REPUBLIC OF RWANDA

RWANDA AGRICULTURE BOARD

SUSTAINABLE AGRICULTURAL INTENSIFICATION AND FOOD SECURITY PROJECT

INTEGRATED PEST MANAGEMENT PLAN

FINAL REPORT

April 2018

EXECUTIVE SUMMARY

Agriculture is the backbone of Rwanda's economy, accounting for about 33 percent of GDP, 72% employment, and 25% of all exports. The total arable land in Rwanda is slightly above 1.5 million ha, 90% of which is found on hillsides. The agriculture sector faces several challenges: (i) a binding land constraint that rules out intensification (bringing more and more land under cultivation); (ii) small average land holdings (more than 60% of household cultivate less than 0.6 ha and 15% of rural farms less than 0.1 ha); (iii) poor water management (uneven rainfall and ensuing variability in production); (iv) the need for greater (public and private) capacity from the district to the national levels and insufficient extension services for farmers; and (v) limited commercial orientation constrained by poor access to output and financial markets. Without the option of continuous intensification, agricultural intensification must take place in the context of a potentially fertile, but challenging physical environment.

Various agricultural projects aiming at increasing the agricultural productivity both in the marshlands and hillsides were implemented over the past 15 years by the Ministry of Agriculture and animal Resources (MINAGRI). The Rural Sector Support Project (RSSP) and Land Husbandry, Water Harvesting and Hillside Irrigation Project (LWH) are among the projects which boosted the country's economy. Despite substantial growth in agricultural production over the past 10 years, food security and nutrition remain a concern, especially when looking at the vulnerability to shocks at the household level.

The Government of Rwanda through the Ministry of Agriculture and Animal Resources and the World Bank are preparing the implementation of the Sustainable Agricultural Intensification and Food Security Project (SAIP) to increase agricultural productivity, market access and food security in targeted areas across the country. It will receive funding from the World Bank and will focus on 8 LWH and RSSP3 sites, including Muyanza, Rwamagana 34, Karongi 12, Karongi 13, Kayonza 4, Nyanza 23, Gatsibo 8, and Nyabihu and will target 2,500 Ha.

SAIP has triggered the World Bank's Operational Policy on Pest Management (OP 4.09) which is a safeguard policy for the promotion of safe use of pesticide and integrated pest management (IPM). This policy implies the preparation of a Pest Management Plan (PMP) to include the adoption of IPM and safe use of pesticide during the implementation of SAIP. The objective of the current assignment is to prepare

the pest management plan for SAIP in line with World Bank's Operational Policy on Pest Management (OP4.09) and local regulations on chemicals use.

The SAIP development objective is to increase agricultural productivity, market access and food security in targeted project areas. It will be implemented through three technical components: (i) institutional strengthening, nutrition improvement and agriculture productivity enhancement; (ii) market linkages, value addition and access to finance; and (iii) Irrigation and water use efficiency and utilization.

The PMP under SAIP will focus on intensification of 13 target crops namely maize, irish potato, climbing bean, vegetables (onion, tomato, sweet pepper, chilli, French bean) and fruits (avocado, watermelon, papaya, tree tomato, passion fruits).Main pest and diseases problems on these crops were discussed in the report. Major pest problems under Rwandan condition mainly include diseases, insect pests and vectors. While the major diseases of Irish potato, tomato, tree tomato and passion fruits need fungicides for their control, the major diseases of other target crops do not require pesticides, they can successfully be controlled by IPM strategies.

The current IPM practices commonly applied by the majority of farmers in Rwanda include a combination of cultural practices, resistant varieties and pesticides. The pesticides application is limited to crops of high value like tomatoes, Irish potatoes, rice and coffee, etc, while pest management in staple crops like bean, maize depends mainly on cultural practices and resistant varieties.

The SAIP will promote among the target crops the use of IPM and where necessary the safe use of pesticides as a component of IPM approach. The use of resistant varieties and cultural practices (crop rotation, weeding, removal of affected plants, etc) will be supported and pesticides will continuously be used on Irish potato, tomato, tree tomato and passion fruits. The use of pesticide on other target crops will be very minimal depending on scouting of field damage, but it will generally be reduced or avoided without any significant yield loss. However, it will require close monitoring and capacity building of farmers on safe pesticide use and IPM strategies.

SAIP will finance the PMP activities in the project areas on all target crops. The PMP activities will include (i) training farmers in improved production technologies to produce healthy plants, (ii) Training on life cycle of pest and diseases, (iii) Pest distribution mechanisms (movement from place to place) for major pests and diseases, (iv) pest and diseases impacts on productivity, (v) development of different

control methods, (vi) promotion of safe use of pesticides and (vii) integrated pest management for each crop and monitoring programme.

The project will be implemented by Rwanda Agriculture Board (RAB) under the Ministry of Agriculture and Animal Resources (MINAGRI) and RAB/SPIU will coordinate the PMP implementation at national level. The Project and participating Districts will coordinate it at subproject level. The farmers, grouped in Self Help Groups (SHGs), zones and cooperatives will be responsible to learn and implement IPM tools in the pest war. The Monitoring of the implementation of this PMP will be carried out by RAB/SPIU, REMA and all key implementing institutions of the project (Districts and farmers organizations).

The SPIU SAIP has enough capacity to implement Project activities. The safeguards team at the SPIU is made of 3staff (2 Social safeguards specialists and 1 Environment specialist) who have been overseeing the overall issues related to safeguards in the LWH and RSSP project sites. The existing SPIU safeguards team will be repositioned to RAB under the new institutional arrangement and there is no doubt they will still execute the same responsibilities for the implementation of SAIP.

After the clearance of this PMP by the World Bank, the Government of Rwanda through MINAGRI will locally disclose it and will authorize the Bank to disclose it through its external website. The estimated budget for SAIP PMP implementation is US $ 231,000.

Given the nature of the project, the potential adverse impacts associated with pesticides use are minimal and can be managed through proposed mitigation measures in this PMP. Successful implementation of this PMP will depend to a large extent on the involvement and participation of local communities. It is recommended that awareness and capacity building on IPM and proper use of pesticide be organized mostly to extension staff, cooperatives and farmers.

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ABBREVIATIONS AND ACRONYMS

FAO : Food and Agriculture Organization

GDP **:** Gross Domestic Product

GIS **:** Geographic Information System

GoR **:** Government of Rwanda

GPS **:** Geographical Positioning System

IPM : Integrated Pest Management

LWH **:** Land husbandry, Water Harvesting and Hillside irrigation Project

MDG **:** Millennium Development Goal

MINAGRI **:** Ministry Of Agriculture and Animal Resources

MINALOC **:** Ministry of Local Government of Rwanda

MINECOFIN **:** Ministry of Finance and Economic Planning

MINICOM **:** Ministry of Trade and industry

MIS **:** Management Information System

MSME **:** Micro Small and Medium Enterprises

NAP **:** National Agriculture Policy

NGO : None Government Organization

PDO **:** Project Development Objective

PMP : Pest Management Plan

PSTA **:** Plan Stratégique pour Transformation d'Agriculture

RAB **:** Rwanda Agricultural Board

RSB **:** Rwanda Standards Board

RSSP : Rural Sector Support Project

SAIP **:** Sustainable Agricultural and Intensification and Food Security

WB **:** World Bank

CHAPTER ONE: INTRODUCTION

1.1General Context

Rwanda is a small landlocked country, with arable land estimated to be 48 percent of the total area of 26,338 km2 with a population of 10.7 million (2012). It has achieved impressive growth and poverty reduction over the last decade. Its economy has grown at 7.9% per year since 2000 and its gross domestic product (GDP) per capita has increased from $242 in 2000 to $729.The poverty has fallen from 60.3 to 39.1% during that period.

Agriculture is crucial for Rwanda's economic growth and reduction of poverty. The 2015 report showed that the agriculture accounted for about 33 percent of the gross domestic product (GDP) and contributes to 35 % of the total decline in poverty rates over the past decade. Also, about 70 percent of population is engaged in the sector. It is also a major source of export earnings, and exports of agricultural and agro-processed goods were roughly 52 per cent of total goods exports.

Various agricultural projects aiming at increasing the agricultural productivity both in the marshlands and hillsides were implemented over the past 15 years by the Ministry of Agriculture and animal Resources (MINAGRI). The Rural Sector Support Project (RSSP) and Land Husbandry, Water Harvesting and Hillside Irrigation Project (LWH) are among the projects which boosted the country's economy.

Despite substantial growth in agricultural production over the past 10 years, food security and nutrition remain a concern, especially when looking at the vulnerability to shocks at the household level. While stunting and undernourishment have been reducing at a steady pace, overall stunting rates remain high by international comparison (38 per cent), and 17.8 per cent of the children between 6 and 23 months old do not meet the minimum acceptable diet. By the CARI measure, 20% of Rwandan households are food insecure. The Food Consumption Score has improved from 65 per cent in 2006 to 74 per cent by 2015 but a large share of the population remains dependent on rain-fed agriculture and auto-consumption. Hence, people's ability adequately to feed themselves is vulnerable to shocks to the domestic harvest such as periodic droughts and floods. Consequently, food security and nutrition remains important areas to which agriculture development can contribute.

The Government of Rwanda through the Ministry of Agriculture and Animal Resources and the World Bank are preparing the implementation of the Sustainable Agricultural Intensification and Food Security Project (SAIP) to increase agricultural productivity, market access and food security in targeted areas across the country. The Project will focus on consolidating and expanding results obtained in the Bank funded projects, Land Husbandry, Water Harvesting and Hillside Project (LWH) and the Third Rwanda Sector Support Project (RSSP3), and other selected MINAGRI developed schemes. It will receive funding from the World Bank and will focus on 8 LWH and RSSP3 sites, including Muyanza of Rulindo District in Northern Province; Rwamagana 34 of Rwamagana District, Gatsibo 8 of Gatsibo District and Kayonza 4 of Kayonza District in Eastern Province, Nyanza 23 of Nyanza District in Southern Province and Karongi 12 and Karongi 13 of Karongi District, and Nyabihu of Nyabihu District in Western Province. However, the list of sites may expand during the SAIP implementation as needed by the GoR. The map showing the project sites per Province is presented below:

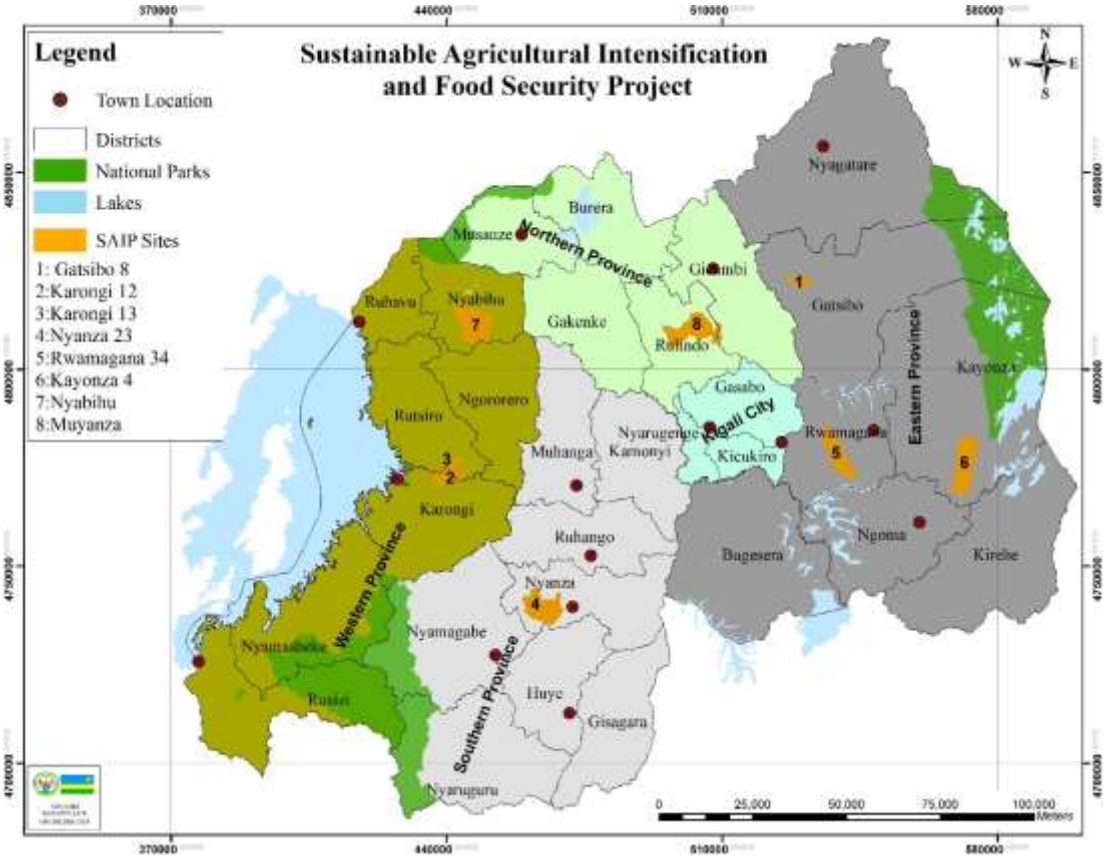

Figure 1: Project Sites per Province

The crops targeted by SAIP are maize, climbing bean, Irish potato, vegetables (tomato, onion, sweet pepper, chili and French bean) and fruits (watermelon, papaya, avocado, and passion fruit and tree tomato) and will target 2,500 Ha.

SAIP has triggered the World Bank's Operational Policy on Pest Management (OP 4.09) which is a safeguard policy for the promotion of safe use of pesticide and integrated pest management (IPM). This policy implies the preparation of a Pest Management Plan (PMP) to include the adoption of IPM and safe use of pesticide during the implementation of SAIP. The objective of the current assignment is to prepare the pest management plan for SAIP in line with World Bank's Operational Policy on Pest Management (OP4.09) and local regulations on chemicals use.

1.2 Project Description

1.2.1 Project Development Objective

The SAIP development objective is to increase agricultural productivity, market access and food security in targeted project areas.

1.2.2 Project components

SAIP will be implemented through three (3) technical components and one Project Management and Technical Assistance Component. The technical components include (i) institutional strengthening, nutrition improvement and agriculture productivity enhancement; (ii) market linkages, value addition and access to finance; and (iii) Irrigation and water use efficiency and utilization. The project components are detailed below:

Component 1: Institutional Strengthening, Nutrition Improvement and Agriculture Productivity Enhancement

The objective of this component is to "strengthen farmer organizations' and other Institutions for increased agricultural productivity and household (HH) nutrition". This component will have three sub-components: sub-component; 1.1 will build on and further strengthen the existing farmer organizations including self-help groups, zones, cooperatives, water user association and farmer unions; youth and women groups; and other organizations; sub-component 1.2 will focus on Agriculture Productivity Enhancement, and sub-component 1.3 will focus on strengthening household nutrition.

Sub-Component 1.1. Strengthening Farmer Organizations and Other Institutions:

The following activities are proposed to be implemented under this sub-component:

At the outset, an enterprise capacity needs assessment of Farmer Organizations will be carried out to help them transform into dynamic, successful and sustainable enterprises. Accordingly, capacity building, vocational enhancement and skills training of farmer organizations will be carried out through three training streams of (i) Organizational Development, (ii) Technical and (iii) Entrepreneurial.

The project will have a special emphasis on vocational training, skills enhancement, business planning, buying and selling in the market, market analysis, financial planning, inventory and stock checking, understanding input cost and pricing, accounting and book keeping, dealing with middlemen, traders, retailers and wholesalers, quality control, hands on support for the selected business, training in extension services, training in kitchen gardening, back yard poultry, management and upkeep of small livestock, vaccination, preparation of nutritious food menu, preparation of nutritious meal. Special effort will be made to ensure participation of youth and women groups effective participation.

Sub-Component 1.2 Agricultural Productivity Enhancements:

It was agreed that the project will carry out analysis of select value chains on needs basis for a deeper understanding of productivity constraints, potential and opportunities so that the limitations and barriers could be addressed and the available potential could be harnessed to the fullest. The interventions will include but not limited to : (i) maintenance and expansion of land husbandry and climate smart agriculture interventions; (ii) establishment of demo plots, green houses, tunnel farming etc.; (iii) use of ICT for productivity enhancement; (iv) adoption of improved farm implements; (v) adoption of appropriate technology, especially for female farmers; Support inputs supply (including improved/bio-fortified seeds, fertilizers, pesticides, etc); (vi) support seed production, multiplication and storage (vii) climate smart agriculture interventions; (viii) preparation and utilization of compost; (ix) appropriate application of fertilizer and pesticide; and (x) introduction of standard operating procedures (SOPs) and protective gear for application of fertilizer and pesticides. Modalities of co-financing by beneficiaries for these activities will be further detailed during pre-appraisal.

Sub-Component 1.3 Household Nutrition Improvement:

The sub-component aims to significantly improve nutrition status of selected households:

(i) The key intervention will include Behavior Change Communication (BCC) for improved nutrition, Social marketing campaigns, radio programs, ICT messages, media, cultural activities (e.g. theater, songs, music); promotion of local food based dietary guidelines and healthy cooking menu /demo meals; promotion of nutrient-rich crops and animal proteins sources; kitchen garden demos and provision of bio-fortified seeds; promotion and distribution of poultry and small livestock. The mission agreed to finalize the criteria for provision of bio-fortified seeds, poultry and small livestock, and beneficiaries' contribution during pre-appraisal.

(ii) The mission agreed that the project will not pursue the proposed activities of fish farming in existing dams based on high dam safety risks, and food safety risks related to fishing without proper cold chain or water access in rural households in the project's targeted areas.

(iii) To attain maximum impact the project will work very closely the Bank Funded Stunting Prevention and Reduction Project which is under preparation and other government initiatives. To the extent possible, especially in the three districts where both projects are likely to have a presence, every effort will be made to complement the interventions so that any duplication could be avoided and benefits could be multiplied.

Component 2: Market Linkages, Value Addition and Access to Finance:
The objective of this component is to strengthen the capacity of farmers, their organizations and relevant value chains actors, to increase access to markets, value addition, and expand access to financial services. The project will consolidate and scale-up the efforts undertaken by LWH and RSSP3, strengthening the development of sustainable market linkages and value addition, through increased performance and commercialization of select value chains.

The component, will build on Component 1, working with the farmer organizations, to increase their market orientation, in facilitating and connecting farmers to markets. To improve availability of inputs, the component also aims to develop the network of agro-dealerships. Through a value chain approach, the project aims to bundle its interventions along the value chains ensuring that market infrastructure and technology is demand-driven and market-oriented, and co-funded by the private sector.

The component interventions will be implemented in close cooperation with Rwanda Agriculture Board (RAB), National Agricultural Export Development Board (NAEB), Rwanda Cooperative Agency (RCA), Ministry of Trade and Industry (MINICOM), Rwandan Standards Board (RSB), and Rwanda Inspectorate, Competition, and Consumer Protection Authority (RICA).

Sub-component 2.1: Market Linkages:
This sub-component seeks to build on the productivity gains and investments made in LWH and RSSP, strengthening the market linkages and value addition potential for selected value chains. The project will promote a public private partnership (PPPs) programs, supporting farmers to add value to their produce, and find reliable market outlets, leading to significant increases in income, and secure nutrition improvement. The following activities will be implemented under this sub-component:

Value chain analyses: The project will fund detailed value chain analyses will be undertaken in the select vegetable and fruits, maize, Irish potato and beans value chains, to guide interventions throughout the project, ensuring market orientation, and supporting the process of commercialization. Financing modalities (including in-kind contribution by agribusinesses, including farmers and farmer groups) of market and processing equipment will be developed and agreed on. The value chain analyses will provide vital market and technical input to the capacity building of farmers and farmer groups in Component 1.

Marketing: The project will target both domestic and regional markets for staples and horticulture, as well as higher-impact export markets. In order to strengthen market and pricing information the project will support farmers in accessing existing (and future) market information systems, such as RATIN and eSoko. Complementing this, the project staff, together with farmers groups, will facilitate dialogue between farmers 'groups and the private sector, to establish contractual arrangements and linkages to intermediary markets, such as the Rwandan Grain and Cereal Cooperation (RGCC) and East African Exchange (EAX) as well as directly with end buyers, such as African Improved Foods (AIF), and exporters, such as Proxi fresh. Technical support and other embedded services to improve productivity and quality will be promoted through MoU and other contracting modalities. To strengthen public-private dialogue within the relevant actors in the value chain, and foster the development of the sector, value chain specific multi-stakeholder platforms4 will be supported.

Value addition: To enhance the income generation margins at farm level, the project aims to capture and create value addition at farm level. The project will provide capacity building in post-harvest handling in priority value chains to minimize losses, and reduce perishability. Second, the project aims to support farmer groups in capturing value, by promoting quality, and pre-processing activities, such as cleaning, grading, sorting and packaging, and facilitating farmers to obtain certification, to ease access to domestic and export markets. These will include targeted efforts towards the reduction in aflatoxin levels in maize grains and Global GAP certification for horticulture. The project will support agro-processers in obtaining the Standardization Mark (S-Mark) from the Rwandan Standards Board (RSB). Post-harvest handling and quality equipment, such as threshers, plastic sheets for drying, plastic crates, dryers, moisture meters, hermetic bags and aflatoxin kits will be provided, through co-funding grants. In addition, the project will co-invest in packaging and primary processing equipment and technology, including preservation and fortification, to reduce food loss, and preserve and increase nutrition content. These interventions build on Component 1 skills development and business training, of youth and women in cooperatives and/or individual entrepreneurs already managing or wanting to start up a business.

Public-private partnerships (PPP): to leverage private sector investment for the above interventions, the project will establish a challenge fund, focused on export promotion, support to MSMEs in agro-processing and packaging, and the promotion of agro-dealership and commodities aggregation. Innovative solutions will be developed to address challenges in the supply chain, such as improved and immediate post-harvest handling practices and facilities, together with spot aflatoxin checks at cooperative level.

Sub-component 2.2: Market and Processing Infrastructure:

To complement the interventions in sub component 2.1, the project will invest in post-harvest, marketing and processing infrastructure, to the benefit of those cooperatives which are not yet mature enough to be able to fully self-finance required infrastructure needs. Operation and maintenance (O&M) activities and related capacity building will be provided for the existing and newly constructed infrastructure. This sub-component will facilitate the provision of relevant infrastructure and facilities. The following interventions will be supported by the project:

A needs and suitability assessment on necessary post-harvest handling and market infrastructure requirements will be undertaken. Furthermore, the development of appropriate financing modalities (including in-kind contribution from agribusinesses, including farmers and farmer groups) will be elaborated through grant agreements.

Under LWH and RSSP3 focus was on drying and bulking at main collection points, but a need has been identified in immediate post-harvest handling such as food waste and food safety including reduction in aflatoxins. This includes drying shelters and grounds, and collection points, near the fields, for immediate post-harvest handling, as well as in bulk. From these smaller drying/collection facilities, the produce will be transferred to existing bigger storage facilities at the cooperatives level. These larger storages will also be used to stock strategic reserves to cope with food shortage during possible droughts.

For the horticulture sector, cold rooms will be constructed to increase shelf life and preserve quality and nutrient content, and reduce post-harvest losses. Agro-dealership shops, processing and storage facilities and will be constructed to enable entrepreneurs, in particular, youth and women, to establish micro and small enterprises.

The project will train farmer groups to manage these facilities to ensure their profitability and sustainability. In addition, the project will facilitate the quality control and certification of the above infrastructure per relevant standards and requirements.

The provision of the infrastructure will be done through grant agreements based on contributions from agribusiness, including farmers and farmer groups. The infrastructure will complement the market linkages and therefore facilitate the linkages with potential investors for financing opportunities.

The modalities for co-financing by beneficiaries will be clarified and confirmed during pre-appraisal.

Sub-Component 2.3: Access to Finance

Access to finance remains a limiting factor for farming activities in Rwanda and Government is focusing on local level institutions to ensure that farmers are served. Building on the activities and interventions of the LWH the project will focus on the identification of financial services and products required by farmer organizations, youth and women groups. To meet the growing business needs of cooperatives and farmers, the project will continue to support financial literacy of farmers, business planning for cooperatives, enhancement of the culture of savings and use of credit, and better portfolio management of selected SACCOs.

Linkage with other financial institutions and intermediaries will be undertaken to enhance their understanding of the agriculture sector, build awareness to the market/business potential (i.e. business case for investing/supporting the sector) and utilization of SACCOs for agent banking. The project will reach out to and collaborate with existing government ministries/agencies that are tasked with supporting the capacity building of SACCOs to develop financial products that better meets the needs of farmers, de-risk their investments, and enhance their access to timely and appropriate financial services.

The project will also work with private non-bank financial institutions to expand credit to farmer organizations, develop forward contracts and buy back guarantee schemes and utilization of warehouse receipts.

Component 3 Irrigation and water use efficiency

The objective of this component is to promote technology and best practice for increased availability and efficient use of water for irrigation. The project is expected to provide, among others, the essential infrastructure and technology for small-scale irrigation, with total area of 2,500 ha, to intensify crop production in a participatory fashion, accompanying the capacity development and institutional strengthening activities. The Project will co-finance small-scale irrigation infrastructure and support package (maintenance and business plan development).

The small-scale irrigation technology includes ready to use 1ha, 5ha, and 10ha complete sprinkler, drip and rain-gun kits with portable diesel/petrol pump-units and pipes as well as the treadle pump etc. technologies.

The proposed investments into improved management of water and other natural resources will be beneficial not only to Rwanda but to downstream riparian as well. Water quantity can be impacted by the investments into the small-scale irrigation and related activities; but this impact is expected to be negligible as detailed in the technical annexes.

Based on the estimates of areas to be developed under new small-scale irrigation, the team calculation of water abstraction for the major river basins in Rwanda (Nile and Congo), found 0.106 % abstraction of mean annual discharge for both basins, which is estimated to be insignificant part of the current flow of the rivers.

The mission proposed that the Project seek a riparian notification exception under OP 7.50 paragraph 7(a) pertains to "any ongoing schemes, projects involving additions or alterations that require rehabilitation, construction, or other changes that in the judgment of the World Bank (i) would not adversely change the quality or quantity of water flows to the other riparian; and (ii) would not be adversely affected by the other riparian possible water use. With concurrence of the RSA and the Lawyer, the team will seek guidance on obtaining exception to riparian notification the Africa Vice President.

Component 4: Project Management and Technical Assistance

This component will support all aspects of project management including: (a) management and coordination, (b) monitoring and evaluation, (c) technical assistance, and (d) a grievance redress system.
The expected outcome of this component is an effective and transparent project management system. The main functions and activities will be to: (a) provide overall governance and direction to the project; (b) provide strategic, management, and operational guidance and support to project staff for achieving the PDO and expected outputs; (c) regularly monitor and analyze the overall and component specific quality and pace of implementation, ESMF compliance, budget and expenditures, and address any issues, bottlenecks, and gaps to ensure that progress in project implementation is on track; (d) conduct a capacity needs assessment of project staff and provide requisite knowledge, management skills, exposure visits, and specific thematic/technical training in a systematic manner; (e) establish a robust monitoring and evaluation (M&E) and reporting system, including baseline surveys, a mid-term assessment, and end of project evaluation; (f) establish a clear and effective mechanism for grievance redress, including a system for receiving, recording, and addressing complaints and using them for course corrections as required; (g) strengthen project communication and knowledge management as well as document, collate, and disseminate project experiences and learning; and (h) support reviews, studies, and policy analysis that would contribute to the country's agriculture, food security, and nutrition policies and plans.

1.3 Project activities

The Project specific activities include (i) strengthening farmers organizations, youth and women as successful enterprises through skills enhancement, vocational training, exposure visits, farmer field schools (FFS); (ii) improve farmers organizations' access to financial services through financial literacy

and improved financial services and products; (iii) sustain and further increase productivity and profitability of selected agriculture crops and horticulture; (iv) analyze and develop select value chains to help farmers to transition from subsistence farming to commercial farming, strengthening market linkages and value addition; (v) build capacity of youth and women for self-employment, jobs, improved nutrition, off-farm activities, small livestock and fish farming; and (vi) enhance availability of water for agriculture through efficient use of water and rehabilitation and scale up of existing irrigation schemes.

1.4 Methodology for preparation of PMP

The study for the preparation of the Pest Management Plan (PMP) was conducted by the Project Safeguards team using the following approach and methodology:

a) Desk review

The preparation of PMP involved a review on the existing baseline information and literature material. Detailed review and analysis of the national relevant legislations and policies as well as World Bank Safeguards Policies and other relevant documents were done.

b) Field Visits

Field visits to potential project areas were organized to collect information on IPM experience from other projects and identify issues and possible impacts of IPM adoption for the future subproject activities. The project team visited five (5) sites including Muyanza, Nyabihu, Karongi 12, Karongi 13 and Rwamagana 34.

c) Public consultations

Various discussions and consultation meetings were held with Project beneficiaries, relevant districts and sectors' officials, other relevant staff of the key implementing partners of the SAIP including among others Rwanda Environment Management Authority (REMA), Rwanda Cooperative Agency (RCA), Cooperatives in visited schemes, Rwanda Land Management and Use Authority (RLMUA), Rwanda Agriculture Board (RAB) and MINAGRI projects.

CHAPTER TWO: LEGAL AND INSTITUTIONAL FRAMEWORK

2.1 Policy framework for Rwanda

2.1.1Policy on Agriculture Sector

The main objective of this policy is to intensify and transform subsistence agriculture into market oriented agriculture. The use of contemporary inputs like improved seeds and fertilizers is envisaged. This policy puts emphasis on marshland development for increased food production because the soil on hills is degraded by erosion, rendering it unproductive.

In order to achieve sustainable development in agricultural sector, the policy emphasizes the need to adopt Integrated Pest Management (IPM) practices. The use of IPM practices is highly recommended in this PMP study as this will guide on the best use of pesticides.

2.1.2 National Biodiversity Strategy and Action Plan

This strategy defines the objectives and priorities for the conservation and sustainable management of biodiversity. The action plan includes hillsides, wetlands and protected areas as some of the areas that need to be conserved. The national biodiversity strategy and action plan approved in June 2000, defined the objectives and priorities for sustainable biodiversity conservation and management. Biodiversity includes wetlands, protected areas and the strategies are ranked as follows: Political and legal frameworks relating to environment unknown by the population and/or decentralized entities; ii) low level of awareness among people with regard to environment; iii) inadequate exploitation of forests; iv) erosion; v) exploiting quarry sites without restoring exploited parts; vi) insufficient knowledge on environment status; vii) weakness of decentralized structures in environment management; viii) absence of appropriate environment-friendly technologies.

The strategy on biodiversity aims at: improving conservation of protected areas and wetlands; sustainable use of biodiversity in natural ecosystems and agro-ecosystems; rational use of biotechnology; development and strengthening of policy, institutional, legal and human resources frameworks; and equitable sharing of benefits derived from the use of biological resources.

2.1.3 Policy on Health Sector

One of the objectives of this policy is to improve the quality of life and demand for services in the control of disease. The policy identifies the most common illnesses in Rwanda and puts priority to addressing these diseases. SAIP has a vital role to play in the increased incidences of water borne diseases and respiratory diseases.

2.2 Legal instruments

Currently, two major laws regulate the use of pesticides in Rwanda, one for agrochemicals (pesticides and inorganic fertilizers) and another on plant health (addressing issues of plant protection and quarantine). The law on plant health focuses more on phytosanitary (inspection of imports and exports) and safe trade than on plant protection while growing in the field.

The section of protecting growing crops in the field is not well elaborated; as a result there is very little mention of different pests' management strategies such as integrated pest management and other methods.

The law No 30/2012 of 01/08/2012 governing agrochemicals focuses on both pesticides and mineral fertilizers and aims to regulate manufacturing, importing, distribution, use, storage, sale, disposal and burial of expired agrochemicals. The Ministry of Agriculture and Animal Resources (MINAGRI) has the responsibility for its implementation.

However, there are other laws and texts making it possible to reduce the risks of pesticides. This includes the Law No. 04/2005 of 04/08/2005 determining the modalities for the protection, conservation and promotion of environment in Rwanda.

2.3 Institutional framework

2.3.1 Ministry of Agriculture and Animal Resources

The Ministry of Agriculture and Animal Resources (MINAGRI) through RAB/SPIU is the executing agency for the SAIP. It seeks to protect crops and improve agricultural productivity and soil conservation through selected districts across the Country. MINAGRI is responsible for the implementation of the laws on plant protection and agrochemicals.

2.3.2 Ministry of Environment

Environment is a crosscutting sector and the Ministry of Environment (MoE) is responsible for the development of policies, laws and regulations as well as coordination of all activities in the management of water resources activities and environment, as well as their follow up and evaluation.

2.3.3 Rwanda Agriculture Board

Rwanda Agriculture Board (RAB) ensures improved food security and livelihoods of all Rwandans by transforming agriculture from subsistence into modern farming through generating research and extension innovations that generate sustainable crop, animal husbandry and natural resources management.

2.3.4 Rwanda Environment Management Authority

Rwanda Environment Management Authority (REMA) was established in2004 to act as the implementation organ of environment-related policies and laws in Rwanda. REMA is also tasked to coordinate different environmental protection activities undertaken by environmental promotion agencies; to promote the integration of environmental issues in development policies, projects, plans and programmes; to coordinate implementation of Government policies and decisions taken by the Board of Directors and ensure the integration of environmental issues in national planning among concerned departments and institutions within the Government; to advise the Government with regard to the legislation and other measures relating to environmental management or implementation of conventions, treaties and international agreements relevant to the field of environment as and when necessary; to make proposals to the Government in the field of environmental policies and strategies; etc.

2.3.5. Local Governments

With regards to pest management, Local Governments (including the study area Districts) are tasked to participate in the implementation and monitoring of Environmental and Social Management Plan (ESMP), specifically in the mobilization for the proper use of pesticide and IPM implementation by the Communities.

2.4 World Bank safeguards policies

Within the overall set of OPs, the Bank has identified ten key policies critical to ensuring that potentially adverse environmental and social impacts are identified, minimized and mitigated. These include Environmental Assessment (OP 4.01); Physical Cultural Resources (OP 4.11); Disputed Areas (OP 7.60); Indigenous Peoples (OP 4.10); Project on International Waterways (OP 7.50); Involuntary Resettlement (OP 4.12); Natural Habitats (OP 4.04); Forests (OP 4.36); Pest Management (OP 4.09) and Safety of Dams (OP 4.37).

The World Bank (WB) and Government of Rwanda (GoR) agreed that SAIP will trigger five (5) WB environmental and social safeguards policies discussed below:

Environmental Assessment (OP 4.01)

This policy requires environmental assessment (EA) of projects/programs proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus improve decision making. The core requirement of this policy is to screen early for potential impacts and select appropriate instrument to assess, minimize and mitigate the potentially adverse impacts. Relevant safeguard instrument for the policy include Environmental and Social Impact Assessment (ESIA), which is prepared for specific projects already identified before project appraisal; Environmental and Social Management Framework (ESMF), which is prepared to establish a mechanism to determine and assess future potential environmental and social impacts during implementation of the project activities and investments, which are not specified before project appraisal; and Environmental and Social Management Plan (ESMP).

The policy calls for the proposed project as a whole, and for activities/investments to be identified at a later stage during project implementation to be environmentally screened to determine the extent and type of the EA process.

At screening stage, the proposed project of sub-projects will be classified as Category A, B or C, depending on the type, location sensitivity, and the full scale of the project and the nature and magnitude of its potential environmental impacts. For Category A: full Environmental and Social Impact Assessment (ESIA) will be required, since project activities may have adverse, irreversible and significant environmental impacts. For Category B: a limited ESIA will be adequate, since projects may have site-specific environmental impacts, and their mitigation measure can be designed more readily. Under Category C: subprojects are likely to have minimal or no adverse environmental impacts, hence beyond screening; no further environmental assessment action may be required.

OP 4.01 further requires that the ESIA and ESMF report must be disclosed as separate and stand-alone documents by the Government of Rwanda and the World Bank as a condition for Bank Appraisal of the proposed project. The disclosure should be both in Rwanda where it can be accessed by the general public and local communities and at the Info-shop of the World Bank.

Categorization procedures:

Category "A" Projects

A full EIA is always required for projects that are in this category, and for which impacts are expected to be ′adverse, sensitive, irreversible and diverse with attributes such as pollutant discharges large enough to cause degradation of air, water, or soil; large-scale physical disturbance of the site or surroundings; extraction, consumption or conversion of substantial amounts of forests and other natural resources; measurable modification of hydrological cycles; use of hazardous materials in more than incidental quantities; and significant involuntary displacement of people or other significant social disturbances.

Category "B" Projects

Although an EIA is not always required, some environmental analysis is necessary and some form of environmental management plan should be prepared. Category B projects have impacts that are ′less significant, not as sensitive, numerous, major or diverse. Few, if any, impacts are irreversible, and remedial measures can be more easily designed. Typical projects include rehabilitation, maintenance, or upgrades, rather than new construction.

Category "C" Projects

No EIA or other analysis is required. Category C projects result in negligible or minimal direct disturbance of the physical environment and biological.

SAIP was classified as category B project based on the fact the activities under the project would involve civil works (postharvest infrastructure) and irrigation for increased agricultural production. It is also likely that the activities will lead to increased agrochemical use, to increase production and minimise loss to diseases and pest, which will necessitate efficient management.

SAIP triggers OP4.01 policy because its potential environmental and social impacts on environment will be assessed and mitigation measures to address these impacts will be proposed. The Environmental and Social Management Framework (ESMF) under preparation will establish the EA process to be undertaken for implementation of SAIP activities. This process requires that SAIP and its implementing partners screen their activities to identify their potential adverse impacts and thereby determine the corresponding mitigation measures to incorporate into their planned activities.

Natural Habitats (OP 4.04)

This Bank Operational Policy recognizes that conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats. Natural habitats are land and water areas where (i) the ecosystems biological communities are formed largely by native plant and animal species, and (ii) human activity has not essentially modified the areas primary ecological functions. All natural habitats have important biological, social, economic, and existence value. Therefore, the Bank natural habitats operation policy (OP 4.04) is triggered in all cases where the proposed investments are likely to have potential adverse impacts on Rwanda's natural habitats including wetlands, underground water sources, open water bodies and forests.

The Bank natural habitats operational policy requires that any activities funded under the SAIP that adversely impacts these ecosystems must have a successfully mitigation plan so as to maintain the overall balance and integrity of the ecosystems impacted. This requires that SAIP designs appropriate conservation and mitigation measures to remove or reduce adverse impacts on these ecosystems or their functions, keeping such impacts within socially defined limits of acceptable change. Specific measures may depend on the ecological characteristics of the affected ecosystem.

Such measures must include provision for monitoring and evaluation to provide feedback on conservation outcomes and to provide guidance for developing or refining appropriate corrective actions. Activities that risk significantly degrading or converting critical natural habitat will not be funded under the project.

Pest Management (OP 4.09)

This policy aims at the management of pests that affect either agriculture or public health. The World Bank supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides.

The policy supports safe, effective, and environmentally sound pest management. It promotes the use of biological and environmental control methods. An assessment is made of the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management.

The SAIP project components will trigger this policy especially those activities that will focus on improving land productivity. In appraising a project that will involve pest and disease 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.

Rural development and health sector projects have to avoid using harmful pesticides. A preferred solution is to use Integrated Pest Management (IPM) techniques of the existing Pest Management Plan of the project. 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. 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, sectorial or project specific environmental assessments, participatory IPM assessments, and investment projects and components aimed specifically at supporting the adoption and use of IPM.

For World Bank funded agriculture projects, 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 approved pesticides when their use is justified under an IPM approach.

The policy calls for assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users for procurement of any pesticide in Bank financed projects. The policy sets criteria to apply for the selection and use of pesticides in Bank financed projects including must have negligible adverse human health effects, must be shown to be effective against the target species, and 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.

The policy requires putting in place a Pest Management Plan (PMP) and structure for adoption of IPM and safe use of pesticides. The SAIP PMP is prepared and will be disclosed both in-country and on World Bank external website before the project execution.

Involuntary Resettlement (OP/BP 4.12)

Interventions in the agriculture sector could lead to displacement, loss of assets and restriction of access to sources of livelihood. Project areas would be screened for impacts and a Resettlement Action Plan (RAP) will be prepared, if required.

Resettlement Policy Framework (RPF) sets the guidelines for the Resettlement and Compensation Plans (RAPs) that would have to be prepared when any project investment (activity) triggers this policy. The standalone Resettlement Policy Framework (RPF) has to be prepared by the Government and approved by the Bank in compliance with OP 4.12. The RAPs would be prepared by the subproject implementers (e.g. districts) and would have to be submitted to the Bank for approval.

This policy is triggered when a project activity causes the involuntary taking of land and other assets resulting in: (a) relocation or loss of shelter, (b) loss of assets or access to assets (c) loss of income sources or means of livelihood, whether or not the affected persons must move to another location. Therefore, people are in most cases compensated for their loss (of land, property or access) either in kind or in cash of which the former is preferred. The resettlement policy applies to all displaced persons regardless of the total number affected, the severity of the impact and whether or not they have legal title to the land. Particular attention should be paid to the needs of vulnerable groups among those displaced.

The policy also requires that the implementation of the resettlement plans are a pre-requisite for the implementation/start of the construction to ensure that displacement or restriction of access does not occur before necessary measures for resettlement and compensation are in place. For chosen sites involving land acquisition, it is further required that these measures include provision of compensation and of other assistance required for relocation, prior to displacement, and preparation and provision of resettlement sites with adequate facilities, where required. In particular, the taking of land and related assets may take place only after compensation has been paid, and where applicable, resettlement sites, new homes, related infrastructure and moving allowances have been provided to displaced persons.

SAIP would involve the construction of postharvest infrastructures, including drying shelters, storage facilities, horticulture collection centers and cold rooms. The planned civil works are likely to lead to land acquisition resulting in relocation or loss of shelter, loss of assets or access to assets, loss of income sources or livelihood means.

SAIP will prepare the Resettlement Policy framework (RPF) and Resettlement Action Plans (RAP), where needed, to guide the implementation of SAIP activities and ensure that the World Bank safeguards Operation Policy 4.12 for involuntary resettlement and national requirements for land acquisition are adequately addressed.

Projects on International Waterways (OP/BP 7.50)

This policy applies to the following types of international waterways:

(i) any river, canal, lake, or similar body of water that forms a boundary between or any river or body of surface water that flows through, two or more states, whether bank members or not;

(ii) any tributary or other body of surface water that is a component of any waterway described in (i) above and;

(iii) any bay, gulf, strait or channel bounded by two or more states or, if within one state, recognized as a necessary channel of communication between the open sea and other states and any river flowing into such waters.

This policy applies to the following types of projects:

(i) hydroelectric, irrigation, flood control, navigation, drainage, water and sewerage, industrial and similar projects that involve the use or potential pollution of international waterways as described in paragraph 1 above, and

(ii) Detailed design and engineering studies of projects under paragraph 2 (i) above, including those to be carried out by the Bank as executing agency or in any other capacity.

The Project ascertains whether riparian agreements are in place, and ensures that riparian states are informed of and do not object to project interventions.

The SAIP will co-finance small scale irrigation (SSI) infrastructure and support package (maintenance and business plan development). The SSI technology includes ready to use 1ha, 5ha, and 10 ha complete sprinkler, drip and rain-gun kits with portable diesel/petrol pump-units and pipes as well as the treadle pump, etc. Given that the activities to be financed by the project will not adversely change the quality and quantity of water flows to the other riparian, SAIP has requested for a riparian notification exception in line with the requirements of OP/BP 7.50.

2.5 World Bank industry Sector Guidelines for Agribusiness

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry specific examples of Good International Industry Practice (GIIP). The General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. The EHS guidelines should be used together with the relevant Industry Sector Guideline(s).

The WB industry Sector EHS guidelines for Agribusiness cover EHS Guidelines for annual crop production, aquaculture, breweries, dairy processing, fish processing, food and beverage processing, mammalian livestock production, meat processing, perennial crop production, poultry production, poultry processing, sugar manufacturing and vegetable oil processing.

SAIP is anticipated to comply with the annual crop production, perennial crop production as well as food and beverage processing (possible processing of vegetables like tomato, sweet pepper and chili as well as fruit raw materials such as passion fruit, tree tomato, watermelon, etc into value-added food and beverages).

The industry sector EHS guidelines to be complied with by SAIP provide potential issues associated with annual crop production, perennial crop production and food and beverage processing along with recommendations for their managements.

The Environmental, occupational health and safety and community health and safety issues both in annual crop production and perennial crop production primarily include Soil Conservation and Management, Nutrient Management, Crop Residue and Solid Waste Management, Water Management, Pest Management, Use and Management of Pesticides, Fertilizers, Biodiversity and Ecosystems, Genetically Modified Crops, Energy Use, Air Quality and Greenhouse Gas (GHG) Emissions. Occupational health and safety (OHS) issues associated with annual and perennial crop production include the physical hazards (operational and workplace hazards, machinery and vehicles, confined and restricted space entry, exposure to organic dust), risk of fire and explosion as well as biological and chemical hazards. The potential exposure to pesticides and presence of pesticides or by-products in potentially harmful concentrations in foodstuffs and postharvest products, potential exposure to pathogens associated with the use of manure, potential exposure to air emissions from fires, burning of crop waste, residues, or solid waste and increased risk of vehicle or machinery injuries on roads and access routes around the community are the major community health and safety risks. These guidelines provide specific recommendations and performance indicators to monitor to minimize risks to communities.

CHAPTER THREE: CURRENT STATUS OF IPM AND USE OF PESTICIDE IN RWANDA

3.1 Current and anticipated pest problems

SAIP was designed to promote of IPM practices on areas developed under RSSP3 and LWH in the targeted project sites. This requires a plan for the development and promotion of IPM for targeted crops. The crops targeted by SAIP are maize, climbing bean, irish potato, vegetables (tomato, onion, sweet pepper, chili and French bean) and fruits (watermelon, papaya, avocado, passion fruit and tree tomato)
Major pest problems under Rwandan condition include mainly diseases, insect pests and vectors. While the major diseases of potato, tomato and cabbage need fungicides for their control, the major diseases of cassava, banana, wheat, maize, onion, green beans, carrot and mushroom do not need pesticides, they can be controlled by IPM strategies successfully. In particular, a combination of cultural practices, resistant varieties and minimum pesticides may control most of pest problems.

3.2 Current and anticipated pest problems in Maize

3.2.1 Major pests and diseases of maize

Maize is an important staple crop in Rwanda both as a food and source of income. The crop has a list of pests and diseases which are generally considered to be major constraint in production, however, their economic importance varies according to environmental conditions and cultural practices applied by farmers. These include maize stalk borers such as *Busseolafusca*, maize streak virus, leaf blight, striga weeds and storage pests. The diseases like maize streak, leaf blight are currently controlled using resistant or tolerant varieties such as Tamira, Katumani, Isega, and Magumba and cultural practices such as crop rotation with legumes for at least three months and flooding along Akanyaru river marshlands commonly practiced by many farmers.

The storage pests like grain weevils *(Sitophilus* spp.) and tropical warehouse moth (*Ephestiaca utella*.) are a threat, where there's need for storage of cereals.

In addition, there is also striga weed (*Striga asiatica* or *Striga hermonthecas)* which is expanding in the Eastern province and is reported to cause up to 100 % yield loss. This will be controlled by using "push-pull" technology as an IPM tool. The couch grass (*Digitaria scularum*) is widely distributed in the country while it is one of noxious weed of the world, specifically found in eastern African region. It causes a large loss if not controlled. Farmers use deep cultivation, but the later reduces area cultivated per person/day, hence use of system herbicide such as glasphosate (round up) is a best option recommended. However, it will require training and demonstration to farmers and extension staff.

Nevertheless, maize insect pests and diseases are manageable using cultural practices, resistant varieties and reduced pesticides as components of IPM tools. The current maize production systems such as crop rotation with legumes or potatoes, application of organic manure, flooding in marshlands like "Akanyaru" where large quantities are produced reduce pests and diseases. In addition, the current hermetic grain storage (known as "cocoons") promoted by Rwanda's Ministry of Agriculture and Animal Resources helps to reduce storage losses from pests through suffocation, which is a good IPM tool.

3.2.2 Current pest and diseases management practices of maize in Rwanda

Many farmers lack the basic knowledge in good crop husbandry which gives high productivity, and pest and disease management techniques. Therefore, the Rwandan farmer interested in investing in maize production should learn improved maize production technologies and their role in pest and diseases management.

Maize crop is produced on hill side and in some marshlands. In the Southern province, it is mainly produced in the marshlands along Akanyaru River and its tributaries during the dry season. It is followed by a rotational crop or flooding during the rainy season. In the Northern and Eastern provinces, maize is produced on the upland and as rain feed crop and in rotation with other crops like bean, potato, etc. Maize stalks are also used to feed livestock in the Northern Province. This is a good practice which is useful in the management of stem borer and other maize pests. The management of major maize pests and diseases are indicated in the following sections.

The maize crop has a list of pests which are generally considered to be major pests. However, their economic importance varies according to environmental conditions and cultural practices applied by farmers. Nevertheless, maize stalk borers, striga weeds, maize streak virus, leaf blight and storage pests are among the major pests. Diseases like maize streak and leaf blight are reliably controlled using resistant varieties.

Currently, some of these pests are not a threat because the current maize production system which include crop rotation with other crops such as beans, soya beans or potatoes, and in some places flooding as seen in along Akanyaru river marshlands and tributaries. All these practices and their implications on IPM approach will be further elaborated in the sections below.

1) Current pest management practices of maize stalk borers

Stem borers are the most destructive pests of maize crops. Its immature stage (larvae) causes damage either by 'windowing' of the unfolding leaves as an early symptom or death of the central shoot of maize called "dead heart". Sometimes the early stage larvae mine into leaves causing yellow streaks in addition to the 'windowing.

The yield loss from stalk-borers varies from 23 to 53 % of the crop. Control of stem borers by insecticides is not economically justifiable and feasible because it is expensive for poor resource farmers. Moreover, it needs timing of application before boring into stem; otherwise pesticides do not reach the stem borers once inside the stem. There are three species of stem borers: *Chilopartelus, Sesamia calamistis* and *Busseolafusca*. These differ in ecological condition preference.

In Rwanda, there is a possibility that *Busseolafusca* is more abundant and may be causing more damage to maize crop. *Busseolafusca* is indigenous to Africa and present in high and mid-altitude (areas above 1077 m asl). It is therefore expected to be the most common in Rwanda. The following crop management practices can reduce the damage of stem borers to a low and uneconomic level. However, there is a need for nationwide testing and promotion.

a) **Cultural practices**: The management of stem borer is more effective when life cycle is well understood in a particular area. The following cultural practices control borers and reduce the population below economic damage level. These include manipulation to reduce population below the damage threshold such as (1) Simultaneous early planted maize over a large area at the onset of rain to complete its vulnerable stages before the population of borers has time to build up, (2) destruction of thick-stemmed grass weeds which would act as an alternative host, (3) Uproot young plants which have been killed, (4). crop residues burning, deep burying or feeding to cattle to kill pupae left in old stems and tall stubble, (5) destroy damaged cobs and stems which might harbour diapausing larvae, since they will increase infestation in the next crop, (6) watch out for young plants with signs of 'windowing', and apply control early in the season for two reasons: (i) if the first generation is allowed to go unchecked, there will be greater damage to the cobs by the second generation; (ii) the caterpillars are most vulnerable to insecticides when they are in the funnel of the plant, and before they begin boring in the stem; and (7) closed season of at least two months to prevent population continuity, the objective here is to have as long period as possible when there are few hosts for it to feed on. If maize were planted only in the long rains, when it grows best, it would mean an eight month period from harvesting one crop to the young plants of the next, during which the maize stalk borer would find it difficult to survive. Most of them are commonly applied in Rwanda, especially in the marshlands and Virunga areas.

b) **Push pull strategy**: This is a technology developed by ICIPE and her partners as an effective, low-cost and environmentally friendly technology for the control of stem borers and suppression of striga weeds. It is a simple cropping strategy, whereby farmers use Napier grass and Desmodium legume (Silverleaf and Greenleaf Desmodium) as intercrops. Desmodium planted between the rows of maize produces a smell odour that stem borer moths dislike. The odour of Desmodium 'pushes' away the stem borer moths from the maize crop, while Napier grass *(Pennisetum purpureum)* which is planted around the maize plot attracts the adult moth and pulls to lay their eggs on it. Since the Napier grass does not allow stem borer larvae to complete development on it; the eggs hatch and the small larvae bore into Napier grass stems, the plant produces a sticky substance like glue which traps them, and majority of them die, and very few survive. As result the maize crop is saved from damage. In addition, Desmodium fixes nitrogen in the soil and enriches the soil. Details are provided in the maize IPM tool kit.

2) Management of other maize pests and diseases

The maize diseases are important and are serious threats causing heavy losses up to 100 % if not well controlled. The major diseases of maize include: (1) maize streak virus disease, (2) southern and northern leaf blight, (3) leaf rust and (4) grey leaf spot (not yet in Rwanda). However, during the visits, disease incidence and severity were very low in many fields.

(i) Management of maize streak disease

Maize streak virus disease is transmitted by leafhopper of the genus" Cicadulina". The diseased plants show a marked streaky chlorosis of the leaves. The chlorotic streaks are individually narrow, often discontinuous, but evenly arranged in parallel across the leaf. The streaks occur uniformly over the infected parts of the plant that has grown after infection.

The leaves produced before infections are free from streaks. The severity varies according to resistance of the host and virulence of the virus strain. The yield loss is proportional to the time of infection. The seedling infection results in 100% yield loss.

Disease management include the following practices: (1) Use of resistant varieties is the best management option, (2) maize crop planted early escapes buildup of vector population and gets low infection, (3) close season by destroying source of infection from crop grown during dry season and also avoid to plant near the crop that was produced during the dry season using irrigation, and (4) rogue out all diseased plant as soon observed in the field.

(ii) Management of southern leaf blight (*Helminthosporum maydis*)

This disease is common in areas with warm damp climate. The dry weather is unfavorable for disease development. The primary source of inoculums is frequently plant debris from previous season. The disease develops very fast and can appear on young crops from infection of neighboring fields. The fungus is also seed born and can spread by untreated seed, and seed should be dressed using fungicide & insecticide mixture. The disease management includes the following practices: (1) Use of resistant varieties is the best management option and the most important measure, (2) destruction of crop residue prevents early diseases development, (3) use of seed dressed with fungicide & insecticide mixture to delay early infection.

(iii) Management of maize leaf rust (*Puccinia polysora, P. sorghi*)

This is a host specific disease and it does not have an alternative host. The spores are air-borne and are carried long distances by wind. The infected plant can spread diseases over long distance. *P. polysora* favors high temperature and high humidity and it is common in low altitudes, while *P. sorghi* is common in cooler high elevations in the tropics. Maize leaf rust management include the following practices: (1) Use of resistant varieties which is the best management option and the most important measure, (2) use of resistant varieties screened against rust, and (3) destruction of source of infection at community level to delay early disease development.

(iv) Management of striga weeds (witchweed) (*Striga hermonthica, Striga. asiatica*)

The parasitic weed Striga 'witch weed' is an important pest of maize, especially in drier areas like the Eastern Province. There are two species of Striga which are common ***(Striga hermonthica and Striga asiatica)***. The *Striga hemotheca* has large attractive pink flowers, while the *Striga asiatica* is smaller species with purple flowers. A distinctive feature of both species is that each striga plant can produce up to 20,000—50,000 seeds, which lie dormant in the soil until a cereal crop is planted again.

This dormancy can last for over 15 years. As striga germinates, its roots grow towards the host crop because the host plant releases chemicals which break dormancy and stimulates striga seed germination. The roots of seedlings of striga penetrate the host crop's roots and start to draw nutrients from the host. The young striga plants tap the roots of the maize plant and draw water and nutrients in the underground part, reducing production from 30% to 100%, or complete loss of the crop. If maize plants are attacked by both stem borers and striga weed, the yield loss is often 100%.

When a farm is infested with striga, the affected plants seldom grow more than one foot (30 cm) tall. The weed does not put roots into the soil so as to grow on its own, but grows by attaching itself onto the host (e.g. maize) plant.

Taking into account the peculiar nature of striga seeds, farmers are advised to control it before the weed emerges above the soil. Manual removal of the striga reduces re-infestation, but it is uneconomical since most damage is done even before the weed emerges. Any control strategy has to begin within the soil. Currently striga management is possible using "push-pull" technology. A ground cover of Desmodium (*Desmodium uncinatum*, or silverleaf), interplanted among the maize, reduces striga weed. Research at ICIPE has shown that chemicals produced by the roots of Desmodium are responsible for suppressing the striga weed. Therefore, striga does not grow where Desmodium is growing. Being a legume, Desmodium also fixes nitrogen in the soil and thus enriches the soil. Therefore, "push-pull" technology used on maize stalk borers manages also both stem borers and striga.

3.3 Current and anticipated pest and disease problems of Irish potato

3.3.1 Current and anticipated pest and disease problems of potato

The experience from the field visit is that the major pest and disease problems of potatoes are (1) Late blight, (2) Bacterial wilt, (3) Potato tuber moths and (4) Aphids (serious during low rain season). The potato crop is one of the major crops in Rwanda and it is produced in rotation with maize in the Northern Province.

Among the major pests and diseases, the late blight is the most serious and is continuously controlled using fungicides (e.g., Dithane M45 or Ridomil) in combination with resistant varieties. Late blight (*Phytopthora infestans*) is a major disease which cause up to 100% yield loss when no control measures are applied. To date there is no record of resistance to fungicides. Moreover, resistance can occur mainly on systemic fungicides. The commonly available systemic fungicide is ridomil which is not used regularly, hence not easy to develop resistance. It is applied only when rainfall is continuous and heavy rains can wash out protective on leaves.

3.3.2 Pest Management of major pests and diseases of irish potato

The pest management in potatoes is complicated and difficult, as the potato is a vegetative propagated crop using tubers for seed. The seed can carry easily bacteria, viruses, fungi and insects. Additionally, and some pests and diseases are rapidly disseminated by cutting knives. Therefore, the source of relatively pest-free seed is essential for healthy potato production. This is complicated by the quantities needed as seed rate per unit area. The experience from the field visit under RSSP1 was that major pests and disease problems include: 1). Late blight (*Phytophthora infestans)*, 2) Bacterial wilt *Pseudomonas solanacearum* 3). Potato tuber moths and 4) aphids. Pest management tools include cultural practices, resistant varieties and fungicide application.

Increase in potato yield is a result of good cultural methods such as right fertilizer, weed, insect and disease management. There is a wide variety of cultural practices and agro-ecosystem manipulations used to control potato pests. Some of them may be integrated into pest management programs in Rwanda.

The best IPM tool is the use of healthy planting material since most of the major diseases of potato can be carried by 'seed tubers'.

The production of healthy seed tubers requires the use of virus-free mother parts. These are often produced by micro-propagation techniques; and are grown under disease-free conditions, including the absence of virus vectors. Basic prerequisite for improved agricultural production is the availability of a reliable source of relatively disease free seed. Potato seed producers should obtain their seed from "foundation" seed produced in isolated areas either at ISAR or certified fields, where they are maintained extremely in high standards free from disease.

The general phytosanitary techniques such as crop rotation are also essential. Potato rotation with other crops is a component of both traditional and modern agriculture. Crop rotation is recommended as a means of disease control, and is especially important for the long-term control of diseases such as verticillium wilt, and fusarium wilt *(Fusarium* spp.) etc. It is important that crop rotation does not include plants that are also hosts of the potato pathogens, like tomatoes since that may make the problem more serious.

The cultural manipulations and sanitation procedures such as use of clean seed, destruction of source of inoculums, hilling up and killing of infected vine near harvesting are used to reduce losses due to disease organisms such late blight disease (*Phytophthora infestans),* as it is important to delay initial infection.

The potato farmers in the North Province are very conversant with both protective and curative fungicide against late blight.

They apply Dithane M45 (protective fungicide) when rainfall is not continuous, and Ridomil (systemic fungicide) when there is continuous rainfall which can wash out protective fungicide. This knowledge is good and their experience is an important tool in IPM because it is based on their observation.

It is recommended to apply fungicide (e.g. Mancozeb/Dithane M45), when growing both susceptible and resistant varieties as cash crop, especially when weather condition is favorable for spread of disease. A combination of fungicides and resistant varieties gives a relatively higher yield. The only risk with potato farmers is that they mix the insecticide with fungicide whenever they apply on weekly basis without any recommendation.

1) ***Management of potato late blight*** *(Phytophthora infestans, Oomycete):*

The late blight disease is caused by the fungus (*Phytophthora infestans, Oomycete)* and it is the most important limiting factor for high potato yields in the country. The epidemics are more severe in the North province of Rwanda. The first reason for the severity of blight epidemics is the absence of a prolonged dry period to check the disease; where it thrives throughout the year not only on potato crops, which are planted in many months of the year, but also on volunteer potato, tomato and alternative species. The second reason is that the climatic requirements of both the fungus and the crop are identical and are met in most months of the year. The management options include:

i) ***Resistant varieties****:* Although resistant cultivars are important tools in disease management, given the highly variable pathogenicity of the fungus, complementary fungicides have to be applied in order to get high yield. There are a number of resistant varieties in the country under national

seed service including Kigega, Gikungu, Mizero, Ngunda and Nderera etc. The production and distribution of clean tubers is important in disease management. Farmers will learn how to get clean tubers on time in their own community.

ii) ***Cultural control****:* The cultural manipulations and sanitation procedures are used to reduce losses due to late blight disease (P. *infestans).* It is important to delay initial infection as long as possible by using whole clean tuber seed, destruction of source of inoculums, hilling up and killing of infected vine near harvesting. The details of these practices are found in the potato IPM tool (copy attached) kit.

(iii) **Fungicides management***:* It is recommended to apply fungicide (e.g. Mancozeb), whether a farmer is growing a susceptible or resistant variety, especially when weather conditions are favorable for the spread of the disease. The potato farmers in the Northern Province are very much aware that the fungicide spraying is necessary when growing susceptible varieties. There is an increasing use of fungicide in Rwanda to control late blight, which at the same time controls the other fungal diseases like early blight *(Alternaria solani),* because fungicides used are broad spectrum. In general, fungicides used are essentially protectants, and for effective control, a continuous film over the entire surface of the plant is necessary. Many of the protective fungicides control late blight effectively and economically. They are applied at regular short intervals of 5, 7, or 10 days depending on weather conditions and the proximity of source of infestation. The mode of action of the protective fungicide is generally nonspecific in interfering with many vital functions of fungi. In contrast, systemic fungicides (e.g., Ridomil) penetrate the cuticle and are translocated throughout the plant making their action much more efficient. However, some systemic fungicides such as Ridomil/ Metalaxyl are highly specific in their mode of action.

Thus, their fungicidal action seems to depend on the interference with only one or a very few vital organs, and a single gene mutation in the pest organism can result in a modified system, which may be no longer sensitive to an attack of fungicide. Such change would result in an immune individual and provide the basis for a resistant population. As a result, a fungus population with resistance to that fungicide may probably arise.

2) Management of bacterial wilt (Ralstonia solanacearum , Bacterium) :

Bacterial wilt disease is caused by the bacteria *Ralstonia (formerly known as Pseudomonas) solanacearum.* The external symptom is wilting of the vegetative parts in spite of a moist soil. A white bacterial mass oozes from the vascular tissue when the base of the stem or a tuber is cut. The main method of spread is by diseased seed tubers. Once the bacteria are in the soil, it remains there almost indefinitely and it can survive saprophytic ally since it parasitizes a number of very common weeds. The disease management plan includes the following:

a) Resistant varieties: Planting of resistant varieties is the only reliable means of combating bacterial wilt. There are a number of tolerant varieties including Mabondo, Kirundo,

Mugogo, Mizero, Ngunda, Nderera. Currently, there is only one resistant variety in the list of RAB/RADA namely cruza which is not favored by farmers.

b) Use of clean seed: Bacterial wilt is often transmitted in tubers. It is important to use clean seeds when growing susceptible variety on clean site. The use of bare fallowing during the dry season reduces the amount of inoculums by desiccation but it cannot eliminate it entirely. Infected tubers often show vascular discoloration. Typical wilting with bacterial exudation from the vascular tissue is clear symptom. Other cultural practices have very little impact.

3) ***Management of potato tuber moth (Phthorimaea operculella, Gelechiidae):***

The tuber moth is one of the main pests of potato. Infestations arise initially in the field and continue during storage of the tubers. Potato is the main hosts, while tomato, eggplant, tobacco and other Solanaceae members and *Beta vulgaris are al*ternative hosts. The potato tuber moth was in the past reported in the former Mutura district and was serious, but currently it is under control.

Cultural control*:* The cultural manipulations and sanitation procedures are used to reduce losses due to potato tuber moth (*Phthorimaea operculella).*

It is important to delay initial infestation by hilling up to cover the tuber properly and delay infestation in the field. To avoid continuous availability of hosts in the field before the following season, encourage crop rotation with none host crops to ensure complete rotting of potato residues and rejected tubers.

Management of aphids in the potato production will depend on natural control. The heavy rainfall in the area is sufficient to minimize aphids' problem. Aphids are usually a serious problem during dry season in the tropics.

3.4 Current and anticipated pest and disease problems of target fruits

3.4.1 Avocado (Persea Americana)

a) Major pests and diseases of Avocado

The major diseases affecting Avocado tree are discussing below:

Tree Cankers – Cankers are usually minor diseases of an avocado tree with sores on tree trunks and branches that may sink slightly and ooze gum, giving the sore a rusty appearance. Cankers can often be cut out of limbs, but the cankers in trunks often kill the affected trees.
Fruit rots– Caused by fungal pathogens, fruit riots typically occur where sanitation is poor and tree stressors are high.

Root rots – They generally appear in areas with poor drainage or in trees that are chronically over watered. If conditions can be improved, the tree may be able to be saved.

Sun blotch – This is a serious, incurable disease of avocado trees. Fruits are often discolored or scarred, twigs may develop red or yellow discoloration or rectangular cracks may develop in bark. Infected trees are also often stunted, but some trees show no symptoms at all, aside from a reduction in yield.

Wilts and blights – Wilts and blights are characterized by dead areas in trees, especially when only a part of the tree is affected.

Wilts unsurprisingly cause sudden wilting and death in branches; blights may kill small branches or only affect the leaves themselves.

The avocado tree pests are dominated with insects and include:
Borers – Borers tunnel into avocado trees, where they feed or lay eggs. Entrance holes are highly visible and may leak sap and borer-weakened branches may break easily. Stressed trees are preferred by borers; keeping your tree healthy can prevent infestation.

Caterpillars – Caterpillars attack foliage, flowers and fruits and can cause substantial damage in a short time.

Lace bugs –lace bugs damage leaves when they are present. Feeding sites cause yellow spots that soon dry out and stressed leaves will drop, exposing fruit and wood to ultraviolet rays.

Mites – Mites cause similar damage as lace bugs, but leaves may also take on a bronze appearance and the pests will be difficult to see with the naked eye. Some mites spin fine webs as they feed, similar to those of spiders.

Thrips – They rarely cause serious damage to trees, but will seriously scar fruits. Scabby or leathery brown scars appear as fruits enlarge, sometimes stunting fruits.

Other pests include Mosquito bugs *(Helopeltis schountedeni), fruit flies* and systates weevils.

b) Management of Avocado pests and diseases

The following can be performed to control pests and diseases

(a) Proper pruning and prompt removal of fruits;
(b) Digging around the tree and exposing the roots to allow the crown to dry enough to prevent tree death.
(c) Use of certified disease-free stock and practice good tool sanitation;
(d) Cutting out infested branches and disposing of them immediately.
(e) Spraying *Bacillus thuringiensis* or other appropriate insecticides
(f) Careful pruning and fertilization to prevent thrips. They can be destroyed with horticultural oil or pyrethrin.

3.4.2 Watermelon

a) Major pest and diseases in watermelon planting

The main diseases identified in Watermelon planting may be fungal, bacterial or viral. The fungal diseases are dominated with Alternaria leaf blight (*Alternaria cucumerina*), Alternaria leaf spot (Brown spot) (*Alternaria spp*), Anthracnose ***(****Colletotrichum orbiculare*), etc.

Alternaria leaf blight are small, yellow-brown spots with a yellow or green halo which first appear on the oldest leaves; as the disease progresses, lesions expand and become large necrotic patches, often with concentric patter nation; lesions coalesce, leaves begin to curl and eventually die. This disease is prevalent in growing areas where temperatures are high and rainfall is frequent.

The Anthracnose, another fungal disease is spread by wind and rain. It is characterized by angular dark brown or black lesions on leaves with yellow border; elongated lesions with sunken centers on stems and fruit.

Cercospora leaf spot (*Cercospora citrullina*), Downy mildew (*Pseudoperonospora cubensis*), Fusarium wilt (*Fusarium oxysporum*), Gummy stem blight ***(***Didymellabryoniae), Powdery mildew (*Podosphae raxanthii/ Podosphaera fuliginea*), Verticillium wilt (*Verticillium dahlia*) are other diseases, mostly spread by wind and water splash and favoured by favored by warm, wet conditions.

Angular leaf spot (*Pseudomonas syringae*), Bacterial fruit blotch (*Acidovoraxavenae*) and Aster yellows (*Aster yellows phytoplasma*) are the major bacterial diseases of watermelon. They are spread through infected seed, splashing rain, insects and movement of people between plants.

All Cucurbit species are susceptible to the virus. Cucumber green mottle mosaic/ Cucumber green mottle mosaic virus (CGMMV), Cucumber mosaic virus (CMV), Watermelon mosaic virus (WMV) and Zucchini yellow mosaic virus (ZYMV) are the main viruses affecting watermelon.

Aphids (Peach aphid, Melon aphid) (*Myzus persicae*), Cabbage looper (*Trichoplusiani*), Cutworms (*Agrotis spp.*), Flea beetles (*Epitrix spp.*), Thrips (Western flower thrips, Onion thrips, etc.) (*Frankliniella occidentalis*) are some of the insects attacking the watermelon.

b) Management of pest and diseases in watermelon planting

The following is recommended for the control of pests and diseases:

- ✓ Rotating Cucurbits (watermelon, pumpkin, squash, and cucumber) with non-cucurbit crops every 1 to 2 years to prevent disease build-up;
- ✓ Using only disease free, treated seed prior to planting;
- ✓ Removing/reduce crop debris (crop residues) from the field as quickly as possible after harvest or plowed deeply into the soil;
- ✓ Applications of appropriate protective fungicides to slow the development of the disease;
- ✓ Watering plants from the base rather than from above to reduce periods of leaf wetness which are conducive to the development and spread of disease;
- ✓ Planting in sites with good aeration and sun exposure. Do not overcrowd plants and avoid overhead irrigation,
- ✓ Planting resistant varieties if available;

- ✓ Do not plant in areas where other susceptible crops have been grown previously; delay planting until temperatures are warmer
- ✓ Protective copper spray may help reduce incidence of disease in warm, humid climates;
- ✓ Planting resistant varieties;
- ✓ Seedlings and plants infected with the virus should be removed and destroyed to prevent spread.
- ✓ The virus can be spread mechanically via tools and on hands. Good sanitation should be practiced at all times to prevent virus transmission; disinfect all tools and equipment between uses by dipping in a solution of bleach or using a commercially available disinfectant such as Virkon.
- ✓ Treatments that control populations of aphid vectors can also reduce the incidence of the virus;
- ✓ Spraying plants with mineral oils or insecticidal soaps can help to reduce aphid numbers

The Watermelon pests can be controlled through:

- ✓ Checking transplants for aphids before planting. If aphid population is limited to just a few leaves or shoots, then the infestation can be pruned out to provide control. Insecticides are generally only required to treat aphids if the infestation is very high.
- ✓ Hand-picking larvae from the plants;
- ✓ Applying *Bacillus thuringiensis* which effectively kills younger larvae. Chemical sprays may damage populations of natural enemies and should and should be selected carefully
- ✓ Removing all plant residue from soil after harvest or at least two weeks before planting,
- ✓ Apply appropriate insecticides to infested areas if pests become problematic ;
- ✓ Plant seeds early to allow establishment before the beetles become a problem - mature plants are less susceptible to damage; application of a thick layer of mulch may help prevent beetles reaching surface.
- ✓ Avoid planting next to onions, garlic or cereals where very large numbers of thrips can build up; use reflective mulches early in growing season to deter thrips;

3.4.3 Tree Tomato

a) Major pests and diseases problems in Tamarillo

The tree tomato is susceptible to a number of problems, which can be controlled with proper care. The fungus, bacterium, virus and pests (mostly insects) are the most common problems.

The major fungal diseases include anthracnose (*Glomerella cingulata*), powdery mildew (*Erysiphe sp., Oidium sp.)*, and verticillium wilt, a soil-fungal disease which can also affect tomato, potato, and eggplant (Morton, 1987; Prohens and Nuez, 2005; Orwa *et al*., 2009*)*. Other fungal diseases of tamarillo are ascochyta disease, black spots disease, etc.

Though not an important problem, bacterial diseases can also attack Tamarillo. However, bacterial wilt, bacterial canker of tomatoes (*Corynebacterium michiganense*), bacterial blast (*Pseudomanas syringae* and *P. solanacearum*) and crown canker (*Agrobacterium sp*.) have been shown to cause damage to tree tomato (Prohens and Nuez, 2005).

Tamarillo is susceptible to a number of viruses including tamarillo mosaic virus (TaMV), Potato aucuba mosaic virus (PAMV), alfalfa mosaic virus (AIMV), tomato spotted wilt virus (TSWV), arabis mosaic virus ArMV), tobacco strick virus (TSV), and tomato aspermy virus (TAV).All virus will cause loss of

yield and "mottling" on the fruit (this does not affect eating quality). Symptoms are most severe on young or unhealthy plants, and will be worst if several viruses have infected the plant at once.

Different species of aphids attack Tamarillo but the green peach aphids (*Myzus persicae*) are the most important. They are vectors of several viruses that affect tamarillo such as cucumber mosaic virus (CMV) and potato virus 'Y' (PVY). Whiteflies secrete honey dew over the leaves and fruit. This can lead to the appearance of sooty mould, which leaves fruit unsalable. They also transmit viral diseases. The nematodes are also among the most dreaded tomato problems. Some insect pathogenic nematodes can actually help control other gardening pests such as fungus gnats or flea beetles.

b) Management of Tamarillo pests and diseases

Pest and diseases cause a lot of problems in tamarillo plantation but they can be controlled. The following are the management measures:

- Avoid overcrowding of plants.
- Application of a sulphur based fungicide like Thiovit/Thionil at 40g/20L of water with 2 weeks spray interval. Spray benomyl (e.g. benobest) at 40g/20L water in alternation with the above product.
- Crop rotation for about 3-4 years is recommended to prevent diseases like Verticillium wilt, etc.
- Proper hygiene is required to prevent bacterial and viral diseases. The affected plants should be removed and burned. The good pest management program will also help to reduce pests and diseases.
- Good control over aphids and whiteflies as they are carriers of viruses.
- Weed control is also important as some weeds can harbour viruses that infect tamarillos. Weeds also compete for light, water and nutrients especially when tamarillos are young.
- Use pest-free planting materials.
- Keep recently received plants isolated to monitor closely and prevent the spread of any potential infestation.
- Field sanitation to destroy weeds which may act as refuge and alternative hosts.

3.4.4 Papaya

a) Pests and diseases problems of papaya

The *Papaya* are very susceptible to diseases caused by many microorganisms especially fungi. Fungi can infect the fruit at pre harvest, during harvesting, subsequent handling and marketing operations. Besides, the infection is also greatly affected by the physiological conditions of the fruit, the temperature and the storage environment. Papaya can also be attacked by pests, mostly insects and birds.

Anthracnose and charcoal spot (*Colletotrichum gleosporoides*), ***Black rot (****Mycosphaerella caricae*), ***Black spot (****Asperisporium caricae)*, ***Cercospora black spot (****Cercospora papaya)*, ***Powdery mildew (****Oidiumcaricae-papayae)* are the major diseases of papaya. The bacterial diseases are dominated with Bacterial canker and decline (*Erwinia spp*) and internal yellowing (*Enterobacter cloacae*) while Bunchy top and Papaya ring spot **(**Papaya ring spot virus (PRV)) are the main viral diseases.

The mealybug and grasshopper, scale insects, aphids, fruit fly, etc are the main insects' pests damaging papaya. The Jungle crow (***Corrusma crocercus***), Myna (***Acridotherestristis* L**) are among the birds species damaging papaya.

b) Management of Pests and diseases of papaya

i. Use of tolerant varieties of papaya is currently the only method of control recommended
ii. Application of appropriate protective fungicides and dipping fruits in hot water at 48°C for 20 minutes reduces the incidence of the disease.
iii. Removal of the infected parts and disposal of them properly.
iv. Avoiding irrigating the trees by sprinkler.
v. New planting materials should be free of the diseases;
vi. intercropping papaya with a non-host such as corn can help to reduce the incidence of the disease in papaya orchards by providing aphid vectors with an alternative feeding site;
vii. Providing proper nutrition to trees to withstand powdery mildew infection. If the disease is severe, apply suitable fungicides;

3.4.5 Passion fruit

a) Major Pests and diseases problems in Passion fruits

The passion fruits are grown in most parts of the country but it is being affected by many pests and diseases problems. It is therefore important to avoid or minimize them and have the knowledge on how to control them. The following paragraphs compiled some of the harmful pest and diseases that lead to big losses in farms. The main pests problems affecting passion fruits are described below: **Mealy bugs**: These are small, oval, sucking insects with a cottony white waxy covering to their bodies. Infestation generally occurs on the tender floral buds and fruits. The insect secrets a sugary substance over which a black coating develops. Such development interferes the food manufacture by the leaves and it downgrades the quality of the fruit.

Passion Vine Mite: The passion mite may cause serious damage to the plants. Unless damage from these mites is checked the plants may die or the growth may be so adversely affected that there is a marked reduction in fruit. This mite appears as scattered, reddish patches on the lower surface of the leaves along the mid-rib and veins as well as on the fruit surface. The mites attack the young leaves and suck the sap, the affected leaves are generally curled. As a result a heavy infestation may cause complete defoliation and the plant may eventually die.

Fruits flies: These insect pests puncture the immature fruits while the rids are still tender. As the fruit enlarges, a woody area develops around the puncture. If the fruit is still quite small and under developed, the damage may be sufficient to cause it to shrivel and fall from the vine. If the fruit is well developed, it may grow to maturity. At the time of opening, the area around the puncture has the appearance of a small woody crater which disfigures the outer appearance of the fruit but apparently does not impair the quality of the juice.

Aphids: Aphids infest passion fruit and plants and suck the sap. On fully grown vines, severe damages seldom results. On seedlings, however, aphids may cause severe damage. Aphids are known to be efficient vectors of passion fruit woodiness virus, which is proving to be a serious disease of passion fruit in various country like Kenya.

The major diseases in passion fruits, caused by fungi and virus, include:

Brown spot disease **(*Alternaria passiflorae*):** The disease is caused by fungus known as Alternaria passiflorae; this is characterized by the development of brown spots and lesions on the leaves, stems and fruits. The disease may infect vines of all ages. Humid conditions, accompanied by slightly higher temperatures than normal may accelerate the spread of the disease. When the attacks are very severe, fruits begin rotting either from the stalk or from the bottom producing a brown color in the attacked parts.

Fusariam wilt: This is a serious disease in Passion fruit particularly the local purple passion fruit. The disease is soil borne, which means that the fungus lives in the soil from where it attacks the rooting system of the affected plant. The disease spreads upwards along the stem and one can easily recognize brown patches scattered on the stem.

The brown patches can easily be mistaken for the brown spot disease and can only be diagnosed by an experienced person. Since the attack originates from the roots the transaction of water and minerals from the soil are interfered with, the plant starts to wither and eventually it dies.

Woodiness disease: Virus causes the disease. The infection is characterized by grossly misshapen fruits, which show abnormal thickening and hardening of the tissues of the fruit wall and a reduced pulp cavity. The foliage becomes mottled with dark green areas localized on the raised portions of the leaves. The leaf color between dark green and the raised areas is yellow green (mosaic appearance). The leaves are frequently misshapen and reduced in size. In some instances there is lack of growth of the terminal shoot accompanied by a bunchiness of the harsch-textured terminal leaves. The disease is one of the most serious diseases of passion fruit and may curtail the commercial life of a vineyard. Aphids spread the virus, by at the transfer of sap from diseased to healthy plants during pruning and other cultural operations.

b) Management of Pests and diseases in Passion fruits

Different practices can be applied to control pests and diseases in passion fruit farming. The diseases control measures include:

(i) Control of Brown Spot Diseases

1. Constant removal of all infected materials, which should be burnt at least once a week. The pruning frequency should also be increased during humid periods when the disease appears to spread very rapidly.
2. Besides keeping the cines reasonably exposed to the sun by judicious pruning, regular spraying is very necessary to reduce losses where the disease is prevalent.

(ii) Control of woodiness diseases

1. Uprooting and burning all plants showing typical symptoms of the disease;
2. Use seedlings or seeds that are certified to avoid this disease.
3. Plant hygiene measures should be practiced, especially during training and pruning. Pruning knives should be sterilized by use of appropriate disinfectant, both before and after use.

4. Passion fruits should never be planted again in the same field or in the immediate vicinity particularly where a severe attack has occurred.

(iii) Control of fusarium Wilt

Though there is no control of this disease once it attacks the plant, the following can be done for its management:

1. Uprooting and burning the infested plants;
2. Do not use passion fruits' seedlings or seeds which are very susceptible to this disease on the same soil.

3. Use passion fruit which is resistant to this disease, which is used as a rootstock against this disease.

The control of pests, which attack the passion fruit, involves two basic problems: (1) the destruction of insects which attack the plants and (2) the preservation of the insects whose function in pollination is of vital importance to fruit plant.

The problem is complicated because both beneficial and destructive insects are so closely associated with the plant. The injurious insects must therefore be eliminated without destroying the beneficial ones.

An approach to this problem is the proper timing of spray applications. Less damage to the beneficial insects, when a farmer schedules his chemical spray application during periods when the pollinating insects are not active.

3.5 Current and anticipated pest and disease problems of target vegetables

3.5.1 French beans *(Phaseolus vulgaris)*

a) Current and anticipated pests and diseases of french beans (*Phaseolus vulgaris*)

The French beans (*Phaseolus vulgaris*) are among the major crops produced in Rwanda. It is the major source of protein for majority of people (both urban and rural areas). Bean crop has many pests (insects and diseases) both in the field and in the store. Some diseases are seed born and are easily transmitted through infected seeds. The major insects pests and diseases attacking bean are the following: (i) beans fly or bean stem maggot (*Ophiomyia spp*.), (ii) Angula leaf spot (*Phaeoisariopsisgriseola*), (iii) bean anthracnose (*Colletotrichumlindamuthianum*), (iv) common blight (*Xanthomonascampestrispvphaseoli*), (v) halo blight (*Pseudomonas syringaepvphaseolicola*), (vi) bean common mosaic virus, (vii) White flies: *Bemissiatabaci* and *Trialeurodesvaporiorum*, (viii) cutworms (*Agrotis spp*.), (ix) Pod borers: African bollworm (*Helicoverpaarmigera*) and Legume pod borer (*Marucatestulalis*), (x) Stinking bug (*Nezalaviridula*), (xi) Flower and Pollen beetles: Blister beetles (*Mylabris spp*.) and *Coryna spp*., (xii) Aphids (*Aphis fabae*), (xiii) Thrips: African bean flower thrips (*Megalurothripssjostedti*) and Blossom or cotton bud thrips (*Frankliniellaschlultzei*), (xiv) red spider mites (*Tetranychus spp*.). These diseases are seed born and are managed through clean seed or treated seed.

b) Management of major pests of French beans

Management of French beans field pests (insects and pathogens): The successful management of pests and diseases of beans depends on the crop husbandry applied. The important beans diseases are seed

borne and are transmitted by using infected seeds. Field insect pests have little effects on a health and vigorous plant. Therefore by applying recommended agronomic practices, the pests and diseases management can be easily achieved. The following are the general management options for producing health bean crop without significant pest damage effects.

- ✓ **Clean seed**: Use treated clean seeds, and plant on clean soil which was not planted with beans for at least 2 years.
- ✓ **Resistant variety**: Plant your crop using resistant varieties against major diseases where they are available, accessible and affordable.
- ✓ **Crop rotation**: Rotation of beans with none legume crop such as tuber crops. This practice will reduce bean stem maggot (BSM) and root rot.
- ✓ **Fertility management**: Make sure the soil is fertile, and if not, apply manure and inorganic fertilizers as recommended. A vigorous crop tolerates small infection without significant effect on yield.
- ✓ **Weeding**: Timely weeding is important for producing healthy crop. While weeding, it is recommended to do hilling up soil around the stem of the seedlings to encourage development of adventitious roots and enhance recovery of plants from BSM damage.
- ✓ **Crop residue management**: After harvesting, bury the crop residues, and do not use manure from livestock which were fed residues from legume crop.
- ✓ **Fungicide**: In case the above methods fail, you can apply systemic fungicides like benomyl at recommended rates in your area.

3.5.2 Tomato

a) Current and anticipated pests and diseases of tomatoes

Tomato is one of the most important vegetables, relatively easy to grow, important source of nutrition (vitamin A and C) and income for smallholders. Tomato varieties can be divided into two main types. (1) *Bushy varieties* (also called *determinate* cultivars) which can usually grow without support (e.g. Roma variety), (2) *Vine varieties* (also called *indeterminate* cultivars such as Money maker) which need to be supported by *stakes,* and usually *pruned* to leave only one or two main stems.

The tomato crop is attacked by a variety of insect pests and a wide range of diseases attack leaves, fruit and roots, particularly in the rainy season when high humidity favours insects and pathogen development and transmission.

The major insect pests include*:* Bollworm (*Helicoverpaarmigera)*, Leafminer (*Liriomyza spp.*)**,**Cutworm (*Agrotis spp.*) African Spider Mites (*Tetranychus spp.),* Aphids (*Myzuspersic**a**e*&*Aphisgossypii*)**,** Whitefly (*Bemisiatabaci*)**,** Root-Knot Nematode (*Meloidogyne spp.*)*;* while the major diseases include*:* Late Blight (*Phytophthorainfestans*), Damping Off (*Pythium spp*. &*Rhizoctoniasolani*), Early Blight (*Alternariasolani*), Fusarium WiIt (*Fusarium oxysporum f. sp.lycopersici*), VerticilliumWiIt (*Verticilliumdahliae*), Powdery Mildew (*Leveillulataurica*), Septoria Leaf Spot (*Septorialycopersici*), Anthracnose (*Colletotrichum spp*.), Leaf Mould (*FulviaFulva*), Bacterial Wilt*(Pseudomonas*

solanacearum also known as *Ralstonia solanacearum***,** Tomato Yellow Leaf Curl Virus (TYLCV), Tomato Mosaic Virus (TMV) and Blossom End Rot. Farmers possess little knowledge of most of these pests. It is important to monitor the use of pesticides on tomatoes otherwise farmers may overuse them. Among these diseases, the late blight (*Phytophthora infestans*) is the most serious and is currently controlled using fungicides such as Dithane M45/Mancozeb or Ridomil/Metalaxyl. Both fungicides are category U and III respectively which are acceptable.

Staking practice helps to avoid diseases by improving air circulation in the crop, and preventing plant parts and fruits from touching the soil. Tomatoes are usually grown in seedbeds and then transplanted when they have grown to a height of about 10 to 15 cm. As with many crops, it is better sowing seeds thinly and to remove competing weeds to produce vigorous plants which are more likely to withstand pests and diseases. .

b) Management of major pests of tomato

Tomato is one of the most important vegetables, relatively easy to grow, important source of nutrition (vitamin A and C) and good source of income for smallholder farmers. In general tomatoes production is constrained by diseases and insect pests and all are economically important.

African Bollworm (*Helicoverpa armigera*): Bollworms are large caterpillars often seen feeding in tomato fruit. Adults are large brown moths (figure 1a) which fly at night. The larvae (caterpillars) feed on leaves, flowers and fruit. The leaf damage can reduce leaf area which slows plant growth and the flower feeding can prevent fruit formation.

When they burrow in the fruit they are difficult to reach and control with insecticide. The damage may cause the fruit to drop or make it more susceptible to secondary fungal and bacterial diseases. Management options include:

(1) Scouting is important to detect infestations early, preferably for the presence of eggs, since the larvae are well-protected once they move into the flowers and fruits. When larvae have entered the fruit, the damage caused is severe, (2) crop rotation can only help to prevent build-up of populations, if it is done over large areas, since adult moths can move quite long distances and is likely practical for smallholders in associations, (3) hand picking of eggs and larvae can be an effective method if infestations are not too severe.

Chickens can help by eating larvae and pupae at certain times of crop development, although they should not be allowed in seedlings or plants with fruit since their scratching and pecking will cause damage, (4) infested fruit should be destroyed, and after harvesting infested plants should be composted or burnt, (5) infested crop residues are carefully destroyed to prevent pest switching backwards and forwards between different hosts. Pesticide may be used as last resort when other options have failed. A number of pesticides are effective and commonly available in Rwanda e.g., Dimethoate

Cutworm (*Agrotis spp*.): Cutworms cause serious damage by cutting young plant stems at the base. Young larvae may feed on leaves and cause tiny holes, but they drop to the ground after a few days. Mature larvae are about 4 cm long, but because they hide in the soil during the day, and only emerge at

night to feed on the crop, they are not often seen unless the farmer digs them up. The caterpillars are easy to recognize by their smooth skin, greasy grey/black colour and C-shaped posture when disturbed.

Cutworm infestations can appear suddenly (as a result of moths flying into the area) and are often associated with fields that are weedy, having high amounts of organic residue or very wet due to poor drainage or heavy irrigation.

The following are management options: (1) prepare fields and eliminate weeds at two weeks before planting to reduce cutworm number. Ploughing can help to expose larvae to predators and bury others so that they cannot reach the surface, (2) early detection of cutworm infestations helps to initiate control before serious damage occurs. Cutworms are usually present when seedlings are found cut off at the base of the stem.

However, small infestations can be controlled by digging near damaged seedling to find and kill the individual larva, (3) delayed transplanting slightly ensures bigger size seedlings that can be more tolerant to damage, (4) widespread outbreaks may require use of a pesticide application around the plant as drenchor granules. Granules are best option when spread in a circle around the plant, (5) in the marshlands areas like Nyabarongo valley, flooding of the field for a few days before transplanting helps to kill larvae present in the soil.

Leaf miner (*Liriomyza spp*.): The main damage is caused by larvae mining inside the leaves and reducing the photosynthetic leaf area. Some species mine over 2cm per day. If the infestation level is high, when the weather warms up, the leaves may be killed and drop off, leading to yield loss, fruit sun scald or in serious cases, death of the plant. The management options are indicated in tomato IPM tool kit.

Spider mites (*Tetranychus spp*.): Infestations start first on the lower surface of leaves, particularly around the main vein. The leaves may become spotted, yellow, brown or silvery as a result of the spider mites' feeding activity. Yield can be greatly reduced as the plants are weakened or even killed as a result of feeding by large numbers of spider mites. Fruit can also be attacked, causing white speckling and loss of market value. The pest management options are indicated in the tomato IPM tool kit.

Aphids (*Myzuspersicoe & Aphis gossypii*): Aphids damage tomato plants in two ways. (1) They suck plant sap which can reduce plant growth; and (2) they excrete sticky liquid called honeydew, which coats the leaves, causing sooty moulds and develop slow plant growth. Aphids infest upper and lower leaf surfaces and are often seen on tomato plant stems.

Infested plants may show signs of curling, wrinkling, or cupping of leaves. This is a minor pest during rainy season. Pest management options are indicated in tomato IPM tool kit.

Whitefly (*Bemisiatabaci*): Whiteflies damage plants in three ways. Firstly, by sap-feeding of adults and nymphal stages which distort and cause yellowing of the leaves and weakens the plant. Secondly, mould develops on the excreted honeydew deposit which reduces plant growth and fruit quality. Thirdly, whiteflies can carry some virus diseases tomato yellow leaf curl virus.

Plants with heavy whitefly infestations will not yield well, however, a small numbers of whitefly can be tolerated, and pesticide sprays not necessary. When the tomato yellow leaf curl virus is known to be common in the area, even small numbers of whiteflies should be controlled. The white fly can be managed using the following options.

(1) Spraying the plant with soap and water solution controls whitefly. However, the mixture should be no more than 1 part soap to 20 parts water (1:20). If it is too concentrated, it can burn the plant, (2) the use of neem seed extracts in control of whitefly is effective, as it inhibits young nymphs to grow and develop into older nymphs, and reduce egg-laying by adults, (3) growing African marigolds has been reported to discourage whitefly, however, it is bad weed which is difficult to control when it is established, (4) in case the population of whitefly increases to high levels, application of pesticide by spraying may be necessary using effective and commonly available pesticides. The application of a systemic pesticide will be more effective than contact one.

The addition of soap to the spray solution will help the spray droplets spread on the waxy wings of the whiteflies. A single pesticide application may not be effective against eggs or nymphs, so a second application may be necessary to control the adults which have emerged from the immature stages. Whiteflies develop resistance to pesticides very quickly so pesticides should be rotated to prevent it.

Damping off (*Pythium spp. &Rhizoctonia solani*): Damping off disease can occur in two ways, first as pre-emergence damping off when seedlings die before they have pushed through the soils, resulting in patches which appear to have germinated poorly. The second type is post emergence damping-off which occur after seedlings have emerge, which fall over and die while still small, and usually within two weeks after emergence. The fungus infects the roots and base of the stem, and the infected plant show water soaked and shrivelled stem at ground level. The damping off disease of seedlings in the seedbed is caused by fungi. Development and spread of fungi is influenced by wet soils, crowded seedbeds and high temperatures. Damping off usually occurs in small patches at various places in the seedbeds, and disease spots increase in size from day to day until the seedlings hardened after two weeks from emergence.

The fungi are common in moist soils and may survive for several seasons without crop. The infection of plants is through the roots or via leaves which are touching the soil or have been splashed by rain or irrigation water. The fungi can also be transmitted on seed which has not been treated. The management of damping off include the following options:

Use disease-free seed, and sow thinly to avoid crowding of seedlings in the seedbed and do not apply too much irrigation water or nitrate fertilizer. When buying seedlings, examine them in the seedbed to be sure they have been grown well. If there is doubt about the seed, for example, with farmer-saved seed, it can be given the hot water treatment (for 10 minutes at 50-52°C) or seed-treated with systemic fungicide. Use wax stick to bind a piece of metal and a floater tied on thread and stick which lay across the pot to monitor temperature. When temperature reaches 52^{O}C the wax will melt and the metal drops in water, the floater comes on surface. Destroy diseased seedlings by burning them; do not throw them in the field where tomato is to be planted. Make the seedbeds on land which is several metres from land which has previously produced crops of tomato or related crops such as potato, pepper or eggplant, and if there is a tomato field, make sure the seedbed is preferable located up-wind or upstream.

Seedbed soil can be partly sterilized by fire, solarisation or by drenching with a fungicide. If damping off occurs in the seedbed, spraying may be effective using effective and commonly available fungicides. Make sure the seedlings are thinned to enable good air circulation.

Early blight (*Alternaria solani*): Early blight affects all aerial parts of the plant. Disease incidence increases in warm moist conditions (high temperature and humidity).

The disease may defoliate the crop in the seedbed; plants may develop dark, wet patches all around the stem *(girdling)* near the soil surface.

This is sometimes called collar rot, and will damage or kill small plants. When older seedlings are infected, it causes stem lesions that are usually restricted on one side, to become elongated and sunken.

The affected leaves have brown circular spots with concentric rings (rings inside each other) and yellow halos, the pattern of which distinguishes this disease from other leaf spots on tomato. The leaf spots first appears early in the season on the older leaves and progress upward on the plant.

The greatest injury occurs as the fruit begins to mature. When this coincides with favourable conditions for disease development, it causes great loss of foliage, weakening the plant and exposes fruits to sunscald. When plants are larger, patches of disease *(lesion)* sink into the tissue of the stem forming dark hollows. Black sunken spots can also develop around the stalk of the fruit causing it to fall.

Control options are as follows: Avoid planting tomatoes next to related crops such as potato, pepper and eggplant, and remove Solanaceous weeds such as *Solanum nigrum.,* if there is doubt about the seed, for example, with farmer-saved seed, it can be given the hot water treatment (sink in hot water at 50-52^{0}C for 10 minutes with seeds lapped in cloth, use thermometer to monitor temperature) or treated with a fungicide. (See details above), when the crop is harvested, remove plant residues and use them for compost making or destroy them and do not plant consecutive tomato on the same land, if the problem of blight is serious, spray the crop using effective and commonly available fungicides such as Mancozeb, and avoid windbreak and shade areas as they encourage dew and disease development, and keep the field free from weeds.

Late blight (*Phytophthora infestans*): Late blight is one of the most serious diseases in cool moist conditions, and may completely and rapidly destroy the crop (contrary to early blight which prefers warmer condition see above) causing 100% yield loss in absence of any intervention.

The disease causes leaves to develop irregular greenish-black, water soaked patches, usually at the edge of the leaves. The leaves turn brown and wither but often stay attached to the plant. Under humid conditions, a white dusty layer which contains spores can be seen on the underside of the leaves.

When conditions are good for the development and spread of the disease, the whole crop can be lost in a very short time. Grey green watery spots can develop on the upper half of the fruit, which later spread and turn greasy brown and bumpy. Stems can also develop long watery brown patches. However, it is usually a very minor or non-existent problem in the dry season.

Cultural techniques can help to reduce the risk of blight outbreaks. Stake plants to keep them off the soil, mulch to reduce splashes, and remove or deeply bury in old crops after harvest. Pruning will increase air movement and allow good spray penetration if pesticides are to be used. Irrigating in the heat of the day should allow the crop to dry before nightfall and reduce transmission and development. If there is wet weather, apply fungicide as soon as the disease is seen or as soon as local experience suggests that the weather conditions are favourable for disease development. Use of effective and commonly available fungicides such as Mancozeb or Ridomil can provide adequate control.

Fusarium wilt (*Fusarium oxysporum f. sp.lycopersici*): Fusarium wilt disease affects the tubes which carry sap (water and nutrients) and blocks the supply to the leaves. The leaves turn yellow and die, usually the lower ones are the first to die The wilt is typically one-sided - at first only one side of a leaf is affected, then leaves on only one side of a branch, then leaves on only one side of the whole plant. If a stem is cut lengthways, the tubes appear brown/reddish.

Light sandy soil and high temperatures both cause water stress which makes the disease worse. Fusarium wilt can be accidentally introduced to the field on infected seeds and seedlings. It can be in soil on farm tools, staking materials and shoes. Once it has been introduced, it can survive in the plant residues and weed hosts and can re-infect new crops. The fungus also produces special spores which can survive for many years even when no tomatoes are grown. Acidic soil and nitrogenous fertilizer favor the disease, and there is evidence that presence of root knot nematodes encourages Fusarium wilt.

Disease management includes the following options: Do not locate seedbeds on land where Fusarium wilt is known to have occurred, where soil is acidic, raise soil pH to 7 by liming or use of farmyard manure, avoid excessive nitrogen fertilisation and control root-knot nematodes.

Verticillium wilt (*Verticillium dahliae*): Verticillium wilt is a disease which affects the tubes carrying sap (water and nutrients) around the plant. The symptoms are similar to those of Fusarium wilt. The older affected leaves turn yellow and gradually wither and/or fall off, but the damage is not one-sided as with Fusarium wilt. Plants with early infections often wilt during the day and then recover at night, but eventually the wilt becomes permanent. When cut lengthways, the plant often shows symptoms of brown colouration of the tissues. The plant may develop a lot of extra roots at the base of stem. This disease can have a devastating effect on the individual plants, but nearby plants may not be affected

Verticillium wilt can be both seed-borne and soil-transmitted. Unfortunately it can remain in the soil for many years in a dormant form or as soil inhabitant. When a plant is infected the spores can also be blown by the wind to infect other plants. The disease is serious if there is any slight root damage when transplanting or cultivation which can allow the disease to establish, or due to root-knot nematode damage.

The control options include the following: avoid alkaline soil which is good for the disease development, control root-knot nematodes if present in the field, do not locate seedbeds on land with a history of the disease, destroy crop debris after harvest, rogue out and burn any diseased plants and fruit, if plant is grown in the valley, temporary flooding will help to reduce the verticillium pathogen in the soil.

Anthracnose (*Colletotrichum spp.)*: The anthracnose is indicated by small, slightly sunken circular spots developing on the ripe fruits. Even if green fruit is infected, they will not show any symptom until they begin to ripen. As the disease progresses, the spots spread and fruit cracks open. Leaves and stems of infected plants do not show any clear symptoms. The fungus can be seed-borne or can infect new crops from infected plant residue in the soil. Spores from the soil splash onto lower leaves of the new crop and infect them. Spores produced on these newly infested leaves can be carried by rain splash to the young fruit and spread around the farm by people moving through the crops.

Bacterial wilt (*Pseudomonas solanacearum also known as Ralstonia solanacearum*): Bacterial wilt disease causes rapid wilting of the whole plant and the plant usually collapses and dies without any yellowing or spotting of leaves. All branches wilt at about the same time. If the stem of a wilted plant is cut, the Centre appears brown and water-soaked and hollow. Squeezing the cut stem may cause white or yellowish bacterial slime to appear and if the stem is held in glass of water for a few minutes, the milky bacterial slime starts streaming down from the cut end. Roots turn brown and may become soft and slimy in wet conditions.

The bacterium is soil-born and can survive in the soil for long periods. It has a very wide host range and infects all members of the Solanaceae family, including eggplant, peppers and Irish potato and some common weeds like lantana, black nightshade etc. It infects plants through the roots and when diseased plants are removed, the pieces of infected root which remain can infect new crops.

It is often introduced to fields via diseased seedlings which have been raised in infected seedbeds, in drainage and irrigation water. The disease develops best under warm (above 24^0C), wet conditions, and in slightly acidic soil, not favored by alkaline soil (high pH). Root-knot nematodes can increase the severity of the disease. When the roots of diseased plant decay, the bacteria are released back in the soil.

Disease management include the following practices: growing varieties which have some tolerance; do not grow tomatoes in soil where bacterial wilt has occurred before; removal of wilted plants to reduce spread of the disease from plant to plant; control root-knot nematodes since they may help the disease to establish and spread; liming the soil to raise soil PH; maintain high nitrogen level. If possible prolonged flooding of the field can reduce disease levels in the soil. Spraying pesticides will not help to control this disease.

Tomato yellow leaf curl virus (TYLCV): Infection of young plants causes severe stunting of leaves and shoots which results in the plant looking very small and bushy. The small leaves roll up at the edges and yellow between the veins. Fruit set is severely affected with less than one in ten flowers on infected plants producing fruit. There are no signs of infection on fruit.

TYLCV is neither seed-borne nor mechanically transmitted - it is spread by the whitefly *Bemisiatabaci* and can be accidentally introduced on infected seedlings. High temperatures and very dry conditions favour whitefly populations and therefore help the spread of leaf curl virus.

The earlier plants are infected, the more serious the impact on them. Tobacco can also be infected and, although there are no symptoms, it becomes a carrier which can be the source for re-infection of tomato crops.

Disease Management options include**:** Rogue out diseased plants (in the seedbed and the field) and destroy them. Replace them with healthy plants; protect seedbeds from whitefly, because when plants are infected when are old/large enough, they are less affected, have low yield loss; spraying with oil is said to be effective against the disease, probably because they reduce the infestation of whiteflies.

Use different methods to reduce the ability of whiteflies to find the crop, for example, planting in a new area away from previous tomato cultivation, or planting maize around tomato fields, apply mulches (straw, sawdust, etc) to control the whitefly as vector. However, whitefly control may be not be sufficiently effective to control the TYLCV in areas where the disease incidence is high, because very small numbers of whiteflies can transmit the disease between plants. Cultivars such as Roma and Marglobe are highly susceptible and should not be used in areas where the disease is common

Tomato mosaic virus (T0MV) management: Affected plants show light and dark green mottling and some distortion of the youngest leaves which may be stunted or elongated, a condition called "fern leaf" This refers to the resemblance of these leaves to leaves of many kinds of ferns.

Under high temperature and high light intensity, the mottling can be severe. Under low temperature and low light intensity, stunting and leaf distortion are severe. If fruit is infected when nearly mature, they can develop discoloration and brown streaks inside the flesh. The disease can be seed-borne, but can also survive on plant debris in the soil and so re-infect newly planted crops. The virus is easily mechanically transmissible by contact between plants, or through human activities, for example, transplanting seedlings or pruning.

Disease Management are as follows**:** Remove crop debris and roots from the field, and do not overlap tomato crops; remove any crop or weeds in the Solanaceous family from within and around the field; workers should not smoke or take snuff when working in tomato fields as it is believed that ToMV can be transmitted from the tobacco.

When working with plants, it is claimed that dipping the hands in milk or skimmed milk prevents spread from plant to plant; and field tools should be washed thoroughly.

Blossom end rot: Blossom end rot usually begins as a small water-soaked area at the blossom end of the fruit. This enlarges, becomes sunken and turns black and leathery sometimes turning the core of the fruit brown. In severe cases, it may completely cover the lower half of the fruit, becoming flat or concave. Secondary pathogens can invade the fruit and destroy it. The problem is caused by calcium deficiency brought about by rapid changes in soil moisture and poor root development. Other factors that reduce calcium uptake, such as use of ammonium nitrate and high humidity, can make the problem worse. Rapidly growing plants are more susceptible to the disease.

3.5.3 Sweet pepper

a) Pests and diseases problems in Sweet pepper

Damping-off is a disease of seedlings and occurs on the seeding table when the young plants are just beginning to grow. The disease is caused by a number of species of *Pythium* as well as *Rhizoctonia solani*. If the disease attacks the young plants as they are just emerging from the seed, the symptoms of this pre-emergent damping-off is simply seen as areas where no seedlings have emerged. Damping-off in

young, emerged, seedlings is seen as a toppling over of the seedlings as the root systems are destroyed by the fungi. It is possible for some plants to be affected by these fungi and still develop into mature plants. If these plants are stressed later in the season, the fungi can begin to progress in the plants causing a root rot which can eventually kill the mature plant.

Damping-off is not common when seedlings are grown in inert media such as rockwool, it is more common in soil-based media. The disease is more common where greenhouse sanitation practices are poor (Howard *et al*. 1994) or where growing conditions i.e. soil temperature, watering etc. are not optimal, and the young plants are stressed.

Pythium crown and root rot:

Pythium crown and root rot caused by a number of *Pythium spp*. is not common in greenhouse peppers, however it can occur as an extension of an early damping-off problem in the seedlings or as a result of stressful conditions in the greenhouse at transplanting. Transplants infected by *Pythium spp*. develop slowly, are slow to root into and establish on the sawdust bags, and in extreme circumstances, wilt and slowly die.

Fusarium stem and fruit rot

The appearance of soft, dark brown or black lesions on the stems at nodes or wound sites are symptoms of Fusarium stem and fruit rot caused by *Fusarium solani* (Howard *et al*, 1994). Black water-soaked lesions may also develop around the calyx, eventually spreading down the sides of the fruit (Howard *et al* 1994). Under conditions of high humidity, the fungal mycelium is quite apparent on the lesions (Howard *et al*, 1994).

Gray mold

Caused by the fungus *Botrytis cinerea*, the Gray mold is a common disease of greenhouse crops grown under conditions of high humidity and poor air circulation. The fungus enters the plant from wound sites and olive-green lesions develop that can eventually girdle the stem causing the plant to die (Howard et al 1994). Fruit infections commonly begin at the calyx or at wound sites.

Powdery mildew:

Powdery mildew of greenhouse pepper, caused by *Leveillulata urica,* is not a common problem in Canada. The first report of this disease in Canada was in 1999 in two separate greenhouse locations in Leamington and Vineland, Ontario (Cerkauskas *et al*, 1999). Yield losses of 10 to 15% were associated with the disease in these greenhouses (Cerkauskas *et al,* 1999).
Spots with a white powdery coating develops on the lower surface of the leaves, a slight chlorosis of the upper leaf surface is associated with the spots (Cerkauskas *et al,* 1999).

Pepper mild mottle virus (PMMV)

Pepper mild mottle virus occurs practically everywhere that pepper is grown. The presence of the virus is difficult to detect until the plants begin to bear fruit. Leaf symptoms are easily mistake for other problems such as magnesium and manganese deficiencies. As the disease progresses in the plants, the new growth

can be distinctly stunted with a clear mosaic pattern of yellow and green. Fruit symptoms often occur well in advance of the stunting symptoms and include the development of obvious bumps on the fruit as well as color streaking and green spotting as the fruit matures to color. Fruit tend to have pointed ends and may also develop sunken brown areas on the surface (Howard *et al* 1994). The virus is very stable in plant sap and it is easily spread from plant to plant.

Other viral diseases include Tobacco mosaic virus (TMV), Tomato spotted wilt virus (TSWV), Tomato mosaic virus (ToMV) and Tomato mosaic virus (ToMV).

Apart from diseases and pests, the sweet pepper may suffer from physiological disorder associated with a number of environmental stress as well as calcium deficiency (Howard et al 1994). Any condition which causes water stress or a reduction in transpiration, and resultant movement of nutrients through the plants can bring on symptoms. The Blossom end rot (BER), fruit cracks, fruit splitting, fruit spots, etc are some of the physiological disorder.

The main insect and mite pests of sweet pepper are presented below:

Aphids: Aphids are soft-bodied insects with tubes or tail-pipes (cornicles) protruding from the end of the body (abdomen). They may vary in color from green, black, yellow to pink. Aphids can develop and reproduce throughout the year under continuous pepper production.

Aphid species feeding on grown peppers mainly include the green peach aphid (*Myzuspersicae*) and potato aphid (*Macrosiphum euphorbiae*). They cause direct damage by removing plant fluids with their piercing-sucking mouthparts; they feed on new growth that may cause leaf yellowing and plant stunting. Leaves affected may appear distorted or curled upward or downward. Excessive aphid populations may result in the presence of white cast or molting skins. The indirect damage caused by aphids is associated with the excretion of honeydew during feeding. Honeydew is a clear, sticky liquid that serves as a growing medium for certain black sooty mold, which may inhibit the ability of pepper plants to produce food by means of photosynthesis. Aphids may also vector certain viruses like Cucumber mosaic virus.

Broad mite (*Polyphagotarsonemus latus*): This insect has four life stages: egg, larva, nymph and adult. Nymphs and adults feed on the undersides of young leaves and flower buds, flowers and fruit. Broad mites inject a toxin into pepper plants that causes twisted, hardened, distorted and/or stunted terminal growth. Leaves may curl downward and turn purple in color. Fruit may be scarred and discolored, with premature fruit drop occurring under severe broad mite infestations. In addition, damaged fruit may be not be marketable.

Whitefly (*Trialeurodes vaporariorum*): The life stages include the egg, nymph, pupa and adult, which are located on the underside of pepper leaves. Whitefly nymphs and adults have piercing-sucking mouthparts that are used to withdraw plant fluids. In general, nymphs cause greater plant damage because they feed more than adults. Direct feeding damage to peppers may result in leaf curling, leaf yellowing, chlorotic mottling, stunting and wilting. Greenhouse whitefly can also cause indirect damage by secreting copious amounts of honeydew.

Two spotted spider mite (*Tetranychus urticae*): All life stages are located on the leaf underside because two spotted spider mites are very sensitive to drying-up when exposed to ultraviolet light (sunlight). Two spotted spider mite feeding reduces the chlorophyll content in leaves and decreases the ability of plants to manufacture food through the process of photosynthesis.

Damaged leaves appear bleached and stippled with small, silver-gray to yellow speckles. Fine mottling on the upper leaf surface may be noticeable. Heavily infested leaves may appear bronzed, turn brown and eventually fall off pepper plants. In addition, webbing may be present on leaf undersides.

Western flower thrips (*Frankliniella occidentalis*): This causes direct damage by feeding on pepper leaves and even flowers. Symptoms of feeding include leaf scarring, distorted growth and sunken tissues on leaf undersides. Black fecal deposits may also be present on the underside of pepper leaves. Western flower thrips cause indirect damage by vectoring the Tomato spotted wilt virus.

b) Management of pests and diseases of sweet pepper

i. Ensure good air circulation within the crop, maintain and avoid the formation of free water on the plants and fruit;
ii. Prevention obtained by using high quality, fresh seed, and by maintaining optimal growing conditions for the young plants;
iii. Infected plants should be carefully removed and destroyed as the virus can survive in dry plant debris for up to 25 years.
iv. Use disease-free seed and ensure that resistant cultivars are grown. Use a skim milk dip when handling the plants;
v. Efficient control of insects vectors (like thrips) and weeds as well as preventing the establishment of virus infected weed plants. Plants infected with a virus must be disposed of immediately.

3.5.4 Chili pepper

a) Current and anticipated pests and diseases of Chili pepper

Slugs and Snails, Aphids, Caterpillars, Flea Beetles, Pepper Maggots, Nematodes (Root Knot), Spider Mites and Whitefly are the major pests in Chili farming.

The Chilli pepper diseases are caused by fungus, bacterium or virus. These diseases are discussed below:

Anthracnose: This disease is caused by the fungi *Colletotrichum piperatum and C. capsisi* and is promoted by warm temperatures, high moisture and poor air circulation between plants. Though it does not affect pod growth, the disease can seriously damage the pods themselves. Symptoms appear in both ripe and un-ripe pods and are characterized by sunken, circular spots that can grow up to 1 inch in diameter. In moist conditions, pink or yellow spore masses may appear.

Crop rotation and the use of disease-free seed controls this fungus. Remove affected pods, if disorder is severe a fungicide may be needed.

Bacterial leaf spot: Caused by the seed borne bacterium *Xanthomonas campestris pv. Vesicatoria* which also causes bacterial spot in tomatoes. Moist conditions encourage the disease development. However, the principle source is infected seeds. The disease first appears as small water sacked areas that enlarge up to a quarter of an inch in diameter. The disease spots have black centres and yellow halos. The spots are depressed on the upper leaf surface whereas on the lower surface the spots are raised and scab like. Severely spotted leaves will eventually turn yellow and drop off leaving pods susceptible to sunscald. To avoid this condition buy disease-free seeds from a reputable grower only.

The use of copper based fungicides can have some success in controlling the issue although may cause growth issues.

Bacterial Soft Rot: It is caused by the bacterium *Erwinacarotovora pv. Carotovora* and affects chilli pods. The internal tissue softens before eventually turning into a watery mass with a foul smell. This problem is worse in wet conditions because the bacteria are splashed from the ground up onto the fruit. It can also be spread by insects.

Keeping plants off the ground and controlling insects can help help with avoiding this disorder. Remove affected pods immediately.

Bacterial Wilt: The disease is caused by the bacterium *Pseudomonas solanacearum*. The first symptoms start with the wilting of the leaves. After a few days, the entire plant will wilt with no leaf yellowing.

Test for this condition by cutting the roots and lower stems, then look for milky-white streams when they are suspended in water. There is not much that can be done for a plant with this condition, always buying seeds from reputable growers can help avoid this condition.

Cercospora leaf spot (Frog eye) is caused by fungi *Cercospora capsici* and is worst under extended warm, wet conditions. The disease is characterized by small brown circular leaf lesions that have a watery appearance. Excessive leaf drop may occur in large infestations. Good airflow around the plants will minimize the problem.

If the problem is severe you may wish to consider a fungicide - read instructions carefully and take note of how using this chemical affects the edibility of the pods.

Damping-off: The disease is caused by poor seed quality, improper planting depth, high salt concentrations, wet seed beds or severe nutrient deficiencies. Seedlings fail to emerge (pre-emergence damping-off), small seedlings collapse (post-emergence damping-off) or seedlings are stunted (root rot or collar rot). Poorly drained soil is often a major cause of this condition, good ventilation around the plants helps.

Grey Mould: it is caused by the fungus *Botrytis cinerea*. Symptoms include a sudden collapse of succulent tissues, such as young leaves, stems and flowers. Grey powdery spore masses occur on the surface of dead plant matter. This condition is worsened by high humidity.

Phytophthora Blight (Chilli Wilt): The disease is caused by a water-borne fungus called *Phytophthora capsici* and is generally found in wet waterlogged areas. The fungus invades all plant parts causing the syndromes leaf blight, fruit rot and root rot. Plants suffering from this conditions often wilt and die very

quickly. Once the fungus enter the roots the plant is beyond saving unfortunately due to root rot. The condition may also affect a section of the plant rather than the plant as a whole.

This section is often bordered with white mould - remove immediately. Avoid excess watering of plants and try to give your soil good drainage. A fungicide can be used on the leaf blight and fruit rot symptoms however root rot is usually terminal.

Powdery Mildew is caused by the fungus *Leveillulataurica* and primarily affects the leaves of chilli plants in warm wet conditions. This disease generally affects older leaves and symptoms include patchy white, powdery growth that can enlarge to cover the entire lower leaf surface. Diseased leaves eventually drop off leaving pods susceptible to sunscald.

Verticillium Wilt is caused by the fungus *Verticillium dahlia* and is a soil-borne fungi which can infect the chilli plant at any growth stage. Cool air and low soil temperatures can worsen the condition. Plants may show yellowing of leaves and stunted growth.

As the disease progresses the plants can shed leaves and may finally die. If the stem is cut, a brown discoloration may be visible. Crop rotation is the only control currently.

White Mould is caused by the fungus *Sclerotinia sclerotiorum*. It causes blighting or rotting of any above or below ground plant parts. At first the affected area of the plant has a dark green, greasy or water-logged appearance. On the stems, the lesion may be brown to grey in colour.

Pepper Mosaic & Pepper Mottle Virus (PeMV): This is caused by infected aphids and other insects that have come into contact with the plant. Symptoms include stunted growth, distorted fruit, and chilli pod yield reduction.

Other viral diseases affecting Chilli pepper include Tobacco Etch Virus (TEV) and Tobacco Mosaic Virus (TMV). The first is caused by infected aphids and other insects coming into direct contact with the plant while the 2nd is spread by touching plants after handling tobacco or smoking.

b) Management of pests and diseases of Chili pepper

The following are techniques recommended for the control of identified fungal, viral and bacterial diseases:

(i) Diseases Control

1. Adopting crop rotation;
2. Using disease-free seeds;
3. Removing the affected pods;
4. Applying copper based fungicides (mainly copper based fungicides) if disorder is severe.
5. Planting in a well-drained soil and ensure proper plant spacing;
6. Ensure the good control of insects vectors (like aphids and other insects) to avoid the propagation of viral diseases;
7. Smokers should always disinfect hands (milk kills TMV) thoroughly before touching chilli plants.

(ii) Pests Control

1. Manual removal of insects and eggs,
2. Check pods for small entry holes and destroy infested chillies (ie removal of affected leaves and pods);
3. Spray chemicals once pest damages are very severe.

3.5.5 Onions

a) Current and anticipated pests and diseases of onions (Alliums cepa.)

The onions are produced in many parts of Rwanda, and commonly used by many people, especially in urban areas. These crops are attacked by many pests and diseases.

The major pests include: (i) onion thrips (*Thripstabaci)*, (ii) cut worms , (iii) Nematodes, (iv) Aphids (*Myzuspersicae*), (v) downy mildew (*Peronospora destructor*), (vi) Purple blotch (*Alternariapori*), (vii) Blast and neck rot (*Botritis spp*.) (viii) and other minor pests and diseases which may attain higher significance with time and need close monitoring.

The diseases commonly found in Onion planting are mostly fungal and include **Black mold (***Aspergillus niger*), Botrytis leaf blight (*Botrytis squamosal*) , Downy mildew (*Peronospora destructor*), Fusarium basal plate rot (*Fusarium oxysporum*), Fusarium damping-off (*Fusarium oxysporum*), Pink root (*Phomaterrestris*), Purple blotch (*Alternariaporri*), Smut (*Urocystiscolchici*). The Onion yellow dwarf Onion yellow dwarf virus (OYDV) is a viral disease.

b) Management of major pests and diseases of onion

The onions and leek have less pest problem. They are easily managed using the cultural practices such as:

(i) Good cultural practices,

(ii) destruction crop residues and off season or continuous production,

(iii) use resistant varieties,

(iv) plant on clean soil, avoid infested soils where previous crop was attacked,

(v) Apply pesticide like furadan against thripswhen necessary, in its granule formulation applied on soil. However, dimethoate may also be effective. The right dose and timing will be established through field trials with farmers

3.6 Current and anticipated pest and disease problems of climbing bean

3.6.1 Current and anticipated pest and disease problems of bean crop

The bean (*Phaseolus vulgaris*) is an herbaceous plant grown in the whole country and constitutes the staple food in Rwanda. It can be bushy or climbing depending on the variety being grown. The common bean is used as a pulse and green vegetable eaten fresh or cooked. It grows best in a fertile, well-draining soil with a pH between 6.0 and 6.75, full sunlight, at soil temperature between 15.5 and 29^{o} C and are sensitive to cold temperatures and frosts.

The major diseases are fungal, bacterial or viral. The fungal diseases include (i) Alternaria leaf spot (*Alternaria alternarata*), (ii) Anthracnose (*Colletotrichum lindemuthianum*), (iii) bean rust (*Uromyces appendiculatus*), (iv) black root rot (*Thielaviopsis basicola*), (v) fusarium root rot (*Fusarium solani*) and (vi) White mold (*Sclerotinia sclerotum*). The bacterial diseases are dominated with bacterial blight (*Xanthomonas campestris*), bacterial brown spot (*Pseudomonas syringae*). Bean diseases caused by virus include among others Mosaic (Bean common mosaic virus BCMV), Bean common mosaic necrosis virus, BCMNV).

The major bean pests are mostly insects. The Aphids (Cowpea aphid, Pea aphid, etc) (*Aphis crassivora* or *Acyrthosiphon pisum*), Armyworms (beet armyworm, Western striped armyworm), Corn earworm (Helicoverpazea), Cutworms (*Agrotisspp*), Leafminers (L*yriomyzaspp*), Loopers (*Trichoplusiani, Autographacalfornica*), Mexican bean beetle, Stinkbugs and Spider mites are the major insects damaging bean.

3.6.2 Management of major pests and diseases of beans

The successful management of pests and diseases of beans depends on the crop husbandry applied. The important beans diseases are seed borne and are transmitted by using infected seeds. Field insect pests have little effects on a health and vigorous plant. Therefore by applying recommended agronomic practices, the pests and diseases management can be easily achieved. The following are the general management options for producing health bean crop without significant pest damage effects.

- ✓ **Clean seed**: Use treated clean seeds, and plant on clean soil which was not planted with beans for at least 2 years.
- ✓ **Resistant variety**: Plant your crop using resistant varieties against major diseases where they are available, accessible and affordable.
- ✓ **Crop rotation**: Rotation of beans with none legume crop such as tuber crops. This practice will reduce bean stem maggot (BSM) and root rot.
- ✓ **Fertility management**: Make sure the soil is fertile, and if not, apply manure and inorganic fertilizers as recommended. A vigorous crop tolerates small infection without significant effect on yield.
- ✓ **Weeding**: Timely weeding is important for producing healthy crop. While weeding, it is recommended to do hilling up soil around the stem of the seedlings to encourage development of adventitious roots and enhance recovery of plants from BSM damage.
- ✓ **Crop residue management**: After harvesting, bury the crop residues, and do not use manure from livestock which were fed residues from legume crop.
- ✓ **Fungicide**: In case the above methods fail, you can apply systemic fungicides like benomyl at recommended rates in your area.

3.7 Integrated Pest Management (IPM) experience of SPIU RSSP-LWH and in Rwanda

The IPM experience among farming community has increased due to RSSP3 and LWH capacity building of lead farmers on pest and diseases control and Farmer Field School (FFS). Trainings, workshops, study tours and demonstration plots were organized for direct project beneficiaries. The IPM and safe handling and use of pesticide were the major topics. However, the development and promotion of IPM and safe use of pesticides is still an urgent issue to address low knowledge on pesticides hazards among extension staff, farmers and retailers in rural areas since the RSSP and LWH and other MINAGRI projects did not cover the whole country and the skills of trained resources need to be strengthened. This is an important activity because the future of agriculture in Rwanda is dependent on crop intensification and more use of agricultural inputs including pesticides.

The pesticide survey done in 2005 revealed that the trade of the pesticides inside the country was mainly made by farmers' organizations which deal with a particular crop without sufficient knowledge of safe handling of pesticides. Training of people involved in storage, handling, marketing and uses of pesticide is urgent to develop capacity at all levels.

The current pest management practices commonly applied by the majority of farmers include a combination of cultural practices, resistant varieties and pesticides. The pesticides application is limited to crops of high value like tomatoes, potatoes, rice and coffee etc, while pest management in staple crops like maize depends mainly on cultural practices and resistant varieties. It is very rare for farmers to buy pesticide for controlling maize field pests unless there is a serious pest outbreak like African armyworm problem and availability of external support like projects or NGOs. Some farmers may avoid producing a particular crop during a certain season of a year because they are anticipating high disease attacks. For instance, farmers avoid growing tomato during rainy season since they know that they may face high yield losses due to diseases.

The MINAGRI has already a plant protection law (Law No 16/2016 of 10/05/2016) and law governing agrochemicals (Law No 30/2012 of 01/08/23012) to regulate pesticides use in the country and reduce risks of pesticides. In addition, there are different laws including (i) Environmental law of June 2004 prohibiting the introduction and the use of the products dangerous for human health and the environment and bearing creation of the Rwandan Environment Management Authority (REMA); (ii) The law creating Rwandan Office of Standardization (RBS: Rwanda Bureau of Standards) which makes it possible to control the quality of the pesticides introduced into the country, the use and supervision of stocks of pesticides, and (iii) at the institutional level, the Ministry of Environment (MoE) is responsible for the formulation of the policies and laws that aimed to protect human health and the environment, which includes the management of pesticides.

Trainings of agronomists and lead farmers in RSSP-LWH sites have taken place but there is a need to continue and strengthen this important activity and extend it to other sites not covered by SPIU. It is important that pesticides are used safely and in a way which is not hazardous to the users, consumers of the produce, livestock, and/or to the environment. The farmers should be aware and observe the safe use of pesticides as specified in a pesticide guide. All pesticides should be treated with care whether they are known to be particularly poisonous or not.

It is anticipated that SAIP will strengthen capacity building at all levels including farmers, extension staff, pesticide traders and local leaders within the project areas. The baseline data for pesticide use in each target crop is not available at the moment because the cooperatives can buy and supply fungicides only and individual farmers buy insecticides and fungicides on their own. This makes it difficult to establish reliable pesticides quantities used. A rough estimate may be established using area per crop, number of sprays per season and amount per spray. The M&E may be able to establish this information during baseline study at the beginning of SAIP.

3.8 Circumstance of pesticide use, capability and competence of end-user

3.8.1 Circumstances of pesticide use in different crops

The circumstance of pesticide use under SAIP will be mainly in disease management using fungicides and few insect pests for some crops.

Current pesticides use in potato: In the potato crop, the commonly used pesticide is the fungicide, and the most commonly used fungicides are Dithane M45/Mancozeb (contact preventive), and Ridomil/Metalaxyl (systemic). Both of them are unlikely to cause hazard because they are categorized as U and III under WHO respectively. Farmers apply Dithane M45 (protective fungicide) when rainfall is not continuous, and use Ridomil (systemic fungicide) when rainfall is continuous and can wash out protective fungicides. This experience is good and is an important tool in IPM development, since it is farmers' knowledge of their local conditions.

Current pesticides use in tomatoes: The tomato crop suffers a large number of diseases. However, the pesticides are used only to control late blight (*Phytophthora infestans*).The latter is major constraint especially during the rainy season. The disease is controlled using the fungicides such Mancozeb/Dithane M45 or Ridomil/Metalaxyl (category U and III respectively).

Pesticides use in French/green beans and climbing beans: The use of pesticides in pest management in the bean crop is very low under field condition. The use of systemic fungicides like benomyl is effective, however, not applied because the cost of control is very high while the value of beans is very low.

Pesticide use in other target vegetable crops: The pesticides use in other target crops in particular onions, pepper and chilli is expected to be very rare. The circumstance leading to pesticide use in those target crops for SAIP will occur in isolated cases and could be easily handled.

Pesticide use in target fruit crops: SAIP targets to focus on watermelon, avocado, tree tomato, papaya, and passion fruit. Tree tomato and Passion fruits suffers a large number of diseases, mainly fungal and viral diseases respectively. The use of pesticides will be of great help to control mostly fungal diseases in tree tomato and viral diseases in passion fruits. It is anticipated that the pesticide use in other fruit crops targeted by SAIP (avocado tree, watermelon, papaya) will be very rare and pesticide use will happen in isolated cases.

3.8.2 Capability and competence of end-user to handle pesticides

Due to small pesticides market in Rwanda, the legal framework, end-user capability and competence are not well developed for wider community. However, for those directly involved in the pesticides application like in coffee producers, irish potato producers, they have been trained through support offered by their cooperatives and/or coffee and potato authority.

However, for wider community of stakeholders in agriculture, they are not aware on the hazardous nature of pesticides and their effects on health of people, animals and the environment. The farmers are not informed on dangers of over use or sub-lethal dose on pests and environment, on how in long run the pests develop resistance and cause more crop losses.

Similarly, the consumers are not sensitized on the dangers caused by pesticides treated food and impact on their health. Community sensitization on hazardous nature of pesticides and implication on their health in short term and in long period is urgently needed. The adoption of IPM depends on many factors including the community involvement in the process of IPM development in order to understand why it is needed, and that pesticides can be used safely and timely when necessary.
Therefore, SAIP should include in their budget the cost of capacity building and sensitization of safe pesticides use at all levels from production, trading and consumers.

The current pesticides use in Rwanda is limited to few crops of high value and is not guided by legal obligation; moreover, pesticides are profitable for limited crops of high value and in most cases are either not affordable or not accessible in many parts of the country. According to MINAGRI reports, the national average of pesticide use is below 1kg/ha and is mainly fungicides used on coffee and potatoes. The data available are more than ten years old, however, they are indicative. During a three year period (1997 – 2000), the proportion of different pesticides, fungicides, insecticides and herbicides was 75%, 23% and 2% respectively. This is trend may persistent for some time, because fungal diseases are more a threat than insect pests.

The Ministry of Agriculture and Animal Resources (MINAGRI) is currently addressing the problem of pesticides by re-enforcing pesticides laws and regulations as the draft bill is with the parliamentary committee for review as of November 2011. Currently, the regulatory legal framework is not strong enough to address all problems which may arise during intensification of agriculture without support of capacity building among crop producers.

According to the national pesticide survey conducted in 2005, the following actions were recommended: (i) Registration of the pesticides to regulate importation, storage, handling and marketing; (ii) formation of associations for pesticides distributors and importers; (iii) training of all pesticides dealers and distributors; and (iv)introduce competence license in pesticide handling for importers and distributors, in addition to trade license. Meanwhile international regulations will be used for storage and handling of pesticides.

Source of pesticides: In Rwanda, there are two major sources of importation of the pesticides: (i) importers having trade licenses of importation and (ii) donations coming from development partners (e.g. European Union, FAO, Japan, NGO etc).

The pesticide marketing is liberalized and supply is done by private sector. There are only a few importers in Rwanda dealing with import, wholesale and retail of pesticides.
Pesticide retailers based in the country (e.g. Agrotech) have their own storage, transport and disposal of containers. However, due to low purchasing power of farmers and high price of pesticides (e.g. insecticides and some fungicides), the retailers have tendency to buy in large quantities and repack in small containers.

3.8.3 Prerequisite measures to reduce specific risks associated with pesticide use

Legal framework and enforcement: The plant health law and agrochemical law will address all issues concerning pesticides use in the country. As indicated above, MINAGRI has already plant health law and agrochemical law that will regulate the use of pesticides in the country.

Capacity building: SAIP will expand the work done so far by various partners (RSSP, LWH, etc) and address issues of capacity building at all levels (farmers, traders, extension staff, local leaders and decision makers etc) in project sites. Rwanda has small market for pesticides, as result distribution and marketing of various pesticides is small moreover many farmers depend on cultural practices and resistant varieties.

Nevertheless, the training of farmers, extension staff and retailers of pesticides is an urgent and important activity during SAIP. Most extension staff employed by farmers' cooperatives has educational background in pesticide technology, but these skills need to be continuously updated.

Pesticide technology: The training should include more information for safe use of pesticides which should be taught to all farmers, like poisonous effect of pesticides thus safe handling, storage, protective clothes, disposal of containers, sprayer maintenance and calibration, etc. Since farmers will continuously produce potatoes, tomatoes or rice for greater part of their life, the safe use of pesticide is important for their safety, other people's safety and environment in general. Therefore, to ensure safe use of pesticides capacity building exercises will be important at all levels during SAIP implementation, including local leaders, traders and policy makers. In addition, as some of the pests of target crops of SAIP (are known worldwide to develop resistance to pesticides very fast. This gives another reason to give priority to training on pesticide management.

Minimum requirements for a pesticide store

Any pesticide store should answer the following criteria:

- ✓ Impermeable floor
- ✓ Adequate ventilation
- ✓ Locked store
- ✓ Secured site
- ✓ Location that does not pose specific health or environmental hazards (distance from homes, schools and water)
- ✓ Managed by store-keeper with knowledge about hazards and capable of handling leakage and other emergencies

- ✓ Emergency materials and protective gear needed to deal with emergencies (including emergency plan, Material Safety Data Sheets for products kept in store, fire extinguisher, emergency shower for staff).

CHAPTER 4: CURRENT PEST AND DISEASE MANAGEMENT PRACTICES RELEVANT TO SAIP

4.1 Introduction

The 13 crops targeted by SAIP are among the national priority crops and the execution of IPM will involve different partners. In addition, IPM is normally executed at community level rather than at individual plot level. The execution of IPM plan will therefore involve MINAGRI, District authorities, farmers' organizations and farmers.

MINAGRI needs to recommend IPM as a national approach in pest management and develop IPM policy to promote its use in addressing pest problems. Furthermore, improvement to legal framework and enforcement at all levels is needed, as part of the law for plant protection, in the areas of pesticide registration, handling and use. The District and Cooperative authorities should accept IPM as an important activity and include it in their performance contracts on an annual basis.

The execution of IPM at project level alone is not sufficient; resources will be needed to sensitize the community about the plant protection law and some IPM practices like closed season which require cooperation with the community and Local leaders and extensive training of farmers. It is recommended to establish IPM at community level, not at individual farm level only. The plots in the same locality should apply the same principles to avoid source of infestation from the neighborhood. Therefore, the IPM options should be taught to farmer groups and not to individual farmers. Farmers should be organized into groups to work together, make regular field observations, discussions and agree on the best IPM approach to apply at the various growth stages of their crop.

Training of farmers in IPM is an important activity because they should be able to know and distinguish pests and none pest insects, recognize and appreciate damage caused and associate it with particular pests, diseases or weeds. Finally, they should be able to make decision on pest management action to take control of pests, diseases and weeds and the reasons that are underlying the decision to take a particular action.

The pest and diseases control is essential component in crop production. The insects and pests are part of biodiversity of any ecosystem and they cause great losses if not well managed. They become pests only when they multiply and exceed a certainly population level as a result of supply of good and high nutritive food from crops. When the damage causes economic loss, then they become major pest worth of investing in cost for control and stop further yield loss. In Rwanda, the common pest management practices include (i) informal cultural practices for diverse crops, (ii) use of resistant varieties, (iii) natural control (use of natural enemies), and (iv) Pesticides application, mainly done on cash crops and horticultural crops. The pest management practices applicable to SAIP are discussed below:

4.2 Relevant pest and disease management practices to SAIP

4.2.1 Informal cultural practices use in pests and disease management

The use of cultural practice is the most common practices among farmers. Although not formally developed into IPM package, it is still the only method which keeps the pest below damage threshold while preparing their own fields.

The cultural practices applied in Rwanda have some important elements useful in pest management. In most crops, apart from irrigated rice and potatoes, other crops are planted in rotation or under mixed cropping system. The crop residues are normally destroyed by burying, burning or heaping or feed to livestock.

All these methods do not allow population increase of the insect or diseases. The burning of crop residues is no longer allowed and banned across the country. Crop rotation is generally practiced by the majority of farmers.

4.2.2 Resistant varieties use in pests and disease management

Currently, the use of resistant varieties is the most reliable, affordable and sustainable pest management method in the country, in particular for diseases control. Among the most recently released crop varieties, the majority are resistant to particular disease; and both farmers and Government are much interested in such varieties as they provide affordable and sustainable solution to the disease problem. For example, during the last three years, the Government has been involved in assisting farmers to get resistant cassava varieties against cassava mosaic disease.

4.2.3 Natural control in pests and disease management

The natural control or use of natural enemies is an important tool and method in biological control. In Rwanda, the biological control is not one of formal crop protection practices. However, due to very low pesticide use, the effect of pesticides on natural enemies is very low, and conservation of natural enemies is of course effective. In absence of side effect of pesticides, some pests are kept down by a combination of conserved natural enemies with good cultural practices. A field visit in different parts of Rwanda will indicate the importance of this combination. The field observation will indicate that there is much more disease problem at farm level than insect pests.

Since, protective fungicides have little effects on natural enemies as compared to insecticides; it is obvious that the natural enemies of some insect pests are not much affected. However, research on natural enemies distribution and population dynamics for major and minor pests need to be established and funding for research is essential.

4.2.4 Current Pesticides use in pests and disease management

Under this report pesticides means insecticides, herbicides, fungicides, rodenticides and other chemicals used to control, prevent, destroy, repel, or regulate pests. As toxicants (poisons), they detrimentally affect living organisms and usually have adverse effects on other forms of life. Because of their poisonous nature, pesticides can injure or kill people, pets, and livestock; damage beneficial insects, birds, fish, and other wildlife; and can harm desirable plants. It is mandatory that all such materials be very carefully

managed and handled during storage, transport, mixing and loading, application, and disposal. It is critical to stress the importance of safe pesticide use and need for IPM program.

In general, pesticide use in Rwanda targets mainly plant diseases management and nearly 75% are fungicides while the remaining 25% is composed of different insecticides and a few herbicides. Among the fungicides imported, more than 90% of the products are Mancozeb and Ridomil which are applied to potato and tomato against the late blight (*Phytophtora infestans*), coffee leaf rust and coffee berry disease.

Nevertheless, the impact of pesticides use is very high especially in the fungal diseases control such as late blight (*P. infestans*) in potato and tomato, coffee leaf rust (*Hemileavastatrix*), CBD (*Colletotrichum coffeanum*), and rice blast (*P. oryzae*). These diseases are mainly managed using fungicides, and their impact can be tremendous. For example, the late blight without fungicide application can cause up to 100% yield loss on tomato crop in heavy rainfall areas of the country. As a result, fungicides use is more than other pesticides.

During a three years period (1997 – 2000) the proportion of different pesticides was as follows: fungicides (75%), insecticides (23%) and herbicides (2%). Although, the amount used is very small, pesticides use is associated with both positive impact through pest control and negative impact through risks on humans (producers and consumers) and the environment.

In Rwanda, there are two major sources of importation of the pesticides: (i). importers having trade licences of importation and (ii) gifts coming from various partners (European Union, FAO, or NGO (e.g., World vision). The pesticide marketing is liberalized and supply is done by private sector, and directly sold to retailers, while the capability and competence of end-users to handle products within acceptable risk margins is negligible. In general farmers and extension staff have very little capability to handle and use pesticides at low risk.

Basing on the national pesticide survey in 2005 for the whole country, it was realised that there was a need for the following actions: (i) legislation of the pesticides to regulate importation, storage, handling and marketing; (ii) initiating the formation of associations of the distributors and the importers of pesticides; (iii) organizing sessions of training for all distributors of the pesticides; and (iv) importers and the distributors must have not only trade licence but also pesticide dealing licence indicating their competence in pesticide handling delivered by the competent Ministry. Currently there is no policy or regulation as regards to safe pesticide handling and use as required by international code of conduct.

It is important that pesticides are used safely and in a way which is not hazardous to human (producer and consumers), animal/livestock, and to the environment. The farmers should be aware and observe the safe use of pesticides as specified in a pesticide guide. All pesticides should be treated with care whether they are known to be particularly poisonous or not.

It is urgent to do capacity building at all levels including: farmers, extension staffs, pesticides traders, local leaders and politicians. A brief description of current pesticides use in few selected crops is indicated in the following sections. The baseline data for pesticides for each crop is not available because some cooperatives can buy and supply fungicides to farmers as loan deductible after harvest, while

individuals buy insecticides using their own cash. This makes it difficult to establish reliable data on pesticides quantities used in each crop.

Due to the nature of Rwanda land terrain, coupled with high rainfall, the use of pesticide should be limited or used judiciously to minimize side effects to human, animals and environment downstream of watershed and in riparian countries. The alternative pest control means non-chemical methods (cultural, physical and biological) should be explored first before embarking on chemical pesticides application. The use of IPM accepts pesticides as last resort, i.e. if they cannot be avoided. The list of pesticides (insecticides, fungicides, herbicides, rodenticides and nematicides) allowed in Rwanda is provided in annex section, together with prohibited pesticides.

Pest management under SAIP will focus on major pests and diseases of target crops. In addition, it will support other crops on demand driven basis as need arises. Moreover IPM is normally executed at community level rather than at individual plot level; the execution of IPM plan will therefore involve Ministry of Agriculture and Animal Resources, District authorities, NGO's, farmers' organizations and farmers.

The Ministry of Agriculture and Animal Resources needs to recommend IPM as a national approach in pest management and develop IPM policy to promote its use in addressing pest problems. In addition, it needs to improve the legal framework and enforcement at all levels. The pesticide registration, handling and use is required as soon as possible as part of the law for plant protection. The District authorities should accept IPM as an important activity and include it in their performance contracts on an annual basis.

The execution of IPM at project level alone is not sufficient as it will not bring the much needed impact. Resources will be needed to sensitize the community about the plant protection law and some IPM practices like good agricultural practices which require cooperation with the community and Local leaders and extensive training of farmers.

It is recommended to establish IPM at community level, not at individual farm level only. The plots in the same locality should apply the same principles to avoid source of infestation from the neighbourhood. Therefore, the IPM options should be taught to farmer groups and not to individual farmers. Farmers should be organized into groups to work together, make regular field observations, discussions and agree on the best IPM approach to apply at the various growth stages of their crop.

Training of farmers in IPM is an important activity because they should be able to know and distinguish pests and none pest insects, recognize and appreciate damage caused and associate it with particular pests, diseases or weeds. Finally, they should be able to make decision on pest management action to take control of pests, diseases and weeds and the reasons that are underlying the decision to take a particular action. The following section will outline a range of IPM practices for major pests and diseases of each target crops which will form a part of training package for farmers.

4.3 Proposed pesticide use during SAIP implementation

Among the crops that will be supported by SAIP, pesticides will continuously be used on potato and tomato. The use of pesticide on other target crops will be very minimal depending on scouting of field damage, but in general, it will be reduced or avoided without any significant yield loss.

The project will not increase pesticide use because of promoting IPM and safe use of pesticides and needs to be strengthened.

4.3.1 Pesticides use in management of potato, passion fruits and tomato pests and diseases

The use of pesticides will be very important in irish potato, passion fruits, tomato and tree tomato. The pesticides will mainly be used against late blight (*Pytophthora infestans*). This diseases is very stubborn, and is not easily managed even when potato resistant varieties are planted, fungicides are also applied to minimize yield loss. This calls for frequent use of pesticides. The frequency depends on the rainfall, but usually varies from 5 - 10 days between sprays. However, a combination of resistant varieties and fungicide may reduce the amount used. The IPM research should focus on this combination of different options to find the most economical approach.

Protective fungicides: Currently, the commonly used protective fungicide in large amount is Mancozeb/Dithane M45 which is categorized as unlikely to present acute hazard in normal use. Mancozeb is wettable powder which is mixed with water and applied using knapsack sprayer. This fungicide will continuously be used against late blight in both potato and tomato crops because there is no resistant varieties available at the moment in tomato, while in potatoes, the resistant variety need also fungicide application because they are not sufficiently resistant.

Systemic fungicides: When there is wet weather with a combination of heavy rainfall and humidity, farmers prefer to use systemic fungicide, Ridomil/Metalaxyl to control late bright. The alternation of protective and systemic is working among potato farmers and they are conversant with the approach. Since Ridomil is categorized in III, slightly hazardous, and mancozeb as category U, the two fungicides will be useful as IPM component of on both potato and tomato during SAIP. The researchers will establish an alternative fungicide.

Insecticides use in potatoes: It is anticipated that potato tuber moth (PTM) in potatoes will not need the use of insecticides. However, in tomato pest management, the insect pests are also major pests and pesticides will be used as a component of IPM.

Tree tomato and passion fruits are commonly affected by many diseases. The Cypermethrine will be used to control fungal diseases in tree tomato farming while Copper based chemicals will be applied in passion fruits. However, other good agricultural practices will be used as a component of IPM.

4.3.2 Pesticides use in management of pests and diseases of other target crops

In addition to tomato and irish potato, the other crops targeted by SAIP include maize, climbing bean, onion, french bean, sweet pepper, chili, avocado, watermelon, and papaya. It is anticipated that very little pesticides will be used against the pests of these crops. In case it occurs, the researchers will determine the most appropriate pesticide, rate and frequency of application.

CHAPTER FIVE: PUBLIC CONSULTATION AND PARTICIPATION

5.1 Introduction

Project stakeholders' consultation is a vital component of the PMP process. The consultation process focuses on providing information on the proposed project in a manner that can be understood and interpreted by the relevant audience, seeking comment on key issues and concerns, sourcing accurate information, identifying potential impacts and offering the opportunity for alternatives or objections to be raised by the potentially affected people; nongovernmental organizations, members of the public and other stakeholders.

The stakeholder's consultation meetings help in highlighting the socio-economic and environment concerns and impacts that could arise from the project which was significant in coming up with appropriate mitigation measures.

Consultation has also been found to develop a sense of stakeholder ownership of the project and the realization that their concerns are taken seriously, and that the issues they raise, if relevant, will be addressed in the PMP and will be considered during project design refinement.

Out of 8 sites selected for SAIP implementation, the consultation meetings were arranged for 5 sites located in 4 Districts. The visited sites were randomly chosen on the basis of the landscapes where SAIP will be implemented, ie highland, middle land and lowland. Rwamagana 34 and Muyanza sites are located in low land and middle land regions respectively whereas Nyabihu and Karongi sites are located in the high land regions.

Districts leaders/ staff, cooperative leaders and local communities are among the stakeholders met during consultation meetings. These engaged among others affected people in the project sites, Cooperative leaders, and District authorities (Vice-Mayor or his representative in certain Districts, Agronomists, District Executive secretary, Environmental officer, etc).The PAPs representatives were invited from the local farmers' organizations, private sector, civil society and other community opinion leaders. Consultations with Districts and farmers' representatives were organized in the represented Districts and conducted in Kinyarwanda.

5.2 Public consultation findings

5.2.1 Consultations with District authorities

Various meetings with districts authorities have been conducted in project sites by the SPIU staff. The latter met with the Vice Mayor in charge of economic affairs, the Director of Agriculture and Natural Resources and the Environmental Officer in Rulindo, Nyabihu, Karongi and Rwamagana Districts to

explain the project and get their views on the project for its smooth implementation. These meetings were organized on March 2nd, 2018 in Karongi District, March 13th, 2018 in Nyabihu and Rulindo Districts,and on March 15th, 2018 in Rwamagana District. The authorities met appreciated the RSSP3 and LWH contribution to the development of their Districts and welcomed SAIP. They thank the Government of Rwanda and the World Bank for this support and promised their support for the smooth running of SAIP..

5.2.2 Consultation with cooperative leaders

The farmers from a developed scheme were organized in cooperatives. Before the meeting with the local communities, separate meetings with Cooperative leaders were also arranged by the SPIU team to explain the proposed project and get their views on the project. Cooperatives in Muyanza, Nyabihu, Karongi 12 &13 and Rwamagana 34 sites were involved in the consultation. They appreciated the project and requested for support in the following domain:

- ✓ Capacity development of the cooperative members in the production of high value crops like vegetables in Rwamagana 34 and Muyanza sites;
- ✓ Providing or availing good quality seeds of irish potato as well as postharvest infrastructures in Nyabihu site;
- ✓ Technical support for the production of selected crops in each site through demonstration plots.

5.2.3 Consultation with local communities

The local communities, beneficiaries of LWH and RSSP projects, were also consulted and informed on the project under preparation. They were allowed to give their feedback and their suggestions were documented and will be considered during the project design and implementation. The meetings with the affected people were conducted in five sites out of 8 selected. These are Muyanza, Rwamagana 34, Nyabihu, Karongi 12 and Karongi sites.

In total, about *Four hundred and seventy eight (478) people disaggregated by gender as 278 Men and 200Women* in five sites were consulted between February and March 2018. In general, all the consulted categories are in favor of the project and perceive it as a possibility of increasing economic activity in the area through increased agricultural productivity and creation of jobs.

The overall benefits of the consultation meetings are:

- Clarity concerning roles and responsibilities for each stakeholder
- Early engagement of the community and the local administrative authorities
- Understanding of the different challenges encountered from similar projects and sustainable solutions
- Increased ownership from all the concerned parties
- Better strategies for effective communication among all the concerned parties

Below, are some photos from several consultation meetings


The table below highlights the key outcome of the meetings

Table 1: Key outcomes of the consultation meetings

Outcomes of the consultation meetings in Muyanza site	
Issue raised	**Response provided**
Beneficiaries asked if SAIP will connect them to buyers for their produce.	The project will connect the farmers to reliable market outletstargeting both domestic and regional markets especially for staples and horticulture. The project will also support farmers in accessing existing (and future) market information systems
Beneficiaries asked if SAIP will facilitate them with post-harvest infrastructures for horticulture produce	Post-harvest handling needs have been identified; This includes drying shelters, drying grounds and collection points, nearer to the fields, for immediate post-harvest handling. For the horticulture sector, cold rooms will be constructed to increase shelf life and preserve quality and nutrient content, and reduce post-harvest losses.
Construction of additional terraces	There will not be any construction of terraces, however SAIP will facilitate farmers to add value to their produce grown on hillsides and connect farmers to markets for the selected value chains.
Beneficiaries requested that the project will facilitate them to find other sources of income ie Tailoring, Small processing industries etc Beneficiaries further requested that the project will offer capacity building in good agriculture practices.	

Beneficiaries requested that SAIP will help them to fight malnutrition by providing small livestock at the household level.	
Outcomes of the consultation meetings in Rwamagana 34 site	
The beneficiaries asked for the expected community benefits likely to occur from the project implementation.	- Employment opportunities during civil works where PAPs will be given priority - Overall increased agricultural productivity -Capacity building for farmers - Improved nutrition among the project beneficiaries at the household level -Gender equity and engagement of the youth and vulnerable
The beneficiaries further asked for clarity concerning the management of grievances and conflicts during expropriation and compensation procedures	-Grievance redress mechanism strategies will be put in place, including grievance redress committees that will be electedby the local communities. These GRCs will be close to the PAPs and shall be trained on conflict redress mechanisms.
The beneficiaries requested for support in capacity building of post-harvest handling processes and operation and maintenance of the project facilities. Increased access to market for their produce	
Outcomes of the consultation meetings in Nyabihu site	
After explaining to the participants about the scope and objectives of SAIP, the beneficiaries requested for the following: 1. To facilitate the farmers to acquire Irish potato seeds that are pest resistant 2. Access to reliable markets with fair prices 3. Support the farmers to establish an agricultural inputs (seeds and fertilizers) fund 4. Capacity building/Trainings in regards to cooperative management 5. Establishing a centre for nutrition 6. Hiring nutrition agents per village who will assess nutrition issues and train households 7. Facilitate farmers to become seed multipliers by establishing at least one green house in the sector where the project will be implemented.	

<table>
<tr><th colspan="2">Outcomes of the consultation meetings in Karongi 12 and 13 sites</th></tr>
<tr><td>The beneficiaries asked the relationship between LWH with SAIP</td><td>SAIP will build on the results of LWH and RSSP sites and will continue capacity building activities of the farmers' organizations (WUAs, SHGs, cooperatives) established under these projects, help them link better to the markets to create additional livelihood opportunities and expand activities to further scale up nutrition sensitive and climate resilient agriculture.</td></tr>
<tr><td colspan="2">The cooperatives informed the meeting of the benefits obtained from LWH project that include among others: Soil conservation through terraces, Postharvest infrastructures, Good agricultural practices, Cropping throughout all the agriculture seasons, use of organic and inorganic fertilizers and access to markets and finance.

The beneficiaries requested that SAIP will facilitate them in:

1. Increased access to financial institutions and facilitation to bank services like credit etc
2. To connect them to buyers both locally and internationally
3. To hire support staff for the cooperative
4. To expand the command area
5. Provision of more irrigation equipment since the ones they have are insufficient
6. Capacity building in improved nutrition
7. Carrying out regular soil tests to check the for the quantity needed for fertilizers
8. Provision of small livestock that will help them in compost making
9. Construction of temporary dryers per zone (The existing one is far)
10. Capacity building in operation and maintenance of the irrigation systems</td></tr>
</table>

CHAPTER SIX: POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND PROPOSED MITIGATION MEASURES

6.1 Environmental and public health impacts of pesticides use

6.1.1 Environmental and public health impacts of pesticides use

Pesticides are chemicals used to kill fungal or animal pests and improve productivity and control yield loss. However, reports indicate that more than 95% of applied pesticides reach a destination other than their target species because they are sprayed across the whole agricultural land. Runoff can carry pesticide into aquatic environments while wind can carry them to other fields including croplands, grazing areas, forest areas, human settlements or undeveloped areas. A portion of the applied chemical can also infiltrate the soil or spread in the atmosphere. Over time, repeated applications will lead to soil contamination, soil fertility reduction due to soil microorganisms population reduction, air and water pollution and affect plant and animal species (non-target organisms ranging from beneficial soil microorganisms to insects like bees, birds, fish and plants. They can also increase pest resistance, while its effects on other species can facilitate the pest's resurgence.

The best way to reduce pesticide contamination in our environment is for all of us to do our part to use safer, non-chemical pest control (including weed control) methods.

6.1.2 Occupational and public health impacts of pesticides use

In addition to environmental risks, there is overwhelming evidence that some of the pesticides are potentially hazardous to human health. Deaths and chronic diseases (like throat irritation, sneezing, coughing, cancer, etc), reproductive toxicity, etc. due to pesticide poisoning are reported in various sources.

6.2 Proposed mitigation measures

In order to prevent, reduce, or control the potential contamination of soils, water (groundwater or surface water resources) and biodiversity (humans, plant species, animal species) caused by accidental spills during the transfer, mixing, storage and application of pesticides, pesticides should be stored, handled, and applied in a way consistent with the recommendations for hazardous materials management presented in the General EHS Guidelines.

As per these Guidelines, the pesticide transport, storage, handling and use under local conditions need much improvement. Similarly the disposal of containers requires much more effort. The following are the recommended pesticide storage practices:

a) Storage

- ✓ Store all pesticides in a lockable container or store that has sufficient space in which to capture any spills without contaminating the environment.
- ✓ Stores should be set away from water sources, residential areas, as well as livestock and food storage areas.
- ✓ Procure spill kits and institute suitable control measures in case of accidental spillage.

- ✓ Store all pesticides in their original, labeled containers, and ensure that storage instructions are followed.
- ✓ Keep a register of all pesticides procured, recording when they were received, the amount used, the amount remaining in store, and their location.
- ✓ Warehouses must have appropriate ventilation, secondary containment, and emergency showers and kits.

b) Handling

- ✓ Operators must read, understand, and follow product label directions for safe mixing, application and disposal; use trained personnel for critical operations (e.g., mixing, transfers, filling tanks, and application).
- ✓ Insist that correct PPE (e.g., gloves, overalls, eye protection) for each exposure route be worn at all times when handling and applying pesticides.
- ✓ Mandate that any mixing and filling of pesticide tanks occur in a designated filling area.
  o This should be set away from watercourses and drains.
  o If on concrete, water should be collected in a separate sump and disposed of as a hazardous waste.
- ✓ o Ensure that spills are cleaned up immediately using appropriate spill kits; spills should not be washed away into watercourses or drains.

c) Application

- ✓ Give preference to the application method with the lowest EHS risk and ensure non target organisms are not affected.
- ✓ Select pesticide application technologies and practices designed to minimize off-site movement or runoff (e.g., low-drift nozzles, using the largest droplet size and lowest pressure that are suitable for the product).
- ✓ Establish buffer zones around watercourses, residential and built-up neighborhoods, as well as livestock and food storage areas.
- ✓ Ensure that all equipment is in good condition and properly calibrated to apply the correct dosage.
- ✓ Insist that applications occur under suitable weather conditions; avoid wet weather and windy conditions.

d) Disposal

- ✓ Any unused dilute pesticide that cannot be applied to the crop—along with rinse water, and outof-date or no-longer approved pesticides—should be disposed of as a hazardous waste, as per FAO guidelines;
- ✓ Empty pesticide containers, foil seals and lids should be triple rinsed, and washings used in the pesticide tank should be sprayed back onto the field or disposed of as hazardous waste in a manner consistent with FAO guidelines and according to the manufacturer's directions.
- ✓ Containers should be stored safely and securely under cover prior to their safe disposal; they should not be used for other purposes.

It is anticipated that SAIP will promote the use of IPM during its implementation and pesticides will be used once IPM practices become ineffective in pest control. In case it occurs, the Project will work with researchers to determine the most appropriate and less toxic pesticide to use, its rate and frequency of application. The pesticides will always be used in combinations using IPM approaches.

Based on the above information, capacity building for farmers and extension staff, pesticides dealers in IPM practices and pesticides use will be an important component of technology transfer for crop intensification during SAIP.

CHAPTER SEVEN: COMPONENTS OF THE PEST MANAGEMENT PLAN AND IMPLEMENTATION STRATEGY AND CAPACITY BUILDING

The objective of PMP is to combine several different control methods to fight against the pests and diseases, while minimizing environmental hazards and maximizing economic benefits for producers and consumers.

7.1. Integrated pest management under SAIP

Integrated pest management in SAIP will focus on major pests and diseases of target crops. In addition, the Project will support other crops on demand driven basis as need arises. Moreover IPM is normally executed at community level rather than at individual plot level because the plots in the same locality should apply the same principles to avoid source of infestation from the neighborhood. Therefore, the IPM options should be taught to farmers' groups and not to individual farmers. Farmers should be organized into groups to work together, make regular field observations, discussions and agree on the best IPM approach to apply at the various growth stages of their crop.

The execution of IPM at project level alone is not sufficient as it will not bring the much needed impact. Resources will be needed to sensitize the community about the plant protection law and some IPM practices like good agricultural practices which require cooperation with the community and Local leaders and extensive training of farmers.

In each project area, Self Help Groups (SHGs) already created will be used in the valorization and maintenance of developed schemes and the implementation of IPM programme. About 15 to 20 neighboring land owners with terraces form an SHG and several SHGs are organized in Zones. Different zones are united to form a Cooperative. The latter is the farmers' organization to manage the developed site through which IPM programme will be implemented. MINAGRI/RAB will also involve District authorities in this IPM implementation chain.

Training of farmers in IPM is an important activity because they should be able to know and distinguish pests and none pest insects, recognize and appreciate damage caused and associate it with particular pests, diseases or weeds. Finally, they should be able to make decision on pest management action to take control of pests, diseases and weeds and the reasons that are underlying the decision to take a particular action.

7.2 Scope of the Pest Management Plan under SAIP

SAIP Project will finance the PMP activities in the project areas on all target crops and other demand driven crops. The PMP activities will include (i) training farmers in improved production technologies to produce healthy plants, (ii) Training on life cycle of pest and diseases, (iii) Pest distribution mechanisms (movement from place to place) for major pests and diseases, (iv) pest and diseases impacts on productivity, (v) development of different control methods, (vi) promotion of safe use of pesticides and (vii) integrated pest management for each crop and monitoring programme. The PMP activities will be carried out as a learning plot for farmers or other selected members selected from their communities. The PMP activities will form a part of district activities and the later they should own it and include in performance contracts for sustainability.

The Table below indicates the pest control and management practices per crop/commodity that will be promoted as part of this PMP.

Table 2: Pest and diseases management in targeted crops

SNo	Crop	Pests (insects, diseases, weeds and vertebrate pests)	Proposed control & management measures
1	Maize	Maize stalk borers, maize streak virus, leaf blight, striga weeds and storage pests.	Diseases like maize streak, leaf blight are controlled using resistant or tolerant varieties such as Tamira, Katumani, Isega, and Magumba and cultural practices such as crop rotation with legumes for at least three months; Striga weed (*Striga asiatica* or *Striga hermonthecas)* is controlled by using "push-pull" technology as an IPM tool. Farmers also use deep cultivation. Brief maize insect pests and diseases are manageable using cultural practices, resistant varieties and reduced pesticides as components of IPM tools. Maize weeds are managed through push pull strategies or cultural practices.
2	Irish potato	Late blight, Bacterial wilt, Potato tuber moths and Aphids	Application of fungicide (e.g. Mancozeb), use of resistant varieties (like Kigega, Gikungu, Mizero, Ngunda and Nderera) and cultural manipulations and sanitation procedures to control Late blight; Planting of resistant varieties and Use of clean seed for the control of Bacterial wilt disease ***Cultural*** cultural manipulations and sanitation procedures for potato tuber moth control. Management of aphids in the potato production depends on natural control. The heavy rainfall in the area is sufficient to minimize aphids' problem.
3	Avocado (*Persea americana)*	Borers, Caterpillars, Lace bugs and Mites are the major avocado pests; Major diseases: Tree Cankers,	The following can be done to control pests and diseases: (a) Proper pruning and prompt removal of fruits;

		Fruit rots, Root rots, Sun blotch and Wilts and blights	(b) Digging around the tree and exposing the roots to allow the crown to dry enough to prevent tree death. (c) Use of certified disease-free stock and practice good tool sanitation; (d) Cutting out infested branches and disposing of them immediately. (e) Spraying *Bacillus thuringiensis* or other appropriate insecticides (f) Careful pruning and fertilization to prevent thrips.
4	Watermelon	Diseases are dominated with Alternaria leaf blight, Alternaria leaf spot, Anthracnose, Cercospora leaf spot, Downy mildew, Fusarium wilt, Gummy stem blight, Powdery mildew, Verticillium wilt, Angular leaf spot, Bacterial fruit blotch and Aster yellows (*Aster yellows phytoplasma*), etc. Pests: Aphids (Peach aphid, Melon aphid), Cabbage looper, Cutworms, Flea beetles, Thrips, Onion thrips, etc.) are some of the insects attacking the watermelon.	The cultural practices and reduced use of pesticides can be recommended for the control of pests and diseases: ✓ Rotating Cucurbits with non-cucurbit crops every 1 to 2 years to prevent disease build-up; ✓ Using only disease free, treated seed prior to planting; ✓ Removing/reduce crop debris (crop residues) from the field as quickly as possible after harvest or plowed deeply into the soil; ✓ Applications of appropriate protective fungicides to slow the development of the disease; ✓ Watering plants from the base rather than from above to reduce periods of leaf wetness which are conducive to the development and spread of disease; ✓ Planting resistant varieties if available; ✓ Hand-picking larvae from the plants; ✓ Protective copper spray may help reduce incidence of disease in warm, humid climates; ✓ Spraying plants with mineral oils or insecticidal soaps can help to reduce aphid numbers ✓ Apply appropriate insecticides to infested areas if pests become problematic.
5	Tree Tomato (Tamarillo)	Major fungal diseases: anthracnose, powdery mildew and verticillium wilt, ascochyta disease, black spots disease, etc	• Cultural practices including avoiding overcrowding of plants, Crop rotation for about 3-4 years, proper crop hygiene, weed control,

		Bacterial wilt, bacterial canker bacterial blast and crown canker are bacterial diseases. The Tamarillo is also susceptible to a number of viruses including tamarillo mosaic virus (TaMV), Potato aucuba mosaic virus (PAMV), etc. Aphids also attack Tamarillo but the green peach aphids (*Myzus persicae*) are the most important.	etc. • Adequate application of a sulphur based fungicide (like Thiovit/Thionil at 40g/20L of water with 2 weeks spray interval). • Use pest-free planting materials.
6	Papaya	Main diseases: Anthracnose and charcoal spot, Black rot, Black spot, Cercospora black spot, Powdery mildew, Bacterial canker, internal yellowing (*Enterobacter cloacae*), Bunchy top and Papaya ring spot Major insects pests: mealybug, grasshopper, scale insects, aphids, fruit fly, etc are the main insects' pests damaging papaya. Birds pest: Jungle crow and Myna.	✓ Use of tolerant varieties of papaya; ✓ Removal of the infected parts and disposal of them properly. ✓ Application of appropriate protective fungicides and dipping fruits in hot water at 48°C for 20 minutes ✓ Avoiding irrigating the trees by sprinkler. ✓ Providing proper nutrition to trees to withstand powdery mildew infection.
7	Passion fruit	Main pests: Mealy bugs, Passion Vine Mite, Fruits flies, Aphids Diseases: Brown spot disease, Fusariam wilt, Woodiness disease	✓ Constant removal of all infected materials, ✓ Regular spraying where the disease is prevalent, ✓ Use of certified seedlings or seeds, ✓ Plant hygiene measures (pruning knives to be sterilized both before and after use, etc), ✓ Avoid to plant passion fruits in the same field or in the immediate vicinity particularly where a severe attack has occurred.
8	French beans	Major insects pests: beans fly or bean stem maggot, angula leaf spot, bean anthracnose; white flies, cutworms, pod borers (african bollworm and legume pod borer), Stinking bug, (xi) Flower and Pollen beetles, Aphids, Thrips, red spider mites.	Measures for pest and diseases control in French bean planting: o Use treated clean seeds, and plant on clean soil which was not planted with beans for at least 2 years.

		Diseases: Common blight; halo blight, bean common mosaic virus.	○ Use of Resistant variety; ○ Do bean rotation with none legume crop such as tuber crops to control mostly bean stem maggot (BSM) and root rot. ○ Improve soil fertility (apply manure and inorganic fertilizers as recommended) ○ Timely Weeding ○ Crop residue management (bary bean residues, and do not use manure from livestock which were fed residues from legume crop). ○ Fungicide: In case the above methods fail, apply systemic fungicides like benomyl at recommended rates in your area.
9	Tomato	Major insect pests*:* Bollworm, Leaf miner**,** Cutworm, African Spider Mites**,** Aphids**,** Whitefly**,** Root-Knot Nematode Major diseases*:* Late Blight, Damping Off, Early Blight, Fusarium WiIt, Verticillium WiIt, Powdery Mildew, Septoria Leaf Spot, Anthracnose, Leaf Mould, Bacterial Wilt, Tomato Yellow Leaf Curl Virus (TYLCV), Tomato Mosaic Virus (TMV) and Blossom End Rot.	• Hand picking of eggs and larvae can be an effective method if infestations are not too severe; • Crop rotation; • Use disease-free seed, and sow thinly to avoid crowding of seedlings in the seedbed and do not apply too much irrigation water or nitrate fertilizer; • Prepare fields and eliminate weeds at two weeks before planting to expose larvae to predators and bury others so that they cannot reach the surface; • Avoid planting tomatoes next to related crops such as potato, pepper and eggplant, and remove Solanaceous weeds • Delayed transplanting to enable bigger size seedlings to be more tolerant to damage, • Spraying the plant with soap and water solution to control whitefly or application of pesticide if the population is too high; • Improve soil fertility by raising soil pH to 7 through liming or use of farmyard manure and avoiding excessive nitrogen fertilisation and control root-knot nematodes; • Destroy diseased plants, etc. • The late blight (Phytophthora

			infestans) is the most serious disease and is currently controlled using fungicides such as Dithane M45/Mancozeb or Ridomil/Metalaxyl.
10	Sweet pepper	Major Pests: Aphids, Broad mite, Whitefly, Two spotted spider mite, Western flower thrips. Major Diseases: Damping-off, Pythium crown and root rot, Fusarium stem and fruit rot, Gray mold, Powdery mildew, Pepper mild mottle virus (PMMV), etc.	Management of pests and diseases: i. Ensure good air circulation within the crop and avoid the formation of free water on the plants and fruit; ii. Infected plants should be carefully removed and destroyed iii. Use high quality and disease-free seed and ensure that resistant cultivars are grown; iv. Efficient control of insects vectors (like thrips) and weeds as well as preventing the establishment of virus infected weed plants.
11	Chili pepper	Major pests: Slugs and Snails, Aphids, Caterpillars, Flea Beetles, Pepper Maggots, Nematodes (Root Knot), Spider Mites and Whitefly Diseases: Anthracnose, Bacterial leaf spot, Bacterial Soft Rot, Bacterial Wilt, Cercospora leaf spot (Frog eye), Damping-off, Grey Mould, Chilli Wilt, Powdery Mildew, Verticillium Wilt, White Mould, Pepper Mosaic & Pepper Mottle Virus (PeMV), etc.	Pests Control techniques including ▪ Manual removal of insects and eggs, ▪ Check pods for small entry holes and destroy infested chillies; ▪ Spray chemicals once pest damages are very severe. Diseases control techniques: ▪ Adopting crop rotation; ▪ Using disease-free seeds; ▪ Removing the affected pods; ▪ Applying copper based fungicides (mainly copper based fungicides) if disorder is severe). ▪ Planting in a well-drained soil and ensure proper plant spacing; ▪ Ensure the good control of insects vectors (like aphids and other insects) to avoid the propagation of viral diseases; ▪ Smokers should always disinfect hands (milk kills TMV) thoroughly before touching chilli plants.
12	Onion	Major pests: onion thrips, cut worms, Nematodes, Aphids, downy mildew, Purple blotch, Blast and neck rot Major diseases: Black mold, Botrytis	▪ Good cultural practices, ▪ Destruction crop residues and off season or continuous production, ▪ use resistant varieties, ▪ Plant on clean soil and avoid

		leaf blight, Downy mildew, Fusarium basal plate rot, Fusarium damping-off, Pink root, Purple blotch, Smut, Onion yellow dwarf virus (OYDV)	infested soils where previous crop was attacked, ▪ Apply pesticide like furadan against thrips when necessary.
13	Climbing bean	Major insect pests: Aphids (Cowpea aphid, Pea aphid, etc), Armyworms (beet armyworm, Western striped armyworm), Corn earworm, Cutworms, Leaf miners, Loopers, Mexican bean beetle, Stinkbugs and Spider mites. Diseases: Alternaria leaf spot, Anthracnose, bean rust, black root rot, fusarium root rot, White mold, bacterial blight, bacterial brown spot, Mosaic (Bean common mosaic virus BCMV), Bean common mosaic necrosis virus, BCMNV).	○ Clean seed: Use treated clean seeds, and plant on clean soil which was not planted with beans for at least 2 years. ○ Resistant variety: Plant your crop using resistant varieties against major diseases where they are available, accessible and affordable. ○ Crop rotation: Rotation of beans with none legume crop such as tuber crops. This practice will reduce bean stem maggot (BSM) and root rot. ○ Fertility management: Make sure the soil is fertile, and if not, apply manure and inorganic fertilizers as recommended. A vigorous crop tolerates small infection without significant effect on yield. ○ Weeding: Timely weeding is important for producing healthy crop. While weeding, it is recommended to do hilling up soil around the stem of the seedlings to encourage development of adventitious roots and enhance recovery of plants from BSM damage. ○ Crop residue management: After harvesting, bury the crop residues, and do not use manure from livestock which were fed residues from legume crop. ○ Fungicide: In case the above methods fail, you can apply systemic fungicides like benomyl at recommended rates in your area.

7.3. Institutional arrangement

MINAGRI

At National level, MINAGRI through RAB/SAIP will coordinate PMP implementation. In addition, RAB/SAIP will work with different research institutions (RAB, UR, International Agriculture Research

Centres, etc) for new technologies. SAIP will collaborate with organizations (NGOs, etc) or projects experienced with IPM implementation for experience sharing.

District

The District has agronomists at District, Sector and Cell levels who will be trained on IPM, seed technology and safe use of pesticide. SAIP has a Coordination unit responsible for the day-to-day running of the Project site (currently, a project site covers partial district). The Site Project staff will coordinate the PMP activities in partnership with the officers responsible for agriculture in the District and will monitor and report on progress made by farmers' groups. This will include also organizing study tours to different parts of the country (provinces or districts) where is success to re-enforce the training offered to farmers. Since the project will operate demand driven approach, it should establish mechanism to support the local community for timely and affordable inputs (seeds, fertilizers and other agrochemicals and farm equipment, etc).

Community based organizations (SHGs, Zones, and Cooperatives)

The farmers, grouped in SHGs are responsible to learn and apply IPM tools in the pest war. SHGs will identify members to participate in training of trainers (ToT). Each group will comprise of 20-30 farmers for training and not more than 40 at a single training/learning plot. Every trained farmer will be responsible to train other 15 - 20 farmers at his/her site. The training will last at least one season long. This would mean that the PMP and its implementation will form part of farmers' cooperatives and District authorities as key activities to include in performance contract. The SAIP will therefore give support to District (district, Sector and cell level) extension where the project is operating to facilitate the PMP execution.

7.4. Implementation strategy

a) National IPM Workshop

SAIP will organize the launch workshop involving different stakeholders and partners such as donors, NGOs and research institutions (national, regional and international), local leaders and different technical staff in different ministries to initiate the promotion of IPM and sound pesticide use. This will streamline the IPM agenda and improve training curriculum.

b) Capacity building of extension staff in IPM, safe pesticide handling and use

The extension staff will include for every site the Agronomist of the Project site, District, Sector and Cell, Cooperative and other partners' Agronomists within the site. The objective of capacity building in IPM and pesticide technology is to improve extension staff and farmers knowledge in alternative pest control methods at an economical level and safe use of pesticides without compromising the environment. The training will cover in detail all SAIP target crops and pesticides technology.

They will likewise train farmers over season long period on weekly basis on the pests and diseases identification, damage problems, yield loss caused, control methods, and safe pesticide use.

The training in IPM and pesticides technologies will focus on extension staffs in the project site, Sectors and Districts where SAIP will be working with farmers. The cooperative agronomists and other partners 'agronomists within every site will also be invited for the training. This training will create among them the habit to be accountable to the farmers through implementation and close monitoring of activities plans

developed during the training. The training will cover PMP and pesticide technology irrespective of the crop specialized by the participants.

The training of target extension staffs will be followed by an on-site training during execution through experiential learning. Since the application of IPM technologies/practices are site specific; it is therefore recommended to go on training of extension staff on new concepts, options and strategies for them to gain specific skills and knowledge for their respective areas, and share with others experience gained during execution period.

The initial training will be for four weeks (one month) as follows below:
The first two weeks will cover the three crops IPM strategies and safe pesticides use. This is equivalent to three days per crop, and three days for pesticides which is an intensive training. The assumption is that they already have field experience and previous training from their institutions.

The third week will cover pesticides, seed technologies and field and institution visits to assess field situations. This will include a visit to RAB, agrochemical suppliers as need arises.

The fourth week will be used for planning and budgeting for the demonstration andreporting systems. The resource person will guide them on the planning and costing the demonstrations and other related training such as field days, study tours etc. Every extension staff will produce a plan suitable for the site. It will also indicate the link with the whole community. The District and Sector participants will indicate the cost of monthly meetings and reporting and on how it fits in with their plans.

c) Capacity building of farmers in IPM
The training of farmers will be a continuous activity for a season long. Each demonstration or study plot will have 20-30 farmers and not more than 40 farmers. The extension officer will continuously be updated in all aspects of IPM and crop production to enable him/her to train farmers in new improvements. The linkage with research institutes is an important activity. Apart from IPM technologies, farmers will be trained in farm record and cost assessments of all inputs (fertilizers, pesticides, seeds etc) including labor spent for each operation (person days or hours) throughout the season.

The importance of farm record knowledge will enable farmers and extension staff to assess crop productivity by comparing different crop gross margins and make use of this facility in planning for the following season.

d) Demonstrations of IPM technologies
In most cases, farmers training in the application of various IPM techniques and practices will be conducted at the demonstration plots (training sites) established at lead farmer field or other plots of the SHG, in case the lead farmer does not have suitable site.
The SHG lead farmer will offer a plot for establishing the demonstrations, and SAIP will provide all inputs required. Therefore, the site must be accessible and suitable for the crop. The harvest from the demonstration belongs to the owner of the plot. Farmers learn fast when they immediately practice what was taught. It is anticipated that some farmers will start using IPM approach in the following seasons. The latter will be monitored during the project period.

The extension officer will establish a demonstration plot for each crop to address problems identified by farmers, he will also establish control plot with farmers own practices.
The activities on control plot are always done a day before the actual demonstration. The two plots will be used to train farmers in all aspects of crop husbandry, from land preparation, planting and pest and disease assessment and timing of management practice etc.

The demonstrations will be established for each crop. Farming community in the District will get access to learn and practice improved techniques within their reach, since the demonstrations will be more or less accessible to all. The demonstrations are training sites and are useful to farmers willing to learn new technologies which will be well illustrated.

The extension staff together with the farmers will prepare activity plan for the whole cropping season to address the IPM problems arising during the season for each demonstration. The extension staff will make sure that the activities programmed are executed, and weekly training is clearly shown according to crop growth stages.

The extension staff will organize the farmers into small groups of at least 20 - 30 farmers per group from the whole cooperative for weekly training sessions. The farmers in each group, and the extension staff responsible, will decide on the frequency of the training, weekly or biweekly, and the IPM topics to be covered at each session basing on the crop grown. The members of the group may be the lead farmers in the area for large cooperatives.

Each group will be organized by choosing its leadership (chairman, secretary) and together with the extension staff, prepare work programs to be implemented during the whole cropping season. During the field visits, the extension and cooperative leaders will invite farmers and local leaders from neighboring areas to participate. This is an occasion for sensitizing the community on IPM technologies.
.
In addition to demonstration of new technologies, some members may need special training outside project to focus on crop diversification, such as the searching for external markets, meeting market demands and producing sufficient quantities and in right qualities, promotion of processing and conservation of different crops, demonstration of new crops which are not widely produced but have potentials to assist the farming community in wealth creation and poverty reduction like fruit production and marketing e.g. egg plants, pineapples, macadamia and vanilla etc.

e) Organizing field days on demonstration site
The field visit is an occasion at each demonstration to reach the whole community with the message of improved technologies and it is very important in agricultural development. During every major field visit, actions such as planting, fertilizer application, pesticide application and harvesting can benefit the wider community and local leadership. The extension staff will organize the field day and explain the IPM technology and reasons behind the practice, its application, and importance in improving productivity and production. The community will learn about the technology and will be able to follow up the progress throughout the growing season.

In addition, during the growing season, the extension staff will organize farmer to farmer visits for the cooperative or association in which farmers get opportunities of sharing and gaining skills and practical experiences within themselves and from other farmers near the demonstration which does not require transport.

The extension officer will train farmers on farm record keeping as a tool to follow up and assess productivity and cost of different activities and inputs; to enable assess of the profitability or loss of their agricultural activities in terms of resources, input and labor applied. During the farmer to farmer visits and field days, the farmer will show and explain the record he/she has been taking and their importance in the modern farming in their demonstration. The record keeping is compulsory for every demonstration.

f) Study tours for extension staff and farmers

The training of farmers is a continuous activity involving different approaches to accelerate the adoption process. Farmers learn fast when explained to by other farmers who are practicing similar approaches. The extension staff and farmers will learn and acquire the new technologies when they are exposed to a variety of improved technologies applied by other farmers in different parts of the country or neighboring countries.

SAIP would finance study tours to other Districts, Provinces or neighboring countries as need arises and when the experts feels that both the farmers and extension can gain benefit from the knowledge from such a trip. There are many places within the country and Region where farmers may profit from the experience of other farmers on pest problem, thus accelerating their adoption of new technologies. In particular, visiting institutes of research or cooperatives such as in Kenya like KARI, ICIPE, and CAB with proper focused guidance will benefit many farmers, extension and research staff in improved technologies available within the region, elsewhere in the world and on how to diversify.

SAIP would also finance the study tours with focused objectives to address specified problems identified by farmers during execution of their work plan. This will be a follow up training to strengthen the first training. It is better to organize such study tours after first season/year of execution to allow enough time for application and adjustment before the beginning of the following season/year depending on the field experience. The experience elsewhere has shown that the focused study tours give good results.

7.5 SAIP Capacity and PMP execution

7.5.1 Institutional Assessment and Capacity building

The overall SAIP management will be the responsibility of Rwanda Agriculture Board (RAB) under the Ministry of Agriculture and Animal Resources (MINAGRI). The Pest management falls under the Directorate of Agriculture Development of MINAGRI. This Directorate has enough capacity to enforce pesticide regulation. The key staffs responsible for pest control, fertilizer application, environment and climate change are available in the Directorate to monitor the implementation of regulations related to pesticide use. RAB does not have social and environmental safeguards staff to manage safeguards matter. However, it has extension and research staff managing aspects related to pest control who are also responsible for the implementation of the pesticide related regulations.

MINAGRI has been managing RSSP and LWH projects which are World Bank funded through Single Project Implementation Unit (SPIU). The latter has a Safeguards Team familiar with Rwanda and WB safeguards policies.

With the new institutional arrangement, the WB funded SPIU will move together with its experienced safeguards team to Rwanda Agriculture Board (RAB) to undertake the SAIP activities and SAIP components are not significantly different from to those of LWH and RSSP3.

The existing Safeguards team under WB funded SPIU working on LWH/RSSP projects will need to be strengthened through capacity building to be able to manage the tasks mentioned above for the implementation of SAIP.

7.5.2 Human Resource Capacity Requirements

The safeguards team at the SPIU is made of 3staff (2 Social safeguards specialists and 1 Environmental Specialist) who have satisfactorily been overseeing the overall issues related to safeguards in the LWH and RSSP project sites. As mentioned above, the existing SPIU safeguards team will be repositioned to RAB under the new institutional arrangement. There is no doubt they will still execute the same responsibilities for the implementation of SAIP.

SAIP will be implemented in close collaboration with participating Districts. Each District has agronomists at District, Sector and Cell level among other staff that is responsible for the Pest management component of the development projects in the District. They are all responsible for the implementation of SAIPPMP. Due to limited budget, workload and capacity limitation, the engagement of the staff mentioned above is specifically restricted to minor community level development actions.

In addition, all proposed project sites have cooperatives with agronomist who is responsible for the PMP implementation in the scheme. Though trained on IPM programme and proper pesticide use and handling by LWH and RSSP3, their capacity will be strengthened under SAIP execution.

The SPIU will emphasize on capacity building through trainings and workshops of the relevant district staff and cooperative staff on PMP implementation and monitoring aspects. Such trainings and workshops shall be provided by the project management to ensure proper safeguards management under SAIP.

7.5.3 Technical Capacity Enhancement

Mobilization meetings, awareness campaigns and trainings on PMP and IPM practices will be required for the following institutions and personnel:

1. RAB/ SPIU SAIP staff,
2. Local Government Authorities (District, Sector, Cell Agronomists in the Districts covered by SAIP activities).
3. Farmers organizations (Cooperatives and Associations) and farmers;
4. Community opinion leaders.

The Capacity building will cover the following topics:

- Overview on SAIP and Pesticides risks/ impacts and mitigation measures

- Stakeholder engagement, consultation and partnerships
- Implementation and monitoring the compliance of safeguards during the operation phase of the SAIP activities.
- Reporting, monitoring and follow up.

CHAPTER EIGHT: PMP MONITORING AND BUDGET

8.1 PMP Implementation and budget

The Budget for the implementation of this PMP will mainly consist on capacity building and the monitoring for compliance with PMP and ESMPs, especially the section regarding the mitigation of pesticides' impacts. The cost for mitigation measures will be included in PMP and ESMPs. The table below shows the estimated cost for the implementation of the PMP for the proposed project.

Table 3: Estimated budget for the SAIP PMP implementation

Component	Broad Activities	Activities	Cost (US$)	Remarks
Institutional strengthening, nutrition improvement, and agriculture productivity enhancement	Agricultural Productivity Enhancement	Capacity building of stakeholders	70,000	Trainings, workshops, study tours, demo plots on IPM approaches and proper use of pesticide for project staff, relevant district staff, farmers' organizations/ Cooperatives and farmers
Irrigation and water use efficiency	Provision of essential infrastructure and technology for small scale irrigation	Monitoring of PMP and ESMPs	140,000	Small scale Irrigation of targeted areas in the command area catchments as well as monitoring the irrigation in the command areas.
Total			**210,000**	
Contingency (10%)			**21,000**	
Grand Total			**231,000**	

8.2 Monitoring plan of the PMP

This section sets out requirements for the monitoring of the environmental and social impacts of the SAIP subprojects. Monitoring of environmental and social indicators will be mainstreamed into the overall monitoring and evaluation system for the project. In addition, monitoring of the implementation of this PMP will be carried out by RAB/SPIU SAIP, REMA and all key implementing institutions of the project (Districts and farmers organizations).

8.2.1 Monitoring of Environmental and Social Indicators

Two opportunities will be taken to build a simple system for the monitoring and evaluation of environmental and social impacts/risks associated with the use of pesticides. The Environmental Specialist should consider the environmental and social criteria that require measurements (i.e. groundwater levels, soil status, number death or diseases cases related to pesticide use, etc); a list of initial proposals is given below;

Table 4: List of proposals of monitoring indicators

Type of impact/ issue	Monitoring indicators
Water quality and pollution	Presence of pesticides residues in water
Soil contamination and soil fertility reduction	Presence of pesticides residues in soil, nutrient content
Public health problems	Number of reported cases of deaths or chronic diseases due to pesticide poisoning
	Number of people adopting IPM or properly handling pesticides
	Awareness on safety measures at the site (Number of workers with protective equipment, etc)

Using this list of criteria, a set of indicators can be integrated into the screening forms used in the project approval process in each project site. This will ensure flexibility at the subproject design stage, integration of monitoring considerations throughout the subproject cycle, as well as a participatory approach to environmental and social monitoring.

The goals of monitoring are to measure the success rate of the project, determine whether interventions have resulted in dealing with negative impacts, whether further interventions are needed or monitoring is to be extended in some areas.

8.2.2 Monitoring of Participation Process

The following are indicators for monitoring of the participation process involved in the project activities.

- Level of decision making of pesticides dealers and users;
- Level of understanding of project impacts and mitigation;
- Effectiveness of local authorities to make decisions;
- Frequency and quality of public meetings;

- Degree of involvement of women or special groups (youth, elders, etc) in discussions.

8.2.3 Evaluation of Results

The evaluation of results of environmental and social mitigation can be carried out by comparing baseline data collected in the planning phases with targets and post-project situations. A number of indicators would be used in order to determine the status of affected people and their environment (quality of water compared to before, number of people suffering from pesticides effects, etc).

In order to assess whether these goals are met, the SAIP Environmental Specialist with technical support of the Advisor will indicate in the ESMP, parameters to be monitored, institute monitoring milestones and provide resources necessary to carry out the monitoring activities.

8.2.4 Monitoring of PMP Implementation

The Project will monitor the PMP implementation at site level and regularly produce progress reports. In addition to the Project reports, an audit on PMP implementation at mid-term review (MTR) and project end or at any time when deemed necessary will be prepared by the SPIU and delivered to REMA and the World Bank. The table below summarizes the above monitoring program:

Table 5: PMP Monitoring Program

Impact	Parameter to be Monitored	Indicator	Method	Frequency	Responsibility	Cost Estimates (US$)
Water Pollution	pH, N, P, pesticides residue	Test Results	Laboratory Analysis as per Standard Methods	at MTR, project end and as required	SAIP/RAB REMA, RWFA	50,000
Soil Pollution	pH, N, P, pesticides residue	Test Results		As and when required	SAIP/RAB REMA	20,000
Public health Problems	Number of reported cases of deaths or chronic diseases due to pesticide poisoning	Report	Census in the project area, Collection of data from health centers in the site vicinity	Once a year	SAIP/RAB District	20,000

Impact	Parameter to be Monitored	Indicator	Method	Frequency	Responsibility	Cost Estimates (US$)
Low capacity of stakeholders	Number of extension staff, leader farmers trained, Field visits, study tours, demo plots done	Report	Training, field visits, study tours, demo plots	Regularly	SAIP/RAB/ Cooperative Districts	70,000
Total						160,000
Contingency (10%)						16,000
Grand Total						**176,000**

8.2.5 Monitoring Roles and Responsibilities

A) Rwanda Environment Management Authority (REMA)

The REMA will monitor the compliance with the environmental and social management plans (ESMPs) contained in the cleared ESIA and PMP by SAIP. It may provide, where necessary, advice and technical support to SAIP to minimize risks environmental impacts associated with pesticide use. REMA will monitor the reports on a regular basis, mostly annually but will also rely on a bottom up feedback system from the ground by going through the monitoring reports and making regular site visits to inspect and verify for themselves the nature and extent of the impacts and the success or lack of the mitigation measures.

B) Project support and coordination Unit (SPIU)

The SAIP Monitoring and Evaluation Officer will be primarily responsible for ensuring compliance to the monitoring framework. Jointly with the Environmental Specialist, they will undertake review of the monitoring reports from the Project sites and will then upon approval submit these monitoring reports to REMA and the World Bank. The SPIU SAIP will also provide overall coordination in monitoring including training coordinating of training in collection and analysis of monitoring data for data collectors. The critical role of the SPIU will include data analysis, maintenance of management information systems and all baseline data. Lately other than preparation of periodic reports, the SPIU will implement all the necessary modifications in the monitoring framework.

C) Districts

The district authorities will also be involved in the monitoring of the specific components of project that they are targeted to execute. The participating Districts will assist in mobilizing local communities in the project intervention areas for the adoption of IPM and proper pesticide use. Through the district

Agronomist, the district will monitor on daily basis the implementation of safeguards measures reflected in the SAIP PMP report.

D) Local Communities

Local communities will be useful agents in collection of data that will be vital in monitoring and as such they will play a role in the monitoring framework. Local communities in the project intervention areas will receive training and capacity building skills in data collection to be done by the implementing agencies so as to equip them with the ability to collect data.

8.2.6 Reporting

A monthly Site meeting will be organized during the **1st week of every month**. At least three training sessions at each demonstration site are expected per month unless specified during monthly planning. This will initially be done during the beginning of the season and apply to all crops, but more focused on four annual crops (maize, potato, bean and tomato) which grow very fast. The weekly plant growth changes and pest damage understanding is important lesson throughout the growing season.

The information on what was trained, observations made, pest damage, pest management decisions made and other related activities like study tours to farms with disease or pest problem of particular interest for farmers, farmers attendance and visits to demonstration, input use and costs, labour used as man's days and costs will be reported in the monthly report for each demonstration.

The pest damage may be clearly seen in other place and the trainers may need to take farmers to make observations in these fields. The trainers should be sensitive on how to make farmers understand properly pest problems and pesticide handling.

In case the farmers and farmers' organizations are found not to comply with environmental and social safeguards during pesticides application, the Project directly shall technically assist farmers through intensified trainings, workshops, study tours, field visits, etc to increase beneficiaries' awareness, ownership and therefore improve compliance with environmental and social safeguards.

Each IPM demonstration will be about 0.1 ha or less and parallel comparison as farmers own practices. The latter should be treated usually a day before IPM management applied where possible (e.g., fertilizer application). The Site extension staff compiles reports for all demonstrations and forwards to SAIP with copy to participating Districts. The report should reach SAIP not later than 5th of every month. This will give SAIP time to attend to some of the constraints raised during the month. The Project will have a week period to respond to unresolved issues at the site. The extension staff will monitor the progress through established monthly reports and regular field visits to backstop them and give on- spot advice.

During every three months, all interested in IPM activities will meet to discuss the progress report and activities plan for the following three months. SAIP may consider financing such quarterly planning meetings in every District. The District extension staff, cooperative/association extension staff sponsored and none sponsored by SAIP and representative of farmers responsible for IPM execution will give quarterly reports and planned activities for the following quarter, and should reflect the approved work

program for each in association or cooperative. The SAIP liaison officer (SAIP Agronomist) should plan to make sure that this meeting is planned jointly with the monthly meetings. This should include:

- ✓ Name of crop and area under demonstration,
- ✓ Activities performed during the month,
- ✓ Number of farmers involved,
- ✓ Dates of various activities,
- ✓ Inputs used
- ✓ Pest and diseases observed and control methods
- ✓ Person hours or days spent on each activity
- ✓ Field days and number of people attended
- ✓ Farmer to farmer visits done and number of participants
- ✓ Leaders invited and attended any of IPM events
- ✓ Lessons learnt and problems during the month
- ✓ Other activities done by the group
- ✓ Future plans
- ✓ Observation and suggestions

At the end of the season, each group organizes end of season evaluation and planning meeting where all farmers in the groups participates and assess the production and yield. This is the day when they plan activities for the following season for the group basing on the ending season experience.
The SHG leaders compile their group's success, constraints and plans for the following season into a comprehensive report. The Project Site staff will organize the end of season workshop where all group leaders will present their reports. These will be compiled as an end of season report and submitted to the SAIP with copy to participating Districts. The Project Site Coordinator may plan to attend the district planning meetings. The two season reports will make up end of the year report for presenting at the National IPM Planning workshop.

At the end of every year, a senior agronomist/IPM will organize an evaluation and planning workshop where farmers will participate. The workshop will discuss the execution during the year, success and identify key problems met during the ending year. During the workshop, every Site Coordinator/ extension officer will give presentations on the progress, achievements and constraints met during the previous year and the plan for the following year.

During the second year, the representatives of farmers will also be invited and present their reports on their participation and views on performance of IPM extension service and improvement needed. The farmers report may be verbal, not necessarily written to enable participation of farmers who do not know how to write or read but are key people in the execution of IPM in their area to share their experiences with others.

It may also involve different stakeholders such as Research and High Education Institutes, NGOs, and Donors interested in IPM and environmental protection.
The proceedings from workshop are an important document, since it includes farmers experience and reports from all Districts in the country where SAIP will be operating.

8.3 Disclosure of PMP

Subsequent to its preparation by Rwanda Agriculture Board (RAB) of the Ministry of Agriculture and Animal Resource (MINAGRI) and clearance by the World Bank, the SAIP PMP will be disclosed by making copies available at the RAB/SPIU head office, website and to the local government agencies and other stakeholders. The Government of Rwanda will also authorize the World Bank to disclose this SAIP PMP electronically through its external website.

CHAPTER NINE: CONCLUSION AND RECOMMENDATIONS

The Government of Rwanda (GoR) will receive funding from the World Bank Group for the the implementation of the Sustainable Agricultural Intensification and Food Security Project (SAIP). This project aims at increasing agricultural productivity, market access and food security in targeted areas across the country and will focus on consolidating and expanding results obtained in RSSP and LWH projects and other selected MINAGRI developed schemes. RAB/ SPIU RSSP-LWH prepared the PMP for SAIP that will be implemented across subprojects sites to ensure that the project implementation is in full compliance with Rwanda and World Bank environmental and social safeguards policies with regards to pest management.

The document focused on policy, legal and institutional frameworks, current status on IPM and use of pesticides in the country, pest and diseases management practices relevant to SAIP, environmental and social impacts associated with pesticides use as well as guidelines for their mitigation, implementation strategy and monitoring process. The public consultation and participation meetings conducted. The total cost for the implementation of proposed activities to comply with PMP is estimated at US $ 176,000 for 5 years project period.

Given the nature of the project, the potential adverse impacts associated with pesticides use are minimal and can be controlled through proposed mitigation measures. Successful implementation of this PMP will depend to a large extent on the involvement and participation of local communities. Specifically it is recommended that awareness and capacity building on IPM and proper use of pesticide be organized mostly to extension staff, cooperatives and farmers.

This PMP should be regularly updated to respond to changing local conditions. It should be reviewed and approved through the national approval process and by the World Bank prior to project negotiations. It should also incorporate lessons learned from implementing various Components of the project activities. This framework will apply to any project activity within the SAIP.

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ANNEXES

Annex 1: Agricultural inputs and pesticides recommended and prohibited in Rwanda (source: MINAGRI-RAB).

1. List of agricultural inputs

1.1. Fertilizers

*Agricultural lime

*Ammonium sulphate

*CAN

*Compound fertilizers; DAP 18-46-0; NPK 17-17-17; NPK 20-10-10; NPK 20-5-5

*Micro-nutrients fertilizers

*Nitrogen fertilizers: urea 46%

*Others fertilizers

*Phosphates fertilizers

*Potash fertilizers: KCL

1.2. Seeds and plant material

1.2.1. Insecticides and acaricides

* Abameclin

*Acephate

*Acrinathrin

*Alphacypemethrin EC

*Alphamethrin EC

*Amitraz EC

*Azocyclotin WP

*Beta-cyfluthrin 2.5% EC

*Betacypermethrine EC

*Bifentrhin 0.05%PP,80g/l

*Bromopropylate EC

*Carbofuran 2.5%, 5% Granules

*Chlorpyriphos-ethyl 48%EC, 5% Granules

* Chlorpyriphos-methyl 50%EC

*Clofentezine

*Clofenzine EC

*Confidor super

*Cyfluthrin EC

*Cyhalothrin (15g)+Chlorpyriphos(300g)

*Cypermethrin 10%EC

*Deltamethrin (12g) +Chlorpyrifos(300g)

*Deltamethrin 2.5% EC,WP, Tablets

*Detamethrin

*Dichlorvos EC

*Dienochlor WP

*Dimethoate 40% EC

*Fenazaquin SC

*Fenbutatinoxyde SC

*Fenitrothion EC

*Fenthion 50% EC

*Fenvalerate EC

*Fipronil 0.05 RB, 25g/IFS

*Flufenoxuron EC

*Flumethrin EC

*Hexythiazox WP

*Imidachlopride 200g/l SL, EC, 300g/l SL, EC

*Lambda-cyalothrin 50g/l EC

* Malathion, PP

*Methomyl 90 WP

*Methomy SL

*Nimbecidine

*Omethoate EC

*Permethrin 0.5%PP; 0.7%EC; 20%EC; 25%EC

*Phosphured'aluminum(PH3):pillis, tablets and plates for fumigation

*Pyrimiphos-methyl 2%PP

*Tau-fluvalinate EC

*Tebufenpyrad WP

*Teflubenzuron SC

*Teradifon EC

1.3. Fungicides

*****Azoxystrobin SC

*Benalaxyl

*Benomyl 50%WP

*Bitertanol EC

*Bupimate EC

*Captan

*****Carbendazime+chlorothalonil EC

*Chlorothalonil

*Cuivre+chlorothalonil 250g/l WP

*Cuivre+propineb 37%+17%WP

*Cuivre de l'oxyde de cuivre cuivreux

*Cuivre hydroxyde WP

*Cymoxamil+propineb

*Dichlofluanid WP

*Difenaconazole EC

*Dimethomorphe+mancozeb 69%WP

*Dithianon SC

*Dodemorph

*Epoxiconazole+carbendazime EC

*Fenarimol

*****Flutriafol+thiabendazole EC

*Flutriafol 125g/SL, EC

*Fluzilazole EC

*Folpel 50WP

Folyoxin-al

*Fosetyl-aluminium WG

*Hexaconazole SC

*Iprobenfos 480g/EC

*Iprodione SC

*Kresoxim-methyl WG

*Mancozeb+metalaxyl 62.5% WP

*Mancozeb 80% WP

*Metiram WP

*Micronised Sulphur WG

*Oxychlorure de cuivre WP

*Penconazole EC

*Propamocarb hydrochloride SL

*Propineb 70% WP

*Pyrimethanil SC

*Tebuconazole WP, EC

*Thiabendazole EC

*Thiophanate methyl SC

*Thirame 80% WP

*Tricyclazole 75% WP

*Triforine EC

*Vinchlozoline 50% SL

1.5. Herbicides

*2,4 D(acide dichloro-2.4 phenoxy acétique)

*Acide organique halogéné: dalapon 85% WP

*Alachlor+Atrazine

*Amerthrym 50SC

*Diuron

*Diuron 80 SC

*Gluphosate 360 LC

*Glyphosate 360g/l SL, Granulés

*Lasso-atrazine,EC

*Methribuzin

*Metolachlor 960g/l EC

*Paraquat 40g/L SL

*Propanil 360 g/l EC

*Trietazine : Atrazine 500g/l SC, Ametryne 500g/SC

*Trifluraline+linuron EC

1.6. Rondenticides

*Brodifacoum

*Bromadialone

*Bromadialone+Cumatetralyl+Sulfaquinox

*Coumatetryl

*Difenacoum

1.7. Nematicides

*Aldicarbe

*Dazomet 98% G

*Phenamiphos

1.8.Molluscicides

*Mercaptodimethu

*Methaldehyde 5 G

1.9. Growth Regulators

*Daminozide 85% SP

*Substances à composition complexe : rootone ; speedone ;etc

1.10. Oil additive

*Alkyl phenol/ethylene

1.11. Biological control

** Bacillus thurengiensis*

List of pesticides prohibited in Rwanda

Name	Category
1. Aldrin	Organochloré
2. DDT	Organochloré
3. Dieldrin	Organochloré
4. 1-2 Dibromoethane	Dérivé bromé
5. Fluoroacetamine	Dérivés fluorés
6. H.C.H Gamma(lindane)	Organochloré
7. Choldimeforme	Organochloré
8. 2 , 4 , 5-T	Acide phénoxyacetique
9. Captafol	Phtalimide
10. Chlordane	Organochloré
11. Dinoseb et sels de dinoseb	
12.H.C.H (melandes d'isomeres)	Organochloré
13. Heptachlore	Organochloré
14. Hexachlorobenzene	Organochloré
15. Composés de mercure	Dérivés de mercure
16. Chlorobenzilate	Organochloré
17. Penchlorophenol	Chloronitrophenol
18. Monocrotophos	Organochloré
19. Methamidophos	Organochloré
20. Phosphamidon	Organochloré
21. Methyle-parathion	Organochloré

Summary table 2. Proposed areas of intervention in IPM in Rwanda

Nature of Intervention	**Who should intervene**	**Expected gain**	**Conducive issues**	**Obstacles**
• Research to establish pests status in different agro-ecological zones	Research and Universities	• Focus on major pests for control • Monitoring the control practices • Monitor pests situation on different crops • Develop appropriate technologies	Availability of fund for carrying on research • Joint effort between Institutes	Lack of funding • Lack of qualified staffs
Training of Extension staffs and farmers on available IPM technologies	• MINAGRI • MINALOC • Research • Universities • NGOs	Farmers knowledge on IPM increased • Yield increased due to reduced pests damage • Environment, human	• Funding availability • Coordination effort to network all actors • Sharing responsibilities	• Lack of funding • Lack of qualified staffs • Poor coordinatio

		and animal health improved due to proper use of pesticides • Researchers and Academia experience increased	according to proximate • Development of technical manual for all pests and diseases used by any actor • Making researchers and academia responsive to farmers needs as a part of their workload	n
Development of IPM materials	• MINAGRI • Research • Universities	• Technical IPM information available • Develop approval mechanism	• Funding for these materials development	• Lack of fund
Conducting adaptive research with farmers in different agroecological zones	• Research, • Universities	Working technologies approved and adopted by farmers • Dissemination of approved	• Availability of fund • Willingness of Research and Universities	• Lack of approval mechanism • Lack of funding for

		technologies		adaptive research

Annex 2: Minutes and attendance lists of consultation meetings in Nyabihu site

INYANDIKOMVUGO Y' INAMA YAHUJE ABATURAGE B'UMURENGE WA RAMBURA NA MULINGA N'ABAKOZI B'UMUSHINGA LWH MU RWEGO RWO GUSOBANURIRWA GAHUNDA Y'UMUSHINGA MUSHYA(**SAIP**) UGIYE GUFATANYA NABO MU BIKORWA BY'UBUHINZI.

Inama yabereye ku biro by'Akagari ka Kibisabo yayobowe n'UmunyamabangaNshingwabikorwa w'Umurenge wa Rambura Bwana Rusingiza Esron, yari yitabiriwe n'abaturage b'Umurenge wa Rambura na Mulinga hari kandi n'abakozi b'umushinga LWH bakorera mu Karere ka Nyabihu.

Atangiza inama, UmunyamabangaNshingwa bikorwa w'Umurenge yahaye ikaze abakozi b'Umushinga LWH baturutse I Kigali ndetse n'abakozi bakorera Nyabihu, yashimiye kandi abaturage bitabiriye inama bo mu Mirenge ya Rambura na Mulinga, yabashimiye uburyo bari gushyira mu bikorwa igihembwe cy'ihinga cya 2018B, abasaba kwishutisha ihinga muri iki gihe imvura irimo igwa.

UmunyamabangaNshingwabikorwa yahaye ikaze umukozi w'umushinga LWH waturutse I Kigali ushinzwe gukurikirana ishyirwamubikorwa by'Umushinga(M&EO) Bwana **BIZIMANA Jean Claude** ngo asobanurire abaturage bitabiriye inama, gahunda y'Umushinga mushya ugiye kuza gufatanya n'abaturage guteza imbere ubuhinzi.

Umukozi w'umushinga wa LWH waturutse I Kigali Bwana Jean Claude Bizimana yasuhuje abaturage maze ababaza niba amaterasi bakorewe hari icyo abamariye , abaturarage bamusubije ko amaterasi abafitiye akamaro kanini kuko uretse guhagarika isuri yatwaraga ubutaka bwabo n'umusaruro wariyongereye, Umuturage witwa Barakengera wabajijwe iki kibazo yasubije ko isuri yatwaraga ubutaka bwabo yarahagaze , umusaruro nawo iyo umuntu yakoresheje inyongeramusaruro (imborera n'imvaruganda) wikuba inshuro kuva kuri eshatu (3) kugeza ku nshuro eshanu(5).

Umukozi w'Umushinga LWH yashimiye abaturage ba Nyabihu ubwitange n'umurava bashyira mu kazi kabo ka buri munsi n'imbaraga bashyira mugutegura igihembwe cy'ihinga cya 2018B.

Kuri gahunda y'umushinga mushyashya, uyu mukozi (M&EO) yabasobanuriye ko umushinga igiye kuza gufatanya nabo guteza imbere ubuhinzi witwa SAIP (Sustainable Agriculture for intensification Project), yakomeje abasobanurira ko uyu mushinga uzabanda ku bikorwa bikurikira:

1. **Kongerera ubushobozi inzego z'abahinzi** (amatsinda, zone na Koperative) hakorwa amahugurwa n'ingendoshuri hamwe no gukorana n'ibigo by'imari.
2. **Iyamamazabuhinzi**: Guteza imbere igihingwa cy'ibirayi no kwigisha abaturage tekiniki zose zijyanye n'ubuhinzi kuva mu gutegura ubutaka, gutera,gukurikirana ibihingwa kugeza bisaruwe ndetse no gufata neza umusaruro.
3. **Guteza imbere imirire**: Hazatangwa amahugurwa ku mirire mu rwego rwo guteza imbere imirire myiza (hakorwa amahugurwa mu gutegura indyo iboneye ndetse no kubishyira mu bikorwa mu ngo zacu) hagamijwe kurwanya indwara ziterwa n'imirire mibi (Bwaki,)
4. **Ibikorwa remezo byo kongera agaciro umusaruro**: gufatanyiriza hamwe n'abagenerwabikorwa mu kongerera umusaruro agaciro no kuwugeza ku masoko.

Umukozi ushinzwe gukurikirana ibikorwa by'Umushinga LWH yasobanuriye abaturage ko umushinga mu Karere ka Nyabihu uzibanda mu guteza imbere igihingwa cy'ibirayi.

Nyuma yo kuganiza abaturage kuri gahunda z'umushinga mushyashya (SAIP) ugiye gutangira, Umukozi ushinzwe gukurikirana ibikorwa by'umushinga yahaye abaturage ijambo ngo batange ibyizuzo byabo mu byo umushinga ugiye gutangira wazabafasha gukemura; maze abaturage batanga ibyifuzo bikurikira:

A) Gufasha abaturage kubona imbuto y'ibirayi itanga umusaruro kandi yihanagnira uburwayi
B) Kubonera abahinzi b'ibirayi nkunganire ku mbuto y'ibirayi kuko imbuto ihenda no kubafasha kubona isoko ritabahombya ku musaruro baba bejeje.
C) Gufasha abahinzi gushyiraho ikigega cy'imbuto n'izindi nyongeramusaruro
D) Guha amahugurwa abanyamuryango ba Koperative zashizweho ku micungire y'amakoperative
E) Gushyiraho ikigo mbonezamirire (Centre de formation nutritionnelle)
F) Gushyiraho ihuriro ry'abahinzi b'ibirayi (potatoes platform).
G) Gushyiraho abajyanama mu mirire muri buri mudugudu bakaba bashingwa kureba ingo zifite ibibazo mu mirire no kubafasha uko bagerwaho ndetse no gutegura indyo nziza.
H) Gufasha abaturage uburyo bwo gutubura imbuto y'ibirayi hafi yabo hubakwa Greenhouse byibuze imwe mu murenge aho umushinga uzakorera.

Umukozi ushinzwe gukurikirana ibikorwa by'Umushinga LWH yasabye abaturage kwita ku materasi yakozwe na LWH abasaba ko igihe hagize iterasi risenyuka komite zasizweho zishinzwe kubungabunga ibikorwaremezo ndetse na ba nyirimurima bagomba guhita barisana mu rwego rwo kwirinda ko byateza isuri no ku materasi ari munsi yiryo ryacitse.



Photo 1,2 &3: Umukozi w'umushinga aganiza abaturage kuri gahunda y'umushinga mushya.

Mu gusoza Inama umunyamabanga Nshingwabikorwa yashimiye byimazeyo Umushinga LWH ku bikorwa byinshi wateyemo inkunga abaturage b'Akarere ka Nyabihu ariko cyane cyane abaturage b'Umurenge wa Rambura na Mulinga kuko aribo bazi ibyiza by'umushinga LWH.
UmunyamabangaNshingwabikorwa w'umurenge kandi yahaye ikaze umufatanyabikorwa mushya ariwo SAIP ko biteguye gufatanya mu bikorwa byose bifuza gukorera mu Karere ka Nyabihu by'umwihariko mu Mirenge ya Rambura na Mulinga.
Umunyamabanga Nshingwabikorwa kandi yasabye abaturage b'Akagari ka Kibisabo by'umwihariko nkuko bari babyiyemeje kuremera mugenzi wabo wahuye n'ikiza inkuba igahitana inka ze eshatu gushyira mu bikorwa bakamugurira inka y'inzungu bamwemereye.

Uyu muyobozi kandi yasabye abaturage gushyira ingufu mu kwihutisha igihembwe cy'ihinga cya 2018B cyane cyane ku baturage bahinga ingano, amashaza n'ibirayi kuko abahinze ibigori bo barimo kumenera yabasabye ko batarenza tariki ya 25/3/2018 bazaba barangije

gutera imbuto birinda ko nyuma yiriya tariki imyaka bazatera yazahura n'izuba ntitange umusaruro.
Inama yasojwe saa kumi n'igice(16h30')

Umwanditsi w'Inama

SEBAZUNGU Modeste
M&EO LWH/RSPP/Gishwati Coordination

Umuyobozi w'Inama:

RUSINGIZA Esron
Executive Secretary of Rambura Sector

EPUBULIKA Y'U RWANDA
UTARA Y'UBURENGERAZUBA
AKARERE KA NYABIHU

URUTONDE RW'ABITABIRIYE INAMA Y'ABAGENERWABIKORWA B'UMUSHINGA "SAIP" MURI SITE YA NYABIHU - ITARIKI 13/3/2018

AMAZINA YOMBI	No Y'IRANGAMUNTU	UMUDUGUDU	AKAGARI	UMURENGE	UMU
Nyigiramahoro	1198470080503015	NYAMUKUMBI	Mwigomeke	Murambi	
TWAMBAZEMUNGUBakal	1197480044358001	KABEZA	KIBISABO	RAMBURA	
NTAWUNGABASHIZU		NYAMPUHU	KIBISABO	RAMBURA	
NYIRABAZERA Alphonsine	1195970085708074	Nyangurugumu	GURIRO	RAMBURA	
MUREGO Emmanuel	1197080091527033	RARO	GURIRO	RAMBURA	
SINGA Jean de Dieu	1195680023525080	BUGARIRO	RUGARA	RAMBURA	
NTAHONDI Félicien	1196480031909025	NTANDO	RWANTOBO	Murambi	
SEZIKEYE Anastase		Rwandarugeri	RWANTOBO	Murambi	
GASANA Jean Damascène	1196780034728091	KARAMBI	RWANTOBO	Murambi	
HAGUMINEZA Seraphin	1196630029650008	KIGUGU	MUNYARUKIKE	Murambi	
MUKASINE Gaudiana	—	BUGONDE	KIBISABO	RAMBURA	
UMUHOZA Janette	—	RATARE	KIBISABO	RAMBURA	
NYIRASHYIRAMBERE Rachel	1196270022504 2	NYAMPUHU	〃	〃	
BWIZAMIRO	—	GATARE	KIBISABO	〃	
ZANINKA ~~Joseph~~ Janette	—	BUGONDE	〃	〃	
USABEMARIYA Cristine	—	BUGONDE	〃	〃	
MANISHIMWE Devotha	—	NYAMPUHU	〃	〃	
MANIRAKIZA Immaculé	—	NYAMPUHU	〃	〃	
MUJAWAMARIYA Claudine	—	〃	〃	〃	
NYINKAMIYE Domitila	—	BUGONDE	〃	〃	

REPUBULIKA Y'U RWANDA
INTARA Y'UBURENGERAZUBA
AKARERE KA NYABIHU

URUTONDE RW'ABITABIRIYE INAMA Y'ABAGENERWABIKORWA B'UMUSHINGA "SAL
MURI SITE YA NYABIHU - ITARIKI 13/03/2018

NO	AMAZINA YOMBI	NO Y'IRANGAMUNTU	UMUDUGUDU	AKAGARI	UMURENGE	UMUKONO
1	Nzaseka Emmanuel	1198480084580121	Bugonde	Kibisabo	Rambura	
2.	Ndabiyumva Elie	1193080073211050	Gatare	Kibisabo	Rambura	
3	Ayitegetse Samuel	1197880060090066.	Kanyinya	Kibisabo	Rambura	
4	Nkubito Celestin	1197270044461815	Kiniha	KIBISABO	RAMBURA	
5	Mukamusoni Patricie	1195670023466036	Nyamyumu	KIBISABO	RAMBURA	
6.	Mukamukiramde Josephine					
7.	Mukasine Claudine	1197870060165068	Nyamyumu	Nyundo	Rambura	
8.	Nkurunziza Jean Régis	1197380042075074	Kabeza	Kibisabo	RAMBURA	
9.	Mukandikuli Beraliha	1198670044506483	Kabeza	Kibisabo	Rambura	
10	Nyirahabineza Therese	1199230037775066	Kalamli	Icyitsabo	RAMBURA	
11	Umuhoza Uwase Christine		Kinihira	Icyitsabo	Rambura	
12	Ukwizagirabanze Emmanuel	1198580094513038	Icyarumbi	Ruantobo	Mukunga	
13	Bisobanyimana Jean Damascène	1197080039008043	Bugome	KIBISABO	RAMBURA	
14	Kabanyana Jean Damascène	1198370171986627	Kanyinya	Kibisabo	Rambura	
15	Habyarimana Jean Daniel		Bigoke	Ruantobo	Mukunga	
16	INGABIRE Floride		Bugonde			
17	Bizimana Remezi		Bugonde			
18	Kazi Umuhoza Beatrice	1199280166817063	Rurambo	MULINGA	MULINGA	
19	Nyamahanyo Jean	1198770072710025	Kinihira	KIBISABO	RAMBURA	
20	Mukamugema Beatrice	1199480845660053	Bugonde	KIBISABO	RAMBURA	
21	UZABAKIRIHO Faustin					

REPUBULIKA Y'U RWANDA.
INTARA Y'IBURENGERAZUBA
AKARERE KA NYABIHU

* SAIP" MURI SITE YA NYABIHU - URUTONDE RW'ABITABIRIYE INAMA Y'ABAGENERWABIKORWA B'UMUSHIN[GA] - ITARIKI 13/3/2018

N°	AMAZINA YOMBI	N° Y'IRANGAMUNTU	UMUDUGUDU	AKAGARI	UMURENGE	U[…]
1	Kalimutumye Patricie	N°	Nyankukuma	Muryanike	Muringa	
2	HATEGEKIMANA		Nyampunwe	Kibisabo	Rambura	
3	SEBUKUKA Felix	11989 80075 687079	Bugonde	Kibisabo	Rambura	
4	NDAYISABA	M:	Bugonde	Kibisabo	Rambura	
5	BAZAMENYERA J de dieu		Bugonde	Kibisabo	RAMBURA	
6	Sentamaye J. Damascene	11965 800 280 780 64	Nyampuhu	Kibisabo	Rambura	
7	Nsabumuki Theoneste		Rwenzo	Kibisabo	Rambura	
8	Mbarikiu Thomas	11965 8005 1322063	Kinihira	Kibisabo	Rambura	
9	NDAGIJIMANA		Nyampuhu	Kibisabo	Rambura	
10	Udegamiye		Murwenzo	Kibisabo	Rambura	
11	Bagirishya		Nyamabuye	Kibisabo	Rambura	
12	Ntabisanimana		Bugonde	Kibisabo	Rambura	
13	Ntabahuzimana Samson		Nyampuhu	Kibisabo	Rambura	
14	Tumuramboze Ildefonse		Nyampuhu	Kibisabo	Rambura	
15	Rurazekose Marko Palestin		KARAMBI	KIBISABO	Rambura	
16	Nyangabirwe jean chretien	0789001748	Bugonde	KIBISABO	RAMBURA	
17	DUSENGIMANA JOHNSON		BUGONDE	KI BISABO	RAMBURA	
18	NZAMUMARUWANIKI jean Claude	~~[illegible]~~	KINIHIRA	KibisAbo	RAMBURA	
19	Mukasine M. Louise	1199480088437043	Runinya	Nyundo	RAMBURA	
20	Kayira Bonafantire		Ntongo	Rwantebo	Muringa	
21	Habuzimana J Damascene	1197780048149067	Rwandarugeli	Rwantebo	Muringa	

REPUBULIKA Y'U RWANDA
INTARA Y'UBURENGERAZUBA
AKARERE KA NYABIHU

URUTONDE RW'ABITABIRIYE INAMA Y'ABAGENERWABIKORWA B'UMUSHINGA "SA
MURI GITE YA NYABIHU - ITARIKI 13/03/2018

NO.	AMAZINA YOMBI	No. YIRANGANWUNTU	UMUDUGUDU	AKAGARI	UMURENGE	UMUKONO.
1.	Ndagijimana J. de Dieu	1197480044377090	Nyamperu	Kibisabo	Rambura	
2.	Mukamuteta Alphonsine	—	Bugomba	Kibisabo	Rambura	
3.	Nduwayezu Fulgence		Rurimo	Kibisabo	Rambura	
4.	Habakizimana Stellaire	—	Kimihina	Kibisabo	Rambura	
5.	Nkuranga Emmanuel	1199888081440011	Bugonde	Kibisabo	RAMBURA	
6.	Nyirabakunzimfashwanyi	1197270042717054	Kimihina	Kibisabo	Rambura	
7.	NGABONIMA Emmanuel	1178400845520 52	BUGONDE	KIBISABO	Rambura	
8.	Nyiramahirwe		Kimihina	Kibisabo	Rambura	
9.	Mpamo Sylvestre	—	Kanambi	Kibisabo	Rambura	
10.	Ndamukunda	—	Kanambi	Kibisabo	Rambura	
11.	Nyirabukana	—	Kanambi	Kibisabo	Rambura	
12.	Ntawumenyimana	—	Birembo	Birembo	Rambura	
13.	Banyegombere	—	Nyamukuna	Murangara	Murenge	
14.	Nyiramahirwe	—	Kanambi	Rugarama	Murenge	
15.	Habakurimana Leonidas	—	Kimihina	Kibisabo	Rambura	
16.	HABAZIMANA Christophe	1197480044345076	NTAMPUHU	KIBISABO	RAMBURA	
17.	BUHUMBANO Pierre	—	NYANKOKUMA	MWIYANIKE	MURINGA	
18.	MUHIRE Valente	—	NYANKOKUMA	MWIYANIKE	MURINGA	
19.	Twagiramariya M. Clere	—	NYANKOKUMA	MWIYANIKE	MURINGA	
20.	NSENGIYUMVA Godefroid	—	NYANKOKUMA	MWIYANIKE	MURINGA	
21.	Kamanzi Philippe	—	Bugonde	Kibisabo	Rambura	
	Nyiramwikali Leocadie	—	Kanambi	Kibisabo	Rambura	

REPUBULIKA Y'U RWANDA
INTARA Y'IBURENGERAZUBA.
AKARERE KA NYABIHU

URUTONDE RW'ABITABIRIYE INAMA Y'ABAGENERWABIKORWA B'UMUSH
" SAIP " MURI SITE YA NYABIHU - ITARIKI 13/08/2018

Nº	AMAZINA YOMBI	Nº Y'IRANGAMUNTU	UMUDUGUDU	AKAGARI	UMURENGE	UMUK
1	Tuvugiramariya Fransais		Rwandarugari	Rwantobo	Muringa	
2	Ruigemera Anastase Clément	1197080004278302 6	Nyantutama	Runyamike	Mulinga	
3	Barazelasvyo	"	Nyampuhu	Kibisabo	Rambura	
4	Zamimba Laurence	119687 00365 20098	Bugunde	Kibisabo	Rambura	
5	Mariraora Eugenie		Rwerero	Kibisabo	Rambura	
6	Dingatore Angelique	11970 700 830 3-10 34	Kinihira	Kibisabo	Rambura	
7	Nyirabonesha Belomille					
8	Hagumimana J. Damascène	11988800 75453089	Kalambi	Kibisabo	Rambura	
9	SEBASORE J. Pierre	119898007566 1029	Ntango	Rwamatabo	Muringa	
10	Habiyaremye J. Claude		-	-	Muringa	
11	Murekatete Joselyne	11976800 45353046	Bugonde	Kibisabo	RAMBURA	
12	Ntirwamunyagajije Therese		Bugonde	Kibisabo	RAMBURA	
13	Nyiragatigwa Ranguida		Gatare	Kibisabo	Rambura	
14	Humomko Zabuloni		Gatare	Kibisabo	Rambura	
15	Nyirahabimana Hirekamanzi	11982800 84415032	Bugonde	Kibisabo	Rambura	
16	Nibeze Angelique	1198770075-663033	Bugonde	KIBISABO	RAMBURA	
17	Hitimana Joseph	119598002975 7021	KINIHIRA	BIBISABO	RAMBURA	
18	SAGAHUTU J. Baptiste	11975-8004444 4049	Kinihira	Kibisabo	Rambura	
19	Bapfakurera		Bugonde	Kibisabo	RAMBURA	
20	NIYONSHUTI		Bugonde	KIBISABO	RAMBURA	
21	NTEZIMANA	11981700 7181 6036	Rwerero	" "	" "	
22	Tuyisabamungu p. Célestin	11970 800 808 78026	Bugonde	" "		
23	SEBYAGUNGU Modeste	119778009 7908005	Leo H-RSSA MKED			

Annex 3: Minutes of consultation meetings and attendance lists in Muyanza site

INYANDIKO MVUGO Y'INAMA ZO GUSOBAURA UMUSHINGA MUSHYA W'UBUHINZI URI GUTEGURWA

Nyuma y'imyaka igera kuri itanu (5) umushinga wo gutunganya ubutaka, gufata amazi no kuhira imusozi (LWH)ukorera kandi ukorana n'abaturage bo mu Mirenge yo mu Karere ka RULINDO, abaturage bagaragaje ubufatanye no kugira uruhare mu migendekere myiza y'umushinga, igihe kikaba cyigeze ngo usoze igihe wari uteganijwe kumara.

Murwego rwo kubunganga ibyo LWH yagezeho, Leta y'u Rwanda, iri gutegura umushinga witwa SAIP uzafasha abagenerwabikorwa kubyaza umusaruro ibyo LWH yakoze.

Mu rwego rwo kwitegura gukorana n'umushinga mushya, abakozi b'umushinga LWH kuri site ya site ya MUYANZA gukorana ibiganiro n'abagenerwabikorwa bagamijwe kubasobanurira umushinga mushya no kumva ibitekerezo byabo.

Inama zabereye aha hakurikira: Akagali ka TABA na KARENGERI, Umurenge wa BUREGA, Akagali ka NDARAGE, GAHORORO Umurenge wa BUYOGA, zikaba zarabaye taliki ya 13/03/2018 mu nteko rusange z'abaturage.

Ibiganiro byibanze kuri izi ngingo zikurikira:

1. Gusobanura mu magambo make umushinga mushya;
2. Kumva icyo abagenerwabikorwa batekereza kumushinga mushya;
3. Kubaka ubushobozi bw'abahinzi binyuze mu matsinda no muri cooperatives;
4. Kongera umusaruro;
5. Kurwanya imirire mibi;
6. Kubegereza ibikoresho byo kuhira mu gice cyitazajya cyuhirwa n'amazi ya dam.

Abakozi b'umushinga mu nama zabereye mu tugari dutandukanye batangiye basobanura mu ncamake umushinga mushya ariwo SAIP ukaba ari umushinga wo gukomeza ibyagezweho,kongera umusaruro no kurwanya imirire mibi. Bashimira uburyo abagenerwa bikorwa bitabiriye kwibumbira mu matsinda no kubungabunga ibikorwa byabakorewe birimo amaterasi, ibiti bivangwa n'imyaka, imirwanyasuri hamwe na hamwe ndetse n'urugomero rw'amazi azakoreshwa mu kuhira imirima.

Basabwe kuzakorana neza n'umushinga mushya cyane cyane mu gukomeza kwongera umusaruro w'ibikomoka k'ubuhinzi cyane cyane batekereza ku kwihaza mu biribwa no gusagurira isoko.

Kuri iyo ngingo yo kwihaza mu biribwa, abagenerwabikorwa basabwe kuzafatanya n'umushinga SAIP kwita ku mirire cyane cyane bategura indyo yuzuye mu mirire yabo ya buri munsi. Bakaba bateguzwa gutangira kuvugurura no gutekereza ku turima tw'igikoni.

Babwiwe kandi ko umushinga SAIP muri gahunda zawo harimo gufasha abahinzi batazagerwaho n'amazi y'urugomero rwa Muyanza kubona ibikoresho bitandukanye byo kuhira kugirango umusaruro w'ibikomoka k'ubuhinzi ukomeze kwiyongera.

Haganiriwe kandi ingingo yo kubungabunga ibikorwaremezo cyane cyane amatiyo yo kuhira, imihanda inyura mu cyanya cyuhirwa, ibiti bivangwa n'imyaka n'ibindi. Basabwa kubyitaho kuko ari ibyabo kandi buri wese akaba ijisho rya mugenzi we.

Ibibazo byabajijwe n'ibisubizo byatanzwe.

No	Ikibazo cyabajijwe	Igisubizo cyatanzwe
1.	Abagenerwabikorwa babajije niba umushinga uzabafasha kubona umuguzi kumusaruro w'ibigori n'ubutunguru.	Basubijwe ko umushinga uzabafasha kubahuza n'amasoko ajyanye n'umusaruro bazaba bejeje hakurikijwe kandi uburyo bawufushe neza.
2.	Abagenerwabikorwa babajije niba umushinga uzabafasha kwimuka bakava mu cyanya cyuhirwa murwego rwo kuhatunganya aho bari batuye hagakorerwa ubuhinzi.	Basubijwe ko umushinga udafite gahunda yo kubakira amazu abatuye muri command area ahubwo bagomba kujya bagenda bava mu cyanya kizuhirwa buhoro buhoro.
3.	Abagenerwabikorwa babajije niba umushinga mushya uzaza ukora amaterasi mubice byagiye bisigara no mugice kitari icyerekeranye n'umugezi wa MUYANZA	Abagenerwabikorwa basobanuriwe ko umushinga SAIP utazakora amaterasi ahubwo uzajya ufasha abaturage kubaka ubushobozi mubijyanye n'ubuhinzi bunoze no kurwanya imirire mibi, gufasha mukubona ibikoresho byo kuhira imyaka.
4.	Abagenerwabikorwa babajije ikibazo cy'uko bazubakirwa ubwanikiro cyane cyane abahinga ubutunguru mu gice kitazuhirwa	Basobanuriwe ko ubwanikiro ari muri bimwe umushinga uzaba ukara ariko hamaze kugaragazwa umusaruro ufatika uturuka mu materasi y'indinganire yakozwe na LWH.

Ibyifuzo abagenerwabikorwa bagaragaje byakongerwa mu mushinga mushya:

- Abagenerwabikorwa bifuje ko hazatekerezwa kubindi bikorwa byazajya byunganira ubuhinzi: (Ubudozi bw'imyenda, ububaji, gukora amasabune n'ibindi,…)
- Abagenerwabikorwa bifuje ko umushinga mushya wazabafasha mu kurwanya imirire mibi bahabwa amatungo (amagufi n'amaremare hakurikije ubushobozi bwa buri mugenerwabikorwa) urugero: inka, ihene, inkoko n'ibindi,…
- Bifuje kandi ko umushinga mushya wazafasha abahinzi kubegereza hafi inyongeramusaruro n'imiti yo kurwaya ibyonnyi (fertilizers and pesticides);

- Abagenerwabikorwa kandi bifuje ko bakongererwa ubushobozi mu bijyanye n'imihingire myiza yazatuma amaterasi bakorewe yazabyanwa umusaruro kandi akamara igihe kirekire;
- Bifuje ko mu mushinga mushya bafashwa mu gukoresha no kubungabunga ibikorwa byo kuhira imyaka (Operation and maintenance of the irrigation infrastructure in CA).

Inama yashojwe abaturage bagaragaje ko bashimira Leta y'u Rwanda ko ikomeza kubatekereza ibagenera ibyahindura ubuzima bwabo bukarushaho kuba bwiza. Bijeje imikoranire myiza no gukomeza gufatanya mu bikorwa byose by'umushinga mushya.

Ku mugereka w'iyi nyandiko mvugo haragaragaraho urutonde rw'abitabiriye inama mu tugari dutandukanye two mu Mirenge itandukanye umushinga uzakomerezamo ibikorwa byakorwaga na LWH.

Abegeranyije ibitekerezo n'ibyifuzo by'abagenerwabikorwa:

- UWIZEYE Willy, CDO

Umuyobozi wa LWH Site ya MUYANZA

- MUKAMUGENGA Angelique, TL

AKARERE KA RULINDO
UMURENGE WA.....Bumbogo.....
AKAGALI KA.....Tuba.....
UMUDUGUDU WA.....Ryinzaza.....

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	Hagenimana Nicolas	M	0788616841	
2	Rukundakuryo Augustin	M	0727405354	
3	Mukamunyanga Alphonsine	F		
4	Habineza Cyprien	M	0720035836	
5	Twizeyimana Faustin	M		
6	Nyiraguhatse Epiphanie	F		
7	Habumuremyi Emmanuel	M		
8	Ntawigishatse Damascène	M	0782632153	
9	Nyirakamana Speciose	F		
10	Rusagara Faustin	M	0725821712	
11	Habineza Alphonse	M		
12	Murabyimana Béatrice	F		
13	Uwizeyimana	F		
14	Mukamabera Alphonsine	F	0727716467	
15	Mukamana Séraphine	F		
16	Murabyimana Vestine	F		
17	Kanyandekwe Yuditha	F		
18	Mukantabana Peraqie	F		
19	Mukandayambaje Alphonsine	F		
20	Mukamwiza	F		

AKARERE KA RULINDO
UMURENGE WA.....
AKAGALI KA.....
UMUDUGUDU WA.....

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
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AKARERE KA RULINDO
UMURENGE WA...Bu.R.E.G.A.....
AKAGALI KA.....KA.R.E.N.G.E.R.I.....
UMUDUGUDU WA...Ri.u.M.u.k.a.....

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	MUHIRE Justin	M	0785397727	
2	MUPARASI JMV	M	0727600612	
3	KAMUFO Zi Feneciné	M		
4	Nizeyimana Silas	M	0723035687	
5	Mugabaligira [illegible]	M.	0723659884	
6	Nkizamacumu Bosco	M.		
7	Kalaza ALphonsi	M.		
8	MUSABYIMANA Jean Damascène	M	0726310865	
9	MUKANDAYISENGA Donatille	F		
10	MUKARURINDA Falatiana	F		
11	Mukabuginga Xaverine	F	0728811049	
12	Mukamahirwe Josephine	F		
13	Uwizeyimana Enata	F		
14	Mukarwigira Beatrice	F	0729564462	
15	[illegible]			
16	[illegible]	F		
17	[illegible]	F		
18	MUKAKOMERE	F		
19	NYIRANDEGEYA Chantal	F		
20	Bitaha Fabien	M		

AKARERE KA RULINDO
UMURENGE WA.....MBW.REGA.....
AKAGALI KA.....TABA.....
UMUDUGUDU WA....RUSIZI.....

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	BIZIMANA Jean Pierre	M	0781721803	
2	NYIRABAGANDE Julienne	F	—	
3	MUKESHIMANA Claudine	F	0726502464	
4	Mukantabana Annonciata	F	—	
5	Ndereyo Damien	M	—	
6	Ukwizagenye Pleasidie	F	—	
7	Bangayinama Augustin	M	—	
8	Kanyarwanda Felicien	M	—	
9	Zainabu Safari	F	—	
10	Mukandahiro Alphonsine	F	—	
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AKARERE KA RULINDO
UMURENGE WA... Bu.R.E.Ma.....
AKAGALI KA..... RE.M.C.L.....
UMUDUGUDU WA.. Ruramira.....

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	Karamuka [illegible]	M	0783543757	
2	Habumuremyi [illegible]	M	—	
3	Kimenyo Celestin	M	—	
4	Mubizi Faustin	M	—	
5	Kanyegeli [illegible]		—	
6	Hitimana [illegible]	M	—	
7	Habyakare Cassien	M	—	
8	Hakizimana Aimable	M	—	
9	Habumugisha Celestin	M	—	
10	Ba Zaza [illegible]	M	—	
11	Rubebo [illegible]	M	—	
12	UBAHIRWA Gilbert	M	—	
13	[illegible]	M	—	
14	Habumugisha Célestin	M	0783792237	
15	IMANISHIMWE [illegible]	M	0783283145	
16	Mukabimana [illegible]	F	—	
17	Uwajeneza Marcelle	F	—	
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AKARERE KA RULINDO
UMURENGE WA..Bo.Rs.Q.A.....
AKAGALI KA.....T.A.Bp.....
UMUDUGUDU WA.....Mw.e.pE.Nē.....

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	Niz[illegible]	M	07[illegible]	
2	Mu[illegible]	F		
3	Mu[illegible]			
4	Uwi[illegible]	M		
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AKARERE KA RULINDO
UMURENGE WA.....
AKAGALI KA.....
UMUDUGUDU WA.....

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

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AKARERE KA RULINDO
UMURENGE WA..... BUYOGA
AKAGALI KA..... NYARAGE
UMUDUGUDU WA..... KARAMBI, GIKUNGO

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	MPOGAZI pascal	M	0783078865	
2	Ndokimana Damien	M	0727186223	
3	Twagiramungu Ildefonse	M	0725529081	
4	Nzeyimana Mathieu	M	-	
5	Habimana Philippe	M	0728677854	
6	Ngabirenimana Jc	M	0726925671	
7	Ugendahayo Emmanuel	M	-	
8	BIZIMUNGU Damien	M	0725209207	
9	Habiyaremye Isaie	M	0786077060	
10	Akobantegeye Odette	M	0723602824	
11	Ruzigamanza Jb	M	0725423654	
12	NDAHAYI Charles	M	0727044234	
13	Ellitesa Donath	M	0788925518	
14	Uwimpuhwe Jeanine	M	0722856203	
15	Uwamukunda Aline	F	-	
16	Mukunzi Esperance	F	-	
17	Umuhoza Yvonne	F	-	
18	[illegible]	M	-	
19	Nyiramana [illegible]	F	0727302124	
20	Ruzigamanza Emmanuel	M	0789514404	

AKARERE KA RULINDO
UMURENGE WA.....BUYOGA.....
AKAGALI KA.....NDARAGE.....
UMUDUGUDU WA.....KARAMBI na..GIKINGO

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	KAMEGELI Laurent	M	0786272962	
2	Mukamusoni Cecile	F	—	
3	Mukamuyema Jeseline	F	—	
4	Mukamunkindi Thérèse	F	-	
5	Bugingo Sesitumi	M		
6	Nkakabuganwa [illegible]	F		
7	Nyiramatabaro Ephrem	F	-	
8	[illegible]	F		
9	[illegible]	[illegible]		
10	Kamanzi Acophas	M	0726[illegible]737	
11	Mukamba Marie Chantal	F	078 9622592	
12	Mukakamanzi Séraphine	F		
13	Muteziyimana Patrick			
14	Ngendahayo	M		
15	Mukarisa	F		
16	Uwizeyimana	M		
17	Sikomano Jean Pierre	M	—	
18	Ndagijimana [illegible]	M	0783491035	
19	Harorimana [illegible]	M		
20	MUNYAZIKWIYO [illegible]	M	0727831770	

AKARERE KA RULINDO
UMURENGE WA.....BUYOGA.....
AKAGALI KA.....N.D.ARAGE
UMUDUGUDU WA....KARAMBI ha GIKINGO.

ABITABIRIYE INAMA YO KUNGURANA IBITEKEREZO KUMUSHINGA MUSHYA URI GUTEGURWA W'UBUHINZI

S/N	AMAZINA YOMBI	IGITSINA	TELEFONE	UMUKONO
1	Uwamahoro Beatrice	F		
2	Hakizimana Ladislas	M		
3	MUKAHIRWABYOSUMUNA	F		
4	Mukandoli Damithille	F	0728331919	
5	Nyirabahutu Alphonsine	F		
6	Hugabahoze H. Louise	F		
7	Bizimungu Eric EM.	M		
8	HARORimanzuwe Disc.	M		
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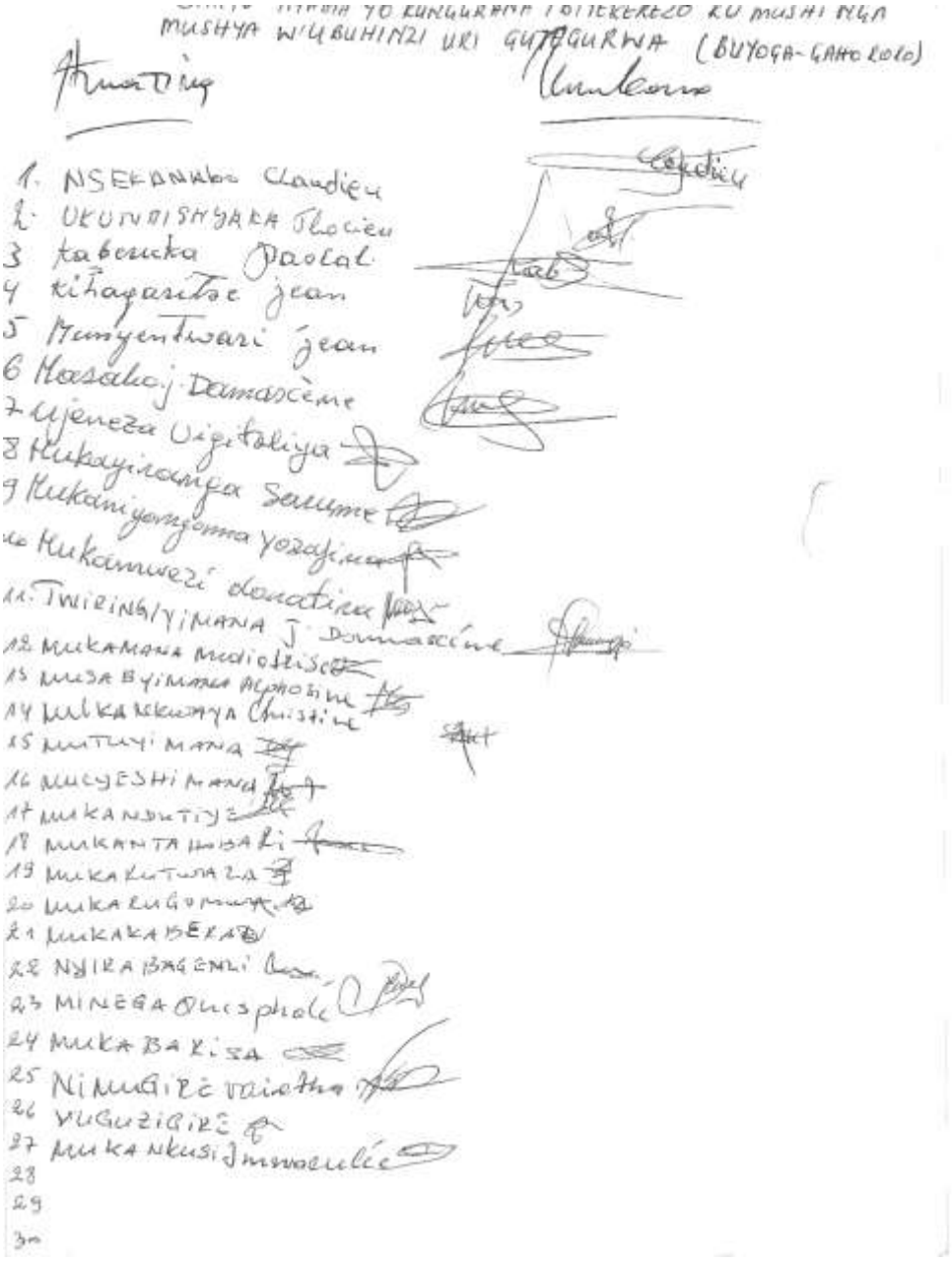

MUSHYA W'UBUHINZI URI GUTEGURWA (BUYOGA-GAHORO)
1. NSEKANABO Claudien
2. UKUNDISHYAKA Jocien
3 tabenska Pascal
4 kihagarikse jean
5 Munyentwari jean
6 Hasabaj Damascène
7 Ujeneza Uzjefaliya
8 Hukayiremuka Semume
9 Hukaniyongoma Yozafina
10 Hukamwezi donatien
11. TWIRINGIYIMANA J. Damascène
12 MUKAMANA Madiosèlisce
13 MUSABYIMANA Agnesine
14 MUKABEKWAYA Christine
15 MUTUYIMANA
16 MUCYESHIMANA
17 MUKANDUTIYE
18 MUKANTAMBARI
19 MUKAKUTWAZA
20 MUKARUGOMWA
21 MUKAKABEKA
22 NYIRABAGENZI
23 MINEGA Onesphore
24 MUKABARISA
25 NIMUGIRE Valentine
26 YUGUZIGIRE
27 MUKANKUSI Immaculée
28
29
30

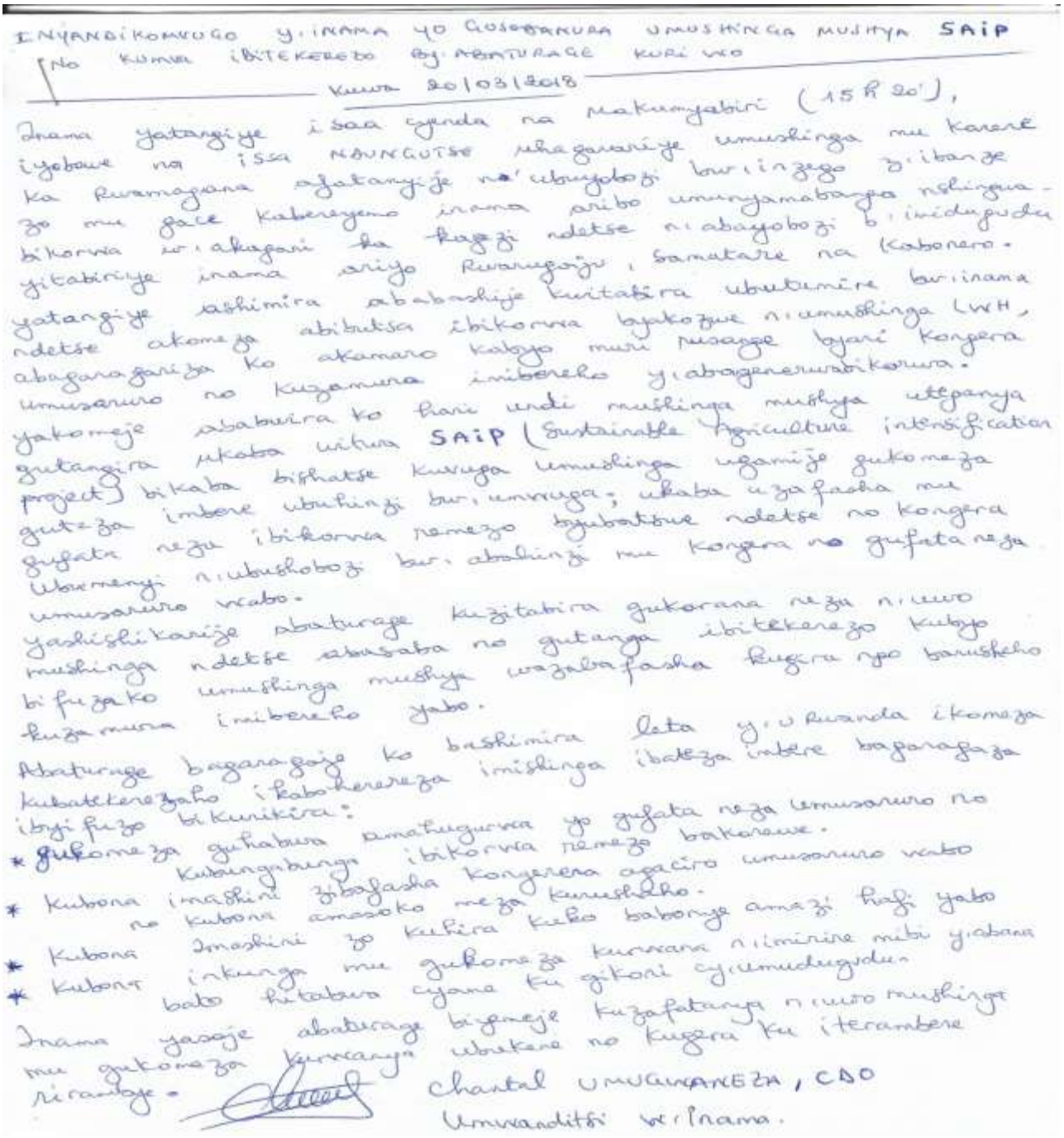
MUSHYAWILIBUHINZI LIRI GUTEGURWA (BUYOGA - GAHOLO)

Amazina

Umukono

1. [illegible]
2. Bangamwabo Floriyani
3. Nyirimpabo Samuheli
4. Mukandayisenga[illegible]
5. Musabyemariya
6. Mukayisenga[illegible]
7. Kwibarirwa
8. Akimana[illegible]
9. Nkubiri
10. Nsabimana
11. Nyirankwaya
12. Barayagwiza
13. Ntabangana[illegible]
14. Muhindahabi
15. Nzamurambaho
16. Bapfakurera
17. Nyiramanywa
18. Mukarabe
19. Kankundiye
20. Mukamurwanashyaka
21. Mukayisenga
22. Nyirabazungu
23. Nyiramugwaneza
24. Ndungutse[illegible]

Annex 4: Minutes of consultation meetings and attendance lists in Rwamagana 34 site



I. NYANDIKOMWUGO Y'INAMA YO GUSOBANURA UMUSHINGA MUSHYA SAIP

No KUMWA IBITEKEREZO BY'ABATURAGE KURI WO

Kuwa 20/03/2018

Inama yatangiye isaa cyenda na makumyabiri (15 h 20'), iyobowe na Issa NDUNGUTSE uhagarariye umushinga mu Karere ka Rwamagana agatangiza na'ubugoboji bw'inzego z'ibanze zo mu gace Kaberuka inama aribo umunyamabanga nshingwa - bikorwa w'akagari ka Rugazi ndetse n'abayobozi b'imidugudu yitabiriye inama ariyo Rwamagoje, Samutare na Kabonero. yatangiye ashimira ababashije kwitabira ubutumire bw'inama ndetse akomeza abibutsa ibikorwa byakozwe n'umushinga LWH, abagaragariza ko akamaro kabyo muri rusange byari kongera umusaruro no kuzamura imibereho y'abagenerwabikorwa. yakomeje ababwira ko hari undi mushinga mushya uteganya gutangira ukaba witwa SAIP (Sustainable Agriculture Intensification project) bikaba bishatse kuvuga umushinga ugamije gukomeza guteza imbere ubuhinzi bw'umwuga; ukaba uzafasha mu gufata neza ibikorwa nemezo byubatswe ndetse no kongera Ubwemenyi n'ubushoboji bw'abahinzi mu kongera no gufata neza umusaruro wabo.

Yashishikarije abaturage kwitabira gukorana neza n'uwo mushinga ndetse ababasaba no gutanga ibitekerezo kubyo bifuzako umushinga mushya wazabafasha kugira ngo barusheho kuzamura imibereho yabo.

Abaturage bagaragaje ko bashimira leta y'u Rwanda ikomeza kubatekerezaho ikabakorera imishinga ibateza imbere bagaragaza ibyifuzo bikurikira:

* gukomeza guhabwa amahugurwa yo gufata neza umusaruro no kuwungukirwa ibikorwa nemezo bakorewe.
* Kubona imashini zibafasha kongerera agaciro umusaruro wabo no kubona amasoko neza kuruhiho.
* Kubona Imashini zo kuhira kuko babonye amazi hafi yabo
* Kubona inkunga mu gukomeza kurwana n'iminine mibi yabaye babo hitabwa cyane ku gikori cy'umudugudu.

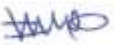
Inama yasoje abaturage bigeneje kuzafatanya n'uwo mushinga mu gukomeza kurwanya ubukene no kugera ku iterambere rirambye.

Chantal UMUGWANEZA, CSO

Umwanditsi w'Inama.

URUTONDE RW'ABITABIRIYE INAMA YO GUSOBANURA UMUSHINGA MUSHYA SAIP yo kuwa 20/03/2018

AMAZINA	UMUDUGUDU	UMUKONO
1. Bankundiye Anastase	Rwarugaju	
2. Niyitanga Denys	Rwarugaju	
3. Rukundo prence	Rwarugaju	
4. Bihoyiki Mathew	Rwarugaju	
5. Nayihaga Manweri	Rwarugaju	
6. Mukamana Specioza	Rwarugaju	
7. Mukeshimana Vestine	Rwarugaju	
8. Bihoyiki Niwemsiya	Rwarugaju	
9. Mugabowagwe Emmanuel	Rwarugaju	
10. Ntanwezera	Rwarugaju.	
11. Mukantambara Valentine	Rwarugaju	
12. Mukarukaka Clotilde	Rwarugaju	
13. Kazakura Jean Claude	Rwarugaju	
14. Mafashimana Valens	Rwarugaju	
15. Nabutsitsi Augustin	Rwarugaju	
16. Hakizimana	Rwarugaju	
17. Bamporiki	Rwarugaju	
18. Uwimana Alex	Rwarugaju	
19. Mupenzi Patric	Rwarugaju	
20. Karangwa Innocent	Rwarugaju	

AMAZINA	UMUBUGUZI	UMUKONO
1. Dusabimana Laurence	Kabonero	
2. Niyiramuhanda Yozafina	Kabonero	
3. Bihoyiki Vestina	Kabonero	
4. KANYANGE M. Goreti	Kabonero	
5. Uwimbabazi Gratia	Kabonero	
6. Nyirabukara Marie	Kabonero	
7. NTAKABONYI Liberata	Kabonero	
8. Mukamuziga Faviana	Kabonero	
9. Lidivina Mukanyangezi	Kabonero	
10. Morekatete Bujeniya	Kabonero	
12. Nizeyimana Alex	Kabonero	
13. IRADUKUNDA Maria	Kabonero	
14. HABIMANA Francois	Kabonero	
15. KANKINDI Nonciata	Kabonero	
16. MUKANDAYISABWE	Kabonero	
17. Bayingana Firibori	Kabonero	
18. Bizige Jean Corode	Samatare	
19. NTIZIMIRA Francois	Samatare	
20. MUKEBANGANGO Jean	Kabonero	
21. Nyirampirima	Samatare	
22. MUKANYERIGIRA	Samatare	
23. Nyiraburakozi	Samatare	
24. Mukandori	Samatare	
25. KIBIBI Eustache	Kabonero	

Amazina	Umudugudu	Umukono
1. Uwamurera Queen	Kabonero	
2. MUTUYIMANA	Kabonero	
3. Ntambara	Kabonero	
4. Mukamuhizi	Somatare	
5. Niyandiki	Somatare	
6. Kayamahanga	Kabonero	
7. Hategeka paul	Rwungo	
8. Uwizeyimana Specio	Rwungo	
9. Ntibazirikana J.B	Kabonero	
10. Nsengiyingi JMV	Kabonero	
11. MBARushimana	Kabonero	
12 MURARA Carien	Somatare	
13. MUNYANSINDA Claude	Somatare	
14. NISHIMWE Elisa	Somatare	

Annex 5: Minutes of consultation meetings and attendance lists in Karongi 12 and Karongi 13 sites

INYANDIKOMVUGO Y'INAMA ITEGURA UMUSHINGA SAIP HAMWE N'ABAFATANYABIKORWA NA KOPERATIVE.

Inama yatangiye Saa Saba n'iminota irindwi (13h07) yitabiriwa n'abahinzi bahagarariye abandi (Abayobozi ba Koperative Kobamuru (Komite nyobozi), abayobozi b'amatsinda.

Uhagarariye umushinga muri iyi nama, MBABAZI Fiona, yatangiye asobanurira abitabiriye inama imiterere y'umushinga SAIP ndetse anabasobanurira ko umwanya nuwuni kugirango basaragaze aho icyuho n'ibindi bibazo bafuza ko byakemurwamo imbaraga kugira ngo barusheho gukora ubuhinzi bw'umwuga ndetse bagahungira icyo.

Ibyifuzo byabahagarariye abahinzi

→ Guko meza kubafasha kubona imyongeramusaruro (imbuto nziza, ifumbire,

→ Gutunganya imihanda iyaza muri site

→ Kubatera inkunga mu gutubura imbuto y'ibirayi muri green house,

→ Ubworozi bw'amatungo magufi kugira ngo abahinzi babone ifumbire yo gukoresha compost.

→ Gufasha abahinzi kubona ishuzaza kuko hari amatsinda/amazu menshi ibarbyizwemo mu gihe amaterasi yakorwaga

→ Ikigega cyihariye cy'ibirayi

→ Gukomeza gutegura amahugurwa n'ingendo shuri ku buhinzi bw'umwuga

(1)

no kwitabwira imbuto zose bakenera (Ibiraji, ibigori, ibishyimbo; ...)

→ Amahugurwa agera kuri benshi (FFP, Gahiriro, i Gasiganwa-tungo n'ibarura mari, no gusobanurira abagore iko indege guguruka iyo eriyo.

Umwanditsi w'inama
Rurangwa Emile

Umuyobozi w'inama
Ishyaka Leopard
President/KOABIMURU

KOPERATIVE Y'ABAHINZI B'IBIRAYI NA RUBENGERA KOABIMURU

(2)

Inyandikomvugo y'inama yo gusobanura iby'umushinga SAIP

Inama yatangiye saa munani n'igice (14h30) yitabiriwa n'abahinzi n'abahagariye abandi (abayobozi ba Kooperative KOABIBIKA (Komite nyobozi), abayobozi b'amazone n'abayobozi b'amatsinda.

Uhagarariye umushinga muri iyi nama, MBABAZI Fiona, yatangiye asobanurira abitabiriye inama imiterere y'umushinga SAIP ndetse anaburira ko umuvuduko munini kugira ngo bagaragaze ahari icyuho n'ibindi bishya bifuza ko byashyirwamo imbaraga kugira ngo barusheho guteza imbere ubuhinzi bw'umwihariko ndetse bagahingira isoko.

~~Ibyo~~ Ibyo abahagarariye abahinzi IBYO UMUSHINGA LWH WAFASHIJE ABAHINZI

- Umushinga wafashije abahinzi kuvuvanya isuri hakoreshwa amaterasi y'indinganire.
- Abahinzi bashima ko umushinga warabafashije kubaka uburambiro bw'imyaka.
- Umushinga watumye abahinzi bunguka ubumenyi bw'ibijyanye n'imihingire igezweho.
- Umushinga LWH wafashije abahinzi kwitabira guhoresha imbuto y'indobanure n'amafumbire (imvaruganda + imborera).
- Umushinga LWH wafashije abahinzi guhinga muri season (season) zose bitewe n'uko yafashije abahinzi kubira imyaka mu gihe cy'imeshi
- Umushinga LWH wakanguriye abahinzi guhoresha inyongeramusaruro kubi nkunganire (Voucher)

IBYIFUZO BY'ABAHINZI KUGIRANGO UMUSARURO WIYONGERE MU BWINSHI NO MU BWIZA

→ Abahinzi bifuza ko bahuzwa na za Banki bakaba bakoroherezwa mu gufata inguzanyo.
→ Abahinzi bifuza ko amazi yuhirizwa yasubukuwa.
→ Gufasha abahinzi bubahonereza isoko ndetse no kubahuza n'abaguzi yaba mu gihugu ndetse no hanze yi'gihugu.
→ kubaka ubushobozi bwa koperative (gushakira koperative abakozi, ...).
→ Abahinzi bifuza ko ~~ubuhinzi~~ buhinzwa ko bwakongerwa.
→ Guhugura abahinzi ko ~~bahugurwa~~ abandi mu byiciro bitandukanye.
→ Guhugura abaturage ku misoro myiza.
→ kongera ibikorwa byifashishwa mu kuhira imyaka (imipira yuhirizwa.
→ Abahinzi bifuza ko ubutaka buvakongerwamo ishwaza ndetse n'imbarera gahunda kongerera ubutaka ubushobozi bwa gutanga umusaruro.
→ kubafasha kubaka agaseke n'ibusanyizo kugirango bite ze imbere kandi bahahire hafi.
→ kubafasha kubaka umuhanda urambye (ubomeye)
→ kubafasha kuboha amatungo ~~abafasha~~ ya kugira nga babashe kubona imbarera anyishi (ihagije).
→ kubaka ubusambiro muri buri zone.

→ kongerera kooperative ubushobozi bwo gucunga no gucunga imyongerera umusaruro

→ Gufasha amahinzi kumenya imiterere y' ubutaka bwabo n' icyakorwa kugira ngo ubutaka butange umusaruro mwiza ushoboka. (Conducting soil test)

→ kongerera abahanzi ubushobozi bwo gufata neza ibikorwa remezo byifashishwa mu buhinzi.

Umwanditsi :
BATUMANYETHO Gilbert

Umuyobozi w' INAMA :
GASHYEKERO Pascal
President / KOABIBIKA

KOPERATIVE Y'ABAHINZI B'ISHYIGO
KOABIBIKA
KARONGI

URUTONDE RW'ABITABIRIYE INAMA KU KUNGURANA IBITEKEREZO KU MUSHINGA WA SAIP

SITE: KARONGI-12 & KARONGI-13

Date: 2/3/2018

Nº	AMAZINA	UMURENGE	IGITSINA	UMUKONO
1	SIOMZABAKIIRA Innocent	RUBENGERA	M	
2	HARERIMANA Cyprien	RUBENGERA	M	
3	Sibomana Théogene	Rubengera	M	
4	Ntamuhanga Valens	Rubengera	M	
5	NGIRABIJE Damien	Rubengera	M	
6	KAGENA Potothis	Rubengera	M	
7	KABARE Bonaventure	Rubengera	M	
8	Umubamukiza Donatila	Rubengera	F	
9	Mubafidele yassefa	Rubengera Rukabano	F	
10	NIKOBAREMYE Jean	RUBENGERA	M	
11	KARINGARIRE JAPHET	GASETE Rubengera	M	
12	Simbibabubwabo	Rubengera	M	
13	KAYITESE XAVIO	Rubengera	M	
14	NTIRUMUSHA Michel	RUBENGERA	M	
15	Kabanyana Espérance	Rubabano	F	
16	Mukansonera Aterena	Rubengera	F	

URUTONDE RW'ABITABIRIYE INAMA KU KUNGURANA IBITEKEREZO KU MUSHINGA WA SAIP

SITE: KARONGI-12 & KARONGI-13

Date: 2/3/2018

Nº	AMAZINA	UMURENGE	IGITSINA, Umuda	UMUKONO
1	BWIRIKA Anastase	RUGABANO	IGUZUZO (M)	
2	Uwayisaba. Narcisse.	Rugabano	Dufatanye (M)	
3	Uwiyabo. Patricie.	Rugabano.	Twitabirumuri (F)	
4	Ntaba Anastase	Rugabano	Ngerimoubeke (M)	
5	Umuhoza Emile	Rugabano	Kurwanyeinzara (M)	
6	HAKIZIMANA Eric	RUBENGERA	Manazabiza (M)	
7	SENYENZI Appolinaire	RUGABANO	TWITABIRUMURIMO (M)	
8	DUSABIMANA Iliane	RUBENGERA	MANA ZABIZU (F)	
9	NYIRAHABUGUJE odette	RUBENGERA	11 11 (F)	
10	MUKAKARIGA Delajiya	RUBENGERA	MANA ZABIZU (F)	
11	Rwasisokeraphie	Rubengera	Rukingu (M)	
12	Yakujijemariroze	Rubengera	Manazabizu (F)	
13	Mukansonera Herena	Rubengera	Manazabizu (F)	
14	Kabanyana Siperansi	Rugabano	Nguinureba (F)	
15	ARobamperezeEM.V	Rugabano	iGuzuzo Gabo	
16	Simbisinamukaolivie	Rugabano	M	

URUTONDE RW'ABITABIRIYE INAMA KU KUNGURANA IBITEKEREZO KU MUSHINGA WA SAIP

SITE: KARONGI-12 & KARONGI-13

Date: 2/3/2018

Nº	AMAZINA	UMURENGE	IGITSINA	UMUKONO
1	Hakizimana Amositosi	Rubengera	G	
2	Mukamugema Rufsim	Rubengera	F	
3	Mukeshimana Jeniem	Rubengera	F	
4	Ndikumana Eliosi	Rubengera	G	
5	Bavugayumva Frederk.	Rubengera	G	
6	Ntamwemezi Narisisi	Rugabano	G	
7	Mushimwaga Siperasi	Rubengera	F	
8	Mukakabera Ariverna	Rugabano	F	
9	Nyirabutokagurwa Kollerine	Rubengera	F	
10	Ndindabahizi Jacques	Rubengera	M	
11	Sindihabulesabo	Mudemeza Rubengera	M	
12	Karinganiye Japolo	Gatsibo Rubengera	M	
13			G	
14	Hakuzimana Claude	Rubengera	G	
15	Rwasibo Theophile	Rubengera	M	
16	Yakiyo Jemaricota	Rubengera	F	

URUTONDE RW'ABITABIRIYE INAMA KU KUNGURANA IBITEKEREZO KU MUSHINGA WA SAIP

SITE: KARONGI-12 & KARONGI-13

Date: 2/3/2018

Nº	AMAZINA	UMURENGE	IGITSINA, Itsindo	UMUKONO
1	Nshimyimana Edouard	Rubengera	Umugabo	
2	Niyonzeza Apolinari	Rubengera	Umugabo	
3	Mukakarera Vestina	Rubengera	Umugore / F	
4	Mukashakiana Sipesiyaza	Rubengera	Umugore / F	
5	Nsengimana Sarafina	Rubengera	Umugore / F	
6	Niyabucye je Danciléé	Rugabano	Umwanyinzira	
7	BUSHIMANA Félicien	Rubengera	Umunyange M	
8	Gashegheru pascal	Rugabano	Umwanyinzira M	
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URUTONDE RW'ABITABIRIYE INAMA KU KUNGURANA IBITEKEREZO KU MUSHINGA WA SAIP

SITE: KARONGI-12 & KARONGI-13

Date: 2/3/2018

Nº	AMAZINA	UMURENGE	IGITSINA	UMUKONO
1	NYAKABEMYE Wenceslas	MUKURA	M	
2	[illegible] DANIEL	MUKURA	M	
3	HABIMEZA I. d'Amour	Mukura	M	
4	NGEZAHAYO Evariste	Rubengera	M	
5	GAKWEREZE André	MUKURA	M	
6	NYABYENDA Théoneste	MukuRA	M	
7	NTIBITONDERWA Sincérigha	MukuRA	F	
8	MBAHUNGIREHE Manassé	MukuRA	F	
9	NIYEMUKAGA Théogène	MUKURA	M	2/3/2018
10	BAMEGEYE Bamfinida	MukuRA	F	
11	NZABONIMPA Célestin	MUKURA	M	
12	Sibabagingo ANastasia	MUKURA	F	
13	Rurihose Pascasie	Mukura	F	
14	BAVUGIRIJE Jean	MUKURA	M	
15	UWINEZA Appoline	Rubengera	F	
16	SEBURYAUNAS- THÉOGÈNE	MUKURA	M	

URUTONDE RW'ABITABIRIYE INAMA KU KUNGURANA IBITEKEREZO KU MUSHINGA WA SAIP

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Date: 2/3/2018

Nº	AMAZINA	UMURENGE	IGITSINA	UMUKONO
1	ISHYAKA Léopold	MUKURA	M.	
2	BIZIMUNGU Emmanuel	MUKURA	M	
3	AKUMUNTU Yesimbe	MUKURA	F	
4	Simajiyamumuke Agnès	mukura	M	
5	Mukakayumba Tamazimpaka	Mukura	F	
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