc/2011/0008340/Fu/RR	Rooter 80 WP	Mancozeb 80 WP	Willowood LTD, Hongokong
11.08.2011	Ugc/2011/000839/In/RR	Ascoris 48% EC	Chlorpyrifos 480g/l	Bhagiradha Chem Ind LTD, China
8.08.2011	Ugc/2011/000838/He/RR	Roundfarm	Glyphosate 480 SL	Shangai Jilong Chemicas LTD, China
13.07.2011	Ugc/2011/000837/Fu/RRR	Emthane M45	Mancozeb 80WP	Sabero Organic, Gujarat, India
13.07.2011	Ugc/2011/000836/In/RRR	Cyperlacer 5 EC	Cypermethrin 5%	Isagro Asia PVT, India
13.07.2011	Ugc/2011/000835/In/RRR	Malataf 57 EC	Malathion 57% EC	Rallis, India
13.07.2011	Ugc/2011/000834/In/RRR	Tafgor 40 EC	Dimethoate 40% EC	Rallis, India.
29.06.2011	Ugc/2011/000833/In/RR	Rockett 44 EC	Profenofos 40% + Cypermethrin 4%	PI – Industries, India
29.06.2011	Ugc/2011/000830/In/RR	Trounce 40 EC	Dimethoate 400g/l	Rallis, India
17.06.2011	Ugc/2011/000829/Fu/RR	Victory 72 WP	Metalaxyl 80g/kg + Mancozeb 640g/kg	Invectra Agro LTD, Cyprus
6.06.2011	Ugc/2011/000828/In/RR	Keshet Super 312 EC	Deltamethrin 12g/l + Chlorpyrifos 300g/l	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000827/In/RR	Apollo 50 SC	Clofentezine 500g/l	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000826/In/RRRR	Thionex 35 EC	Endosulfan 350g/l EC	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000825/In/RR	Rimon 10 EC	Novaluron 100g/l EC	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000824/In/RRRR	Pyrinex 48 EC	Chlorpyrifos 48g/l	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000823/In/RR	Methomex 90 SP	Methomyl	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000822/In/RR	Lamdex Super 315 EC	Lambdacyhalothrin 15 g/l+ Chlorpyrifos 300g/l	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000821/Fu/RR	Orius 25 EC	Tebuconazole 250g/l	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000820/Fu/RR	Odeon 720 SC	Chlorothalonil 720 g/l	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000819/Fu/RR	Nimrod 25 EC	Bupirimate 250g/L	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000818/Fu/RR	Folpan 50WP	Folpet 500g/kg	Makhteshm Chemical Works, Israel
6.06.2011`	Ugc/2011/000817/He/RR	Diurex 80 WG	Diuron 800g/kg	Makhteshm Chemical Works, Israel
6.06.2011	Ugc/2011/000816/He/RR	Diurex 80 SC	Diuron 800g/l	Agan Chemical Manufacturers, Israel
6.06.2011	Ugc/2011/000815/He/RR	Ametrex 50 SC	Ametryn 500g/l	Agan Chemical Manufacturers, Israel
25.05.2011	Ugc/2011/000814/He/R	Erasate 410 SL	Glyphosate 410g/l	Shanghai Mio Chemical Co Ltd, China
28.04.2011	Ugc/2011/000813/In/RR	Endocel 35% EC	Endosulfan 350g/l	MS Excel Industries, India
14.04.2011	Ugc/2011/000812/He/RR	Green Fire 50% SL	Glyphosate 500g/l	Limin Chemical Co, China
8.04.2011	Ugc/2011/000811/Fu/R	K Zeb M-45	Mancozeb 80% WP	Shanghai Sunstar Trading Co Ltd, China
8.04.2011	Ugc/2011/000810/He/R	Klin Up	Glyphosate IPA 41%W/W SL	Shanghai Sunstar Trading Co Ltd, China
8.04.2011	Ugc/2011/000809/ He/R	K,2,4-D Amine	2,4-Dimethylamine salt 720gm/l SL	Shanghai Sunstar Trading Co Ltd,China

20.01.2011	Ugc/2011/000804/In/RR	Hipower 5EC	*Cypermethrin 5%EC*	Sulphur Mills Industries, India
20.01.2011	Ugc/2011/000803/In/RR	Sulmathion 50EC	*Malathion 50EC*	Sulphur Mills Industries, India
20.01.2011	Ugc/2011/000802/Fu/RR	Manco	*Mancozeb 80WP*	Sulphur Mills Industries, India
5.08.2010	UgC/2010/000796/He/R	Touchdown 48%SL	480g/l of glyphosate Isopropylamine salt	Ningbo Free Trade Zone FineChem Ind. Co., Ltd, China
5.08.2010	UgC/2010/000795/Fe/R	Sugar Mover	Bo:8%, Mo:0.004% + Inert 91.986%	Stoller Enterprise, USA
5.08.2010	UgC/2010/000794/Fe/R	Sett Enhanced	Ca:8% + Bo:1% + Inert 91%	Stoller Enterprise, USA
5.08.2010	UgC/2010/000793/Fe/R	Bio-Forge	N2% + K3%+ Inert 95%	Stoller Enterprise, USA
5.08.2010	UgC/2010/000792/He/R	Fammine	2,4-Dimethylamine salt 720gm/l SL	Shanghai Jilong Chemical Company Limited, China
5.08.2010	UgC/2010/000791/He/RRRRR	Round UP 36% SL	*Glyphosate 36% SL*	Monsanto Europe NV
5.08.2010	UgC/2010/000790/He/R	WeedFire	*Glyphosate 480g/l*	Shangai Agrochemical Int Trade, China
26.07.2010	UgC/2010/000786/He/R	Weed End	Glyphosate 410g/l SL	Topsen Biotech Co. Ltd., China
19.07.2010	UgC/2010/000785/He/R	2,4-D Amine	2,4-Dimethylamine salt 720gm/l SL	Atul Ltd. Agrochemical Divisions, India
19.07.2010	UgC/2010/000784/In/R	Sicoban	Chlorpyrifos 480g/l	Scientific Fertilizer, India
19.07.2010	UgC/2010/000783/In/R	Twiga Lace 100EC	Lambda cyhalothrin 60g/l + Acetamiprid 40g/l	Volcano Agroscience Ltd., South Africa
19.07.2010	UgC/2010/000782/In/R	Hitcel	Profenofos 400g/l + Cypermethrin 40g/l EC	Excel Crop Care Ltd. India
19.07.2010	UgC/2010/000781/In/R	Tricel 48% w/v EC	Chlorpyrifos 480EC	Excel Crop Care Ltd., India
07.07.2010	UgC/2010/000767/He/R	Super Weeder	Glyphosate 480g/l SL	Zhejiang Topchance Chemical Industries, China
06.07.2010	UgC/2010/000765/He/R	Glyphotox	Glyphosate 41% SL	AIMCO Pesticides Ltd., India
05.07.2010	UgC/2010/000764/In/R	Linex 48% EC	Chlorpyrifos 480g/l EC	Modern Insecticides Ltd., India
05.07.2010	UgC/2010/000763/In/R	LB-Dichlorvos	Dichlorvos 1000g/l EC	Modern Insecticides Ltd., India
05.07.2010	UgC/2010/000762/In/R	LB-Ambush	Cypermethrin 5% EC	Modern Insecticides Ltd., India
05.07.2010	UgC/2010/000761/In/R	Procyper	Profenofos 40% + Cypermethrin 4% EC	Modern Insecticides Ltd., India
05.07.2010	UgC/2010/000760/In/R	LB-Dimethoate	Dimethoate 400g/l	Modern Insecticides Ltd., India
05.07.2010	UgC/2010/000759/Fu/R	LB-Mancozeb	Mancozeb 80%WP	Modern Insecticides Ltd., India
05.07.2010	UgC/2010/000758/Fu/R	Lancozeb	Mancozeb 80%WP	Honbor Chemical Company Limited, China
05.07.2010	UgC/2010/000757/He/R	LB- 2,4-D Amine	2,4-dichlorophenoxyacetic acid	Honbor Chemical Company Limited, China

05.07.2010	UgC/2010/000756/He/R	LB-Glyphosate	Glyphosate 480g/l SL	Modern Insecticides Ltd., India
29.06.2010	UgC/2010/000755/Fu/R	Mancoera-M45	Mancozeb 80%WP	Sinochem Shanghai Corp, China
29.06.2010	UgC/2010/000754/He/R	Eramine 2,4D Amine 720g/l	*Amine Salt 2,4 D Dichlorophenyl acetic acid*	Sinochem Shanghai Corp, China
29.06.2010	UgC/2010/000753/In/R	Insecta KILL	Chlorpyrifos 480g/l	Sinochem Shanghai Corp, China
29.06.2010	UgC/2010/000752/He/R	Weed Up	Glyphosate 360g/l SL	Sinochem Shanghai Corp, China
22.06.2010	UgC/2010/000751/In/R	Shumba Super EC	fenitrothion 50% + Deltamethrin 5%	EcoMed Manufacturing Ltd, Zimbabwe
22.06.2010	UgC/2010/000750/In/R	Shumba Super Grain Protectant	fenitrothion 1.0% + Deltamethrin 0.13%	EcoMed Manufacturing Ltd, Zimbabwe
19.04.2010	UgC/2010/000748/Ne/RRRR	Vyadate 10G	*Oxamyl 10%*	Du Pont, France
19.03.2010	Ugc/2010/00744/In/R	Fury 10EC	*Zeta-cypermethrin 10%EC*	Juanco SPS Ltd, Nairobi
19.03.2010	Ugc/2010/00743/In/R	Pyesulfan 10EC	*Pyrethrins 10g/l + Carbosulfan 100g/l*	Juanco SPS Ltd, Nairobi
21.10.2009	Ugc/2009/000729/In/RRR	Perkill	*Permethrin 10 EC*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000728/In/RRR	Nugor 40 EC	*Dimethoate 40 EC*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000727/In/RR	Cyrux	*Cypermethrin 20 EC*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000726/In/RR	Chlorban 48 EC	*Chlorpyrifos 48 EC*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000725/In/RRR	Chlorban 20 EC	*Chlorpyrifos 20 EC*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000724/In/RRRRR	Phoskill 40% EC	*Monocrotophos 40% EC*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000723/Ro/RRRR	Ratol 80%	*Zinc Phosphide 80%*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000722/In/RRR	Lancer 75% SP	*Acephate 75% SP*	UNITED PHOSPHORUS LTD INDIA
21.10.2009	Ugc/2009/000721/In/RRR	Ustaad 5% EC	*Cypermethrin 5% EC*	UNITED PHOSPHORUS LTD INDIA
11.03.2009	Ugc/2009/000700/He/R	Weed-Up 48% SL	*Glyphosate 48%SL*	We Young Ind. & Trading Co-China
11.03.2009	Ugc/2009/000699/Fu/R	Mancodose	*Mancozeb 80WP*	Zagro PTE Ltd, INDIA
04.02.2009	Ugc/2009/000698/In/RR	Orthene 97% PALLET	*Acephate 97%*	TOMEN Corporation
24.09.2008	Ugc/2008/000694/In/R	Bestox (DOMINEX)	*Alphacypermethrin 100g/l*	Juanco SPS Ltd Nairobi Kenya
24.09.2008	Ugc/2008/000693/In/R	Brigade (TALSTAR)	*Bifenthrin 2.5%*	Juanco SPS Ltd Nairobi Kenya
19.09.2008	Ugc/2008/000692/In/R	Dudu Ethoate	*Dimethoate 400g/l*	Kingtech Corporation Shenzhen- China
19.09.2008	Ugc/2008/000691/In/R	Dudu Alpha	*Alpha Cypermethrin 30g/l EC*	Kingtech Corporation Shenzhen- China
03.09.2008	Ugc/2008/000684/In/RRR	Icon 10 CS	*Lambdacyhalothrin 10%*	Syngenta Crop.Protection Ag. Basle.

03.09.2008	Ugc/2008/000683/In/RRR	Icon 10 WP	*Lambdacyhalothrin 10%*	Syngenta Crop.Protection Ag. Basle.
03.09.2008	Ugc/2008/000682/In/RRR	Dynamec 1.8 EC	*Abamectin*	Syngenta Crop.Protection Ag. Basle.
14.08.2008	Ugc/2008/000675/In/R	Rogan 40 % EC	*Dimethoate 400 g/l*	Agrimor Ltd - Israel
14.08.2008	Ugc/2008/000673/ In, Ac/R	Abamectin	*Abamectin 18g/l*	Agriphar S.A Belgium
14.08.2008	Ugc/2008/000669/He/R	Cordal GOLD	*Prometryn 3,5-triazine 2, 4 diamine*	Syngenta Crop. Protection Ag. Basle.
16.07.2008	Ugc/2008/000662/He/R	Garil	*Propanil + Triclopyr 432 g/l*	Dow Agro Sciences - France
19.05.2008	Ugc/2008/000647/He/R	RICAL 345 EC	*230g/l Propanil + 115 g/l Thiobencarb*	ARYSTA LIFE SCIENCE KENYA
19.05.2008	Ugc/2008/000646/He/R	Kalach Extra 70 SG	*Glyphosate 700g/l SG*	ARYSTA LIFE SCIENCE KENYA
19.05.2008	Ugc/2008/000645/In/R	Titan 25 EC		ARYSTA LIFE SCIENCE KENYA
19.05.2008	Ugc/2008/000644/In/R	Mospilan 200 SP	*Acetamiprid 200 g/l*	ARYSTA LIFE SCIENCE KENYA
19.05.2008	Ugc/2008/000643/Fu/R	Banko 500 SC	*Chlorothalonil 500 g/l*	ARYSTA LIFE SCIENCE KENYA
02.05.2008	Ugc/2008/000641/In/RRRR	Fenkill 20 % EC	*Fenvalerate 20 % EC*	United Phosphorus Ltd. India
02.05.2008	Ugc/2008/000639/Fu/RRRRR	Uthane 80% WP	*Mancozeb 80% WP*	United Phosphorus Ltd. India
14.03.2008	Ugc/2008/000637/In/R	push Herbal	*Plant Extracts mixture of NEEM, Mustards, Aloe Vera, Chilies, Garlic*	Prathista Industries Ltd Choutuppal -508 252, A.P. India
14.03.2008	Ugc/2008/000636/Fe/R	Bio Zinc	*10 % Organic Zinc*	Prathista Industries Ltd Choutuppal -508 252, A.P. India
14.03.2008	Ugc/2008/000635/Fe/R	Bio-Potash	*10% Organic Potash in Gluconate / Lactate form*	Prathista Industries Ltd Choutuppal -508 252, A.P. India
14.03.2008	Ugc/2008/000634/Fe/R	Biophos	*10% Bio-available Phosphorus*	Prathista Industries Ltd Choutuppal -508 252, A.P. India
14.03.2008	Ugc/2008/000633/Fe/R	Megacal	*Bio-available calcium, magnesium, Potassium, Zinc, Manganese, Ferrous, Copper, Boron.*	Prathista Industries Ltd Choutuppal -508 252, A.P. India
14.03.2008	Ugc/2008/000632/Fe/R	New Suryamin	*Vegetable / Cereal Protein based formulated with sea weed extract, Itumic acid, ulvic acid with organic micronutrients and trace elements*	Prathista Industries Ltd Choutuppal -508 252, A.P. India
20.12.2007	Ugc/2007/000621/In,Ne/RRR	Furadan 5G	*Carbofuran 5%*	FMC Corporation ,Philadelphia,USA C/O Juanco- Nairobi
06.11.2007	Ugc/2007/000620/Fu/RRRR	Antracol 70 WP	*Propineb 70 %*	Bayer East Africa

21.09.2007	Ugc/2007/000610/He/R	Velpar WG	*Hexazinone 750g/kg*	DuPont, France
21.09.2007	Ugc/2007/000609/He/R	Twiga Glyphosate	*Glyphosate 360SL*	Volcano Agroscience (Pty) Company Limited, South Africa
21.09.2007	Ugc/2007/000608/In,Ac/R	Romectin	*Abamectin 18g/l EC*	Rotam Ltd, China
21.09.2007	Ugc/2007/000606/In/R	Twigacyper	*Cypermethrin 50 g/l*	Agrochem Alexandria, Egypt
21.09.2007	Ugc/2007/000605/In/R	Twigafos Combi (Telton-C- 425 EC)	*Profenofos 400g/l +Cypermethrin 40g/l*	Agrochem Alexandria, Egypt
21.09.2007	Ugc/2007/000604/In/R	Twiga Malathion 57%EC (FAMTHION)	*Malathion 57%EC*	Agrochem Alexandria, Egypt
17.07.2007	Ugc/2007/000590/In/R	Famban 48% EC	*Chlorpyrifos 480 g/l*	Rallis Ltd, India
10.07.2007	Ugc/2007/00584/Fe/R	Algifol TM	*Algifol Foliar fertilizer*	Neomed Pharma GmbH, Germany
23.05.2007	Ugc/2007/00580/In/RRRRR	Bulldock 0.25 EC	*Betacyfluthrin 2.5%*	Bayer East Africa
23.05.2007	Ugc/2007/00579/Ne/RRR	Nemacur 5 GR	*Fenamiphos*	Bayer East Africa
23.05.2007	Ugc/2007/000578/Fu/RR	Sencor	*Metribuzin 70 WP*	Bayer East Africa
17.012007	Ugc/2007/000576/Fu/RRR	Famcozeb 80% WP	*Mancozeb 80 WP*	Limin Chemical Co. Ltd, China
03.11.2006	UgC/2006/000575/He/RR	Ronstar 25EC	*Oxadiozon 250g/L*	Bayer East Africa (Rhone Poulenc)
26.10.2006	UgC/2006/000574/He/RRR	Helosate (Twigasate)	*Glyphosate 48%SL*	Helm AG. Germany
26.10.2006	UgC/2006/000573/He/RRR	Actril DS	*2,4-D Amine 60% + Ioxynil 10%*	Bayer East Africa
26.10.2006	UgC/2006/000572/Fu/RRR	Kocide 101	*Cupric Hydroxide 77%*	Du Pont France
26.10.2006	Ugc/2006/000568/He/RRR	Gesapax 80 WG	*Ametryn 80%*	Syngenta Agro AG, UK
26.10.2006	Ugc/2006/000567/He/RRR	Dual Gold 960 EC	*Metolachlor + Chloroacetanilide*	Syngenta Agro AG. UK
24.10.2006	Ugc/2006/000564/He/R	Alazine350/200SE	*Alachlor 350g/l+Atrazine200g/l*	Agan Chemical Manufacturers, Israel
14.09.2006	Ugc/2006/000555/He/RRR	Sweep W.S	*Glyphosate 41% SL*	United Phosphorus India.
06.09.2006	Ugc/2006/00545/In/R	Famcyper 5EC	*Cypermethrin 5%EC*	AGROCHEM Co. Alexandria Egypt

Source: Department of crop Inspection and Certification, Directorate of Crop Resources, MAAIF - 2014

Annex 2: Information and Issues Raised During Consultations for ACDP

Dr. Mark Erbaugh – IPM CRSP in Uganda and Prof. Samuel Kyamanywa of Makerere University College of Agriculture	• **Vulnerability to Pests/Diseases** - Uganda is very highly vulnerable to pests and diseases; virtually every crop requires some form of pest management for its cultivation. One of the reasons is the country's location in the tropics which has a lot of food for pests in addition to the weather that favours the pests and diseases. For example, historically, the Coffee Wilt Diseases was a big problem. However, as it was being managed, the Twig Borer broke out. For cassava, the problem has been the cassava mosaic disease. Now the new challenge is the Brown Streak diseases. Therefore pests and diseases problems are endless. • **Economic Losses** – There is no latest literature on the economic losses caused by pests and diseases in Uganda. The only existing work was done by Peter Walker during the colonial days up to 1967. There has not been a serious need of doing serious loss assessment as effort has moved from understanding the pests and diseases to managing them i.e. if the stalk borer is there, go and kill it. • **Ongoing Studies** – the CRSP is currently conducting studies on the economic thresholds for crops based on different ecological zones including coffee. • **Need for IPM** – The ACDP is considering 5 crops i.e. coffee, beans, rice, cassava and maize; each requires different priorities and pest management styles. Therefore, there is need for IPM to address all of the problems. • **Information** – Agricultural information management in the country is still poor and investment is required to have such a system in place. • **IPM Knowledge** – Based on experience from a number of IPM studies in Uganda under the CRSP, weeds has been mentioned by smallholder farmers as a big constraint to farmers. The farmers have some knowledge on pests but know very little about diseases. In addition, as regards pests, the farmers are actually mainly familiar with the "big" pests. • **IPM Adoption Mechanism** – The 2 key strategies that have been tested in Uganda by the IPM CRSP in Uganda are the Participatory Rural Appraisal (PRA) and the Farmers' Field Schools (FFS). There is need to engage the farmers on each step of the pest/disease problem i.e. to identify the problem, at farm trials and then during evaluations. The PRA model includes organizing the farmers in small groups of say 5-20 and asking them about their important crops, the important constraints to production and the important pests and diseases. So such surveys are conducted to get quantitative data as well as its validation. In addition, the feasible controls are identified, the pests and diseases monitored and knowledge gaps identified. The PRA is important as it engages the farmers in conducting the surveys and is also a critical strategy in acquiring indigenous knowledge. However, it is a very intensive and expensive method and therefore may not be feasible for a project such as ACDP that is targeting the whole country. The other strategy is the "modified FFS" where framers are educated about the whole cropping system including basic agronomy and identification and management of pests. After that, the farmers are tested on what they have learnt and evaluations conducted. The FFS has been popularized in Indonesia and it is a very effective mechanism for IPM adoption. Unlike the typical FFS where the schools last a month or so continuously, what has been tested in Uganda are the "modified FFS" typically a week or once in a month.

	• **Constraints to IPM Adoption** – The farmers have been ignored for a longtime and don't know what to do. There is need for MAAIF or Government to show interest in what they (farmers) do. The farmers need to be trained to build their confidence. There is need to demonstrate to them and to make them participate. This can be done through village schools that can be run by extension staff to teach the farmers. • **Knowledge of Extension Staff** – Extension workers need training in areas of pest and disease identification, IPM and alternatives to pesticide use as well as in-service training i.e. new areas of science to help them do their job. In addition, there is need to redefine the role of extension workers. • **Pesticides Misuse** – There is need to sensitize the masses. An interesting example is the practice of spraying harvested tomatoes with fungicides to preserve tomatoes sold in markets in Uganda. **Research areas**: 5. There is need to conduct economic losses assessment to have a basis for prioritizing and targeting a particular pest or disease. 6. Economic Action Thresholds for the different crops. 7. Genetically Modified Organisms (GMOs) might be a solution to the existing pest problems and should be considered. 8. There is need for IPM packages for specific crops. **Recommendations on Research and Capacity** 1. There is need to build capacity of people capable of conducting quality agricultural research. Currently, there are only about 6-7 Agricultural Entomologists at PhD level (2 Entomologists and 1 Nematologist at MUK). Priority areas include entomology, plant pathologists and weed scientists among others. 2. There is need for MAAIF to engage MUK more in research. NARO should build clear collaborative research linkages with MUK to ensure stronger synergies. 3. There is need for consistence in research and therefore it is important that the good researchers in Uganda are paid well to ensure that they continue with their research work; otherwise if they abandon it and join other organizations or leave the country for greener pasture, then that will affect the continuity of research. 4. There is need for developments of transferring technology to the extension workers. 5. Few donors are willing to fund studies on the ecology and biology of pests. However the right thing to do is to spend money on studies or research to predict ways on how to deal with the pest and disease problems. 6. Research is a continuous process as pests and diseases change over time. You have to deal with residual populations. 7. Agricultural research has been underfunded by Government because the Government doesn't appreciate that agricultural research is actually a public good.
Tony Kiwanuka – ESIA Assistant at NEMA 16/1/2014	**Environmental Issues** • Rice mainly grows in wetlands; it is important to map out the sections of wetlands to be utilized; • It is important to involve the local leadership from the start of the project so

	as to understand the key concerns of the stakeholders; • It is important to obtain the required permits from NEMA for activities to be carried out in the wetlands; • It is key to identify the portions of wetlands to be utilized and what to be left for ecological purposes; • Overall, the project will require a detailed ESIA
NEMA Laboratory Officer 16/1/2014	**Laboratory Capacity of NEMA** • NEMA laboratory only conducts on-spot analysis using mobile equipment and typically sends samples that require advanced sampling to Government Analytical Laboratory (GAL) or to the Water Resources Laboratory in Entebbe; • Soil samples that require advanced analysis are usually sent to the Soil Science Laboratory at Makerere University; • NEMA sometimes monitors pesticide contamination specifically from flower farms and takes such samples to GAL; • NEMA received funding from the World Bank to equip laboratories including the PEPD laboratory which has capacity to analyze heavy metals and other inorganics. Next to be equipped will be the Water Resources Laboratory in Entebbe; • Overall, NEMA has an institution has limited laboratory capacity but has working relationships with other national labs that have the necessary equipment.
Edmund Kananura Quality and Regulatory Services Manager at Uganda Coffee Development Authority (UCDA) 16/1/2014	**Information** • Coffee Types - There are 2 types of coffee grown in Uganda i.e. Robusta (majority) and Arabica (20-30%); • Growing Areas - Robusta coffee growing areas are the low land areas (900 – 1300 m) that include Rukungiri-Ntungama to old Masaka to Buganda area to Bunyoro and Busoga and now even Northern Uganda areas. Arabica coffee is grown in the mountains i.e. Mt. Elgon areas of Mabale, Rwenzori, Kasese, Ibanda, Buhweju in Rubindi District, Rukungiri and West Nile areas in Paidha. • **Pests and diseases** – The sector is recovering from the shock impact of the Coffee Wilt Disease (CWD) that destroyed nearly 50% of the Robusta coffee in Uganda. • **Extension services** - The recovery has been through UCDA and research. UCDA has a production department and has divided up the country into 5 regions (Central, Eastern, Western, South-Western and Northern) each headed by a Principal Agricultural Officer. Each region has a number of Regional Coffee Extension Officers on that interact with farmers, carry out sensitizations and training and also gather information such as on coffee pests and diseases as needed by UCDA. In total, UCDA has only 28 Extension Officers for the whole country! • **Research** - UCDA has a working relationship with the Coffee Research Center at Kituza and 10% of the UCDA budget goes to the Center for coffee research purposes; • **Pests** – The biggest threats in the Country are the Coffee Wilt Disease and the Twig Borer. The twig borers used to be in low lands but due to climate change, they are everywhere and now attack either types of coffee. • **Management of pests and diseases** – Assessment studies are always done including field trials before full-scale operations against pests and diseases

	are conducted. When there is an attack, UCDA through collaboration with MAAIF and NARO conduct checks to establish the pest or disease's mode of attack, habitat etc. Then laboratory trials are conducted to identify the most suitable options. After that, demonstrations are then conducted to farmers in every coffee growing area on how to deal with the particular pest or disease. • **Varieties** – UCDA has been working with the Coffee Research Center at Kituza and over the years, 7 Coffee Wilt Resistant strains were developed. However, they had to be assessed for their commercial viability and aroma/taste. Only 1 strain met the two criteria which will proceed to the next stage of multiplication. UCDA intends to finance the production of 2 million seedlings of the resistant strain through tissue culture. The 2 million seedlings will be distributed to those local nurseries associated with UCDA for further multiplication and distribution. Commercial distribution of this resistant and commercially viable variety to farmers is expected to commence in 2015. • **Management of pesticides** – UCDA does not supply pesticides to coffee farmers. However due to issues of fake agrochemicals in the country, UCDA usually identifies a distributor of genuine pesticides in the region and advises the farmers to procure their agrochemicals from him or her. So, in principle, UCDA only tells the farmer, go to Shop X, he has the genuine pesticide. No direct involvement in the purchase of agrochemicals. • **Value chain addition** – Smallholder farmers dominate the coffee growing in Uganda; UCDA is encouraging farmer organization as part of its activities to ensure that the individual farmers form farmers' groups. UCDA gives the farmers support through extension services and free planting materials and also ensures that coffee nurseries are near the farmers in every district. UCDA is also teaching the farmers business skills on how to plan for the proceeds from coffee sales. UCDA also works with the existing cooperatives. UCDA is mainly concerned with regulatory and production issues and not marketing. The former coffee marketing board (CMB) is now fully liberalized. However UCDA also links farmers with buyers through exhibitions. • Value addition begins from the farm; anything done to the coffee after that is value addition. UCDA is promoting wet processing and international donors are helping establish coffee milling and washing stations. UCDA advises farmers on proper post-handling practices and also provides them with tarpaulins for drying purposes. UCDA also trains farmers in coffee grading. • UCDA also conducts pilot studies on value addition through collaboration with institutions of learning where students engage in research on projects such as coffee hulling. • **Training** – UCDA conducts the "Basic Coffee Quality Control" course every 2 years for university students and for the general public that involves tours. **Challenges faced by UCDA** • Funding – UCDA has limited funding to address all coffee issues across the country. • Consumption – Consumption of coffee in Uganda is very low; UCDA has embarked on training people in coffee brewing. Initially there were cases of some people actually roasting husks! UCDA is helping processors to develop coffee blends and brands. UCDA also holds competitions or brewers. As a result of UCDA's interventions, the quality of coffee served has greatly

	improved and has in the long run attracted more investment. The number of coffee brands has increased from 2% 6 years ago to 6%. **Recommendations by UCDA** • **Funding** – Extension services are currently very inadequate; UCDA recommends that Government to support and fund coffee extension services to fulfill the objectives of the national coffee policy. Since coffee is vital to the national economy, it is important for coffee as a sector to have particular of separate extension services. Every Sub County should have a coffee extension officer. UCDA currently has only 28 Coffee Extension Officers! • **Coffee planting** – There is need to plant more coffee in addition to rehabilitation of old plantations. Therefore, there is need for NAADS to work with UCDA to identify the priority areas for new coffee plantations or those that require rehabilitation; • **Pest and Diseases** – UCDA recommends that Government intervenes to address coffee diseases which should be timely. Where possible, the Government should provide free fertilizers and agrochemicals to the farmers. • **Quality of inputs** – Government should urgently address the issue of quality of fertilizers and pesticides as many on the market are fake or adulterated making fighting of pests and diseases a challenge. • **Consumption** – There is need for marketing and promotion to explain and address myths about coffee especially that "coffee kills". It is critical to sensitize the masses on the health benefits of coffee. Increased consumption will boost prices. • **Infrastructure** – The coffee sector needs the right equipment to help those investing in the sector. UCDA advises Government to eliminate taxes on coffee packaging materials that are expensive but are also taxed at 120%. • **Hygiene** – There is need for regulation of hygiene involving food products such as coffee. • **Factories** – UCDA requests that Government invests in a medium size factory for instant coffee.
Mr. Mugabi Assistant Commissioner Wetlands Management Department 17/1/2014	**Project Analysis** • The project's components are similar to the Water Management Development project under MWE since it has irrigation and access roads components. • The ACDP is among the projects listed in the Third Schedule of the National Environment Act Cap 153 that require conduct of ESIA. The project is probably category B under the World Bank categorization since significant environmental and social impacts are not anticipated under the project. • 3 of the components (inputs, irrigation, roads and value addition) will involve civil works; the impacts of the project should be identified depending on the phase i.e. construction and operation. **Project Benefits** • Irrigation schemes – Rehabilitating existing hydrologic structures will ensure water security and will increase food security through availability of water for crops as well as other production activities. Farmers will be able to be active throughout the year whether dry or wet conditions. In addition, reviving irrigation as a technology will increase the efficient use of water; rainwater can be collected and put into useful use. • Rehabilitation of the hydrologic structures will also stabilize the structure by

	guarding them against siltation and sedimentation. • Value addition – More profits are likely to be realized by the farmers through value addition which money can be used for alternative businesses. • Access Roads – This will allow farmers to safely access the markets as well as the social service centers in general. **Potential Negative Impacts** • Access Roads – If a dam or irrigation scheme was abandoned, then its former access road has to be opened up and could be currently under settlement. Therefore, it may require creation of a new access or opening up of the former access and you have to negotiate with the land owner. Both of these scenarios will trigger land disturbances as well as land acquisition or displacement issues. • Land uptake – The value addition infrastructure (maize mills, coffee hullers, storage facilities such as silos etc.) will require land and therefore land has to be negotiated. • Public health - Dust will be an issue especially from value addition structures such as coffee plants and millers. Dust for construction of access roads will also be an issue. • Water use – Water will be required for wetting road surfaces during construction; sometimes there are limited water sources in some areas and the contractor has to draw water from the same sources used by the community. This could lead to conflicts between contractors and the communities over water use. • Camps and value addition centers – Waste will be a challenge as such camps can increase the demand on local services in the respective localities. In addition, the social interaction at value addition centers can lead to spread of HIV/AIDS and increase prevalence rates in the areas. **Issues/Challenges** • Sanitation – There is need for the project to avail public toilets at the different irrigation schemes as many people are likely to join the rice schemes. There are currently no toilets at Dokho; where do the people go? Sanitation is very critical during the operation phase. • Dams – As per the ACDP, MAAIF claims that the project will involve "simple hydrologic structures" such as weirs and canals; how do you carry out irrigation minus a reservoir? If the existing reservoirs or dams are currently silted, then they have to be rehabilitated as well. • Land acquisition – Most Ugandans never consider increasing productivity per unit area but think increasing productivity is all about acquiring more land. The project may trigger encroachment on protected areas or increase deforestation in search of arable land. • Conflicts – The dams and reservoirs under ACDP are meant for crop agriculture; however, livestock people may pick interest in utilizing the same structures which could be a challenge in managing pests and diseases. • Inputs – The rice production trend in Eastern Uganda is that people have begun fertilizing the wetlands to grow rice. Issues of pollution of the wetlands have become a big concern. **Recommendations** • Environmental assessment – All the specific subcomponents of ACDP should undergo detailed studies i.e. ESIAs. There is need for a detailed

	ESMP for the project to guide its implementation. The ESIA and ESMF should conduct stakeholder analysis and clearly define the roles and responsibilities regarding the ACDP. The ESMF should also include a dummy for the ToRs of the ESIAs. • Sensitization on productivity enhancement - There is need to educate the farmers on how to enhance productivity per unit area to mitigate the need for new land i.e. by a combination of utilizing high quality seeds, use of fertilizers, protection of crops from pests and use of irrigation to achieve high yields. • Project subcomponents – Since ACDP is considering sustainability, it should include afforestation by providing seedlings to farmers to plant trees to enhance the soil's productivity and to improve upon environmental protection.
Ongol Joseph Wetlands Management Department 16/1/2014	• How many people are going to be employed under the irrigation schemes in the wetlands? • Sanitation has been an issue as some rice schemes involve thousands of people utilizing the wetlands; some people actually defecate in the wetlands; • Hydrology – How will the project ensure that the ecological functions of the wetlands are not drastically affected? In Olweny, some fields dried up and the volume o the water in the streams declined. The detailed studies (ESIA) should give mitigations to address the challenges; • Much of the water that moves through the wetlands comes from the catchment; how do we ensure that the nearby springs and wells do not dry up? Wells need water; how do we balance the water needs? • Conflicts – People who have been grazing in or near the wetlands may be against conversion of the wetlands into rice cultivation; • Ecology – How do we ensure that the frogs, birds, and other rodents remain in the wetlands? Birds can clear rice fields and rodents can uproot young seedlings; so how do you find the balance? • Agrochemicals – Communities downstream of wetlands utilize water for drinking and for livestock; how do we ensure food safety e.g. of beef for consumers? Contamination of the food chain has to be considered; • Some families use their children to scare away birds; the new schemes may be a disadvantage to education in the respective areas. If the schemes are profitable, children may abandon education and venture into rice cultivation. How do we find a balance not to affect education? • Increased revenues from rice will mean big chunks of money which may motivate men to marry more women which may lead to collapse of families in addition to HIV/Aids issues; • Rice being a commercial crop may be a motivation of farmers to abandon other essential food crops; issues of food security have to be assessed? • Gender issues – In Agor wetland in Lamwo, opening up of land is by men while weeding, harvesting and threshing is done by women. The children are supposed to scare away birds. However when it comes to selling, men typically do it alone under pretense that they have the energy to transport the rice on bicycles to the market. In the end, the women have no powers over the proceeds. These issues need to be addressed to ensure that women equally benefit from the project; • Invasive species – seeds are not always sorted prior to sowing and some of these seeds contain invasive species which can colonize and occupy the entire wetland. Mitigations on how to ensure invasive plant species don't get

	into the wetlands have to be proposed; • Silt – A lot of silt materials are accompanied with opening up of drainage canals; it is important to ensure that the soil retaining capacity of the wetlands is enhanced; • Sustainability – Schemes collapse after some time due to funding among others; as the schemes collapse, they do along with the ecological and hydrological functions of the wetlands. Olweny 3 in Lira collapsed with both the ecology and hydrology of the wetland as people invaded the wetlands when the scheme collapsed. The project was handed over to the district which had no money and also abandoned the scheme. At one point, the scheme actually belonged to nobody. Therefore, there should be mechanisms to ensure if the project ends, the ecological and hydrological functions of the wetland are maintained. The project should build capacity of the districts to handle the project. There has to be transition when handing over the schemes to the districts. • How long is the project? If to be handed over, to whom? Are local governments well equipped to take over the projects in due course? Do they have agricultural officers to handle the projects? • If the project affects water quality, what action will be taken and who takes it? Analysis and monitoring – at what period or frequency? Who takes action on the results? • Crops – What is the basis of the crops selected for cultivation in the wetlands? In some cases, onions have been more profitable than rice such as in Olweny. The choice of crops and their impact on the wetland ecology should be assessed taking into account the types of crops preferred by the farmers themselves; • Wetland use permits – There are procedures for use of wetlands. Anything beyond ¼ of an acre requires the intended user to apply for a Wetland User Permit to the District Environment Officer (DEO) by filling an application form. The DEO then sends the application to the District Environment Committee which either approves or disapproves the application. If approved, the applicant is also required to prepare a detailed Project Brief that is sent to NEMA for review. NEMA seeks input or comments from stakeholders and where satisfied issues a Wetland User Permit. Typically, a full ESIA is not required. However if the use o the wetland involves components like dams, milling etc., then a full ESIA report is required. If say 10-20 people intend to utilize the wetland, a Project Brief should be adequate. However if it is a scheme of many people, them it is likely that modifications of the wetland will occur and therefore the need for detailed assessments (i.e. full ESIA). Audits are required every 2 years to provide information on how much the wetland has been impacted and to verify if the mitigations have been put in place; • The Wetlands Management Department also reviews the Project Briefs or ESIAs and conducts both monitoring and enforcement to ensure that the wetlands are not degraded. • Capacity – The Wetlands Department has human resource constraints especially as regards field compliance monitoring and enforcement; it requires more staffing.
Richard Kyambadde – Wetlands Department	• Irrigation sites such as Mubuku have been encroached upon; initially a small number of people utilize a wetland but in the end more people occupy the wetlands and even take up plots for homes in the long run;

	• If farmers are interested in utilizing a particular wetland, land acquisition or wetland use is permitted by the District Local Government. The Wetlands Department however guides the use of such wetlands. There is a minimum area of wetland use that requires assessment before a decision on its use is reached; • There are challenges in monitoring wetland use in Uganda as environmental audits of wetlands underutilization are very rare; • Rice has been grown in many wetlands without conducting any ESIAs which is a critical issue; • Wetlands are not agricultural land unless modified; • The challenge with pesticide use in crops cultivated in wetlands is that you are dealing with water-logged; so there is potential of direct contact between the pesticides and a threat of accumulation of these agrochemicals and therefore toxicity and pollution issues may arise; • There is high risk of contamination of ecosystems and related systems i.e. lakes and rivers; • It is the mandate of NEMA to ensure that audits are conducted to follow-up wetland use permits to verify compliance with conditions of approval; not sure if audits for agricultural projects are being conducted.
Kiryandongo District	
Sekamatte Stephen Ag. District Commercial Officer/Agricultural Officer- Kiryandongo District Busingye David- Senior Probation Officer - Kiryandingo	• Common pests and diseases of maize in the district include the following; Maize Stalk borer, maize streak and smat. The witch weed (Striga) is also very prevalent in the district. • Maize lethal necrosis is a threatening disease though not yet in Kiryandongo, its common in the Busoga districts, therefore can easily be introduced to Kiryandogo. • Management is by use of insecticides like Ambush, tarfgor, Duducyper, Dimethoate. • To control maize striga, farmers are usually advised to plant early, practice crop rotation, other just apply fertilizers to boost growth and allow the maize compete favorably with the weed. • Farmers are encouraged to use all possible methods of pest management, cultural methods are predominantly used like burning, crop rotation, mulching, and early planting. • Training in Integrated Pest Management has not been seriously under taken by the extension staff, however, to help farmers further manage pests and diseases, this project (ACDP) should set up Integrated Pest Management Demos at every parish. • The use of chemical in managing pests and diseases is very limited. • Farmers do not consider the loss due to pests especially the maize stalk borer as significant; as such they hardly manage it. • In Kenya striga is managed by use of Imidazolinone Resistant maize (IR Maize). This maize is pretreated with a chemical, it's resistant to striga. • Annual loss of the maize crop due to pests and diseases in the district is not known. Data on annual production in the district is scanty since it's not collected regularly. The ratio of extension workers to farmers in the district is 1:1000. There are 7 NAADS extension workers (Crop), 1 DAO and 1 AO. Lack of transport is the biggest challenge face by the extension workers • The extension workers are supposed to collect data on crop production from the field, conduct monitoring and surveillance of diseases in the

	fields, training farmers in good farming practices etc. • The District Agriculture Officer is supposed to report to the Ministry twice every year on any disease outbreak. In case of an outbreak in the district, there is a grant, the Production and Marketing Grant (PMG) to handle such emergencies, 45% of this grant is spent on training farmers, while 55% is channeled to capital developments like establishing demonstrations. • Storage facilities for the maize include traditional cribs, (Handles 400-600Kg) modern cribs (1000Kg-3000Kg) and stores. However, if possible the project should introduce warehouses at village level which are managed by the farmer themselves in their established structures. Currently, farmers are in groups but do not process their produce nor store it collectively. Middle men have exploited this loophole to exploit the farmers. Such facilities will help farmers to attract better prices for their produce at the right time. • The common land tenure system in the district is customary • Agrochemicals used by the farmers are supplied by the local drug dealers in the towns and trading centers. They are licensed by the respective lower local governments. Regulation of fake agrochemicals on the market is not done since the district does not have the expertise to do so. • Farmers have complained about fake seeds and agrochemical on sale in the district. Some drug shop operators are not trained or completely illiterate, they instruct farmers wrongly. • In response to the farmers' outcry, the district has embarked on formulating an ordinance for controlling the sale of agrochemicals and other farm inputs. The draft ordinance is out and will be sent to the solicitor general for review before it's passed by the district council. We request that the project (ACDP) supports the implementation of this ordinance. **Training needs recommended under this project include;** o Value addition skills; o Use and handling of agrochemicals; o Gender and environment mainstreaming in the agriculture
Gift Grace- Agro-Chemical Shop operator (Mo-AgroLinK-Kiryandongo) Opio Sam Oceng – Cassava farmer	• The owner of the business is trained in Agricultural management but the operator is not trained, she holds an ordinary certificate in education and without any specialized training in handling and management of agrochemicals. She was trained on job by the owner. • There is no supervising authority and the sale of fake chemicals is not checked in any way. The town council issues trading license to the drug shop but is not bothered of what is sold. • Expired drugs are taken back to the supplier but only when picked by the supplier, hence they continue to be displayed in as long as they have not been picked by the supplier. • PPE are available in the shop but are hardly bought by the farmers, farmers rarely use them while applying the chemicals. • Chemicals usually stocked for maize growers include the following; o Ambush (insecticide) o Supagro (Growth booster)

	○ Rapid gro (Growth booster) ○ Booster (Growth booster) ○ NPK (Fertilizer) ○ Urea (Fertilizer) ○ DAP (Fertilizer)
Apac District	
Ojok George Johnson – District NAADS Coordinator, Apac	• There are 11 sub counties in the district and 33 NAADs extension workers. Only 11 of these have means of transport (Motorcycle). • The road network is still very poor, there only foot paths to most cassava gardens • Common pests and disease of cassava include the following; ○ Cassava brown streak virus ○ Cassava mosaic virus • Pests are insignificant, annual loss due to pests and diseases is approximately 5%. • Disease management practices include; timely weeding, controlling the movement of planting materials • Farmers have been encouraged to plant recommended species/varieties, for example, NASA14 which is resistant to the cassava mosaic has been adopted by all farmers in the district. • Disease surveillance and monitoring is done by the district staff who in turn report to the zonal Agricultural Institute in Lira. There is a technology link officer and several researchers who are attached to Namulonge Agricultural Research Institute. • A few farmers were given 'seed' cuttings and trained in multiplying them. They have multiplied enough cutting to supply all farmers in the district and have now resorted to selling the excess cuttings to South Sudan. • Use of pesticides is not there at all. • Biggest challenge is post-harvest losses; farmers should be assisted to minimize the losses they incur especially in the process of drying. If possible this project should look at providing cassava slicing machines, solar dryers and processing and packaging plants. • There are no specially designed stores for the dried cassava; most of it is stored in the farmers' houses. • There is a need to establish stores for each farmer group (cluster) so that the cassava is marketed collectively. • The annual loss attributed to post harvest handling alone is at approximately 20%. • Farmers have organized themselves into groups and do market their produce (cuttings and dry cassava) themselves. • Training needs identified for the district staff include; ○ Training in post-harvest handling of cassava ○ Training in agronomic practices ○ Training in value addition ○ Soil and water conservation/management
Lira District	
Alum Dorcus – Senior Agricultural Officer Otim Ayita -	• There is more paddy rice than upland rice. • There are no agrochemicals used, only to a very limited extent, some farmers have started applying fertilizers. Generally, the soil quality is deteriorating as evidenced by the declining yields. The proposed project should put some emphasis on soil management and use of fertilizers.

Agricultural Officer Oder John – Farmer Ojom Opero- Farmer	• Water quality monitoring is not conducted but since the use of agrochemicals is very limited in most wetlands in the district, it is assumed that the water quality is unchanged. However, major pollution sources are from human wastes. There are no sanitary facilities close to the paddy fields. • Snails exist in the paddy fields but the district has not received any cases of Bilharzia • Challenges faced by farmers include; o Lack of pure rice seeds o Lack of adequate water for the farmers downstream, the irrigation canals have become silted over time and the water flow downstream is greatly hampered. These canal need to be desilted to allow free and faster movement of water. As a result of the water not flowing freely, some fields upstream have ended up flooding. Ideally, these canals are supposed to be desilted at least once every 5 years. Desilting is labour intensive and cannot be done by the farmers themselves. They require an excavator which is expensive for the farmers to acquire. However, the farmers have tried on their own to desilt the smaller canals. o Rice yellow motto virus. This virus does not attack upland rice. For the paddy rice farmers, NERICA46 is resistant to the virus and is therefore being promoted in the district. o Poor water management within the paddies, denying downstream users of the right quantity required for their rice. At times all the water is utilized by the farmers upstream. • The soils are deteriorating in quality and therefore there is need for application of fertilizers. Some farmers have started applying fertilizers while others still perceive it as an extra production cost. • There is need for decentralized seed supplier who can easily be monitored by the district or any other competent authority. • If the project intends to provide seed and other inputs, these should not be given free of charge to farmers, they need to contribute something which will employ them to develop a sense of ownership of the project. • Training needs identified for the extension workers include; o Quality seed production; o Irrigation and water management; o Post-harvest handling • Division of labour in rice growing o Nursery preparation- Done by Men o Field preparation- women and men o Weeding (Broad casted rice)- Women o Weeding (Planted in rows)-men and women o Bird scaring- Children and women o Harvesting- women but a few men participate o Transportation from the fields- men o Drying-Women o Bagging- men o Selling/Marketing- men
Ntungamo District	
Atwine Esther- District Agriculture Officer	• The coffee here is intercropped with bananas mostly, the bananas provide good shed for the coffee trees as well as mulch. • There 30 coffee processing machines distributed all over the district but the

Mugume Peter – Farmer Mwesigye Elias John-Farmer Tutemberwe James – Agrochemical Dealer	demand is still there for more machines and farmers are willing to provide land for their establishment. Farmers don't sell unprocessed coffee (Kiboko) because it fetches less money. Some middle men have established coffee stores in the villages where they buy and keep unprocessed coffee at low prices from farmers. • Though the bananas contribute tremendously to farmers' daily income, the coffee is valued more by the farmers because it contributes to capital development in the homes. Farmers use proceeds from coffee to construct houses, pay school fees while the proceeds from banana usually go to food items and other consumables like paraffin. Common pests and diseases include the following; o Black trig borer o Coffee wilt; this has now been managed by intercropping with the bananas, planting resistant varieties. Other pests and disease management interventions under taken by the district include; o Sensitization of farmers on good hygiene o Use of cultural control methods like destroying infected plants or parts o The use of pesticides is very limited in the district because most coffee farmers subscribe to the Abategenda Farmers Association which deals in organic coffee. Actually 80% of the farmers in the district belong to this association. • There is no laboratory for crops but there is a mobile plant clinic operated by the district. The clinic operates in the weekly markets (auctions). The clinic comprises of a plant pathologist and 2 assistants. Farmer who come to the markets carry samples of diseased plant parts to the pathologist who in turn identified the disease and also recommends the appropriate intervention. The clinic is a very effective way of advising farmers on diseases control and management but it also has its own challenges; • There are only 3 trained pathologists, and yet many markets operates on the same days, hence the clinic cannot be in all markets at the same time • They all don't have a vehicle to carry their equipment (Tent, chair, seats, microscope etc). Hence their movement is limited to only those nearby markets • Farmers who don't subscribe to the Abetagenda Association (who use inorganic chemicals) buy their agrochemicals from the local drug dealers. • Usually, insecticides are applied on the coffee targeting the borers. The use of insecticides is only once a year when the berries are ripe. • All the agrochemical shop operators have been trained by Uganda National Agro Dealers Association (UNADA) in handling agrochemicals. The District Agriculture Office inspects these shops but their certification is by UNADA • In many households, the pump used for spraying cattle is also used to spray coffee and there is no use of any protective equipment apart from gum boots. • Coffee seedlings are distributed by certified nursery operators. The actual purchase of the seedlings is by either the NAADs programme,

	Uganda Coffee Development Authority or the area members of parliament. It's the farmers' responsibility to look after the seedling right form the nursery where he has picked it from to the farm until it matures. There have been cases of untimely distribution of the seedlings by some nursery operators, where seedlings were distributed during the dry season and they all ended up drying at the farmers homes. The nursery operators should liaise with the district agriculture officer to advise them on the right planting seasons. **Challenges** o Inadequate facilitation to the extension workers; in terms of allowances, transport and field kits, especially for disease control and monitoring; o There is tremendous loss due to post harvest handling, farmers lack drying facilities; wet processing machines have been suggested but they are expensive for the farmers; o Lack of general farm inputs; o High post-harvest handling losses; o The farming is purely rain fed; irrigation is possible since there are several streams with plenty of water. Irrigation canals can be constructed from these streams and the water taken to the coffee plantations • The common land tenure system in the district is customary, on average; every household owns 2.5 acres of land. • There 21 sub counties in the district and 63 extension worker, therefore each sub county has 3 extension workers • Training needs for the staff include the following; o Training in pests and disease management; o Coffee management skills o Post-harvest handling o Soils conservation and management
Kabale District	
Kasimbazi James- District NAADs Coordinator Tusingwire Hilary – AASP Masanyu Justus- Sub county NAADs Coordinator Zatwoshaho James- Farmer	• The climbing beans are predominant here as compared to the bush beans because of their tolerance to diseases **Challenges faced by farmers;** o Lack of quality seed; there is limited access to improved varieties of seeds o Poor management skill by farmers, for example, intercropping beans with peas o Declining soil fertility o Technology adoption by farmers is still very low, they tae long to take on new things o High prices of the seed o Farming is subsistence and not mechanized due to the terrain o Declining soil fertility and therefore declining production and productivity o Weeding is done late at times hence the low productivity o Low application of Integrated Pest Management approach

	○ Pests and diseases; Common ones include; ▪ Bean root rot (fungal) which also reduces soil fertility; ▪ Bean anthracnose ▪ Bean wilt ▪ Bean rosett (viral) ▪ Black aphids ▪ Green aphids ▪ Macro pests like rats which can clear a whole garden • Generally the use of agrochemicals in bean production is not encouraged in the district because of the likely residual effects of the chemicals. The use of fungicides has just started and the economics involved is being studied by the farmers. Insecticides like agrothoate are commonly used to control aphids. • Surveillance and monitoring of diseases is by the extension workers who routinely report to the district. Cases of unknown diseases are taken to the nearest NARO laboratory at Kachwekano research Centre. However, this laboratory is also poorly equipped and under staffed. • Framers are encouraged to improve soil fertility with manure; • Integrated pest Management is not so pronounced in the district, but some farmers growing climbing beans intentionally release chicken into bean gardens to pick the aphids, moths and butterflies. • Post-harvest handling is still a big challenge to farmers. Some farmers shell their beans right in the gardens and on bear ground. A lot of beans are left in gardens as result of this method of shelling. • Because of the terrain, farmers who opt to move their beans home carry them on their heads, in the process losing a considerable amount between the garden and home. • While at home, the unshelled beans are kept and dried on bear grounds, a few farmers who can afford dry their beans on turplines. Solar driers are highly recommended. • Farmers don't have proper storage facilities; beans are kept their houses in baskets, bags, other on the flour. If possible, cylons should be constructed for farmers who in groups. Such cylons should be centrally placed so that all farmers can easily access them, store and keep record of the quantities stored. These same groups can later on look for better markets for their produce. Such an arrangement will also encourage farmers to start sorting their beans. Currently few farmers go through the rigor of sorting. • Involvement by gender ○ Men own the land ○ Women do more of the tilling, land preparation disease and pest management, harvesting, and winnowing. ○ The males do carry the harvested beans to the homes and also do the selling. **Recommendations** • Enhance soil management practices; extension staff should be equipped with simple soil testing kits so that the y advise farmers from an informed point of view;

	• Training of staff and farmers in soil and water conservation; • Metrology department should avail correct information/right predictions of the rains so that farmers are advised to plant at the right time; • Training of farmers in and staff in minimizing post-harvest losses; • Establish storage facilities near to farmers, where their can collectively store and market their produce.