AGRIBUSINESS INVESTMENTS, POST-HARVEST LOSSES AND GENDER DIFFERENCES IN PRODUCTIVITY: EVIDENCE FROM MAIZE AND BEANS VALUE CHAINS IN NYAGATARE DISTRICT, RWANDA

FINAL REPORT

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ABBREVIATIONS AND ACRONYMS

AFPHLIS: African Post Harvest Losses Information System

AFRICRES: African Investment in Climate Research

ASAP: Adaptation for Smallholder Agriculture Program

AVC: Average Variable Cost

BDF: Business Development Fund

6 BP: Business Plan

CAADP: Commercial African Agricultural Development Program

CB: Commercial Bank

CIP: Crop Intensification Program

DC: Developed Countries

DF: Drying Facility

EDPRS: Economic Development and Poverty Reduction Strategy

EU: European Union

FAO: Food and Agriculture Organization

FC: Farmers' Cooperative

FDI: Foreign Direct Investment

FGD: Focus Group Discussion

GDP: Gross Domestic Product

GoR: Government of Rwanda

HH: House Hold

ICT: Information and Communication Technology

IDI: In-Depth Interview

IFAD: International Fund for Agricultural Development

IFPRI: International Food Policy Research Institute

KII: Key Informant Interview

LAC: Latin American Countries

LDC: Less Developed Country

MDP: Master's in Development Program

MFB: Micro-Finance Bank

MFI: Micro-Finance Institution

MINAGRI: Ministry of Agriculture and Animal Resources

MMSG: Mixed Micro-Savings Group

MTR: Medium Term Review

NAPA: National Adaptation Plan of Action

NISR: National Institute of Statistics Rwanda

NSCCLCD: National Strategy for Climate Change and Low-Carbon Development

PASP: Post-Harvest Agribusiness Support Program

PHHTF: Post-Harvest Handling Task Force

PHI: Post Harvest Infrastructure

PHLs: Post Harvest Losses

PPP: Purchasing Power Parity

PPP: Public-Private-Partnership

PSTA: Strategic Planfor the Transformation of Agriculture

RAB: Rwanda Agriculture Board

RCA: Rwandan Cooperative Agency

REMA: Rwandan Emergency Management Agency

RTDA: Rwandan Transport Development Authority

RYAF: Rwandan Youth in Agriculture Forum

RWF: Rwandan Francs

SACCO: Savings Cooperative and Credit Organization

SD: Sustainable Development

SEA: South East Asia

SF: Storage Facility

SHG: Self-Help Group

SWOT: Strength, Weakness, Opportunities, and Threat

TFP: Total Factor Productivity

TVC: Total Variable Cost

WB: World Bank

EXECUTIVE SUMMARY

Rwanda is a rural, agrarian country of about 13million people. In the past two decades, it has made steady progress in economic development becoming, in the process, one of the symbolic narratives of accelerated economic growth in Africa. Emerging from the short but devastating inter-tribal conflict of the 90s, its governance praxis has been carefully defined along policy actions targeted at driving growth and reducing poverty. Since overwhelming majority of Rwandan poor depends on agriculture to generate income, the sector has been prioritized by government to champion the country's post-genocide development vision. Programs and projects targeting elevated production and commercialization of crop products have become central to government's rural poverty efforts. From 2007, Rwanda has been implementing a series of productionist policies beginning with the Crop Intensification Program (CIP). CIP objectives, amongst others, include the delivery of higher volumes of crop products to boost domestic consumption and HH income generation. While the program raised production levels, existing PHI developed for the traditional cropping system became grossly inadequate to cope with the demand of product surplus. The resulting post-harvest handling and storage gaps coupled with climate variability encouraged large-scale PHL. Besides, private sector investment trend in agribusiness operations was markedly low limiting the growth of the product market often resulting in massive stock buildup to further aggravate PHL

To fully realize sector development goals, reduction of PHL, promotion of agribusiness investments and commercialization of crop products were recognized as triad of a new transformation investment in Rwandan agriculture.

As part of efforts to create a trajectory of definite impact and provide additional investment instrument for and with the GoR, IFAD implemented a 5-year booster project christened **Climate Resilient Postharvest and Agribusiness Support Program (PASP)** to promote developments in modern post-harvest technologies, generate reductions in PHL and increase farmers' and farm wage-workers' incomes.

The current study responds to the imperative of assessing project performance in maize and beans value chains in Nyagatare District of the country using project evaluation metrics. Study objectives include, assessing the current magnitude of PHL and their gender distribution, identifying the socio-economic factors undergirding gender-based productivity differences,

carefully elucidating the effects of agribusiness investments on PHL and determining extant marketing channels and their impact on smallholder's incomes.

PASP worked with a total of 22 cooperatives in the district with a cumulative population of 2991. Farmers in the study were pre-qualified by ownership and land size. Those who co-owned plots with wives, husbands or friends were excluded bringing the total eligible population to 2794 from where an uprated sample of 300 farmers was taken through stratified random sampling technique. Primary data was thereafter collected using semi-structured questionnaires. During the four-week survey, enumeration was successfully completed for 272 out of the 300 sampled farmers giving a response rate of 90.6%. 5 FGDs were conducted with a total of 50 participants in attendance. In-depth and Key Informant Interviews (IDI & KII) were held with frontline project staff, management of selected cooperatives and BDF- housing PASP ASAP grant, while representatives of Rwandan Women Network (RWN), Mimuli branch, and the President of the Rwandan Youth in Agribusiness Forum (RYAF) gave useful information on the state of gender and youth involvement in agriculture respectively.

Results on farmers' demographics showed that there were more women farmers (60.7%) in the district than men (39.3%). Mean age of respondents was 44.4 years. Difference between age and gender was significant at $p<0.05$.Adult literacy favoured women (77.5%) than men (22.5%) and was statistically significant at $p<0.05$ (p-0.039). A greater proportion of respondents belonged to the productive age group 31-46 years while arable land cultivation by most farmers fell in the range 0.5-1.0ha (36.8%).

On PHL, findings indicated that PHL were general in nature reported by 86.7% of farmers. The losses were predominantly on-farm (81.5%) arising from prolonged drought (59.3%). There were statistically significant differences in the pattern of PHL between male and female farmers at $p<0.05$ (p-0.026). In absolute terms, women (137) lost more products than men (98) in the season under review. Cross-gender analysis however showed that the percentage of men who experienced product loss was higher (92.5%) than women (83.0%).This loss pattern was underlined by several important factors including differences in literacy, PHI adoption habits as well as type and quality of field support services received under the project. Similarly, PHL differed in character and magnitude both within and among sectors.

Study identified growing use of agro-inputs, higher densities of storage and drying facilities and increasing adoption of modern PH technology (59.0%) causing substantial reduction of

infrastructure-related losses (4.7%). The use of agro-inputs has increased appreciably with fertilizer application rising by 127% among rural farmers in the district. Fertilizer-yield correlation was statistically significant at $p<0.01$. Access to rural financial services witnessed a leap from <3% pre-project to 67.0% at the time of this evaluation. Study however notes that project-sponsored financial intermediation through **BDF** was not working in the district. Access to the fund was dismal at only 4.5%. The TFP for the district was estimated at 0.1% in the ratio 0.04 and 0.06, male and female farmers respectively. Huge economic loss of **568, 341.24 Rwf** per farmer, triggered by massive drought, generates new compelling evidence for intensified actions on climate-smart agriculture

In spite of the virtual non-performance of BDF in the district, PASP has successfully widened the trading space for farmers giving a higher level of commercial orientation to agricultural practice. Jointly and severally, it has promoted both horizontal and vertical value chain coordination in product marketing. Overall, more than 90% of substantive crop harvest was sold in the last planting season against 27% pre-project. Cooperatives' economic rent, and by implications, smallholders' income grew by 162%. The summation of these achievements has reduced both social and economic vulnerabilities in rural HHs, enhanced food security nationally (except among refugees and areas affected by drought in the country) and guaranteed better livelihood for smallhoder farmers. The changing socio-economic levels of Rwandan poor brought about by the beneficence of programs like PASP, have helped reshape Ubudehe model of poverty categorization from the previous six to four categories currently

Based on the Project Success Scorecard (PSS) of 76.8%, the study concludes that the project has evolved meaningfully towards its goal and objectives and rates its performance excellent in the various domains of assessment while admitting the need for continuous situational adjustment of policy responses in certain areas and a new set of initiatives in the other. Recommended areas of policy interventions are as follows: 1) Rethink of water harvesting system and technology. 2) Crop insurance policy to indemnify farmers in drought-prone areas. 3). Resumption of interest rate subsidy for agriculture sector. 4) Review of BDF operational guidelines to accommodate selective equity waiver. 5) Youth empowerment through guided land acquisition. 6) Development of rural infrastructure particularly roads to complement ongoing $96million World Bank-financed “road revolution” in the country

CHAPTER ONE
INTRODUCTION

Agriculture and development are intricately linked. Contemporary development history has shown that early industrialized countries achieved rapid economic productivity by deepening their agricultural production base. The nexus between economic growth originating in agriculture and poverty reduction is more evident in Africa where the bulk of the rural populace depends on the sector both for food and income. Current evidence shows that growth in agriculture is at least two to four times more effective in reducing poverty and eliminating hunger than other sectors. In Sub-Saharan Africa (SSA), the direct contribution of agriculture to GDP is estimated at 34% (Calestous, 2010).

As the surge of urbanization unfolds in Africa and a few other countries in the Global South (UN, 2008), challenges of food security are emerging while the ability of agriculture to contribute to the absorptive capacity of national economies, enhance food sufficiency, generate employment and address the looming shift in poverty from rural to urban areas (Ruel, et al, 2017) is degenerating. With the likelihood that the proportion of the global population not producing food will continue to grow, ensuring efficiency in the agriculture sector by all countries to meet growing and changing demands for food products has become a matter of urgent imperative (Satterthwaite,2010). However, in many African countries, the result-delivery capacity of the sector remains weak being plagued by many deficiencies

Agricultural practice in Africa is mostly subsistence in nature built on local farmers using simple tools. Despite the fertile ecosystem, food production continues to lag behind food demand. Besides, yield trends for staple crops in SSA are showing signs of climate change impacts (Olayide, 2017).The falling yield rates are deeply compounded by loss of crop products occurring during and after harvest in the farm. These Post Harvest Losses (PHL) are recognized as a major cause of inefficiency in SSA agriculture and eliminating them is not just a way of increasing food availability but also a resource-efficient means of increasing food supply without additional cost or environmental burden. Since the 1974 World Food Conference in Rome and the declarative UN Resolution 271 calling on all countries to reduce PHL by 50%, no visible

progress was made until the 2008-2011 global food price hikes which brought back the issue of PHL into the forefront of global policy debate (Mark, et al.).As countries grapple with the many factors hindering capacity utilization of productive resources, more attention is required now, more than ever before, to evolve innovative approaches that build inter-sectoral synergy towards ensuring that the limited crop yields coming out of African farms, receive effective post-harvest care in the pursuit of both national and global food security. Moreover, the growing awareness that African agriculture can only attain global competitiveness if national governments promote equitable gender participation and put in place a framework of value chain growth and development through effective private sector mobilization policies, has led to greater efforts in the promotion of agribusinesses at both primary, secondary and tertiary levels. These efforts are being complemented by concrete youth and gender targeting that aims to take advantage of the creative energy of youths and mainstream women as vital agents of agricultural development.

1.1 Statement of the Problem

Agriculture is vital to the wealth and national pride of Rwanda. Over 65% of its populace live and thrive on agriculture while more than 70% of the country's foreign exchange earnings come from the sector. In macroeconomic terms, agriculture contributes 31% to the GDP of the country from its rich stock of staple and cash crops (NISR, 2017). It is therefore expected that given this impressive profile, the sector would play a pivotal role in the nation's economic development plans and also become one of the most patronized sectors in Rwanda by international development partners. Notwithstanding this premium value, evidence is few and far between to show that the sector's historical constraints are significantly giving way.

Like most other African countries, agriculture in Rwanda is predominantly rainfed and vulnerable to seasonal changes in climate with far-reaching implications at both production and postharvest management levels (PASP,2013). With scarce land and low input use, aggregate yield is unsurprisingly low. The low yield is further worsened by losses occasioned by inadequate postharvest handling practices. Many smallholder farmers in SSA rely on traditional methods of handling and preserving their crop products after harvest. These methods have included, head-load carrying practices, open drying by the road side, on roof tops, concrete platforms and the use of rudimentary holding devices like sacs loaded with cow dung ash, roofed

iron drums sealed with mud, wooden cribs and many more for storage purposes(Wambugu, 2009). Each and every of these rudimentary post-harvest practices is associated with varying degrees of product loss arising either from wind, rain or avoidable attacks from pests and diseases. However, important as these are in the etiology of in-country PHL, unpredictable changes in the climate system are beginning to cause a scale of product loss well beyond the capacity of national governments to evolve appropriate prevention and control measures.

PHL are world-wide in nature and exert a huge toll on planet's resources including fresh water resources, crop land and biodiversity (Kummu et al, 2012). More specifically, PHL are a major source of inefficiency in Rwandan agriculture requiring a set of integrated and innovative measures to secure sustainable food production and consumption. Like elsewhere, loss of crop products in the country lend themselves to conflicting claims arising from the general lack of consensual global modeling data. In spite of the raging divergence, there are figures in the literature to give proximate pictures of both the national and provincial burdens of the problem. Records from the African Post-Harvest Losses Information System (AFPHLIS)-authoritative body that tracks loss trend in grain crops in East and Southern Africa, put the aggregate annual loss at 10-20% for cereal crops for all countries covered. On the other hand, the World Bank in a 2011 report stated that PHL in SSA was between 20% 40%. According to other investigators, PHL in cereal crops may be as high as 50% and 100% for pulses (Obeng-Ofori, 2012). Among perishables, independent government sources in Rwanda rate PHL at 50% against 30% among other food crops. From the Post-Harvest Handling Task Force of the Ministry of Agriculture and Animal Resources, annual post-harvest crop loss was reckoned at only 18% (PHHTF, 2018), well above the government ultimate PHL target of 5%. Altogether, the conflicting figures essentially underscore existing empiric discordance in the measurement of PHL and the challenges of developing effective and inclusive mitigation strategies. PHL lie at a certain intersection of crisis in its unresolved form. It stands at the root of smallholder farmers' poverty in Africa and often trigger a deadly cascade of food security problems, widespread hunger, malnutrition and environmental impairment. In a continent riddled with desperate and fierce competition for resources, the consequences of PHL have not infrequently manifested in the form of generating crude impulses for both social and political conflicts. Developing and strengthening capacities in agricultural innovations have thus become the primary obligation of

many donor agencies working in SSA post-conflict states so as to address emerging food security threats and facilitate employment generation necessary to reduce the derive to new cycles of conflicts (FARA, 2012)

Agribusiness investments hold the key to the global competitiveness of African agriculture. Even though there has been a steady inflow of FDI, the level of participation of local investors in the agriculture sector is low and needs to be strengthened through various policy measures. A 2008 estimate by the Organization for Economic Cooperation and Development put the level of participation by domestic investors at a paltry 18.5% (Nomathemba). In Rwanda, despite a growing SME subsector, agribusiness investments at the level of industrial consumption of crop products have been less pronounced. Until very recently, Africa Improved Food was the only large-scale agro-food processor in the country consequently reducing market capacity to absorb products from the crop intensification program. The poverty of many smallholder farmers in SSA derives from this singular lack of sufficient market space for product uptake.

The centrality of PHL to the concepts of agribusiness investment, rural women empowerment and marketing, calls for conscious country-level efforts at building an integrated package of solutions that reflects the significant contributions of each concept to the problem of and solutions to PHL. In this regard, a clear-headed reduction strategy must follow the path of rigorous process of systematic analysis involving detailed understanding of product flow in the value chain as a preliminary step towards identifying applicable context-specific reduction strategies (Kiaya, 2014). It is often at this level that clear choices are made between the types, levels and costs of monetary and non-monetary investments required to mitigate the problem and the dangers of doing nothing. Over the years, the Government of Rwanda has adopted a multi-pronged solution approach by implementing a number of liberal and national mobilization policy measures to enhance crop production and value chain development. An integral part of the measures is to broaden the scope of private sector involvement in agriculture through a well-programmed process of institutional remodeling that takes maximum advantage of private wealth. With women dominating the staple food crop production and primary processing units in Africa, their long term exclusion from the policy formulation domains has affected the capacity of national agricultural programs to harvest the highest possible returns. Gender action plans

creating a climate of engagement that enables women to articulate their needs in the policy development arena has become a component of the radical paradigm of agricultural transformation pathways currently gaining momentum in contemporary Africa. This progressive feminization of agriculture has become evident and it's being actively promoted in Rwanda through affirmative gender policies of government as well as activities of many donor agencies.

1.2 Objectives of the Study

MAIN OBJECTIVE: Assess the contributions of PASP to the reduction of post-harvest losses and improvement in smallholder farmers' income

SPECIFIC OBJECTIVES

1. Determine the current magnitude of postharvest losses against stated PASP targets for supported crops and assess the pattern of gender distribution
2. Examine the relationship between agribusiness investments and postharvest losses
3. Highlight the socioeconomic factors underpinning differences in productivity and income between male and female farmers
4. Identify marketing channels, associated characteristics and implications for smallholder income**.**

1.3 Justification for the Study

The Climate Resilient Post-Harvest and Agribusiness Support Project **(PASP)** was launched on March 28, 2014, to support the efforts of the government of Rwanda to reduce rural poverty through guided development in the agriculture sector. The project has run for over four years during which many activities have been implemented at enormous costs. Though, a number of assessment studies such as market analysis study, mid-term evaluation report, have been commissioned to look at specific project areas, the need for pre-closure evaluation to determine the level of returns from project investment justifies this study. This is more even so considering the proposed low-cost extension of the project slated for February 2019. In the same vein, many areas of PHL, agribusiness investments, marketing and distribution as well as agricultural productivity have been studied and documented in the literature by scholars like Buzby, Hodges, Faye, Nomathemba, Olayide et al. Very few, if any, have given a sufficiently strong focus to the gender dimensions of the issues in different but related settings. The current PASP project offers a special opportunity to study the characteristics of PHL from gender perspectives in the context of these varying parameters. With evident scarcity of gender data on the district agriculture, this

study is set to fill the gap by providing the first district-level gender and productivity data that will add to existing stock of scientific knowledge and promote the course of further studies.

1.4 Scope of the Study

The PASP project is built around a series of objectives, activities and entities. This study took an intent look at key project areas in PHL, agribusiness investments, gender issues, socio-economic factors underlying differences in gender-based productivity and the impacts of current marketing channels on smallholders' income. On PHL, the study limited itself to looking at the magnitude, causes, gender distribution and solutions. It examined the nexus between agribusiness investments and PHL in the broad context of investments in postharvest infrastructure and related contingencies. It excluded agro-processing in the significant sense of value chain growth. Socio-economic factors underlying differences in productivity between male and female farmers were limited to studying the aggregate of variable costs as identified in the enabling field instrument while the study's key interests in product marketing was to look at changing trend from direct value chain to the aggregator role of cooperatives and the impact of vertical and horizontal value chain coordination on sales and revenue. The mechanisms of price determination and other governance issues in supply chain were excluded.

CHAPTER TWO

BACKGROUND TO THE STUDY

2.1 National Project Context/Situational Analysis

Rwanda is a rural, agrarian country with about 35% of the population engaged in subsistence farming. It's a nation of dual colonial heritage having been run at different points in history by Belgian and French colonial administrators. It comprises two major tribes: Tutsis (15%) and Hutu majority (85%). Rwanda is bordered in the east by the far larger and richer DRC, as well as its closest East African neighbours, Tanzania to the west, Uganda to the north and Burundi in its southern borders. It has a population of 13million people spread over a total arable land of 1.4million hectares making it the most densely populated country in Africa. The large-scale brutalization of society occasioned by the civil war between its competing tribes in 1994 destroyed Rwanda's fragile economic base, drastically impoverished the population involving mostly women, and put on hold the country's ability to attract private and external investments.

In the past two decades however, Rwanda has changed the narratives making steady progress in economic development to become one of the African revelations of the century. Emerging from the grueling genocide experience of the 90s, its governance praxis has been defined by deliberate policy actions targeted at driving growth and reducing poverty through far-reaching economic and structural reforms (WB, 2016).The country's long-term development goals are captured in **Vision 2020** which seeks a phased transformation of the economy from a low income, agriculture-based economy to a knowledge-based, service-oriented economy with middle-income country status by 2020. The vision is driven by a medium-term strategy-the second **Economic Development and Poverty Reduction Strategy 2(EDPRS 2)**which outlines the main goal of growth acceleration and poverty reduction through five interdependent thematic areas: 1) economic transformation characterized by diversification and marked export orientation, 2) rural development including modernization of agriculture, environment and climate change, 3) private sector development, competitiveness and service delivery, 4) productivity and youth employment, and 5) accountable governance. The key objectives of EDPRS 2 are to: raise GDP per capita from $250 to $1,000 ($702.16 as of 2016); reduce the percentage of population leaving below the poverty line to less than 30% and reduce the percentage of the population living in extreme poverty to less than 9%.

Since overwhelming majority of Rwandan poor depends on agriculture to generate income, it makes perfect sense on the part of government to prioritize the sector as a vital tool to champion the country's post-genocide development vision. Programs and projects targeting elevated production and commercialization of crop products have become central to government's effort at reducing rural poverty. Beginning from 2007, the country has been implementing a series of productionist policies with the introduction of the **Crop Intensification Program (CIP).** The program embraces land use consolidation, enhancement of input use, provision of advisory services and improvement in post-harvest handling and storage facilities with a view to delivering higher volumes of crop products to boost domestic consumption and HH income. While CIP raised production levels and attained other concurrent objectives, existing post-harvest infrastructure developed for the traditional cropping system became grossly inadequate to cope with the demand of product surplus. Aside this, changes in the climate system brought about a situation whereby harvest began to take place in the wetter months of the year thus complicating the process of drying of crop products needed to meet specified moisture content. These post-harvest handling and storage gaps coupled with climate variability have exerted heavy tolls on crop commodity losses the magnitude of which is rated between 30-50% in the country depending on crop groups and production areas. Achieving government overall PHL target of 5% inevitably calls for new sector-wide initiatives.

Likewise, extensive destruction of public infrastructure following the genocide experience, pervasive energy shortages, frequent political instability in neighboring states and lack of adequate transportation linkages have played prominent roles to hamper private sector development in the country. As a result, organized businesses that are crucial to crop production and distribution have only started coming up while agro-processors which could feed on the larger volumes of crop commodities from the CIP to reduce shell life and minimize PHL are similarly just emerging. This low private sector mobilization in agribusiness operations has limited the growth of the product market such that in the face of storage constraints, smallholders have to contend with the challenges of unsold inventories and widespread product losses. Moreover, despite the large number of women farmers in the country, their contributions to the development of agriculture have been marginal. They face a series of handicaps with higher

vulnerability to economic and climatic shocks. They are most likely to have low schooling, poor technical skill, poor access to input and operate with little or no savings. Within this gender bracket, labour efficiency is low as they are mostly consigned to the low-input, low-output end of the production gradient leading to unequal utilization of available human capital to drive overall process of national development. The precarious state of women farmers in Rwanda provides the context for interventions that increase their access to social and economic power. Therefore, to fully realize government policy objectives for the sector, reduction of PHL, promotion of agribusiness investments and commercialization of crop products within defined gender boundaries were recognized as triad of the new transformation investments in Rwandan agriculture.`

The foregoing provides a capsule summary of the strengths and challenges of agricultural development program in Rwanda within the broad context of smallholder farming and the potential points of partnership between government and international aid agencies. As part of efforts to create a trajectory of definite impact and provide a platform of resourceful partnership with the GoR, IFAD implemented a 5-year booster project christened **Climate Resilient Postharvest and Agribusiness Support Program (PASP)** to promote investments in post-harvest procedures, generate reductions in PHL and increase farmers' and farm wage-workers' incomes. The Strategic Plan for the Transformation of Agriculture III **(PSTA III)** is the current policy framework that gives direction and spells out the broad steps and measures necessary to achieve sector development goals. Under PSTA III, government commits to promote rural development, modernize agriculture through wider application of modern technology, boost agricultural productivity and facilitate youth and women employment. Through the growth mindset of the nation's political leaders, Rwanda continues to post stunning economic performances and is currently rated 144th globally on nominal GDP and 136th by PPP. Annual growth rate averages 5.9% while the percentage of the poor has dropped from 57% in 2005 to 44.9% in 2016. Current GDP per capita is estimated at $702.16, a near 200% rise in its pre-reform value of $250. Unsurprisingly, all these achievements have changed the overall national social context and by 2015, Rwanda was among one of the few African countries that met most of the MDGs. Strong economic growth was accompanied by substantial improvements in living standards, with a two-thirds drop in child mortality and near-universal basic school enrollment.

Furthermore, the review of the PSTA II and the first Rwanda Comprehensive Africa Agricultural Development Program (CAADP) Compact shows that the agriculture sector is responsible for almost 50% of the total poverty reduction of 12% point from 2008-2012 (IPAR, 2015). This result provides proofs of what is possible and what more can be achieved in poverty reduction through rigorous and resolute implementation of sector-specific programs.

2.2 Background Project Information:

2.2.1 Project Goal:

Alleviate poverty, increase rural income and contribute to the overall economic development of Rwanda.

2.2.2 Projective Development Objectives

1. Facilitation of inclusive business activities that can thrive on increased agricultural production from CIP products
2. Promote investments in improved post-harvest procedures
3. Generate reductions in product losses and increase farmers and farm wage-worker incomes

2.2.3 Project Description

Aligning with government policy framework and the national Agriculture Sector Investment Program (ASIP), PASP project formulation reflects the need to support the rural poverty reduction efforts of government through phased, incremental capacity building of smallholder farmers and strategic value chain market mapping which enable them to grow more, generate surpluses and draw larger share of added value. Project activities are concentrated around a set of smallholder farmers sharing common poverty characteristics as determined by Ubudehe rating- an in-country poverty classification model. Similarly, out of the six CIP crops, only four are currently being supported: maize, beans, cassava and Irish potato. Criteria for selection of project crops were identified to include: 1) competitiveness, including potential domestic and regional demand, 2) potential to reach a broad spectrum of the poor through the number participating in the value chain as well as the potential to raise rural income 3) alignment with government and aid agencies strategies and programs 4) potential to increase HH food security, women's income and economic inclusion of the rural poor. The socio-economic profile of Eastern Province ((one of the three PASP intervention provinces) to which the study area belongs is as shown in table 1

Table 1: Socio-economic profile of Eastern Province supported by PASP

Indices	**Estimate/Number**
Estimated population	1,307, 000
Population in project poverty category	90%
Household headed by most vulnerable	37%
Number of HUBs	70
Number of HH per HUB	150
Number of HH participating in project	11,340
Number of people benefiting in project	54,430
Families in CATs 2, 3 and 4	10,200
Number of poor people	48,960

Source: MINAGRI CIP crop areas (2011-2012), EICV3 and Ubudehe data by districts

Programmatically, PASP operates a multi-level implementation framework made up of three mutually reinforcing components. Each project level or component feeds directly into the other in an output-input model. All projects activities are outsourced and anchored by accredited Service Providers and delivered through the agency of farmers' cooperatives which are called HUBs. A HUB is a one-stop business outfit which brings together a vast array of integrated services run by different economic actors made up of producers, agro-dealers, buyers, traders and financial services providers. Through its three dissemination pathways, the project offers a bridgehead intervention package designed to create a regular and continuous interaction between smallholders on the one hand and industry players on the other hand.

Component 1: HUB Capacity Development and Business Coaching is specifically targeted at helping farmers in cooperative groups to identify their capacity deficiencies and develop a gap action plan that effectively addresses them. It involves training them in crucial areas such as financial and business management, development of business plans, product cost determination, acquisition and management of post-harvest infrastructures etc. This project component is expected to generate a new corps of enlightened smallholder farmers who have a clearer understanding of what they need to address their production and storage challenges, determine

product cost, understand the fundamental prerequisites of effective post-harvest care and be able to access fund through the development of demand-driven, market-oriented bankable proposals (BPs) that lead to both production and marketable surpluses

Component 2: Post-harvest and Agribusiness Support Program (PASP): Constitutes the centerpiece of project intervention. It draws input from the viable BPs delivered by component 1 to facilitate agribusiness investments that leverage the resultant large volume of crop production emanating from it (component 1). Depending on product value chain, these investments could range from building a modern drying facility, acquiring grading equipment, procuring transportation truck to setting up a processing outfit. PASP primarily role under this component is to facilitate linkages to sources of fund to finance different BPs as well as promoting trade alliances in both domestic and regional markets. A special **Business Development Fund** under ASAP is reserved to assist HUBs willing to invest in low-carbon development pathways involving either post-harvest equipment, infrastructure and/or climate resilient buildings. This fund is managed by the Rwandan Development Bank under a special **Credit Guarantee Scheme.**

Component 3: Project Management and Coordination: is the project harmonization arm which ensures that all activities are efficiently and effectively run to achieve expected results.

Key assumptions: Key assumptions underlying attainment of project deliverables include: 1) Government policy and operational commitment to agriculture and SMEs remain in place during the project life 2) Stable macroeconomic environment most importantly, export prices. 3) Domestic political stability. 4) Continued government commitment to promoting PASP value chains

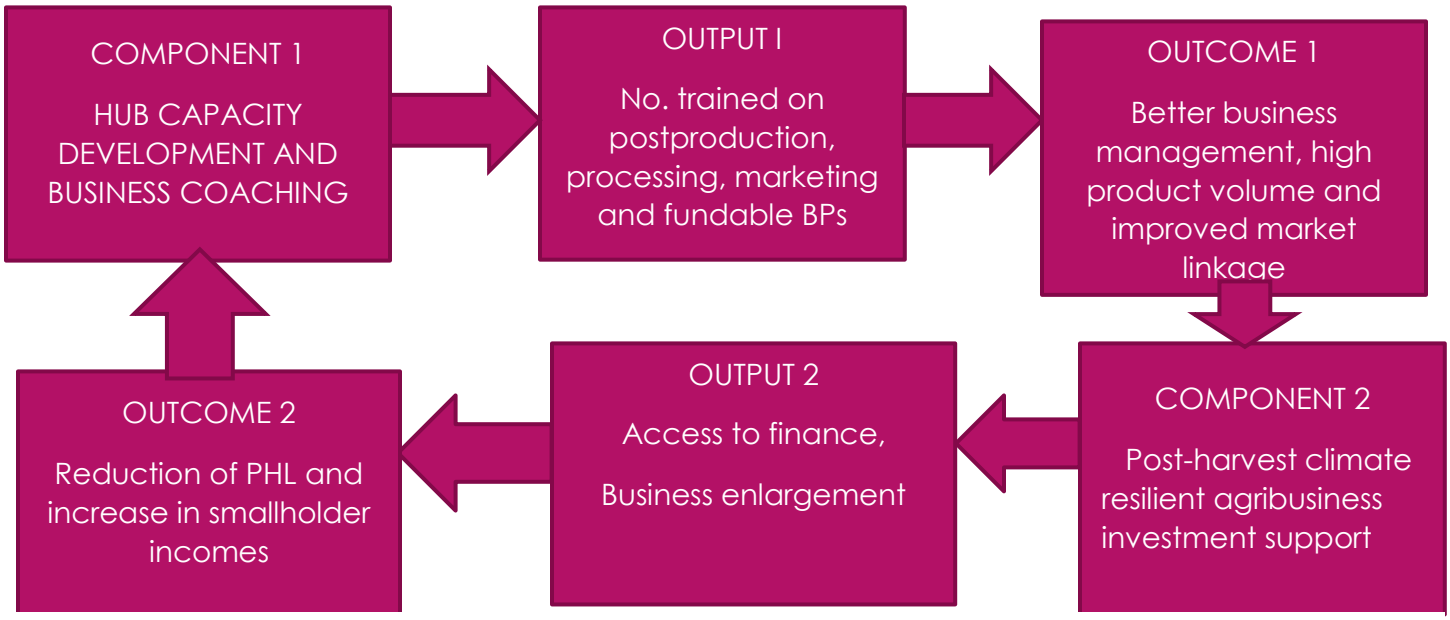

Figure 1: EMPIRICAL PROJECT MODEL

2.3.1 Production Trend

In Rwanda, maize and beans are important both for human and animal consumption and have been recognized as priority staple crops under the National CIP. Like most parts of Africa, they have continued to impact national economy in many and different ways. Both crops are important subsistence crops for smallholder farmers and are widely grown, commonly consumed and regularly used for other purposes in the country. Maize is the third largest crop commodity in the country in terms of land area planted and is cultivated in both seasons and diverse agro bioclimatic regions. According to the 2013 seasonal agricultural survey, Season A accounts for the majority of maize and beans production in the country (Figure 3). During this period, maize share of cultivated land is around 11.9% whilst beans takes about 27%. In Season B, lower percentages of land are taken up by both crops with 5.5% for maize and 17.4% for beans. Yield trends across seasons show an average crop production of 1.87kg/ha and 0.881kg/ha for maize and beans respectively. The 2011 Integrated Living Standard Measurement (ILSM, 2011), estimated that 75% and 90% of Rwandans were into maize and beans farming respectively. The North and West of the country have the longest history of maize cultivation though greater percentage of national maize harvest comes from the Eastern Province. At 26 kg per person per year, Rwanda has the highest per capita consumption of beans in the world and the fourth producer on the continent. While beans are a staple crop in the country, traditional bush beans produce poor yields and lack the capacity to support the country's current population (Katsvairo,

2017). Government move in this direction has been the development of new varieties facilitated by the Rwandan Agricultural Research Institute in partnership with the International Centre for Tropical Agriculture.

Through continued research efforts and incremental sectoral funding in the past years, the yearly production levels of the two crops have been consistently rising. In 2013, maize output rose from 573,038MT in 2012 to 667,833MT (Footstep,2014). Similar figures for beans were from 432, 857MT in 2012 to 438, 857MT in 2013 (FAOSTAT, 2014). The national production trend is shown in figure 2.

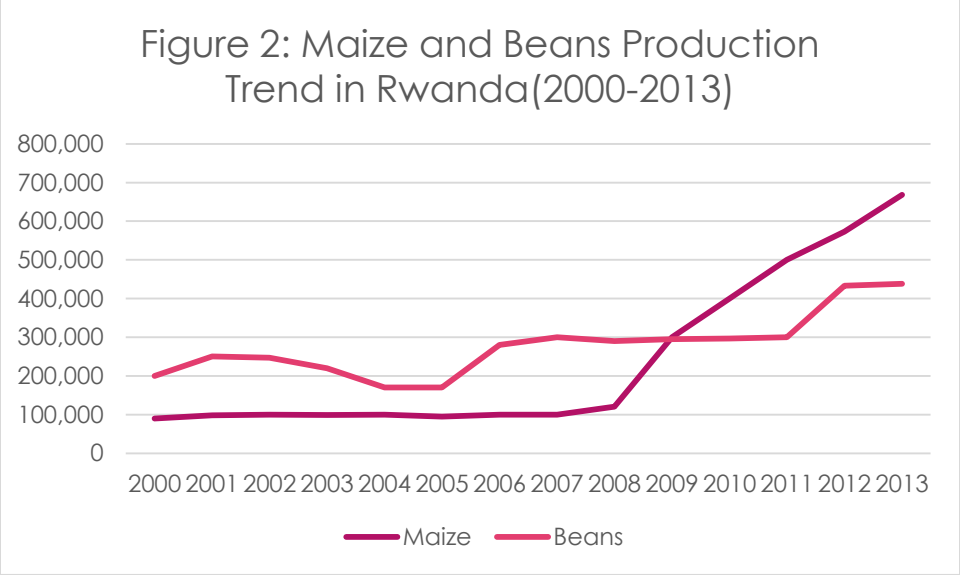

Figure 2: Maize and Beans Production Trend in Rwanda(2000-2013)

Source: FAOSTAT, 2014

Maize and beans value chains comprise several stages and actors with varying scope. Major actors are farmers, traders (distributors, wholesale and retailers), millers and consumers. For maize, key value chain activities involving smallholders are those dealing with shelling, drying, storage, milling, primary processing and marketing. Beans, on the other, has a more elaborate value chain running from threshing, winnowing, drying, cleaning, sorting and grading to the supply chain sector. The comparatively longer value chain makes beans much more vulnerable to PHL than maize even though storage measures remain the same for both. Maize is

predominantly a calorie source while beans is a rich source of protein. In terms of market value, maize sells lower than beans at.500 rwf./kg of beans and 230 rwf./kg of maize though product prices oscillate.

2.3.2 Product Marketing

2.3.2.1 Domestic Market

Maize and beans are considered as crops of great economic importance in Rwanda. Their production is insufficient to meet local demand. Government imports regularly to bridge supply gap and neutralize food security threats despite intensification of crop production. Findings from the 2015 Food Security and Vulnerability Assessment revealed a trade deficit in cereals between 2013 and 2014 necessitating food importation (Cochran, 2016). In 2016, Rwanda and Kenya, imported a total of 11, 502 tons valued at $6.65 million to support domestic consumption needs (FEWS NET, 2016). Market potentialities are high and private sector investment trend in the value chain is growing. Private sector agro-commodity trade in maize and beans is controlled by a few relatively large local buyers and agro-processors. Notwithstanding, maize and beans trade is dominated by substantial informality. Predominant model and relationships are ruled by vertical and horizontal relations at cooperative and buyers' levels which constitute the main channels of product exchange. Farmers sell to cooperatives which, in turn, supply to buyers or traders in both open and contract market operations. In contract farming which has introduced some reasonable measure of guaranteed sale, cooperatives enter into a supply contract with a buyer. These transactions have no legal regulations and there are no specific sanctions for breach of contract on either side. However, contract buyers pay higher product prices than what obtains in the open market. Continued development of the grain markets in Rwanda depends on the extent of formal governance of the product value chain and the degree of integration at both vertical and horizontal levels since current reports suggest dearth of membership in many cooperatives to drive common economic goal. The maize and beans market model is shown in figure 1 below while major market actors and structure are shown in table 2

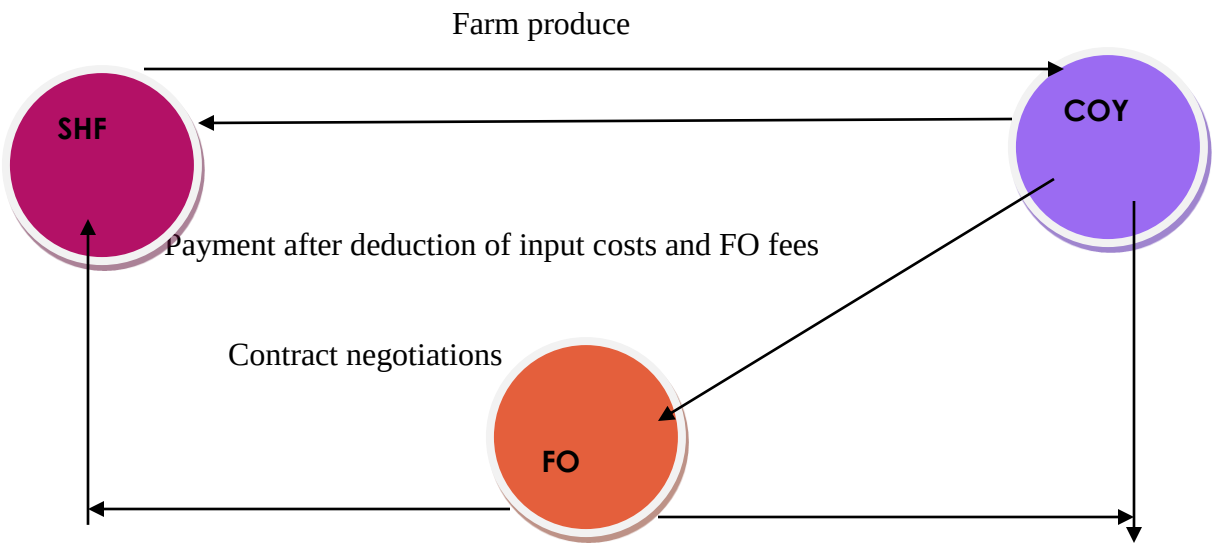

Figure 3: A model for maize and beans contract farming

COY-Company (Buyer)**, SHF**-Smallholder farmers**, FO**-Farmers' Organization

Source: Spore, 2014

Table 2: Market Actors, Structure and Analysis

ATTRIBUTES	**INSTITUTIONAL BUYERS/LARGE SCALE PROCESSORS**	**ORGANIZED TRADERS**	**PASP GROWTH FACTOR**
Who are they?	1.MINAGRI through the National Strategic Reserve Buys 2. WFP. 3. RGCC 4. MINIMEX 5.EAX BRALIRWA 6. Bugesera Agribusiness	1. SARURA LTD 2. Millerse 3. Win-Win Deals Ltd. 4. Exporters 5. Livestock producers and farmers.	Strategic market linkage

	Company. 7. AIF		
What do they buy?	High quality grains	High-to-moderate quality grains	Support for capital investment in drying and storage facilities as well as water harvesting systems
How do buy?	1.Indirect market chain through accredited suppliers after product specifications 2. Product acceptance after rigorous quality checks with moisture meters and weighing devices.	Direct market chain in most cases.	1.Capacity development on product price negotiation 2. Value chain development with emphasis on product quality.
Purchase Decision Catalyst	Product compliance with minimum safety and quality requirements as specified by RBS and International Grain Quality Standards	Price	Continuous technical assistance on quality assurance
Product price determination	As set by government or market mechanism	Negotiations with producers	Skill-building in product cost calculation

Source: Adapted from ADC Business Plan Template for COOPAMA. PASP growth factor added by the researcher

2.3.2.2 Export Market

Within the East Africa Economic Community, Rwanda is not classified as a grain-surplus country. Therefore, not much of direct export earning is traceable to both crops. There is strong evidence suggesting that current production levels of both crops are insufficient to meet domestic demand with 88% grain sufficiency rating for the country (FEWS NET, 2017). Demand-supply gap for both commodities remains significant. Nevertheless, reports and figures from the National Agriculture Export Development Board claimed that the country earned a total of USD 304.6 million from export of agricultural crops in 2017. Though, no detailed disaggregated data was presented, the report only added that maize flour to Democratic Republic of Congo was one of the leading non-traditional export crops for the year (Ntireganya, 2018).

2.4 Environmental Profile, Cropping System and Climate Change Response

Rwanda is ecologically diverse with a mixture of highland mountain forests, savannah grassland and lowland marshes. It has a tropical-temperate climate due to its high altitude. Annual average temperature ranges between 16^{o}C and 20^{o}C (EC, 2006). Rainfall is abundant though there are fluctuations across geographic areas with the northern region having the most rainfall of 1500mm (REMA, 2015). Study by the European Commission estimates the average arable surface area at 0.6ha/person. Four seasons characterize the rainfall pattern which determine the cropping systems in terms of planting and harvesting. First is a short rainy season between September and November followed by a much longer raining season that runs from March to May. The two seasons are interspersed by two dry spells:1. December to February. 2. June to August. Crop planting and harvesting and related post-harvest activities are tied to these seasonal changes as shown in figure4

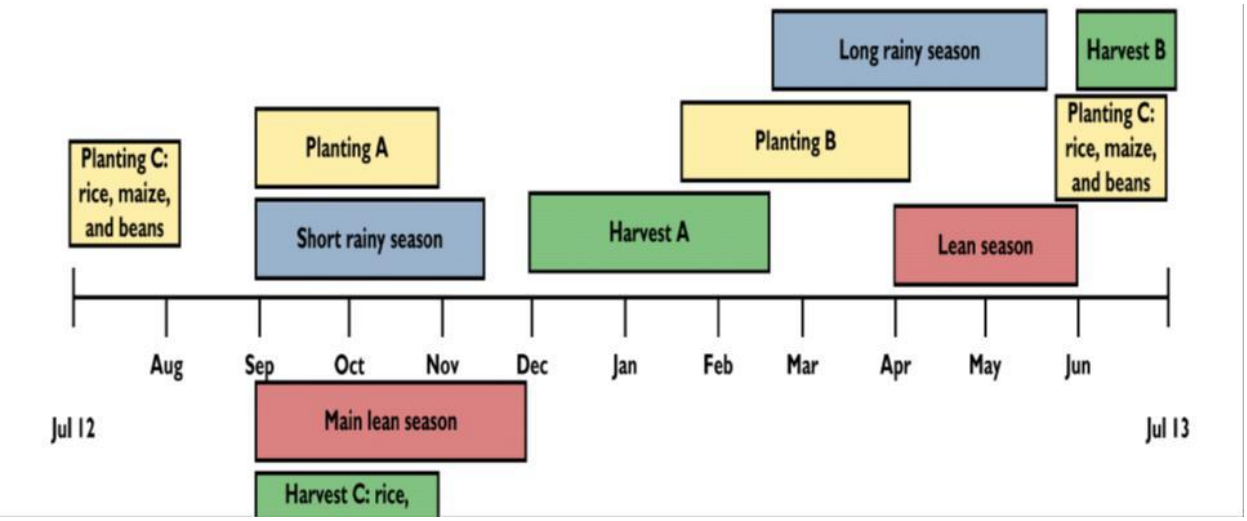

Figure 4: Typical yearly seasonal calendar.

Source: FEWS NET (2012)

However, climate changes, mostly in the form of irregular precipitations, has altered the traditional cropping and post-production dynamics. Early rains are now encountered in February to endanger the natural drying process normally slated for the period while Season C extending from August to October is now reserved for supplementary planting activities

Rwandan soils are heterogeneous in character and naturally fertile. They arose from different ecological processes to create local regional variations in crop types and other agricultural potentials. The pedology ranges from the rich and fertile Alfisols that are suitable for the cultivation of many kinds of cash and staple crops to Ultisols that support animal husbandry in addition to specific crop production. Growing population and land scarcity are exerting considerable pressure on natural resource management in the country leading to widespread exploitation of ecosystem services. Profound deforestation, loss of biodiversity, erosion, landslides and many other dysfunctions of ecosystem health are some of the remarkable consequences of agricultural practice in the country. As a result, regular ecosystem monitoring and research have formed part of the larger strategies for sustainable agricultural production in Rwanda. In the bid to keep economic development within a safe agro-ecological matrix., government has taken a number of environmental stabilization measures. Part of these include, the EU-sponsored Strategic Environmental Assessment in the agriculture sector to address issues

of soil acidity, nutrient depletion, pests and disease management as they relate to the CIP. Other policy instruments on environmental governance such as the National Strategy on Climate Change and Low-Carbon Development (NSCCLCD) have been implemented as part of a robust framework of climate change response while also noting Rwanda's encouraging commitment to climate change financing through prompt compliance with the National Climate Change and Environment Fund.

2.5 Institutional Context of Agricultural Transformation:

Institutional architecture governing Rwanda's sustainable agricultural development program accords with its general structural approach to economic development. The Ministry of Agriculture and Animal Resources (MINAGRI) sits atop the sectoral pyramid as a policy and rate-limiting body which is responsible for developing national action plans and strategies and coordinating projects implemented by different agencies and bodies. A review of allied micro- and macro-institutional bodies both within and outside the direct ambit of government follows.

2.5.1 Farmers Cooperatives:

Since the first documented consumer cooperative began operation in the UK in 1729, cooperatives in general have grown in popularity and economic impact. In Rwanda, cooperative movement of farmers began as a loose confederation of self-help groups operating within the traditional context of social support. As new thinking began to emerge on the nexus between agriculture and poverty reduction, it became increasingly apparent that for rural farmers with small plot sizes to boost their production and revenues, it was necessary not only to grow in membership but also formalize, regulate and supervise their operations. As a result, in the last seven years, more farmers' cooperatives have emerged in the country growing steadily from 900 in 2005 to 4,987 in 2012 (PASP, 2013).Cooperatives provide the major avenues for operationalization of agriculture policies in Rwanda and through them, government has been reaching out to farmers with a vast array of services ranging from technical support, access to agro-inputs, extension services, financial incentives and many others. By building all interventions on this institutional substructure, cooperative movements have become the most effective vehicle of delivering poverty reduction services in Rwanda contributing to the economic well-being of more than 2 million farmers, most of them living in the rural areas (Kanimba, 2014). Through commodity unions and cooperative federations, farmers' cooperatives

have gained greater involvement in policy matters affecting their members and are most vibrant in product trade operations. To underscore government recognition and tremendous support for the movement, Impabaruta, a crop cooperative in the country, won the 2013 Africa Farmers Cooperative of the Year Award sponsored by the African Investment Climate Research (AFRICRES) and Alliance for a Green Revolution in Africa (AGRA) (ICA, 2014) for its outstanding governance and exceptional involvement of youths and women in agriculture

2.5.2 Post-Harvest and Handling Taskforce (PHHTF)

This agency is one in a series of measures to both institutionalize and harmonize post-harvest and handling activities in staple crops in the country. It works closely with farmers and provides specialized services in product quality assurance, handling, storage and processing. The operations of its three main departments: infrastructure development, PHL reduction and quality as well as National Strategic Reserves are woven around these core duties.

2.5.3. Rwanda Agriculture Board (RAB)

Established as an offshoot of the consolidation of multiple agencies rendering similar services, RAB began operation in mid-2011as part of government reforms to remove historical legacy that created artificial gap between research and development. It has four agricultural zones: Eastern, Western, Southern and Northern zones and functions through five departments: Crop Production and Food Security, Animal Resources, Land Husbandry, Irrigation and Mechanization, Research as well as Corporate Services. Each department reflects the duties of the board in mainstreaming agriculture in the country

2.6 Funding of Agriculture

Funding of agriculture in Rwanda has been less than steady but generally encouraging on comparative basis given available domestic resources and budgetary allocation trends in other countries. The immediate recognition that the transformative impact of EDPRS 2 depends on the pattern of funding of this sector has influenced the sectoral capitalization pattern and reflects government enduring commitment to adequate budgetary attention to the sector. Though, Rwanda remains committed to the CAADP annual capitalization target of 10%, achieving this on a yearly basis has been burdensome as budgetary allocations have fluctuated over the last one decade from 8 billion Rwf in 2000 to 23.6 billion Rwf in 2013/2014 (IPAR, 2016). Essentially, most of the capital expenditures are targeted at funding sub-sector strategies under the

Agriculture Sector Investment Plan (ASIP) towards meeting government agriculture-related objectives contained in EDPRS 2. This medium-term plan (2013/2014-2017/208) estimated to cost a total of USD 1, 213 million concentrates on: 1) CIP (Crops and dairy)-52.7%, 2) Value chain development and private sector investments-31.52 and, 3) Irrigation and water management-25.09% and has been carefully ordered to drive the poverty reduction and rural development mission of government. Funds for agriculture in the country come from both public and private sources as well as donor support.

A 10-year (2006-2015/2016) review of budgetary allocations to the sector is as shown in the table below

Table 3: Ten-year review of budgetary allocations to the agriculture sector in Rwanda vis-a-vis CAADP definition

Year	**Amount allocated (Rwf'000)**	**% of total national budget**
2006	13.0	3.3
2007	17.8	3.4
2008	38.2	5.7
2009/2010	57.1	6.4
2010/2011	45.2	6.0
2011/2012	67.1	6.1
2012/2013	78.4	5.1
2013/2014	83.0	5.0
2014/2015	90.3	5.2
2015/2016	78.4	4.3

Source: Revised Financial Laws (2006-2016), adapted from Pamela (2014)

CHAPTER THREE

LITERATURE REVIEW

3.0 Introduction

A large body of literature has developed around the subjects of postharvest losses, agribusiness investments, agricultural value chains, gender issues in agriculture and agricultural productivity. Each of the numerous studies has focused on different aspects of these concepts in varying dimensions of details. This chapter presents a comprehensive review of the major conceptual, empirical and methodological issues around each subject.

3.1 Major Conceptual Issues

The 1974 first World Food Conference in Rome increased the tempo of global research interests into PHL and made it a subject of worldwide policy debates. This growth of research work has tended to concentrate on five main areas of PHL: definition, magnitude, etiology, economic cost and impact as well as possible remedies applicable to each region. Past efforts to define the concept and set clear boundaries of understanding have been marred by controversies among scholars on the field. At the global level, these controversies result from differences in the stages of the post-harvest food chain at which product losses occur across countries. Tyler and Gilman, 1979, quoted in Food and Agricultural Organization publication "Post-harvest Losses" (2011) defined PHL as "measurable quantitative and qualitative loss in a given product which can occur at any point in the postharvest system". Kader (2002), shares similar perspective putting PHL as ""the degradation in both quantity and quality of a food product from harvest to consumption.". The farm to fork dimension of PHL which is common to most definitions has raised important questions on whether or not PHL are the same or different from related concepts such as food waste, food loss and product damage which are frequently interchangeably used with it.

Kiaya, (2014) in the technical paper "Post-harvest losses and Strategies to reduce them" edited for Action Contre La Faim called for the separation of PHL from product damage which he described as a physical sign of deterioration that can only restrict rather than eliminate use. For example, the bad portion of a tuber of yam can be cut off while still making use of the viable part. As a result, product damage is not seen as a case of PHL but one of restriction in use even though there could be a graduation to the former. Notwithstanding, arguments still abound on the precise status of product damage in the typology of PHL. Food loss is the same with PHL in the

context of edible food products. Hodges et al 2011, define food waste as "the subset of food loss that is potentially recoverable for human consumption" and occurs most commonly at the consumer or retailer end of the food chain either as a result of edible product exceeding its expiry date or having been spoilt by different agents. Greater degree of ambiguity emerges for the definition of PHL against the backdrop of the rising worldwide demand for bio-energy. This demand is changing the meaning and scope of PHL and promoting both planned and unplanned food losses (FAO, 2013). In planned, non-use food losses, there is deliberate diversion of crop commodities to bio-energy industries subsequently creating avoidable consumption scarcity especially in situations of localized production shortfalls. In contrast, unplanned, non-use food losses could be a natural resource management strategy whereby spoilt food or food wastes are channeled to similar renewable energy development purposes. However, the extent to which the former constitutes PHL is yet to be agreed among researchers.

The magnitude of PHL is huge and stunning. Countries, governing bodies and aid agencies in the post-harvest sector need to know the size and scope of the problem in order to come up with best practice model for effective and efficient systemitization of post-harvest management. Both global and regional estimates of PHL are generally imperfect arising from differences in modeling data. Linghor-Wolf (2012) argued that most studies in the past were built on old and obsolete data sets to draw faulty conclusions. Supporting him, Parfitt, et al (2010) observed that besides ambiguity of data, global PHL estimates also lack equitable regional coverage being strikingly deficient among emerging economies notably China, Brazil etc, with their enormous population and unique food production and consumption pattern. It is not certain however, if Partfit's observations are anywhere correct given the scholarly work of Tefera (2011) in China and many other similar studies in India (Lundquivst, 2008) documenting regional and national PHL estimates. Furthermore, assessing the magnitude of PHL is most problematic in LDCs with poor information and data management system. This inadequacy often gives rise to wide variations in estimates even within crop groups either in the same region or country. The inconsistency is further aggravated by the fact that all losses have different origins and do not occur concurrently. On-farm, value chain and consumer losses constitute entirely different problems in themselves with different approaches to remedies. Even within each of these groups, Berreta (2013) identified sub-types of estimates which he called avoidable and non-avoidable

losses. In non-avoidable losses, crops after drying and losing their moisture content are bound to decrease in weight. A dissociation in measurement between weights at harvest period and point of marketing tends towards identification as a quantitative brand of PHL

Emphasis of studies by Atanda et al (2011) has been on profiling the causes of PHLs and identifying the predominant pattern among regions. Thus, while environmental, physical, chemical and biological factors are well known etiologic drivers, the degree to which they differ or are the same both within and among countries continues to engage investigator's attention. Generally, however, value chain studies have revealed important details about the character of PHLs in both DCs and LDCs showing much clearly that susceptibility to and the extent of PHL are determined by crop commodity groups, production areas and seasons. They identified different causal factors and studied the mechanisms by which they inflict damage on crop commodities. Among the leading environmental factors of PHL are high temperature, high humidity, excessive rainfall, air velocity etc. Biologically, PHL is aided by a variety of bio-deterioration activities brought about by physiological changes and microbial actions. Most, if not all, are also mediated via changes in environmental conditions showing the greater interdependence occurring among different causal factors. The implication of this is that mitigation measures must be holistic in design while also giving emphasis to each factor according to the quantum of its contribution(s). Some of the notable biological causes include changes in respiration rate, ethylene production and action, and water stress while the most common microbial destructions are those imposed by bacteria and fungi. All these are complemented, depending on the areas of production, by deplorable post-harvest infrastructures affecting, most especially, product drying and storage.

PHL are not physical losses alone, they include losses to resources such as land, water, energy, labor and agro-inputs. These production factors are obviously accumulated at a cost. A comprehensive evaluation of the various cost elements helps to determine not only the annual economic cost but also ascertain whether or not existing level of PHL is significant to warrant public investment resources. Gomez (2011), maintains that cost-benefit interface upon which rests all policy decisions also requires a collateral analysis of the possible impact of PHL in general and the poor and the hungry in particular so as to strike a balance between the cost of investments and the benefits associated with it. Such impacts include cumulative effects on food

prices, economic and physical access to food, and related macroeconomic trend and population health indices

Goldberg and Davis (1957), defines agribusiness as the business of agricultural production embracing agrochemicals, breeding, crop production, distribution, farm machinery, processing, seed supply as well as marketing and retail sales. Agribusiness system is therefore the network of agents in food and fibre value chains and the various institutions that govern them and can be conceived as a set of four interrelated subsystems: 1) input delivery 2) farming/primary production 3) post-harvest and processing (agro-industry) and 4) marketing and distribution. The growth and capacity of African agriculture to reduce poverty truly depend on the volume and scope of investments it can attract. Africa's historical economic backwardness has been linked by several studies to the predominant raw-material producer role it has played over the century to Europe's industrial production strongholds. Statism and protective fiscal policies shortened the range of structural transformation of the economy. Following transformative changes in the global economy and the steady reduction in importance of national boundaries and geographical space as barriers to movement of goods, services and technology (Oyejide, 2011), SSA is becoming a choice investment destination particularly to European and North American investors. A broad review of the literature reveals that private sector agribusiness investments are rising in the continent as large companies are building substantial portfolios across all value chains. Miller, et al (2010) traced the growth of investment funds in SSA to the rising attractiveness of agricultural investment projects as profitable business ventures especially in light of higher product prices. This is further enhanced by the changing political, policy and institutional environments that have grown more investor-friendly since the 90s.Tracking agribusiness investments in SSA is hampered by lack of accurate and reliable data. Most of what is seen in the literature are collations from rating agencies dealing with revenue profiles of mostly big companies. The information frequently excludes SMEs as well as detailed data on the nature and level of investments. It is thus difficult to fully categorize the number of industry players and their respective sectors of agribusiness engagements. OECD publication in 2008featuring rating reports from Fortune Global 500 and Jeune Les Afrique 500 gave a representative picture of agribusiness investment profile in SSA. It captured both foreign and local enterprises distributed across input and machinery supply, agricultural production,

manufacturing and processing as well as retailing. Their activities include wholly owned subsidiaries or in the vast majority of cases, non-equity linkages such as franchise and licensing (Mhlanga, 2010)

Contemporary sociological discourse is increasingly dominated by gender issues in virtually all fields of human endeavour. Many studies have been conducted and volumes of publications released on women participation in agriculture cutting across countries, tribes, culture and religions. Four main issues have pre-occupied scholars in the field: population of women in agriculture, causes and catalysts of women participation, different levels of participation and inherent and overt challenges**.** Yemisi 2009, studied the contributions of women to agricultural development in SSA and concluded on their superior numerical strength in almost all SSA countries except Sudan. In "Dynamics of Rural Livelihood and Poverty in South Asia", Horsam 2011, examined the participation of women in agriculture from the perspectives of traditional Muslim societies using Bangladesh as a case study. His interest was to identify the triggers of women participation in the country and characterize the features of the participation in terms of enablers and barriers. Ghory (2014), studied similar indices in India and the prevailing gender norms. Khan et al (2012) was more interested at the sector-level relationship between women and agriculture with a view to classifying the involvement of women in different subsectors. Studies in Ecuador by Batsaida quoted in Thagwana (2010) identified three levels of women participation and pinpointed different challenges faced by them across regions of the world. Similarly, reports by the European Parliament on the imperative of moving towards multifunctionality of rural areas regretted the relatively low involvement of women in European agriculture. The role of religion, culture and education in women involvement in agriculture has been foremost in the works of Masood et al (2015), Khan et al (2012) and many other scholars. Unsurprisingly, results have varied with both positive and adverse relationships documented. Most of the various studies have tended to paint the picture of a world in need of far-reaching gender homogenization plans, especially as they affect the development of a coherent intersectoral framework of economic engagement that promotes women participation in the context of their demonstrable endowments.

Unless agricultural productivity paradigm changes in SSA, the potential of the sector to meet rising national expectations will remain abbreviated. One of the major targets under the

Comprehensive African Agricultural Development Program is to achieve sustained growth in per capita agricultural production. Despite abundant arable land, Africa contributes less than a quarter of the global food supply. This is much even worse in land constrained nations like Rwanda. Factors governing productivity have been listed to include land, input, finance and technology. Studies on the concept have looked at the pattern of input use, land management practices, extent of application of modern technology, effects of agribusiness investments and productivity interventions at both government and donor levels. Others have looked at the conjugal linkage between productivity and poverty reduction. Benin, S (.2016) traced the historical trend of productivity in major regions of the world along with public expenditure analysis and credit portfolios to the sector. Most studies have shown that Africa is significantly lagging behind other regions. Olayide et al, 2013, worked extensively on agricultural productivity and poverty in Nigeria using maize as a surrogate marker. They conducted assessment and mapping of prices and productivity of maize as well as poverty levels in the various states of the country and used the price-productivity-poverty model to explain the impact of productivity on poverty. The authors contended that effective and sustainable agricultural development policies must keep within sight of activities that target volume production geared towards domestic market for price stabilization, easy consumer access, and meaningful impact on welfare status of the people. The work of Materechera, 2014, on land use management practices in South Africa compared the effects of different farming practices such as natural grazing, field crop and horticultural cultivation and undisturbed savannah, on soil fertility and found different levels of impact on productivity. Place, 2009 in his work on land tenure and agricultural productivity in Africa examined the relationship between land tenure security and productivity showing that land tenure security has both convergence and diverse productivity effects. On this basis, he submitted that national land reform policies must pay attention to local context rather than follow the blind spots of generic patterns.

Calestous 2010, lamented the low level of input use in African agriculture and stressed the need for African countries to pursue policies that give wider vent to more prevalent and diversified use of fertilizer and high yield resistant seed varieties if they must scale up their agricultural productivity. Besides the consideration of input use, attainment of a highly productive, competitive, efficient and sustainable agriculture in Africa rests on a number of synchronous policy actions. The role of innovation based on science and technology that is truly African

developed and Africa appropriate has been repeatedly emphasized (Ngogi, 2010). From input to storage technology, up the line to the more revolutionary growth of biotechnology that promotes genetic alteration of crops, improvement in soil productivity, natural weed and pest control; technology remains vital in changing existing productivity narratives in the continent. Agribusiness investments have been recognized as a growth factor in productivity. Empirical enquiries into the true relationship have been limited. Dlamini et al 2010, studied the pattern of FDI into the agriculture sector of South Africa with a view to classifying the determinants of locational inflows. The question they sought to answer in their study was: Does productivity engender higher investment especially, FDI, in agriculture or the other way round. Their findings were deeply instructive revealing a bi-directional relationship between FDI and GDP.

What has been the role of crop value chains in the development of agriculture as a poverty reduction sector? A broad classification of roles needs a clear understanding of what value chains are and how they function. Value chain has been described as the full range of activities which are required to bring a product or service from conception, through different phases of production (involving a combination of physical transformation and the input of various producer services), to consumers, and final disposal after use (FAO, 2006). Agricultural value chains are segmented into pre-production, production and post-production phases. For crop commodities, pre-production covers all activities involving acquisition and preparation of land such as weeding, ploughing, purchase of seeds and seedlings etc. Production involves planting, application of fertilizer and other aspects of farm care. Post-production activities deal with processing, distribution and marketing. The type and growth of value chains depend on market demand. Therefore, the thrust of studies in the field has been mainly focused on mapping the market, identifying the strengths, weaknesses, challenges and opportunities inherent in the product chain as well as the impact of national and global policy environments. Akinwumi et al (2010), have used value chain studies to identify risk pathways and build resilience against poultry epidemics like the famous Bird Flu crisis that swept the poultry subsector in many countries some years ago. For meaningful intervention projects, value chain studies are commonly used to select priority commodities that deliver the highest possible economic rent. The current PASP project selected its priority intervention crops based on value chain studies which identified inclusion criteria such as the number of rural poor participating in the value chain, ability to raise income level and domestic and regional product demand. Moreover,

explanations on why people choose to participate in growing a particular crop and not the other has also been offered through this approach.

The work of Etwire (2013) et al at the value chain mentorship project in Northern Ghana showed that differential participation in crop value chains is underscored by literacy, access to credit, level of extension service and product prices. Miller and Jones (2006), studied the pattern of agricultural value chain financing in Kenya and Tanzania and concluded that vertical coordination among different stages in the value chain was a reliable security for access to production credits in both countries. "Gender and Value Chains", a joint policy brief of FAO, IFAD and ILO, highlighted the dangers faced by women in changing value chain settings. The authors observed that as most women upgrade in their value chains either by joining farmers' organizations or in the functional sense of the concept, men tend to assume disproportionate control of resultant benefits. For economic development purposes, value chain analysis has offered elaborate opportunity to study the phased progression of economic rent across the product flow and to modify national policy tone on agricultural transformation by concentrating emphasis and promoting investments on points in the value chain that brings the highest possible returns on investments both to smallholder farmers and the country at large. In the particular instance of PHL, analysis of value chain permits a clear understanding of the relevant dynamics in terms of stage, causes and magnitude of the problem in a way that facilitates the development of context-or stage-specific interventions. In addition, development in the food and agricultural market is changing value chain operations. Consumer demand for quality products is rising. Food processing and retailers have come up with new quality assurance schemes to meet consumer quality preferences. Crop products previously sold as standardized commodities have to meet new minimum quality indices for market entry and acceptance. This growing demand for product differentiation has consequences for smallholders who must now adapt their production to fulfill new market requirements through vertical coordination where activities of individual economic actors along the value chain are aligned (Bijman et al, 2011)

3.2 Review of Major Empirical Issues

PHL refer to both losses of quantity and consumer quality attributes. The global magnitude of PHL is huge in whatever dimension of assessment be it quantitative estimate, economic cost or

the volume of public investment required for mitigation. In "Missing food: The case of postharvest grain losses in sub-Saharan Africa" published in 2011 by the WB, FAO and the UK Natural Resources Institute, the cost of PHL in SSA alone was estimated at USD 4bn. This represents a vast amount of food sufficient to meet the annual food need of around 48million people. Using self-reported estimates by smallholder farmers in HH survey of PHL in SSA, Kaminski and Christianensen (2014) showed that on the average, between 1.4, 2.9-4.4, and 5.9 percent of the total national maize harvest is lost in Malawi, Tanzania and Uganda respectively. Tefera's work (Tefera et al, 2011) in China estimating a total of USD45bn in yearly rice-related losses and the finding of Lundquivst et al (2008) in India putting the national PHL at 560bn Rupees have possibly diminished the claim of Mark et al on inadequate regional survey of the global PHL burden as a possible cause of global policy dysfunction that is fast putting food security under threat worldwide. The various stunning PHL figures reinforce the view of Beretta et al (2013), Buzby and Heyman (2012) that addressing the challenge of PHL, especially in LDCs, could play a vital role in reducing the amount of production needed to feed the population. This view resonates with the UN “Zero Hunger Challenge” which called on nations of the world to put an end to food wastes in all their possible forms. However, desirable as reducing PHL is, there are disagreements on the scale of reduction that is both realistic and economically rational. De Gorter et al 2014, assessing the economics of the challenge argued for more realistic ways of battling hunger rather than overt emphasis on elimination of wastes. Part of these would include coordinated investments in complimentary sectors of the economy more especially, power and transport infrastructures which are in gross deficit in many LDCs.

On agribusiness investments, findings by Faye et al (2011) have shown the linearity between agribusiness investment, productivity and socio-economic development. However, SSA is home to a barrage of investments disincentives. Democracy is tottering, ease of doing business is poor in most countries, and national infrastructure is in a decrepit state except in few places while transparency in economic transactions remains suspect. Even though, average public expenditure in terms of annual budget has risen to 7%, finance still remains a key hindrance to investment in the sub-continent. In a 2011 publication, African Development Bank gave a clear indication of the stormy financial challenges that lied ahead for SSA countries to attain investment levels that could engineer broad-based national prosperity. In the report, the bank declared that meeting the

growth targets under the integrated development framework of CAADP by 2015 (the first decade of CAADP) required a huge expenditure of USD 20bn. The ability of African countries to meet this financial demand is undoubtedly low as the current level of domestic financing remains discouraging. Average commercial bank lending to the sector as a percentage of total portfolio for 11 selected countries of Botswana, Gambia, Kenya, Ghana, Lesotho, Malawi, Mozambique, Nigeria, Sierra Leone, Uganda and Tanzania between 1995 and 2008 was a paltry 5.75% (Nomathemba, 2010). This lean volume of capital resource inflow underscores the need by national credit institutions and monetary police elites to rebalance credit policy terms in order to unbutton more investible funds to the sector and complement the growth in FDI in Africa. AfDB continues to play a leading role in this respect with a current investment portfolio totaling $1bn or 7% of the estimated $20bn agribusiness investment requirement. Yet, this total value remains insufficient to cope with the demands of agricultural growth as CAADP enters its next decade of action

Tracking investments in terms of actors, magnitude and specific portfolios has been largely problematic in SSA. Studies using the 2005 UNIDO Africa Foreign Investor Survey revealed that of the total 1,216 enterprises enumerated across all economic sectors, only 340 (35.8%) operated in the agribusiness sector. The contribution of local companies to the total enterprise profile was quite woeful estimated at 18.5% with the beverage subsector taking the lead in the magnitude of investments. Countries in the Southern Africa sub-region had the largest share of agribusiness investments both local and foreign followed by West Africa. The main commodities involved are rice, palm oil, sugarcane, and timbre. Nwibo et al (2013), working in the Southeastern part of Nigeria, found that 60% of agribusiness investments in the region was concentrated in the agro-input subsystem. The shares of others were given as :55%-processing and 54%-distribution and marketing. Undoubtedly, agribusiness operations are putting enormous pressure on Africa's land resources. Arezki (2011) attributed the African “land rush” to diminishing land stock in Europe and other parts of the world which has seen total land area in Europe pummeled from 450 million ha to 405 million ha. The need to reduce environmental sustainability risk contingent on this development has led to the formulation of a rule of engagement by both UNIDO, IFAD, WB and UNCTAD to which all companies whether local or foreign, must submit their operations. Referred to as the "Principles of Responsible Agricultural Investments", the major provisions include recognition and respect for existing land rights,

investments do not jeopardize food security but strengthen it, consultations with and documentation of agreements with those that are materially affected followed by enforcement of agreed terms, diligent environmental impact assessment associated with measures to ensure sustainable resource use, respect for the rule of law, compliance with industry best practices etc.

Understanding the trend of private wealth engagement in the development of agriculture has become especially important in Rwanda where 40% of development resources comes from foreign investors with all the associated risks to both political and economic sovereignty. In this sense, new studies are required to provide current country-level data on FDI inflows, destination sectors, investment promotion policies and determine the level of domestic private sector investment trend in the country. Besides, the need to identify and analyze the character of existing and emerging constraints makes such studies compelling.

Studies on gender issues in agriculture have shown much clearly that notwithstanding the barriers they face, they represent a vital and indispensable economic force. In SSA, findings by Yemisi (2009) show that women labor force participation varies from 30% in Sudan to 80% in the DRC. Many other studies have confirmed that women labor force participation in agriculture is highest in SSA and lowest in Latin America (Hussein et al,) Data released by the European parliament on the state of women in agriculture shows that the share of women in the sector was 42.6% of the total population of 26.7 million European farmers. According to Horsham, 2011, major reasons for women participation in agriculture are poverty, joblessness and the need to rebalance the labor force equilibrium whenever men's involvement is compromised either through migration to non-farm work or some other means. This finding is common to the works of other scholars such as Hussain et al, Masood et al and Thagwana (2010). Thagwana identified a vital push factor in the pandemic of HIV/AIDS in changing the course of women participation in most Southern African countries suggesting a close nexus between epidemic of communicable diseases and labor force structure. Retaining women involvement in agriculture depends on many factors.

While most studies in South East Asia (Ghory et al, 2014; Khan et al, 2012; Masood et, 2015) have revealed the regulatory influence of religion on occupational choices of women, much of this has not dominated the picture in SSA. In contrast, literacy and culture appear the more important limiting factors. As reported by Masood et al, in areas of Pakistan with predominant purdah practice, women are not allowed to work. Women participation in such areas is at a

dismal 1.8%. Likewise, women and agricultural value chain relationship differ from one country to the other. Longitudinal panel data by Horsam, shows that women in Bangladesh participate more in livestock and poultry than arable farming with a labour force distribution of 23% and 1% respectively. On the other hand, women farmers in Kashmir favour involvement in rice cultivation more than livestock. Data on women participation in SSA agriculture published by Yemisi showed that women in the sub-continent have a more diffuse involvement. 73% is in arable crop farming, 16%-post-harvest operations and 15%-agro-forestry. The view that agriculture is reserved for low-income, illiterate women is changing and rapidly too. Participation in the sector is cutting across social strata enhanced by the co-evolution of the global integration of trade and catalytic liberal economic policies on the part of many governments. Bratsaida 1999, quoted in Thagwana classified women participation into three: No participation-20%, Some participation-60% and full participation-20%. It is no longer certain if this differential rating is sustainable given current dynamics in today's world of work. Economically, traditional Islamic societies are more restrictive of women's rights as shown by the works of Masood et al 2015 in Pakistan and Ghory 2011 in India. Of the 38.5% of women engaged in Indian agriculture, Ghory found no evidence of substantial liberty to earn and control economic resources. This finding is similar to the work of Horsham in Bangladesh. Women farmers work longer hours than men do with surveys revealing an average of 12-15hrs. Yet, they receive less than what men take for the same job. Similar pattern prevails in Bangladesh as demonstrated vividly by the work of Horsam. Differential gender remuneration limits incremental participation and is supported by many theoretical debates. Women participation in agriculture affects the global food security status. Calestous (ibid), showed that half of African countries with the highest hunger incidence also have among the highest gender gaps. This finding obviously underscores the strategic importance of mainstreaming women in all economic activities and not just agriculture. Nonetheless, engaging women profitably in agriculture is an ongoing project in the general drive towards building inclusive societies. In this direction, the role of women NGOs is increasing in raising the consciousness of women towards their basic economic rights while development partners are speeding up the pace of women access to economic equity and equality in order to create balanced opportunities for self-actualization

Achieving the CAADP's productivity target of 6% is common to most African countries. Findings of studies by Faye et al showed that of the 29 countries for which data was available, only 9 had met the target by 2010. This finding suggests that between 2010 and 2011, Africa experienced a productivity decline among sampled countries as Rwanda's 3.9% TFP in 2011 was acclaimed the highest in the continent. Benin et al produced a troubling comparative regional productivity data of agriculture showing that from 2001-2010 annual average agricultural output growth rate in percentage was 2.6, 3.5 and 3.2 in SSA, Asia and LAC respectively. This confirms the findings of Faye et al (ibid) that agricultural productivity has grown much more slowly in SSA than other regions. FARA (2006) quoted in Adebayo et al, 2013, remarked that SSA productivity and per capita value is the lowest in the world. Crop output per hectare has shown similar trend. Studies by Fuglie, Nin-Pratt and Olayide, produced striking differences in yield growth among the three developing regions of SSA, Asia, and LAC. According to Fuglie et al, between 1980-2009, crop yield in kg grew from **163-219** in SSA as against **494-773** in Asia and **326-424** in LAC. Olayide et al, using maize as a surrogate productivity marker also compared the yields of maize in Nigeria and South Africa to what obtains in other countries such as Brazil, Argentina, The Netherlands, Indonesia, U.K, Canada etc concluding that crop yields in Africa are almost a third of what obtains in many of these countries.

This productivity trend has significant implications for food prices and poverty rates and is even marked by apparent lack of uniformity across the continent. Remarkable spatial heterogeneity is evident in Africa determined by climate, land suitability, human and animal populations, as well as transport and rural infrastructure (Benin, ed). To sustain land productivity in an age of unstable climate system, Calestous recommends raising the coverage of irrigation agriculture which currently stands at 4%-6% to levels comparable to those of its developmental siblings like Asia where similar coverage is put at 39%. Working further on land use and management practices as a factor of soil productivity, Materechera, in his earlier quoted paper, found that natural grazing by animals and all forms of cultivation deplete the soil organic matter and microbial carbon biomass in contrast to the preservative effect of undisturbed savanna i.e uncultivated and ungrazed land. This finding supports the age-long practice of shifting cultivation by farmers which prevents crop land overuse by observing specific fallow periods. On the relationship between agricultural productivity and FDI, the work of Zhang et al 2014

surprisingly found no positive correlation between FDI and productivity growth stating clearly that other determinants of growth are needed to convert investments to economic growth. In contrast, Gunasekera et al 2015, validated the correlation concluding that combined efforts to improve land productivity and FDI growth could potentially increase Africa's share in global agricultural output and exports more so with respect to oil seeds, sugar and cotton. The work of Frazer and Dlamini on the linkage between productivity and FDI allies with the findings of Gunasekera but generated an egg-and-hen scenario. Which drives which? Does FDI lead to higher GDP or vice versa? Concluding, the authors submitted that high GDP is a necessary precondition for FDI and for countries to attract foreign investors, they must demonstrate a certain level of sustainable economic growth. Rounding up, Olayide et al, remarked that the fight against poverty can only be won on the long run when public policies target sustained improvement in productivity for food price stabilization and enhanced economic access.

Much of the scholarly works on value chains are primarily geared towards identifying the process of harmonization of demand and supply. Consumers want products from producers which are of supremely satisfactory quality. Thus, the harmony of rent-seeking and satisfaction of consumer quality needs is basic to value chain operations. Major empirical issues in the literature have centred on production and post-production processes that generate appropriate consumer response and economic benefits for all value chain actors. technology, access to crucial information, product preservation, optimization of quality, upgrading and generation of the highest possible economic benefits for producers. In all value chains, attainment of quality and vastly marketable products is a dominant goal. This requires access to adequate and timely market information on the one hand, and effective postharvest management practices and different types of integration or upgrading on the other. In all of these prerequisite activities for value chain growth and development, smallholders in LDCs are often at a disadvantage and frequently unable to leverage competitive value chains that boost their incomes. Helin and Meijer (2006) citing the work of FAO in Chiapas, Mexico, Bolivia and Ecuador have helped to highlight the role of market maps in agricultural value chain functions and the fundamental determinants of product diversity. In other words, the nexus between market mapping and the extent to which crop diversity is either being maintained, enhanced or undermined becomes more clearly elucidated. The authors found that where value chain markets are well mapped and linked

particularly to farmers, all economic actors benefit proportionately. Effective market mapping generates useful information on seed type in demand, reasons behind farmers' choice for the particular seed, frequency of purchase, structure of the grain market, price trend and how these can influence new policy tones or modify existing ones. As integration becomes an increasing phenomenon in maximizing advantage for value chain actors, Thorp (2014), has revealed how contract farming (vertical integration) is helping smallholder farmers in Ghana, Madagascar, Jamaica and Uganda participate in high quality, international value chains. Under the various arrangements, farmers' micro-contracts are complimented with extensive farm support and supervision to fulfill complex quality requirements and phyto-sanitary standards.

Using the value chain construct, Hodges, 2010 and Boxall, 2001, have drawn logical distinctions on the characteristics of PHL between developed and LDCs and how the knowledge can guide the development of strategies to address inherent and peculiar challenges. DCs, they noted, have extensive and effective cold chain system as well as wider scope of technology to improve efficiency of postharvest management. PHL, in such setting, arise primarily from consumer intolerance and the losses are more in the downstream sector. On the other hand, poor postharvest infrastructure predisposing to profound bio-deterioration is more pronounced in LDCs and tend to undermine the supply capability of the value chain in both quantity and quality terms. Since each stage of the value chain is not equally affected, mitigation measures tend to address the causes of product loss at each stage in a specific and definite manner.Consequently, while adoption of PH technologies such as hermetic sacs, HH metallic silos etc to improve postharvest handling and storage hygiene are more desirable in LDCs (WB, 2011) consumer education has emerged as the intervention of choice in most DCs.

3.3 Review of Methodological Issues

Studies on PHL, productivity, agribusiness and gender in agriculture have shown a wide array of methodological approaches depending on the objectives, area and the population under study. Both qualitative, quantitative and case study methods have been used in different settings. Research designs, in like manner, have shown appreciable variations ranging from cross-sectional, longitudinal and comparative designs. Most studies, in general, adopt the mixed method survey approach. Studies on PHL dealing predominantly with magnitude assessment are mostly cross-sectional surveys and are often frequently used by large intervention bodies like

FAO, IFAD and WB. Longitudinal design for trend studies such as studying the pattern of women participation, the determinants of increasing levels of participation and reward pattern as in the studies of Horsam and Ghory have been documented in the literature. Case studies are mostly employed for value chain analysis looking at different phenomena such as magnitude of loss per product stage as in the leaking food pipeline study of Offong-Ben Offori or identifying etiologies of certain problems as in the study of Akinwumi on the outbreak of the Highly Pathogenic Avian Influezia Virus. Other case studies have been concerned with tracking the entire production system from both on-field activities to all impacts related to the final product disposal (Brentrup, et al). These are often conducted to assess ecological footprints and implications of PHL on natural resource management. Furthermore, few investigators have hinged their studies essentially on library research model adopting the methodology of meta-analysis which reviews the findings of conceptually related studies to identify common but hidden facts among them

Sample size in the past studies varies both in value and procedure for determination. The size is influenced by the scale of the study**,** purpose and the target population under investigation. Most large surveys (as in the current PASP project) rely on simple percentage of the study population ranging from 5-10%. Others have followed more elaborate mathematical operations governed by such indices as confidence level, confidence interval, population size and standard deviation. In non-CSAM studies which traditionally track single products, past sample sizes have been as low as 97 and as large as thousands as may occur in national surveys as well as large-scale intervention projects. Similarly, variable have reflected the character of the study in question and are designed around specific objectives. For example, studies on PHL have featured variables on land size, crop planted, use of agro-inputs etc while investment-based surveys have contained questions on amount invested, cost of capital assets and many others. More fundamentally has been the regular inclusion of demographic variables like age, sex, marital status etc in virtually all field instruments. The different variables have been both qualitative, quantitative, discrete and continuous. Their measurement is related to researchers' objectives as some have been measured only on categorical scale whilst others have entailed more extensive analysis on interval and ratio scales using SPSS. Besides, a good number of past studies on gender, productivity, agribusiness investments have made use of both conventional and purpose-oriented analytical tools to draw statistical inferences on the relationships between and among

variables. The relationship between FDI and Productivity has been tested by Dlamini et al, Zhang et al under different statistical models using less well known tools such as Dynamic Global Trade Network Model (GDyn), Granger Causality Model (GCM) and Error Correction Model (ECM). International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) developed by IFPRI is a partial equilibrium, multi-commodity, multi-country model. It uses a system of demand and supply elasticities incorporated into a series of linear and non-linear equations to approximate underlying production and demand functions (Rosegrant et al, 2012; Hoddinott and Torero, 2013). Likewise, differences in theoretical conceptualization are also evident and are based on study areas and interests. These include, Probit and Double Hurdle Models to analyze women participation and levels of participation in the sector respectively, Partial and Total Factor Productivity for productivity evaluation as well as Ordinary Least Square Regression approach to determine how each factor affects crop output.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Conceptual Framework

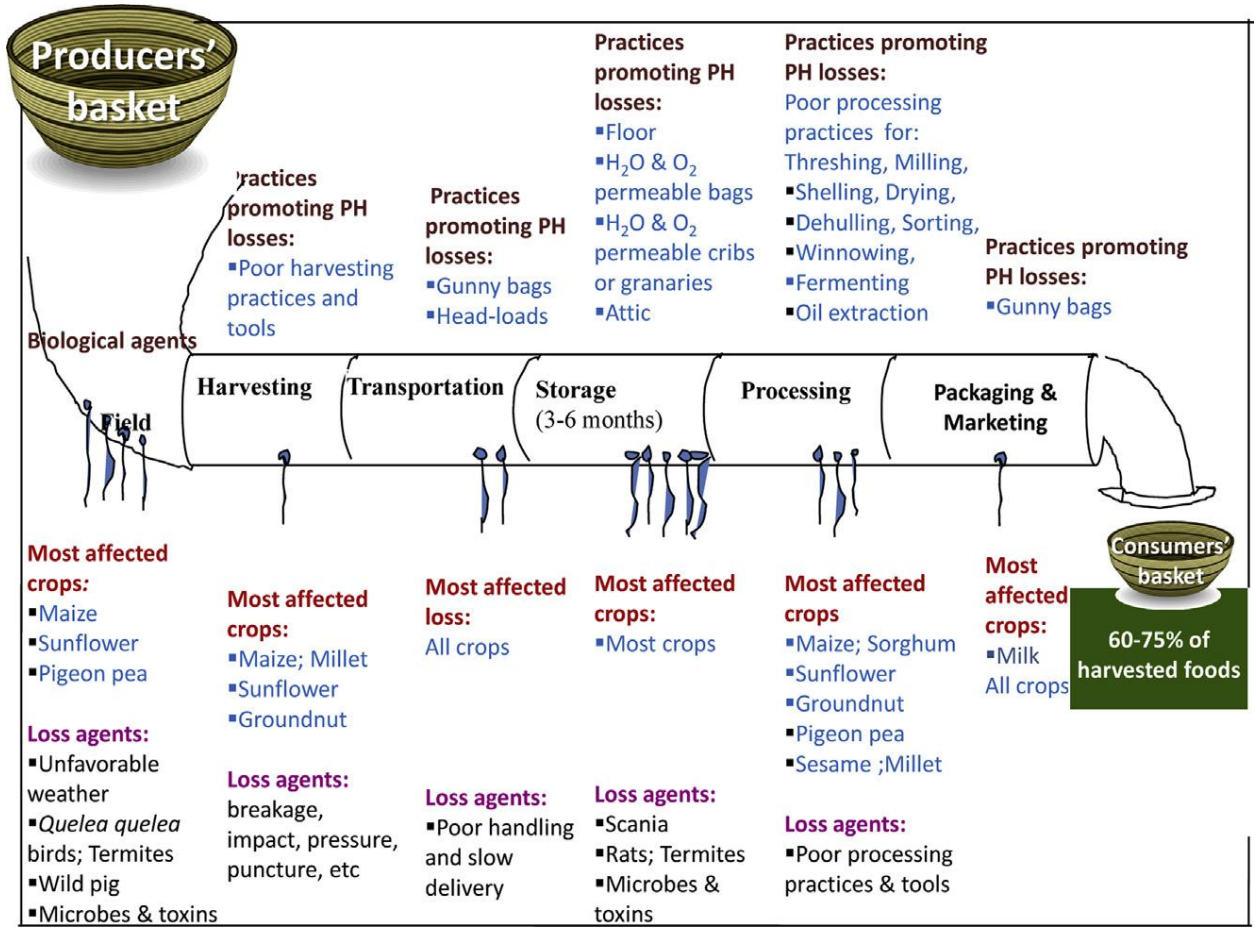

Figure 5: The Leaking Food Pipeline Model (Bourne, 1977; Obeng-Ofori, 2011)

Source: Journal of Stored Products (2014)

The above analytical framework shows the dynamic sequence of product loss from the farm to consumers in a typical value chain. It identifies possible causes of PHL at each phase of the post harvest system and the producer-consumer dissociation in the final product mass. The framework has provided helpful insights into policy options that could be adopted to fight PHL in a stage-specific or system-wide approach.

4.2 Theoretical Conceptualization

4.2.1 Total Factor Productivity Theory (TFP)

This study's interest in assessing the gender agricultural productivity pattern in the district employed the Total Factor Productivity Theory which explores the relationship between the various factors of production to output and determines the efficiency and intensity of their productive utilization. Measured as the inverse of unit variable cost, TFP=$\frac{Y}{\sum PiXi}$ where,

Y=quantity of product or output

P=unit price of i^{th} variable

X=quantity of ith variable

From the foregoing, TFP approximates the ratio of output (Y) to total variable cost (TVC) i.e,

TFP=$\frac{Y}{TVC}$

From cost theory,

Average Variable Cost (AVC)=$\frac{TVC}{Y}$ and

Y=$\frac{TVC}{AVC}$ showing that under efficient production practice, output (Y) is inversely proportional to Average Variable Cost.

The cost elements considered under this study are those related to costs of inputs i.e seed and fertilizer, payment for hired labor and amount of loan obtained during the period. Further to this, the study proceeded to conduct a modest assessment of the economics of PHL estimating both total and average financial loss contingent on PHL in the season under review by deducting total income received by farmers from the total production cost identified similarly as TVC. This operation is given as:

EL=TVC-TI, where;

EL-Economic Loss

TI- Total Income from product sales

Cobbs-Douglas Ordinary Least Square Regression was used to determine the effect of each factor-input on productivity at different coefficient values while gender-based productivity assessment was built on single product analysis with maize as surrogate crop

4.3 Statement of Hypotheses

Four broad, verifiable hypotheses underlined the research study:

1. There is no statistically significant relationship between PHL and gender.
2. Agribusiness and PHL have no statistically significant relationship.
3. There are no statistically significant gender differences in productivity and farm income
4. Marketing channels have no statistically significant effect on farmers' income

4.4 Sampling Design

The study is a comparative evaluation work carried out among smallholder farmers in the project district using both qualitative and quantitative research methods. Benefit attribution was measured against the background of pre-project indices to determine the impact of project along specific priorities areas of the study. A total of 22 cooperatives made up of 2991 members were supported in the district (Appendix 1). They were, in turn, stratified into three groups using geographic and administrative proximity. Proximity factor was defined by the sector to which each cooperative belongs. On this basis, study district was divided into Northern, Eastern and Southeastern sector-clusters. Eligible farmers were prequalified on the basis of land size and ownership. Farmers, who co-owned plots either with their wives, husbands or friends were excluded from enumeration while qualified land size was defined by the project threshold. These exclusion criteria reduced the sampling units to 2,794. An uprated total of 300 smallholder farmers was finally enumerated from the calculated sample size of 247 using online sample size calculator with the following computation variables: population size (2794), 5% error margin, 90% confidence level and a standard deviation of 0.5. In all, a subsample of 100 farmers from each cooperative cluster was taken using simple probability technique. This was followed by Focus Group Discussions, Key Informant and In-depth Interviews with cooperative members, frontline project staff as well as management members of selected cooperatives for more comprehensive details on project activities and impacts. Extensive dialogue sessions were held with key stakeholder groups involving representatives of Rwandan Youth in Agribusiness Forum (RYAF), Rwandan Women Network, Mimuli branch, management of the Business Development Fund (BDF) housing PASP intervention grant as well as the Private Sector Federation in the country.

4.4 Data Requirements and Sources

Both primary and secondary data was utilized in the study. The primary data was obtained from the farmers' survey through the use of semi-structured questionnaires. For secondary data,a broad range of highly informative documents was reviewed to get clearer insights into project history, priorities, parties involved, roles and responsibilities, equity contributions and activity flow. The review set the context for a general understanding of the programmatic structure, operational and applicable methodology, targets and deliverables and related impact evaluation metrics. While most of them came from the Project Documents, others were sourced from reports submitted by different evaluation teams through the SPIU Management Information System Unit, related institutional sources such as cooperatives' records, government annual performance reports as well as records from donor agencies in the development arena.

4.4.1 Study Area

This study was conducted in Nyagatare District within the context of maize and beans value chains.Nyagatare, is one of the four principal project districts in the Eastern Province of the country. It is the largest and second most populous district in Rwanda well known for maize and beans production. 95% of smallholder farmers produce maize in the district while beans production is estimated at 96%. Nyagatare occupies the northeastern extremity of the country and shares boundaries with Uganda in the north, Tanzania in the east, Gicumbi District (in Northern Province of the country) in the west and Gatsibo in the same Eastern Province to the south. It is headed by a Deputy Mayor and administered in a political architecture of 14 sectors, 106 cells and 630 villages with a total population of 466,944 people scattered over a land area of 1,750 km. The capital is Nyagatare City, seat of the now defunct Umulara Province. The district has a unique ecological portfolio. Like the rest of the country, it has two main seasons of comparatively different durations with what obtains elsewhere in Rwanda: A long spell of dry season running from June to October corresponding to Season A and Season B characterized by small quantity of rain and high temperature averaging between 25.3^{o}c to 27.7^{o}C. Annual rainfalls are both very weak and very unpredictable to satisfy the needs of rainfed agriculture thus making it one of the leading drought-prone areas of country.

The afforested grassy savanna gives the district soil its characteristic tight humifere layer that is copious in nutrients mineral elements but lacking in organic substances. This characteristic

makes the soil less exploitable to traditional farming practices and for this reason, the district land is not farmed as much extensively as is done in other areas of the country. Nevertheless, it provides vast forage plains for cattle rearing. A SWOT analysis of PASP-supported crops in the district is shown in table 6 while other important socio-demographic attributes are contained in figures 4-6

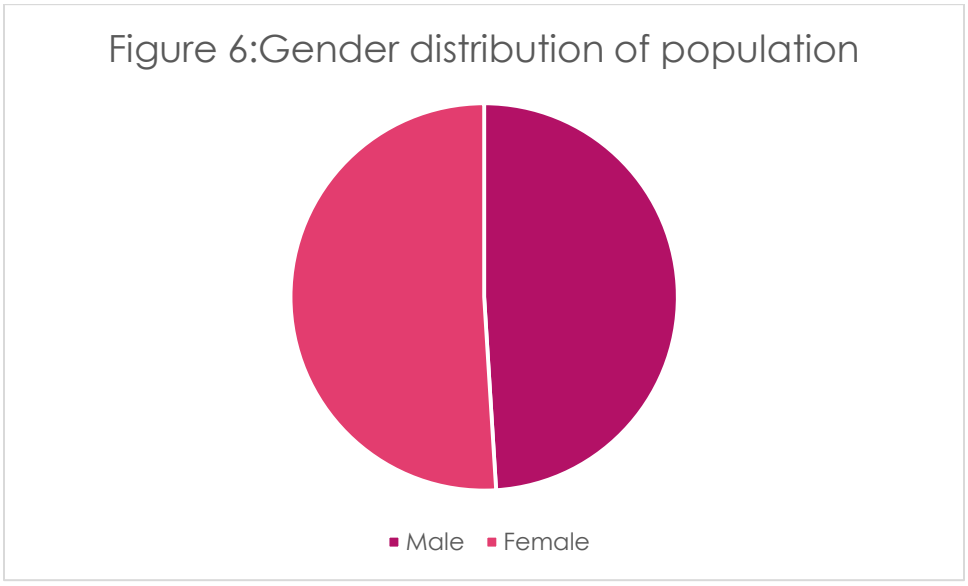

Figure 5: Gender distribution of the population of Nyagatare District

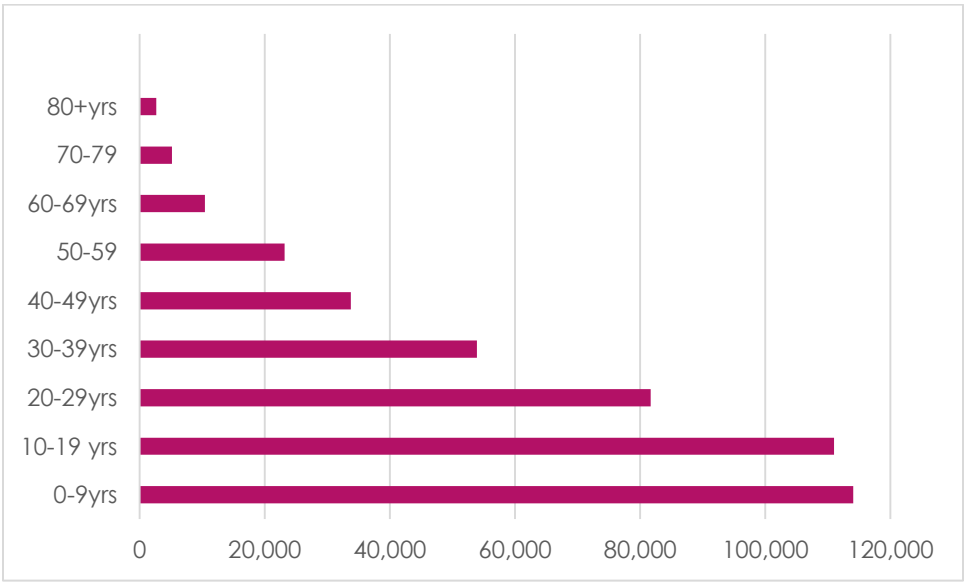

Figure 6: Population age structure of Nyagatare District

Source: NISR, 2016

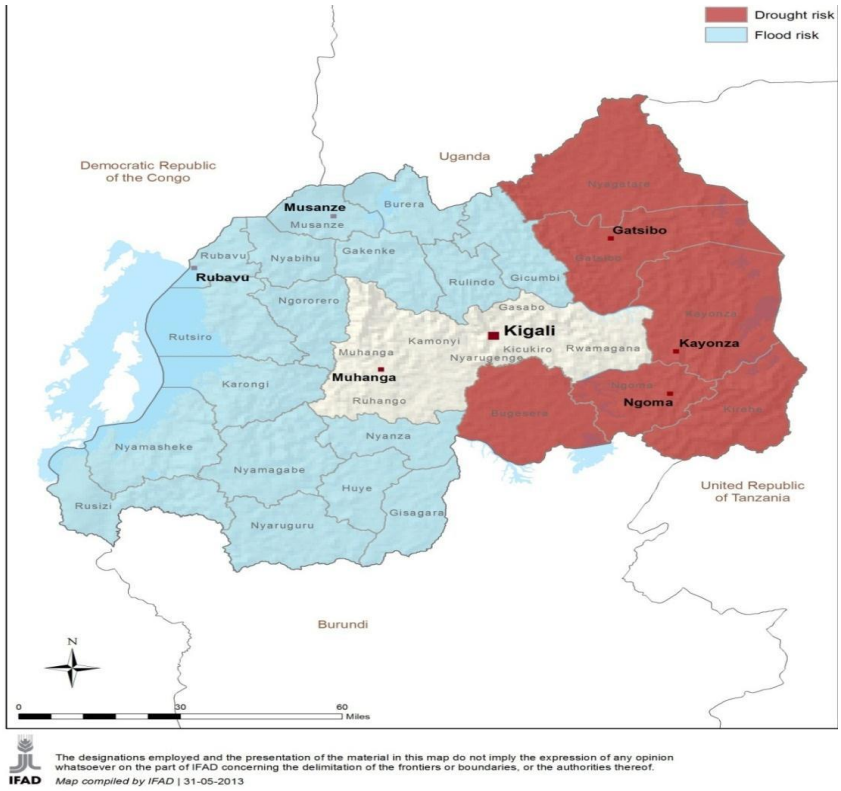

Figure 7: Ecological map of Rwanda showing flood and drought-prone areas

Source: Project file

Table 4: Swot Analysis of PASP-Targeted Crops in Nyagatare District

STRENGTHS	WEAKNESSES
MAIZE: receives strong GoR support, strong domestic demand and high production potential	**Maize**: difficult to dry, production and processing cost is high. Price competitive position in EAC is weak
Beans: perceived quality in region is good, local and regional demand is strong. Price competitive in EAC is strong	**Beans:** No good quality seed available, low actual production volume, low improved production techniques
OPPORTUNITIES	**THREATS**
Maize: introduction of small-scale shelling, threshing etc to improve quality	**Maize:** regional competition, gradual subsidy removal by the GoR on fertilizer and seed
Beans: improved seeds, grading and sorting improvement. Higher production	**Beans:** Same as above

through better techniques and fertilizer use.	

4.4.2 Population and Sample Size

PASP project supported a total of 22 cooperatives with a combined population of 2,991. An uprated total of 300 farmers was enumerated from a calculated sample size of 247 using sample size calculator at an adjusted population of 2,794, confidence level of 90%, and standard deviation of 0.5 (ref 4.3) above.

4.4.3 Preparation of Field Instrument

The field instrument that allowed for controlled and open-ended responses was a 6-part interview module featuring questions formulated according to specific objectives. Section one contained the usual prefatory administrative details and ethical requirement of informed consent. Section two comprised questions on respondents' demographics such as age, sex, marital status etc. The remaining sections three to six were made up of questions covering variables on productive resources, PHL and PH management practices; technical and extension services; financial inclusion and market system; and gender integration. Sample questionnaire is as contained in Appendix 2.

4.4.4 Administration of Questionnaire

Administration of questionnaires took a total of three weeks. This was preceded by a two-day training of farmers' enumerators who were selected with the help of the project district officer and comprised highly efficient and experienced cooperative managers who, jointly and severally, enhanced the quality of the survey process. They were deployed in teams of two members each (1 interviewer, 1 recorder) on village-level basis. Returns were collated daily for appropriate questionnaire audit

4.4.5 Validity and Reliability

Prior to field use, the questionnaire was translated into local language for ease of administration and thereafter subjected to two quality assurance checks leveraging the experience of the project Knowledge Management Specialist and the site supervisor. The pre-test enabled field validation by helping to identify inherent deficiencies and facilitating remodeling particularly in relation to

farmers' account of product losses. Almost all cooperatives in the district were supported by the project. It was therefore difficult to set up a control group with the study cohort. Nevertheless, in order to establish reliability, questionnaire was cross-tested with individual traders in the city centres who had supplementary farms.

4.5 Data Management and Analysis

Aggregate data from the study was analyzed with the aid of SPSS using frequency tables, summary and inferential statistics where required. Gender-based disaggregated tabulation was constructed to highlight the nature and magnitude of relationship among variables. In the circumstance of continuous variables captured in categorical data forms, additional tables were generated to provide explanatory basis for relevant analytical operations. Summary charts were included to magnify findings to high-level policy makers for ease of appreciation of successes and challenges. Framework analysis of study objectives is as shown in table

Table 5: Framework analysis of study objectives

S/N	Specific objective	Data required	Sources of data	Analytical technique
1	Current magnitude of PHL and gender distribution	Estimates of PHL by farmers	Farmers' survey	Descriptive statistics and chi-square
2	Effect of agribusiness investments on PHL	Cost of investment on PHI and farmers' estimates of PHL	Cooperatives' records and farmers' survey	Summary statistics and grouped OLS regression
3	Socio-economic factors underlying gender-based difference in productivity	Costs of all variable factors of production	Farmers' survey and cooperatives' records	TFP and Cobb-Douglas OLS regression
4	Current marketing channels and impact on farmers' incomes	Product yield and sales income	Farmers' survey and cooperatives' records	Descriptive statistics and bivariate

				analysis using Karl Parson Product Moment Correlation coefficient

CHAPTER FIVE

PRESENTATION OF RESULTS

5.0 Presentation of Findings Based on Objectives

5.1 Introduction

This chapter presents the results of farmers' enumeration conducted on the field as well as the outcome of various interview sessions under FGDs, KII, IDI. It also outlines findings from review of relevant institutional records at both government and cooperative levels in an objective-based numeric and narrative formats.

5.2 Demographic Characteristics of Respondents

Table 6: Participants by Gender

		Frequency	Percent
Valid	Male	107	39.3
	Female	165	60.7
	Total	272	100.0

Of the total respondents above, 107 (39.3%) were males, 165 (60.7%) were females. This gender distribution conforms to existing notion and statistics about the pattern of women participation in African agriculture.

Table 7: Gender and Age Distribution

		Age (yrs)				Total
Gender		15-30	31-46	47-62	63-78	
	Male	9	61	28	9	107
	Female	29	56	66	14	165
Total		38	117	94	23	272

From the table above, it comes out that the bulk of smallholder farmers 117 (43.0%) falls into the productive age cohort (**31-46 years**) out of which 52.1% was males. Mean age of respondents

was **44.4years (SD-2.2 years).**This gender-age difference is statistically significant at $p<0.05$ signaling a promising future for agriculture in the district in particular and the country in general.

Table 8: Marital Status

	Frequency	Percentage
Single	19	7.0
Married	211	77.6
Divorced	19	7.0
Widowed	23	8.5
Total	272	100.0

It is apparent from the above table that there were more married farmers 211 (77.6%) among the respondents than any other marital category

Table 9: Household Size

HH Size	Frequency	Percent
1-3 people	51	18.8.
4-6 people	145	53.5
7-9 people	72	26.6
10-12 people	3	1.1
Total	271	
Mean		3.0
Total	272	

Evidence from table 9 indicates that most farmers had a fairly large family size of 4-6 people (53.5%) with an estimated average household size of 3.0 people.

Table 10: Household Head Vs Level of Education

		Level of education				Total
		None	Primary	Secondary	above secondary	
HH Head	Male	8	32	16	0	56
	Female	28	131	55	1	215
Total		36	164	71	1	271

It is observed from table 10 that most households 215(79.0%) were headed by women against 21.0% by men. The distribution contrasts sharply with the 39.0% proportion of men among total respondents as contained in table 3. Besides, women HH Heads were overwhelmingly more educated than their male counterparts having 55(77.5%) of total secondary school enrolment and 1(100%) of post-secondary education. The gender difference in education was significant at $p<0.05$ (p: 0.039)women HH heads were predominantly in the younger age bracket 31-46 years relative to other age groups

Table 11: Household Head and Age Distribution

		Participant's age				Total
		15-30	31-46	47-62	62-77	
HH Head	Male	9	26	15	6	56
	Female	29	91	79	16	215
	4	0	0	0	1	1
Total		38	117	94	23	272

Analyses of table 10 shows that most HH heads 91(42.3%) were predominantly in the younger age bracket 31-46 years relative to other age groups.

5.3 Magnitude of Product Losses in Maize And Beans

Table 12: Types of Crops Planted Last Season

Crop	Frequency	Percent
maize	136	50.0
beans	6	2.2
Both	130	47.8
Total	272	100.0

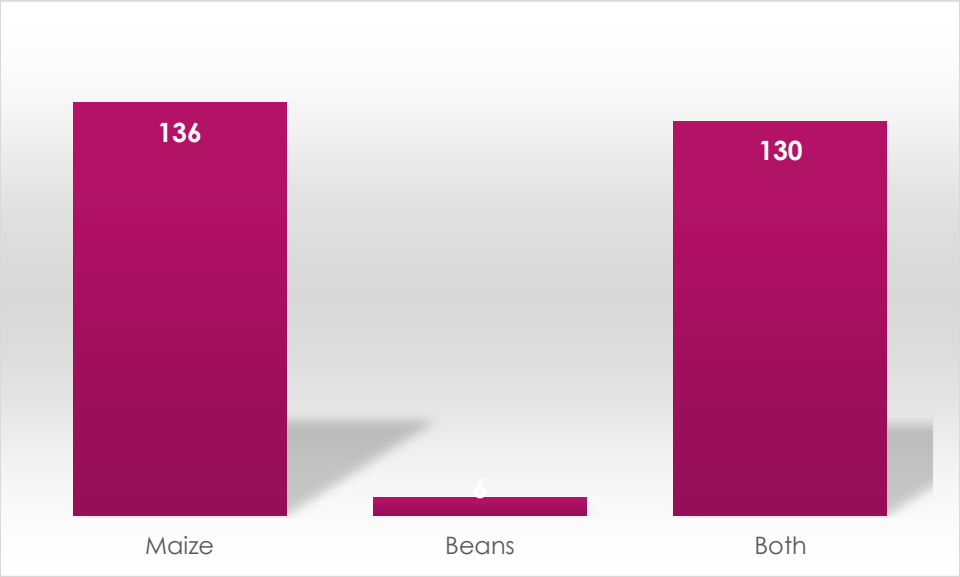

Figure 8: 2017 Maize and Beans Cropping Pattern (Nyagatare)

Table 12 and figure 9 demonstrate the cropping pattern at the last harvest showing that though both maize and beans were farmers' favourite crops, nevertheless, 136 farmers (50%) of total respondents planted maize as against 47.8% for beans and 2.2% for both maize and beans.

Table 13: Number of Respondents who lost Products at the Last Harvest

		Frequency	Percentage
	Yes	235	86.7
	No	36	13.3
	Total	271	100.0
Total			

Apparent from table 13 is the fact that overwhelming number of respondents (235) representing 86.7% lost their crop products at the last harvest season

Table 14: Extent of Product Loss

		Frequency	Percentage
Valid	0-19%	64	27.0
	20-39%	24	10.1
	40-59%	32	13.9
	60-79%	35	15.2
	80-99%	80	33.8
	Total	235	100.0
Total		272	

Table above shows high magnitude of product loss with 33.8% of smallholders losing between 80-99% of their crop commodities

Table 15: Gender and Product Loss

		Product Loss		Total
		Yes	No	
Gender	Male	98	8	(92.5%)106
	Female	137	28	(83.0%)165
Total		235	36	271

The table above elucidates the pattern of product loss between male and female farmers. It shows that more females (137) lost crop products than their male counterparts. However, intra-gender analysis reveals a different scenario. Product loss amongst men was 92.5% compared to 83.0% amongst women. Nevertheless, this gender difference in PHL was not statistically significant at $p<0.05$ (p-0.49)

Table 16: Stages of Product Loss by Respondents

Stage		Frequency	Percentage
Valid	On-farm	189	81.5
	Harvest and Handling	35	15.1
	Processing	6	2.6
	Transportation and marketing	1	.4
	Not applicable	1	.4
Total			

The foregoing table demonstrates quite clearly that PHL in the season under review were predominantly on-farm suffered by 189 (81.5%) of respondents.

Table 17: Causes of Product Loss by Respondents

		Frequency	Percentage
Valid	Too much rain	39	15.4
	Prolonged drought	150	59.3
	Pests and diseases	32	12.6
	Lack of post-harvest handling equipment	12	4.7
	Lack of transportation means	4	1.6
	Poor market access	9	3.6

Table above reveals the causal profile of PHL showing that prolonged drought accounted for the leading cause of PHL in 59.3% of cases followed distantly by too much rate at 15.4%

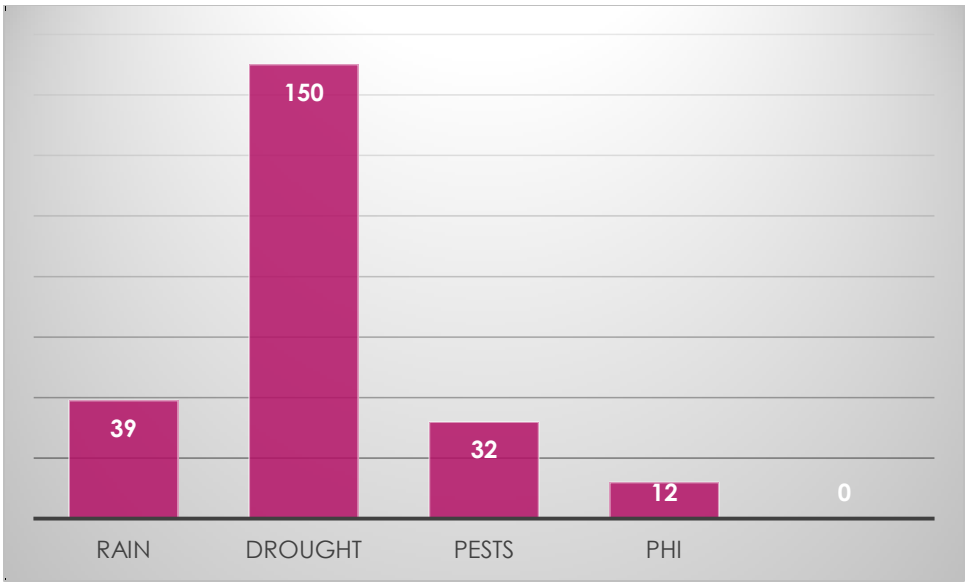

Figure 9: Causal Distribution of PHL

5.4 Relationship Between Agribusiness Investments and PHL

Table 18: Presence of Drying Facility

		Frequency	Percentage
Valid	Yes	160	59.0
	No	108	41.0
	Total	268	100.0

It comes out of table 18 that more respondents 160 (59.0%) confirmed having drying facilities in their areas as against 108 (41%) without dying facilities

Table 19: Presence of Storage Facility

		Frequency	Percentage
Valid	Yes	171	65.5
	No	90	34.5
	Total	261	100.0
Total		272	

Table 19 further confirmed increasing access to modern post-harvest infrastructures earlier previewed in table 21 as the presence of storage facilities was reported by 65.5% of respondents against 59% for drying facilities.

Table 20: Utilization of Storage Facility by Gender

Gender	Usage of storage facility		Total	Percentage
	Yes	No		
Male	57	47	104	54.8
Female	85	63	148	57.4
Total	142	110	252	

Table 21: Utilization of Drying Facility by Gender

Gender	Usage of drying facility		Total	Percentage utilization
	Yes	No		
Male	39	65	104	37.5
Female	73	86	159	45.9
Total	112	151	263	

Tables 20 and 21 show the gender utilization pattern of PHI by respondents. It is observed much clearly that women are better users of PHI than their male counterparts. For drying facilities, utilization among women was 45.9% compared to 37.5% among men. Trend of utilization of storage facilities showed a marginal difference with 57.4-females and 54.8%-males. On the whole, the difference in gender utilization patterns was not statistically significant for both PHI at $p<0.05$ (p-value for DF:0.177 and SF:0.679)

Table 22: Reasons for Non-Usage of Drying Facililities

		Frequency	Percentage
Valid	Too far from my house	44	61.1
	small in size	9	12.5
	Others	19	26.4
	Total	72	100.0
Total			

Table 23: Reasons for Non-Usage of Storage Facility

		Frequency	Percentage
Valid	Too far from home	18	37.5
	Small in size	11	22.9
	Others	19	39.6
Total		272	

Smallholder farmers who had modern post-harvest facilities in their areas but did not use them gave different reasons as shown in tables 22 and 23 above. 44 (61.1%) found the drying facilities too far from them, 9 (12.5%) considered them too small while the rest, 19 (26.4%) had other means of drying their products. For storage facilities, the reasons were slightly different. 19 (39.5%) of non-users claimed they had alternative methods of product storage while 18 (37.5%) report that the facilities were too from their homes. Size of facility was relevant in only 11 (22.9%) respondents.

5.5 Socioeconomic Factors Underpinning Differences in Productivity And Farm Income Between Male and Female Farmers

5.5.1 Productive Resources

Table 24: Size of Farmland

Farm size	Frequency	Percent
below 0.5ha	88	32.4
0.5-1ha	100	36.8
1-2ha	68	25.0
above 2ha	16	5.9
Total	272	100.0

Analysis of table 24 vividly illustrates the pattern of farming and arable land holding in the study district. Majority of respondents (100) corresponding to 36.8% cultivated between 0.5 and 1.0 ha closely followed by 88 respondents (32.4%) who cultivated 0.5 ha and below.

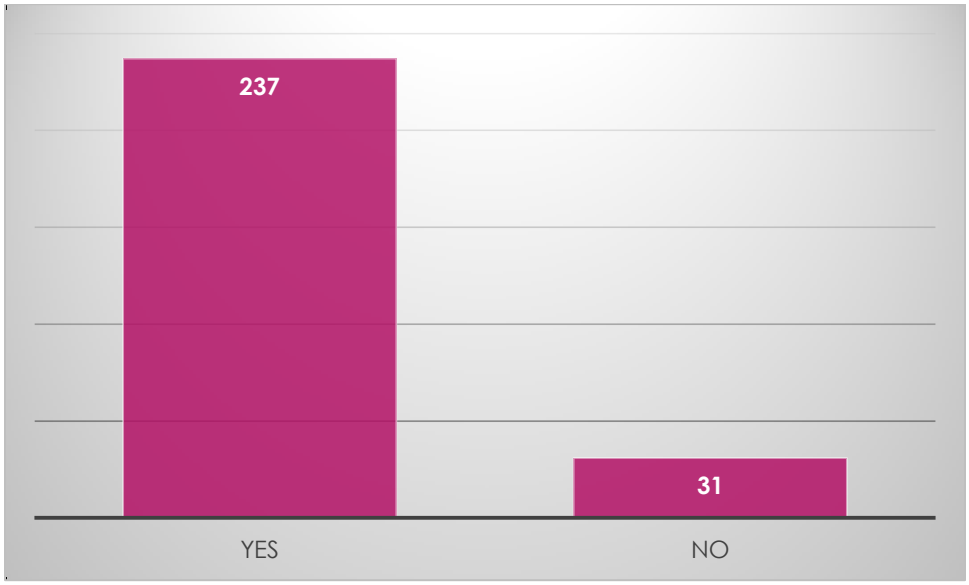

Figure 10: Use of Hired Labor

Further to figure 11, it is seen that engagement of farm wage-workers (manday) has become prevalent in the district practiced by 237 respondents (87.8%)

Table 25: Use of Improved Seeds

	Frequency	Percent
Yes	241	88.6
No	31	11.4
Total	272	100.0

From the above table, widespread use of improved seeds adopted by 88.6% of respondents has become part of the growing crop production technologies in the area

Table 26: Use of Fertilizer by Respondents

	Frequency	Percentage
Yes	243	90.0
No	26	9.6
Total	270	100.0

Apparent from the above table is the growing use of fertilizer in arable farming practiced by 90.0% of smallholder farmers

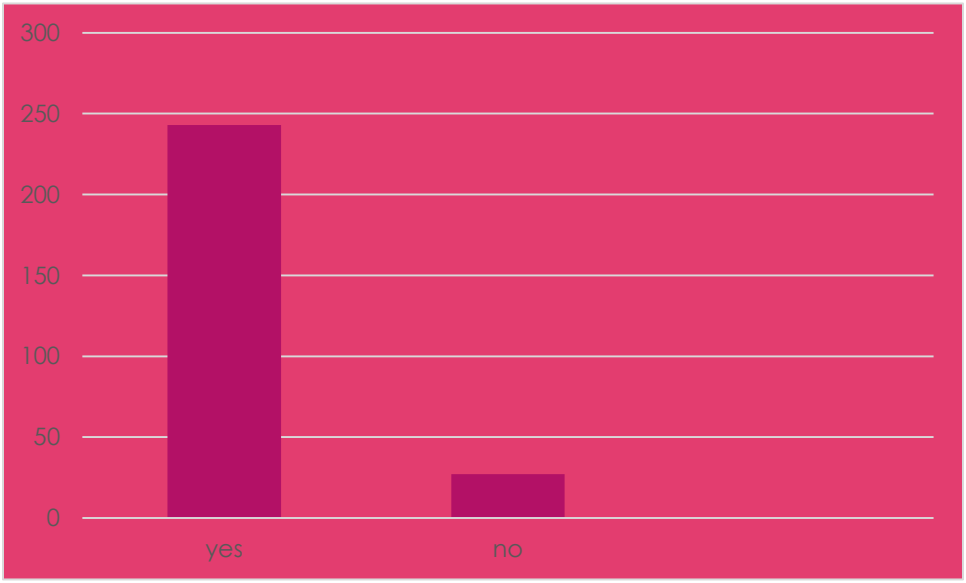

Figure 11: Use of fertilizer among respondents

Table 27: Gender and Pattern of Fertilizer Use

	Total		
	yes	No	
Male	94	13	107
Female	149	13	162
Total	243	26	269

Table 27 shows that fertilizer use is more common among women (149) than men (94). This difference was however, not statistically significant at $p<0.05$

Table 28: Quantity of Fertilizer Used (Kg)

Class interval	Frequency (f)	Mid-point (x)	Class total (fx)
10-49	85	29.5	2507.5
50-89	50	69.5	3475
90-129	34	109.5	3723
130-169	32	149.5	4784
170-209	3	189.5	568.5
210-249	5	229.5	1147.5
250-289	1	269.5	269.5
290-329	13	309.5	4023.5
330-379	9	349.5	3145.5
Total	**232**		**23644**
Mean			**101.91**

Above table shows the quantity of fertilizer applied by respondents during the last planting season. Evidence shows that most farmers (85) used between 10 and 49kgof fertilizer. Average fertilizer use was 101.9kg/person.

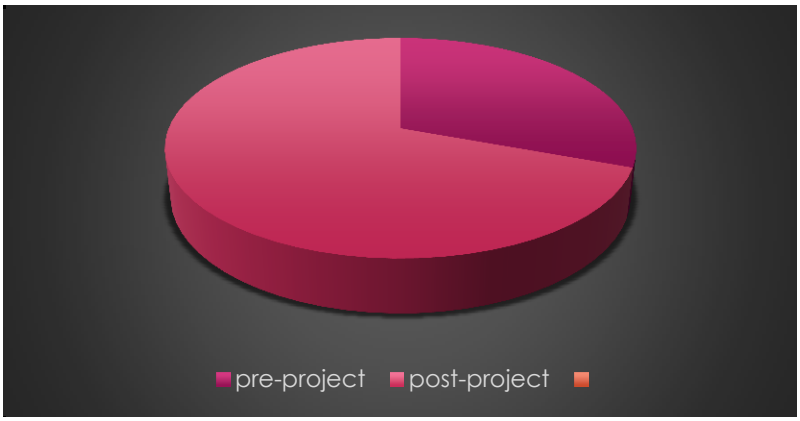

Figure 12: Mean fertilizer use pre-and-post-evaluation (KG)

5.5.2. Financial Resources

Table 29: Labour Cost (Rwf'000)

Class	Frequency	Mid-point	Class total
0-0.5	237	0.25	59.25
0.5-1.0	8	0.75	6.0
1.0-1.5	1	1.25	1.25
Total	246		66.5

Above table shows that the cost of hired labour for most respondents (237) was in the range 0-0.5million Rwf. Total sum accumulated on hired labor during the cropping season was however, 66.5 million Rwf.

Table 30: Cost of Seeds

Class (cost range)	Frequency (f)	Class mid-point (x)	Class total cost (fx)
660-3960	55	2310	127,050
4290-7590	41	5940	243,540
7920-11220	78	9570	746,460
11550-14850	13	13200	171,600
15180-18480	28	16830	471,240
18810-22110	5	20460	102,300
22440-25740	5	24070	120,350

26070-29370	3	27720	83,160
29700-33000	6	31350	188,100
Total	**234**		**2,253,800**

It comes out of table 30 that highest number of farmers (78) spent between 7920 and 11220 Rwf on procurement of seeds with aggregate spending of 2, 253, 800 Rwf

Table 31: Cost of Fertilizer Used

Class(cost range)	Frequency (f)	Mid-point(x)	Class total cost(fx)
4200-20580	85	12390	1053150
21000-37380	50	29190	1459500
37800-54180	34	45990	1563660
54600-70980	32	62790	2009280
71400-87780	3	79590	238,770
88200-104580	5	96390	481,950
105,000-121,380	1	113,190	113,190
121,800-138,180	13	129,990	1689870
155,400-171,780	9	163,590	1472310
Total			**9,599,730**

Table above gives the total expenditure on fertilizer procurement at 9, 599, 730 with most respondents (85), spending between 4200 and 20580 Rwf.

5.5.3 Access to Credit

Table 32: Membership of Savings and Loans Group

	Frequency	Percentage
Yes	262	97.0
No	8	3.0

Table 33: Membership by Group

	Frequency	Percentage
SACCO	68	26.0
MFB	16	6.1
CB	8	3.1
FC	29	11.1
SHG	47	17.9
MMSG	94	35.9
Total	262	100.0

By the evidence in tables 32 and 33, majority of respondents 259 out of 262 respondents (95.2%) belonged to one savings scheme or another as against 8 (2.9%) without any association. MMSG had the highest number of enrollees (35.9%) followed by SACCO (26%) and SHG (17.9%). Only 8 farmers (2.9%), had a formal credit relationship with commercial banks.

Table 34: Loan Application by Respondents

		Frequency	Percent
Valid	Yes	210	80.8
	No	50	19.2

Table 35: Loan Success Rate by Respondents

		Frequency	Valid Percent
Valid	Yes	134	62.9
	No	79	37.1
	Total	213	100.0
Total			

Table 36: Amount of Loan Given

		Frequency	Percentage
Valid	0-0.5mRwf	112	87.5
	0.5-1.0mRwf	12	9.4
	1.0-1.5mRwf	2	1.6
	1.5-2.0mRwf	1	.8
	2-2.5mRwf	1	.8
Total			

Table 37: Sources of Loan Given

		Frequency	Percentage
Valid	SACCO	23	17.2
	MFB	33	24.6
	CB	5	3.7
	FC	37	27.6
	SHG	36	26.9
Total			

It comes out of tables 34-37 that most farmers 210 (80.8%) applied for loan during the last planting season. 134 farmers (62.9%) were successful giving a loan success rate of 63.8%. 87.5% of the total credit portfolio was between 0-0.5million RwF. FC and SHG were the predominant loan sources

Table 38: Total Credit Facility (Rwf'000)

Class	**Frequency**	**Mid-point**	**Class total**
0-0.5	112	0.25	28
0.5-1.0	12	0.75	9
1.0-1.5	2	1.25	2.5
1.5-2.0	1	1.75	1.75
2.0-2.5	1	2.25	2.25
Total			**43.5**
Mean			**0.34**

Above table shows a total loan portfolio of **43.5 million RwF** in favor of smallholder farmers with average disbursement at **340, 843.75RwF** per farmer.

5.5.4 Technical and Extension Services

Table 39: Provision of Technical Services

	Frequency	Percent
Yes	258	95.6
No	12	4.4

Table 40: Provision of Extension Services

	Frequency	Percent
Yes	243	91.0
No	24	9.0
Total		

Apparent from tables 39 and 40 is the near universal coverage of smallholder farmers with both technical and extension services these being 95.6% and 91.0% respectively.

Table 41: Gender Distribution of Technical Services

		Provision of technical services		Total	Percentage
		Yes	No		
Gender	Male	98	8	106	92.5%
	Female	160	4	164	97.6%
Total		258	12	270	

Table 42: Gender Distribution of Extension Services

		Total			Percentage
		Yes	No		
Gender	Male	101	6	107	94.5%
	Female	143	17	160	89.4%
Total		244	23	267	

Though, findings from tables 41 and 42 indicate that in absolute terms, more female farmers accessed extension and technical support services than men, nevertheless, there were appreciable differences in the proportional coverage for both. 94.5% of men as against 89.4% of women received extension services though this was not statistically significant at $p<0.05$ (p-0.265). In contrast, 92.5% of men and 97.6% of women received technical support. This difference was statistically significant at the same probability level (p-value:0.047).

5.6 CURRENT MARKETING CHANNELS AND THEIR IMPLICATIONS FOR FARMERS INCOME

Table 43:Pre-Project Marketing Channels

	Frequency	Percentage
Neighbours	21	7.9
Local market	34	12.8
Traders	139	52.3
Cooperatives	47	17.7
Others	25	9.4

Table 44: Current Marketing Channels

Marketing Channels	Frequency	Percentage
Local market	4	1.5
Traders	32	12.0
Cooperatives	216	80.9
Others	15	5.6
Total	267	100.0
Total		

Tables 43 and 44 show the trend of product marketing both before the beginning of PASP and at the time of this study. Prior to PASP, sales pattern revealed thus: 139 respondents (52.3%) sold their crops directly to traders, 47 (17.7%) to cooperatives, 34 (12.8%) to local markets, 21 (7.9%) to neighbours and 25 (9.4%) to others. At the time of the study, the change in trend shows that 216 farmers sold directly to cooperatives, 32 (12.0%) to traders, 4 (1.5%) to local markets and 15 (5.6%) to others

Table 45: Annual Financial Statements of Selected Cooperatives

S/N	ACCOUNTING YEAR	QUATITY OF HARVEST(tons)	SALES INCOME (Rwf'^{000})
1	2014	171.59	27,956,500
2	2015	336.107	63,047,230
3	2016	187.717	36,892,220
4	2017	297.021	77,629,105

Source: AFR of selected cooperatives (May, 2018)

Above table displays the trend of product aggregation and sales by some selected cooperatives in the district showing that between 2014 and 2017, cooperatives' income grew by 49, 672, 605 Rwf

5.6 Gender Targeting

Table 46: Gender and Decision Making on Income Utilization Before the Beginning of Project and the Time of Evaluation Study

Project time	Male	Percentage	Female	Percentage	Both	Percentage
Before	101	37.5	42	15.6	126	46.9
After	48	18.1	22	8.3	195	73.6

Table 46 depicts the pattern of gender power relations with respect to decision making under changing circumstances. While most respondents (46.9%) shared decision-making responsibilities, however, on gender-denominated analysis, it is observed that before the start of PASP, men (37.5%) were more involved as sole decision makers on HH income than women (15.6%). On the other hand, the role of men declined steeply to 18.1% as ofthe time of this evaluation as most decisions were admittedly taken in the following order: both sexes (73.6%), men only (18.1%), women only (8.3%)

5.7 Economics of Post-Harvest Losses

Table 47: Production Cost Analysis (Rwf'000)

S/N	FACTOR- INPUT	COST (RwF'000)
1	Seeds	**2,253,800**
2	Fertilizer	**9,599,730**
3	Manday (*Hired labor)*	**66, 250,000**
4	Credit facility	**43, 500, 000**
5	Farmers' labor cost	**130, 080, 000**
6	Total	**251, 683, 530**

Source: Data from field survey as contained in tables 29, 30, 31 and 38 (May, 2018)

Table 48: 2017 Product Yields (tons)

Class	Frequency	Class Mid-point	Class yield
0-2	190	1	190
2-4	41	3	123
4-6	25	5	125
6-8	5	7	35
8-10	4	9	36
10-12	3	11	33
12-14	3	13	39
Total	**271**		**581**

Table 49: Quantity of Product Sold (tons)

Class	Frequency (f)	Class Mid-point (x)	Class total (fx)
0-2	194	1	194
2-4	38	3	112
4-6	25	5	125
6-8	4	7	28
8-10	4	9	36
10-12	3	11	33
12-14	3	13	39
TOTAL	**271**		**567**

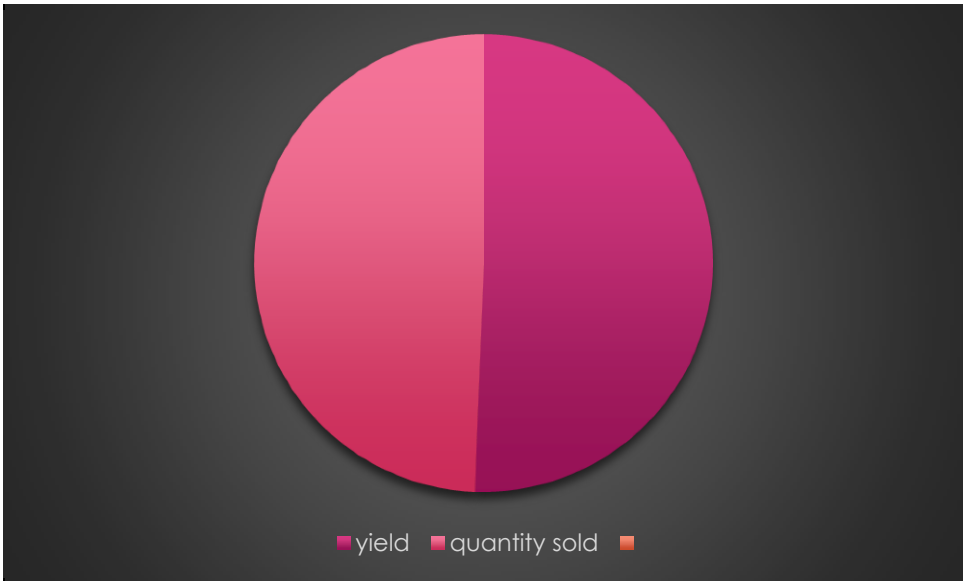

Figure 13: Annual product yield vs quantity sold

Table 50: Sales Income (RwF'000)

CLASS	FREQUENCY (f)	CLASS MID-POINT (x)	CLASS INCOME
0-0.5	195	0.25	48, 750,000
0.5-1.0	42	0.75	31, 500, 000
1.0-1.5	20	1.25	25, 000, 000
1.5-2.0	6	1.75	10, 500, 000
2.0-2.5	4	2.25	9, 000, 000
2.5-3.0	2	2.75	5, 500, 000
3.0-3.5	2	3.25	6, 500, 000
TOTAL			**136,750, 000**

From tables 47-50, the following values emerge:

Production cost=**251, 683, 530**

Total yield=**581T**

Total sales income (revenue)=**136, 750,000**

Total loss: Production cost-Revenue: **251, 683, 530-136, 750, 000**

Total loss=114, 933, 530

Average loss=424, 108.97 RwF

Underlying assumptions behind economic cost analysis

1**.** All loans were integral part of farmers' labor cost

2. Farmers' labor cost was calculated based on the prevailing wage rate of 1500-2000 RwF in the country's tea industry

3. Selling price of maize was used for all income calculations

4. All farmers were assumed to have suffered product loss during the period

5. All fixed capital costs were excluded

Table 51: Framework Assessment of Project Performance Based on Areas Assessed by the study

PROJECT OBJECTIVE	**PROJECT TARGET (ON COMPLETION)**	**STUDY FINDING**	**REMARK**
Increase women and youth participation in agriculture.	Women: 40% Youth: 20%	Women: **60.7%** Youths (15-30 years): **14%**	Delivered above average.
Promote adoption of modern PHI.	80% of farmers disaggregated by sex adopt best post-harvest practices.	Men: adoption rate-37.5% Women: adoption rate: 62.5% **Average: 50.3%**	Average performance
Promotion of agribusiness investments	**20%** of participating HUBs make significant new capital investments in value adding/market development activities **>90m RwF**	**4.5%**	Below average
Increase access to finance by smallholder farmers	**80%** of participating HUBs are able to access loan under commercial conditions	**77.3%**	Satisfactory. High prospect of target delivery with necessary uprating given the timing of this study coming 11-month pre-closure.
Facilitate market linkage and boost smallholders' income.	**80%** of HUBs implement new marketing contracts with traders	**100%**	Delivered above target

Generate appreciable reductions in PHLs and improve value chain development.	**20%** reduction in targeted CIP crops post-harvest losses	**41%** increase in product loss compared to baseline (Maize)	2017 PHL were largely an episode of crop failure and therefore an unreliable measure of project performance
Total score	**340**	**261**	

Project Success Scorecard **(PSS)**: $\frac{what\ has\ been\ achieved}{what\ should\ have\ been\ achieved}$ x 100

PSS: $\frac{\mathbf{261}}{\mathbf{340}}$ X100: **76.8%**

Overall project success scorecard=76.8%

5.8 Discussion of Findings Based on Objectives

5.8.1 Respondents' Demographics

The study found a higher proportion of women (60.7%) in maize and beans farming than men (39.3%) compared with baseline values of 64.1% men and 35.9% women. The gender distribution under the study is compatible with the findings of many other studies confirming the dominance of women in staple crop production in Africa (Yemisi,2009, PASP, 2013). Furthermore, most enumerated farmers (43.0%) were in the productive age group 31-46 years against 31-60 years baseline line finding. This age-labor force distribution compares much favourably with farmer age demographics around the world: US-58.3 years, Japan-60 years and Africa->60 years (Gro-intelligence, 2016) and has important positive implications for the present and future development of agriculture in the country. Notwithstanding the preponderance of women in Rwandan agriculture according to this study, a striking feature of the age distribution is the larger percentage of men (52.1%) in the stated productive age category. Going further, average HH size was estimated at 3.0 people in contrast to baseline finding of 4 people even though most rural farmers (53.5%) still retained preference for large family size of 4-6 people. The proportion of HH headed by women rose to 79.0% compared to baseline (35.9%). In addition, female HH heads were overwhelmingly more educated than their male counterparts having 77.5% of secondary education and 100% of post-secondary literacy. The gender-literacy difference was statistically significant at $p<0.05$. The observed pattern of headship and maternal

literacy has been shown to promote children education and accelerate the social context of national development more importantly in LDCs.

5.8.2. Post-Harvest Losses and Gender Distribution

Generally, loss of crop products was a common experience reported by 86.7% of farmers during the last harvest compared to 44.3% baseline. Higher percentage of these farmers (33.8%), lost between 84-104% of their crops with mean product loss of 56.1% against 25.2% baseline. In absolute terms, women lost more products (137) than men (98). However, further analysis within gender revealed that of the total number of male farmers enumerated, 92.5% of them suffered product loss compared to 83.0% of women. This variation may not be unconnected with differences in literacy and user-habits between both sexes regarding available post-harvest technology. As higher literacy promotes technology adoption, a more positive user attitude to modern PHI was not unexpected among Nyagatare women farmers who have been shown in this study to be more educated than their male counterparts. Currently, average rate of utilization of existing post-harvest facilities in the district confirmed this possible linkage: Men 37.5% Women: 62.5%%

As documented by Kiaya and many other investigators working on PHL in LDCs, 2017 crop losses were concentrated in the upstream sector of the product value chain with on-farm losses accounting for 81.5% of total. Prolonged drought was the leading cause in 59.3% of cases precipitating massive production shortfalls. This contrasts sharply with baseline finding of ‘too much rain’ accounting for 42% of PHL. Nevertheless, the role of excessive rain in the last season was equally of sufficient concern as seen in picture 1.Moreover, sectoral analysis of PHL in the season under review revealed significant differences in the character and magnitude of the problem both within and among sectors. In the far north sectors of the district notably, Musheri-Matimba, Rwimigaya..et al, the share of pests and diseases in driving product loss from unsold inventories secondary to reduction in market activities was comparably higher. For the southward sectors, it was more of crop failure where whole crop fields were either completely or near-completely blighted by prolonged drought. These were the painful experiences of Rukomo, Mimuli, Tabagwe and Nyagatare sectors of the district.

Figure 14; Flooded maize field in Rabeza

5.8.3. Agribusiness Investments and Post-Harvest Losses

PASP engagement with the post-harvest sector looked set for greater achievements if current project tempo is sustained. Apparent from the study findings is the appreciable increase in the number of post-harvest infrastructures as demonstrated in pictures 2 and 3. 65.5% and 59.0% of farmers confirmed having storage and drying facilities respectively in their localities as against 46.8% and 46.6% in baseline findings. In the same vein, there are noticeable gender distinctions in the facility utilization pattern. Men, generally, are poor users of locally-adapted post-harvest technology with overall adoption rate of 37.5% compared to women 62.6%. Conversely, men prefer the use of storage (40.1%) than drying facility (34.8%) while the preference of women was in favour of drying (65.2%) than storage facility (59.9%). On the whole, average adoption rate among surveyed farmers was 50.0% compared to 57.8% baseline finding. Going further, smallholder farmers, who had improved post-harvest facilities but did not use them variously accounted for their user-habits. “Long distance from home” was the greatest disincentive to the use of drying grounds among 61.1% of farmers as opposed to availability of alternative methods of product storage claimed by 39.1% of farmers as the main cause of non-utilization of existing storage facilities in their areas.

This trend was not unexpected given the rising use of hermetic sacs in rural HHs. Obviously, the years ahead are bound to witness the growing recourse to domestic storage following the commencement of distribution of silos bags to rural farmers by PASP in the terminal phase of this study. As a result, infrastructure-related loss was minimal during the last harvest (4.7%). The corresponding effect of these multiple investments has been to increase the commercial orientation of agriculture in the district along with substantial traction to government policy goal of achieving market-led agriculture. Market output of products rose sharply from 27% (PASP, 2013) to 97.5%

Figure 15: PASP-assisted modern drying facility in Kagiragi village owned by Ejoheza Cooperative

Figure 16: Storage facility built by MINAGRI in Nyabugogo village for COOPAMA Cooperative

While acknowledging the strong catalytic role of PASP in minimizing product loss, this study took note of some elements of inadequate pre-project cooperative mapping in the sense of efficiency of governance and result-delivery profile. Quite evidently, some were selected for their huge size and presumed potential to reach a wider range of primary beneficiaries with scant attention to their track record that could inform performance prospects. Example of leviathan cooperatives with disappointing performance on evaluation is **KABOKU** whose operations were marred by many internal wranglings so much that no single record was available to appraise capital project performance. On the other side of the spectrum, the project outreach was low to other valuable but socially and economically vulnerable cooperatives like **CODEMATA** where project support was needed the most. In this cooperative, mean age of members was 54.5 years and for the 4-year intervention duration, no single capital investment traceable to PASP had been undertaken. The only old and crumbling storage facility in the area was donated many years ago by **CARITAS**-a catholic relief organization. (Figure 18)

Finally, cooperatives investments in maize and beans value chains were principally limited to post-harvest care and product syndication for supply purposes. No cooperative displayed any business expansion plan with processing outlook to ensure profitable continuity after PASP programmatic closure.

Figure 17: Dilapidated storage facility owned by CODEMATA

5.8.4 Socioeconomic Factors Underpinning Gender-Based Productivity and Income Differences.

5.8.4.1 Arable Land Holding

Challenges persist with arable land holding though a number of government initiatives and land husbandry projects have been getting ahead of the numerous constraints. Nevertheless, farm plots remain fragmented with ecosystem disservices from population pressure (Rutikanga, 2017). Average farm plot under the study was 0.64ha/person-a 0.1% marginal increase above the baseline average of 0.6ha/person and a 28.9% over the national average of 0.9ha/person (EICV 3, 2011).Indeed, only 5.6% of the surveyed farmers cultivated >2ha validating previous findings of 6.0% (Rutikanga, 2017). Cropping pattern was typically mixed to maximize productivity on small farms. Both maize and beans were planted in alternating seasons though maize enjoyed relative supercession

5.8.4.2 Hired Farm Hands

The use of supplementary labor was becoming prevalent among rural farmers in the district perhaps as standard of living increases and more eligible children get enrolled in schools. Notwithstanding the higher number of women farmers, men (91.5%) had a higher proportional use of farm hands than women (85.9%). During the planting season, a total sum of 66.5 million RwF was expended as hired labor cost.

5.8.4.3 Agro-Inputs

PASP facilitative agribusiness intervention has been crucial in the growth of input use. Sustained promotion of crop production technology while not being primary to its engagements, has been, nevertheless, pivotal to the large-scale use of agro-inputs. For example, use of improved seeds rose from 61.8% (PASP, 2013) to 88.6% at the time of this study. Though, most farmers 85 (36.6%) used between 10-49kg of fertilizer, mean soil nutrient use (as a function of chemical fertilizer application) per person rose from 45kg pre-project to 101.9kg post-study representing an impressive 127% increase.

5.8.4.4 Financial Services

Improvement in access to rural financial services (from 3% to 62.9%) supports the findings of other similar studies and reflects the impressive trend in the nation's micro-capital deposit and lending profile. In 2011, deposit rose from $35-60 to boost lending capacity by additional 70.1% (FSSAR, 2011). This trend may not be unconnected with the rising mobilization of the public towards developing a healthy savings culture as exemplified by the large percentage (97%) of rural farmers belonging to one form of savings and loans group or the other. More commonly, farmers tend to belong to more than one group of these available groups to brighten their loan prospects while pro-poor savings and loans societies such as farmers' cooperatives and self-help groups which are consolidated to form the Mixed Micro-Saving Group (MMSG) remain high in the membership pecking order (35.6%). Unsurprisingly, 54.5% of all successful loan applications came from this group perhaps because of their flexible micro-capital resource lending policy.

These finding shares much in common with both baseline and many other reports on micro-credit status in Rwanda giving highest percentage (27%) to informal credit associations on

group-level access rating (FSSAR, 2011).Average credit facility per farmer stood at 340, 843.75Rwf while most farmers spent their various loans on input purchase such as seeds and fertilizers. This is certainly much at variance with extant government subsidy policy and the post-harvest payment agreement between farmers' cooperatives and agro-dealers. It may therefore be expedient to diligently scrutinize the fertilizer distribution system so as to forestall rent seeking and ultimate sabotage of both government and project efforts.

On the side of sampled HUBs, access to loans on commercial conditions was comparatively high (77.3%). Large part of the burrowed sums was spent either on input purchase, transportation of crops from farmers to buyers or product syndication from dormant HUBs. There was no record of loan spending on capital investment that had sustainability target. Similar worry was expressed by the market analysis report conducted in 2016. At this juncture, it needs be stated that project-sponsored financial intermediation through the **Business Development Fund** has been less than meaningful in the value chain. While the fund has the tag of pro-poor credit guarantee scheme, it was operated within the strict regulatory environment and policy nuances of conventional monetary institutions such that its robust insistence on 50% equity contributions from potential beneficiaries merely reintroduced the familiar collateral constraints of regular commercial banks and wiped off intended financial incentives for farmers. In the district of study, only one capital project was accomplished in the beans and maize value chains consisting of an ultra-modern storage facility for KOHIKA cooperative. Besides collateral barriers, the Fund's reaction time does not currently homogenize with the urgent impulse of rural development in the country. Processing cycle for BPs is too long for a modern spending entity like IFAD. Many instances and in particular, related evaluation reports readily attest to this. For example, COPAMA, a crop cooperative in the district just received approval for its BP to purchase a truck for product transportation after over a year of submission. Meanwhile, it borrows 10millionRwF per harvest season to service transactional costs mostly on transportation for product collection and delivery. In 2017 alone, records showed that the cooperative spent a whopping sum of between 30-40 millionRwF to evacuate and deliver products to its accredited buyers while the total required sum for truck purchase was only 26million RwF. Even though, this amount had received formal approval after a prolonged wait in the tubule of quasi-

bureaucratic processing, yet, there was no cash backing as of the time of winding down this study.

5.8.4.5 Technical and Extension Services

Inclusive and decentralized technical and extension services were some of the vital components of project activities that enjoyed high level of coverage in the study district. Farmers across gender lines received both services in evidently sufficient details. Nonetheless, there are instructive variations. Greater percentage of men received on-farm support while women, on the other hand, benefited more in terms of technical assistance. It may then be reasoned that while men stand higher chance of crop production advantage, women's acquisition of technical savvy predisposes them to better post-harvest care and product processing thereby possibly accounting for the dominance of women in value chain growth and development.

5.9 Marketing Channels and Implications for Farmers Income

This study has found availability of vast market as well as market development potential for both maize and beans in the country. Before the onset of PASP, farmers' commercial partners were: traders (52.3%), cooperatives (17%) and local markets 12.8%. These markets were loose and generally unregulated. Prices were less than competitive and many times, at buyers' behest especially for farm gate transactions. PASP intermediation has seen the dominance of formal markets (80%) over other sales avenues. The various formal channels contained in table 42 present a mix of structural opportunities that broaden farmers option of product sales at competitive rates. While some market actors have strict procurement principles and policies, others run a fairly flexible schemes consequently stratifying the market in a way that allows farmers or cooperative groups with different product grades to retain market access. More importantly, has been the impact of the dramatic expansion of local SMEs and large agro-processing industries on marketing trend. AIF, the major food processing company in Rwanda, and a number of others are facilitating continued product uptake to reduce storage time and attendant PHL.Likewise, institutional market catalysts such as FoodTrade (a five-year trade enhancement and promotion program funded by the UK government for East and Southern Africa) are adding to the new stimulus of enhanced growth in the structured grain markets towards scaling up staple crops trade and delivering a range of attributable benefits to farmers, the private sector and consumers. On its own and through partnership with some of these key

market players, PASP facilitates access to market information and provides vital linkage to wider commercial outlets in addition to other relevant assistance contained in the table under reference. This has given a strong commercial orientation to the district agriculture such that the share of harvest sold as a percentage of total crop production rose from 21% (EICV3, 2011), 27% (PASP, 2013) to 97.5% under the current study

Without doubt, subsisting marketing arrangements provide farmers with a win-win situation. In its most common form, cooperatives enter into purchase forward agreement with major buyers which specifies product quantity and quality with or without buying price specification. In turn, the cooperatives collect products from farmers at zero transaction cost in the direct sense of it. Ultimately, the products are sold to contract buyers with a price differential of 30 RwF for maize and 35.4RwF for beans (Market analysis report, 2016) thereby generating surplus revenue in the process. Evidence abounds to show that this dynamic and innovative marketing approach has correlated with progressive shift in both cooperatives and farmers' incomes. Between 2014 and 2017, there was a 167% increase in the income of selected cooperatives which, in turn, translated to smallholders' income growth since they were paid directly from cooperatives accruals. Though, government continues to play a protective role in product price determination by setting the crop commodity price floor, the strong emergence of inclusive price determination platforms consisting of producers and buyers was noted under this study.

In passing, gender and youth targeting measures have fared differently. The study acknowledged changing trend of gender power relations with respect to critical decisions on utilization of domestic economic resources. Before PASP, HHs where men dominated economic decision-making process were higher (35.5%) than women (15.6%). This share declined steeply to 18.1% though women did not also fare better as lone decision makers (8.3%). The project impact has been to raise the share of collaborative decision-making between both sexes from 46.9% to 73.6%. Gender and leadership has significantly stagnated. Of the 22 cooperatives only 5 (22.7%) were headed by women compared to the project benchmark of 30%. Except in targeted value chain activities, none of which was observed by this study, gender participant quota (40%) specified in the project document did not avail much, if any at all, to alter the balance of women participation. In other words, the pattern of women participation in the district agriculture was

more a function of traditional labour force distribution than may be attributed to deliberate gender targeting. Regrettably, there was no credible evidence of youths mainstreaming in the government agriculture renaissance agenda. The only youth cooperative in the district had a total of 29 disparate and disenchanted members. Access to productive resources was poor and project patronage for them was near zero. Most of them farmed on leaseholds of unpredictable duration as owners of such plots often revoke at will. No youth was able to access financial support arising from impossible collateral requirements. Nationally, the Rwandan Youths in Agribusiness Forum (RYAF) operated largely as a procurement platform from where external intervention projects recruit requisite personnel through their dedicated website. Challenges of land assets in the country were often cited as chief impediment to government willingness to satisfactorily leverage agriculture to address youth unemployment.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of the Study

The Climate Resilient Postharvest and Agribusiness Support Program (PASP) formally took off in Rwanda in 2014 to advance government rural poverty reduction efforts. Operating through a set of three interdependent components, it seeks to reduce staple crops post-harvest losses at producer and first aggregator levels, strengthen food security among rural staple crops producers, support the private sector to strengthen the competitiveness of staple crops value and supply chains, enhance producers' access to, and linkages to wider markets and enhance employment opportunities for women and youths. Since the project's official roll out over four years ago, it has engaged in systematic implementation of activities to deliver on key program objectives. More importantly, it has concentrated on the post-production sector of the product value chain to improve post-harvest handling practice and processes through the introduction of culturally appropriate and socially acceptable post-harvest technologies.

While periodic Country Program Evaluation reports have been providing insights into project strengths and contending challenges, the totality of the evidence on ground from the standpoint of this study is that of a multilateral intervention project marching steadily to its ultimate celebration point. PASP has not only promoted the significant adoption of modern PHI with drastic reduction of PHL, it has provided a new capacity development frontier giving farm support services and training SHF on crucial areas of business management towards effective mobilization of entrepreneurial mindsets. In tandem with other institutional actors, project has expanded access to micro-capital resources, facilitated market linkage and trade alliances on a wider scale with collateral impact on smallholder farmers' income

Though, high crop losses were recorded in the season under review, this was essentially ecological in nature caused by massive drought in many of the large and notable sectors of agricultural production. The resultant drought-driven and huge economic losses suffered by farmers generate new evidence that makes investments in climate-smart-agriculture more compelling on the part of government and smallholders alike. On the whole, PASP is pushing

forward as a valuable partner to the government of Rwanda to draw the line under the past in the context of endemic poverty in the country.

6.2 Conclusions

This study has carefully analyzed PASP contributions to the repositioning of agriculture in Rwanda by looking at the prevailing magnitude of PHL and their gender distribution, effect of agribusiness investments on PHL, the impact of new marketing channels and models on smallholders' incomes and the various socio-economic characteristics that undergird productivity differences between male and female farmers. Results showed that PHLs in the last planting season were profound with clear gender differences. Factors associated with these differences included but not limited to higher number of women farmers who participated in the study, level of literacy, scope and type of extension contacts, all of which directly or indirectly affected the level of adoption of modern post-harvest technology. The bulk of PHLs was crop failure in nature occasioned by prolonged drought that gave rise to high labor inefficiency. This loss was characterized by differences both within and among sectors. In addition, economic cost of product loss was huge and devastating across smallholder value chains and calls for more concerted efforts on prevention and control.

Expansion of agribusiness investments has increased the number of PHIs particularly; modern storage and drying facilities consequently reducing product losses emanating from deplorable post-harvest infrastructures. Moreover, the HUB model which brought together different value chain actors positively impacted the downstream crop production phase by stimulating increased use of agro-inputs to improve crop commodity yields and fostering a climate of improved productivity.

On current marketing channels, findings revealed that the growth of structured and diversified grain markets coupled with increasing levels of agribusiness operations especially in the food industries were fast transforming the practice of agriculture in the district from subsistence to commercial. This transition has increased both the cooperatives and smallholder farmers' income in line with the project development objectives

Going further, the study identified land size, input use, technical and extension services, literacy, access to financial services as some of the crucial factors underlying gender-based differences in productivity and income. On finance, the poor support for farmers in the district by the BDF was

evident. With its continued domiciliation behind seemingly imperforate policy walls, BDF represents one of the stories to be re-written under PASP.

Youths are disinherited and need a special focus to take advantage of their productive energy for national development. Similarly, support for women in agriculture is pivotal to maximum returns on transformation investments given their controlling share of agriculture labour force in the country. Addressing structural challenges facing their participation in the sector is an important part of the many steps required for achieving the growth targets under CAADP.

With a PSS rating of 76.8%, this study concludes that the project has performed well and contributed meaningfully to Rwanda's agriculture renaissance agenda within its four years of engagement with the sector.

6.3 Recommendations

The profound economic loss of close to half-a-million RwF per farmer experienced during the last harvest season raises the urgency of action at all levels of government. The study makes the following advisory proposals in the continued effort to drive the wheel of agricultural transformation forward in the country.

6.2.1 Operational Proposals/Recommendations

6.2.1.1: Water Harvesting

Prolonged drought from changing climate system calls for a change of strategy in the management of irregular rainfall pattern. Even though, the study noted the novel use of climate information boards to complement the various channels of disseminating climate-related information, this is only mostly effective and unreliably so, to guide timing of harvesting and drying. They do not offer overly reliable barometers for ordering the planting time. As a result, government must look more inwards towards promoting on-farm water harvesting technology that gives a greater measure of resilience to agricultural practices. Large-scale production or procurement of damp-sheetings by government and onward sale to farmers at subsidized rates may be part of the local efforts required to build climate-smart agriculture. Since communities are not affected equally by drought, it may seem wise to precede these efforts by drought-prone community mapping so that "most-at-risk" communities are identified for the pilot phase of on-farm multi-site underwater storage with damp sheetings. It is also important if not overly expedient, to rethink the concept of water harvesting away from reliance "on captive rainfall". In

this wise, all water sources with year-round availability and with reasonable potential to supply water to host communities and beyond but without appropriate technology of doing that should be identified and leveraged. Once these sources are identified, a modest pipe-reticulation project may be all that is required to give them a wider reach. Thinking the high stuff of irrigation, mini-irrigation and the likes may sound technology-intensive and discouraging. The study saw this potential somewhere in Rurenge area and bringing a couple of ingenious welders together to channel the water sources could be the solution needed. Apart from water harvesting, smallholders should be encouraged to adopt small ground water irrigation by digging water wells in their farms. Kachenbe 2013, has shown the effectiveness of this practice among farmers in the Atankwidi sub-basin in the Upper East Region of Ghana as part of a strategic indigenous response to climate change challenges.

6.2.1.2 Climate Resilient Post-Harvest Infrastructure

Drying remains a key value chain activity in maize. However, the less than 15% moisture content specification by buyers is becoming increasingly difficult to attain in the face of climate uncertainties. It is vital in this sense to come up with other climate-smart alternatives through the acquisition of low-carbon post-harvest management infrastructures like solar-powered drying machines. The huge cost has become a scare but government can encourage different value-chain actors to form a business partnership around this activity. PASP moves in this regard is well noted and should be taken further by government. Besides drying, adequate storage is equally required for both processing and pre-marketing activities. It is therefore desirable to promote the use of low-cost, effective HH metal silos using local tinsmiths to improve storage hygiene.

6.2.1.3 Scale Up of Phi Density

In sub-program 1.5.2 of PSTA, government commits to focus on agricultural mechanization and increase the use of agricultural input and post-harvest technology. In that regard, more steps should be taken to increase the PHI density. This is especially so noting that distance was a major disincentive to broad-based use of drying grounds and storage facilities in this study

6.2.1.4 Women Mainstreaming

Given that women dominate agriculture and that very high number of HHs are headed by them, opportunities that capacitate their income-generating ability in the sector should form part of the

paramount pursuits of government. Example of these should be setting minimum land allocation quota for women to remove the barrier imposed by traditional land tenure system that largely weighs against them in many parts of Africa. Similarly, initiatives that increase their access to knowledge and new skills grow family income and increases HH living standard. Though, the Village Extension Worker's concept in Rwanda under the PASP project resembles the Community Knowledge Worker Initiative running in neighbouring Uganda, it is nonetheless helpful to take a cue from the ICT-linkage that has made it possible for the Ugandan scheme to track vital aspects of farming outcomes such as asset stock (e.g farming tools, wheelbarrows etc) through periodic HH reports (Spore, 2014)

6.2.1.5 Regular Cooperative Oversight

A good number of cooperatives were actually in limbo during the study. Ejoheza just completed its rebirth after a prolonged leadership crisis. Kaboku was on the verge of a difficult leadership transition and ditto for a few others. From these accounts, it was clear that institutional regulators needed to do more in their oversight functions by reducing yearly to quarterly visits or empowering sector-level branches to act more proactively so as to track cooperative performance and enhance financial and operational stability.

6.2.1.6 BDF Reform

The Medium-Term Review of PASP has this to say of BDF "**…**targeting all SMEs with strong collaterals has caused the project not to reach out to those poorer, less mature cooperatives at an early stage of development which are key to target groups of PASP" (MTR, 2016). In other words, poorer cooperatives are missing out of the project's generous financial provisions because of the stringent BDF guidelines. To effectively operate as an impactful, pro-poor fund, it must undergo a realistic review of its operational guidelines that will incorporate provisions for selective equity waivers. This reform will inevitably include disentangling the Fund from the mainstream of the nation's monetary custody and running it as a stand-alone intervention Fund with liberal but protective requirements. Under this new dispensation, protocols for vulnerability assessment upon which equity waivers are based will need to be developed.

6.3 Policy Implications

6.3.1. CROP INSURANCE POLICY: Adoption of crop insurance policy using cooperatives for premium payment as done currently under the medical insurance scheme is strongly recommended. Through this, farmers are indemnified against climate change hazards while concurrently providing some elements of security for investments. This is a vital requirement for drought-prone sectors.

6.3.2 DEVELOPMENT OF RURAL INFRASTRUCTURE: deployment of adequate public fund to develop rural infrastructure especially the large-scale road deficit in the country is an imperative need. Of the 14,008 km of road network, only 2,662km representing a paltry 5.3% were tarred as of the time of this study (RTDA, 2017) With rising budgetary allocation to the sector as well as the Ministry of Infrastructure, more spending on rural feeder roads should characterize the current fiscal year in order to complement ongoing World Bank-financed $96m "road revolution" in the country. Unarguably, government must come up with a framework of action to leverage private capacity and investment resources in the development of the road sub-sector. Collaborative development models that have been successfully operated in other countries such as Infrastructure Concessioning, Build, Operate and Transfer (BOT) as well as the conventional PPP can prove valuable in government's continued determination to further the modernization of Rwanda.In like manner, sustained investments in other growth-enhancing sectors like ICT is desirable based on the extent to which digital application is simplifying various aspects of human endeavours in contemporary world

Picture 4: Ongoing road construction in Nyagatare

6.3.3 YOUTH EMPOWERMENT. Government should pursue a deliberate policy of land acquisition for youths interested in agriculture. Various districts and sector administrations are quite pivotal in this respect. Many externally financed land-husbandry programs can become experimental template for this initiative. Besides land, youths equally need a specially designed access to finance that will enable them sidestep the often troublesome standard loan application procedures. This could come in the form of a youth-centred loan scheme managed by MFIs in the communities where the prospective beneficiary-youths reside. Countries running youth-dedicated financial incentives have relied on collaterals ranging from degree certificates or the business entity itself. In both cases, bank's dominant focus has always towered above profit motive to embrace all management actions that give direction to business towards securing success as well as timely loan repayment.

6.3.4 INTEREST RATE SUBSIDY. Like any other economic sector, smallholder farming can only grow and prosper in a conducive environment. This requires a range of incentive policies in line with popular practice in the United States, European Union and some parts of Africa. The need to revisit interest rate subsidy for agricultural enterprises in the country has therefore arisen. With less than 10% of farmers accessing credit from commercial banks due to a combination of factors including high interest rate regime, the much desired national and global competitiveness

of the country's agriculture through value chain development may be considerably hampered. In some countries, if not most, monetary policies are defined around single-digit preferential interest rate for agriculture.

6.4 General Remarks

This study has shown the enviable contributions of **PASP** in accelerating the pace of agricultural development in Rwanda. In the process, a number of steps and measures had proven critical to the modest success of the project and should be retained. Some of these are:

6.4.1 INCLUSIVE PLANNING: This involves beneficiary participation in development planning. It came out of the IDI that most project intervention strategies were consensually developed and not imposed. This enabled many HUBs to own most activities and initiatives and to develop a sustainability framework within the limit of their understanding and resources.

6.4.2. INDEPENDENT PROJECT STAFF: Employment of independent project staff particularly for district-and-sector-level engagements gave a huge boost to project progress. Not only were they well remunerated, motivation was incomparable both in financial and capacity development terms. It is doubtful if this similar model obtains elsewhere, especially in places like Nigeria where only career officers with relevant schedules are concurrently appointed as non-stipendiary desk officers to oversee assigned activities without any dedicated mandate often resulting in sloppy intervention performance

6.4.3 ROBUST LOGISTIC SUPPORT: Strong and unwavering logistic backing facilitated field visits as frequently as they were necessary and ensured strict monitoring of project activities at all implementation levels.

6.4.4 DECENTRALIZATION OF EXTENSION SERVICES: The cascade of extension services to the lowest operational level marked an innovative departure from convention extension program. Farmers peer trainings coupled with the role of village extension workers are duly acknowledged for their multiplier effects on agricultural production and post-harvest care.

6.4.5 RESULT-ORIENTED LEADERSHIP: Transparent and accountable project leadership at country level engineered the spread effect of project success and remains a vital driving force.

6.5 The following, on the other hand, did not work and should be improved upon:

6.5.1 Lack of communication among projects which must give way to a gradual de-verticalization process that would enable complementary projects and their operators to hold conversations along lines of common interest.

6.5.2 Over-bureaucratization of intended project financial support services.

6.6 Limitations

Notwithstanding the cooperation of field officers, a number of logistic, methodological and inherent barriers were encountered with potentially significant drawbacks on the study. Direct site visits for on-the-spot assessment of farming activities were greatly hampered due to bad roads and incessant rains. Likewise, questionnaire administration which relied on the use of local interpreters gave genuine concerns for quality assurance regarding the extent to which the researcher's questions were accurately translated to local language and correctly communicated on the field to the interviewees. However, to minimize quality lapses, the translated version was peer-reviewed by the duo of on-site supervisor and the Knowledge Management Specialist attached to the SPIU before eventual field deployment. Shockingly, some farmers insisted on appearance fees before taking part in the survey leading to frustration in some cases. Unexpected public holidays delayed the survey process and encroached on enumeration resources. Furthermore, gender-based productivity figures are no true reflection of differential labor efficiencies between male and female farmers in the district. The gender cohorts enumerated in the study lacked the requisite points of equivalence for valid comparison

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APPENDICES

APPENDIX 1

Table 61 GENDER COMPOSITION AND HEADSHIP OF COOPERATIVES

Name of cooperative	Male	Female	President
COPAMA	88	83	M
CODAR	24	34	M
AMIZERO IWACU	61	75	M
CODEAGA	23	41	M
COAMN	18	25	F
KOTEBARU	23	31	M
COPMRU (Youth coop)	13	16	M
COAMSRU	8	16	F
CAMARU	1	31	F
COPROMARU	11	17	M
RUDEMACO	12	11	M
CODPCUM	44	35	M
KOHIKA	64	36	M
CODEGRIFOGA	80	100	M
RAMBA GATUNDA	84	135	F
DUKUKA	50	90	M
ABIBUMBYE	2	51	M
KOKUINYA	25	18	
CODEMATA	21	20	F
KOABITADU	18	56	M
EJOHEZA	212	105	M
KABOKU	719	364	M
TOTAL	**1,601**	**1390**	

Source: M&E Unit of SPIU (May, 2018)

APPENDIX 2

Table 62: COOPERATIVES AND ACCESS TO LOAN UNDER COMMERCIALCONDITIONS

COOPERATIVE	ACCESS STATUS
COPAMA	Yes
CODAR	No
AMIZERO IWACU	Yes
CODEAGA	Yes
COAMN	Yes
KOTEBARU	Yes
COPMSRU (Youth coop)	No
COAMSRU	Yes
CAMARU	Yes
COPROMARU	No
RUDEMACO	Yes
CODPCUM	Yes
KOHIKA	Yes
CODEGRIFOGA	No
RAMBA GATUNDA	Yes
DUKUKA	No
ABIBUMBYE	Yes
KOKUINYA	Yes
CODEMATA	Yes
KOABITADU	Yes
EJOHEZA	Yes
KABOKU	Yes
TOTAL SUCCESSFUL	17
ACCESS RATE	77.3%

APPENDIX 3

BDF CAPITAL INVESTMENT PROFILE (millionRwF)

S/N	YEAR	AMOUNT	PURPOSE	BENEFICIARY
I	**2015**	87, 657, 810	Warehouse rehabilitation	CODPCUM
2	**2016**	126, 062, 727	Construction of SF for maize and beans	KOHIIKA
3	**2017**	26, 630,000	Purchase of truck for product transportation	COOPAMA

Source: BDF Unit of SPIU

APPENDIX 4

LOCALLY TRANSLATED QUESTIONNAIRE SAMPLE

IBAZO BYIFASHISHWA MU GUKUSANYA AMAKURU MU BAHINZI

1.0.IJAMNBO RY'IBANZE

IrikusanyaryateguwekugirangoheregeranyweAmakurukubikorwaby'umushinga wo guhanganan'imihindagurikirey'ikirere,gufatanezaumusaruro no kuwugezakuisoko**(PASP: Post harvest and agribusness support project)** nukobishirwamubikorwan'ikigompuzamahangagiterainkungaiteramberery'ubuhinzi**(IFAD).**

Irikusanyarizafasha mu gukoraubushakashatsi no kugenzuraimikorerey'umushinga mu kureberahamweahariingufunkeyandetsen'imbogamizi no gutangaibitekerezokugirangohagireibyongerwamo cg bikorwenezaahobikenewe. Izinaryawentabworikenewearkokuvugishaukuri mu Gutangaamakuruniingenzikugirangobibebyizewe.

2.0.AMAKURU AREBA UBUYOBOZI

Umubarew'abagizeumuryango…… Umurenge wa……. Umuduguduwa……

2.1. AMAKURU K'UBUZIMA BUSANZWE BW'UBAZWA

Hitamoikiricyo

2.1.1. Igitsina: 1. GORE 2. GABO

2.1.2. Imyaka: 1. 15-30 yamavuko, 2. 31-46 yamavuko, 3. 47-62 yamavuko, 4. Hejuruya 62 Yamavuko

2.1.3. Imimerere: 1.Ingaragu 2. Arubatse, 3.Yaratandukanye 4. Umupfakazi

2.1.4. Amashuriyize": 1. Ntanarimwe2.Abanza 3.Ayisumbuye 4. Kaminuza

2.1.5. Ni bangahebagizeuyumuryangonaweubariwemo? Andikaumubare

2.1.6. Umukuruw'umuryango 1. Umugore 2. Umugabo

2.1.7. Umukuruw'umuryangoafiteimyaka……..yamavuko

2.1.8. Akaziyakoraga mu mwakaumweushize: 1. Ntakaziyariafite 2. Umunyeshuri 3. Umuhinziw'umuryango 4. Umunyabukorikori

3.1. UBWISANZURE KU MUTUNGO, IBIHOMBO NYUMA Y'ISARURA NO GUFATA NEZA UMUSARURO

3.1.1. Ubusobw'ubutakabwawebuhingwabunganabute? 1. munsiya 0.5 ha 2. Hagatiya 0.5-1.0 ha 3. Hagatiya 1-2 ha 4. burenzekuri 2 ha

3.1.2. Ni ibihemuriibibihingwabikurikiramubyo PASP iterainkungawahinze mu Gihembwecy'ihingagiheruka? 1. Ibigori 2. Ibishyimbo 3. Byombi

3.1.3. Wigezeukoreshaimbutoz'indobanure cg ingemwezatunganijwe? 1. Yego 2. Oya.

3.1.4. NibaariYegowakoreshejeibirobingahekandiikirokimwemwakiguragaamafangaangahe? 1……..kg 2…….. Rwfkukiro

3.1.5. UbusanzweukoreshaAmafumbire mu butakabwawe? 1. Yego 2. Oya

3.1.6. Nibaariyegowakoreshejeinganaikikandiwatanzeangahekukiro?

3.1.7. Wakoreshejeabakozibanyakabyizi mu gihembwegiheruka? 1. Yego 2. Oya

3.1.8. Nibaariyegowabishyuyeamafarangaangahe? Vugaigiteranyo mu mafaranga Koreshaimbonerahamweikurikiramugusubizaibibazo

3.1.9.

Igihingwa	**Inganoy'ibyasaruwe**	**Inganoy'ibyajyanywe murugo**	**Inganoy'ibyaguri shijwe**	**Igiteranyocy'amafaranga**
Ibigori				
Ibishyimbo				

3.1.10. Wigezeuhuranigihombomugusaruraigihembwecy'ihingagishize? 1. Yego 2. Oya

3.1.11. Nibaariyegowahombyeibirobingahe?.....kg

3.1.12. Ni kukihegicewahuye n';igihimbocyane? 1. Mu murima 2. Mwisarura cg gutunganyaumusaruro (Kumisha, guhunika, kugosora) 3. Mukuwugezakwisoko?

3.1.13. Ni ubuheburyoibibikorwabyanyumayogusarurabikorwamo? Andikaumubare mu mbonerahamwe.1. Gakondo 2. Mekanike (Imashini) 3. Ntabwonkoresha

IBIKORWA	**ABIGORI**	**IBISHYIMBO**
Gusarura		
Gusukura		
Koza		

Gufataneza		
Guhura		
Kugosora		
Gutoranya		

3.1.14. Ibikorwabikurikiraby'inyongeragacirobikorwanyumayogusarurogaragazaukobikorwa. 1. Gakondo 2. Mekanike (imashini) 3. Ntanakimwenkoresha

IBIKORWA	IBIGORI	IBISHYIMBO
Gutoranya		
Koza		
Gushyira mu byiciro		
Gupakira		

3.1.15. Niki mu bikurikiracyateyeigihomboubusanzwewahuyenacyo: 1. Imvuranyinshi 2. Izubaryinshi3.ibyonnyin'indwara 4. kuburaibikoreshobyogufataneza5.Kuburaukobigerakwisoko 6. Kuburaamasoko 7. Kudasrurirakugihe 8. Ibimdi (Bigaragaze)

3.1.16. Mbereyukoumushinga (PASP) utangierekanauburyowakoreshagamugufatanezaumusarurokubihingwabikurikirara. Uzuzaimbonerahamwewandikeinomero. 1. Kubikamunsiny'ubutaka 2. Gukoreshaamahema 3. Gushyirahejuruy'ibisengeby'amazu, 4. Mumazumunsiy'ibisenge 5. Mubicucuby'amazu.

IGIHINGWA	**IGIKORWA**
Ibigori	
Ibishyimbo	

3.1.17. Habahariimpindukayabayekuvauyumushinga (PASP) watangira? 1. Yego 2. Oya

3.1.18. NibaariYegosobanura

3.1.19. Uri umunyamuryangowakoperative? 1. Yego 2. Oya

3.1.20. Ni iyihemuzihingaibibihingwaubarizwamo? 1. Ibigori 2. Ibishyimbo 3. Byombi

3.1.21. Ufiteubwanikiro mu gaceutuyemo? 1. Yego 2. Oya

3.1.22. Ubwobwanikirourabukoresha? 1. Yego 2. Oya

3.1.23. Nibaarioyakuberaiki? Hitamoikiricyo: 1. Kure cyaneyahoutuye 2. Ni butocyane? 3. Bwumishabutinze 4. Izindimpamvu (zisobanure)Ufiteubuhunikiromugaceutuyemo? 1. Yego 2. Oya

3.1.24. NibaariYego, urabukoresha? 1. Yego 2. Oya

3.1.25. Nibaarioyakuberaiki?

1. Kure cyaneyahoutuye 2. Ni butocyane? 3. Izindimpamvu (sobanura)

4.1. UBUFASHA TEKINIKE NA SEREVISE ZIRAMBYE

AMAGUGURWA	**1. YEGO**	**2. OYA**
Kubayazaumusaruroubuhinzihakoreshejweikoranabuhanga		
Nyumayisarura		
Kwitakubikorwaremezo cg ibikoreshobyifashishwanyumayisarura		
Kongeraagaciro		
Kubaraibiciriby'umusaruro no kugenaigiciromfatizo		
Ntamahugurwayakozwe		

4.1.1. Iyimbonerahamweyoharuguruigaragazaamahugurwayakozweyatanzwenumushinga PASP. Kosoraikiricyonibaariyego cg oya

4.1.2. Ni ubuhebumenyimubwahuguweukoreshakugezaubu? 1. Kubyazaumusaruroubuhinzihakoreshejweikoranabuhanga 2. IbikorwaNyumayisarura 3. Kwitakubikorwaremezo cg ibikoreshobyifashishwanyumayisarura 4. Kongeraagaciro 5. Kubaraibiciriby'umusaruro no kugenaigiciromfatizo

4.1.3. Imbonerahamweikurikiraigaragazaukoabakozibagombagakugusura mu bihebitandukanye

ABAKOZI	**1.BURI CYUMWERU**	**2.BURI KWEZI**	**3.BURI MEZI ATATU**	**4. NTIBAJYA BAZA**
Umugronomewakarere				
Ushinzweubworozi mu				

karere				
Ushinzweamakoperative mu karere				
Ushinzweubuhinzi mu murenge				
Ushinzweubworozi mu murenge				
Ushinzweamakoperative mu murenge				

5.1. SEREVISI Z'IMARI N'UHUCURUZI.

5.1.1. Hari itsindaryokwizigamiraubarizwamo? 1. Yego 2. Oya

5.1.2. Nibaariyegoniirihemuriayamatsinda? 1. Coperativez'ubwizigamen'inguzanyo (SACCO) 2. Bankizamikoro finance 3. Amatsindamatoyokwifashisha 4. Bankiy'ubucuruzi5.koperativey'abahinzi

5.1.3. Wigezegukeneraamafarangayogukoresha mu ishoramariry'ubuhinzibwawe1.Yego 2. Oya

5.1.4. Nibaariyego, subiza 5.1.5 kugeza 5.1.10

5.1.5. Iryoshoramariryariirihe? Sobanura

5.1.6. Wigezeuteguraumushinga? 1. Yego 2.Oya

5.1.7. Nibaariyegoharimahugurwawahawembereyoguteguraumushinga? 1. Yego 2. Oya

5.1.8. Wahaweangahe?

5.1.9. Iyo nguzanyoyavuye he? 1. SACCO 2. Bankizamikoro finance 3.Bankiy'ubucuruzi 4.Itsinda ritoryokwifashisha 5. Koperativeyabahinzi.

5.1.10. MbereyukoUmushinga PASP Utangiranihewagurishagaumusarurowawe 1. Mubaturanyi 2. Mumasokoaciriritse3.Abacuruzi 4. Koerative 5. Ahandi

5.1.11. Niheheubuugurishahoumusarurowawe? 1. Mubaturanyi 2. Mumasokoaciriritse3.Abacuruzi 4. Koerative 5. Ahandi.

5.1.12. Nindeugenaibicirougurishahoumusarurowawe? 1. Abacuruzi2.Goverinoma 3. Ababikora 4. Bose

5.1.13. Wagizeikibazomubucuruzibwawembere? 1. Yego 2. Oya

5.1.14. Nibaariyegosobanura.

5.1.15. Uracyahuranikibazowahuraganacyombere? 1. Yego 2. Oya

5.1.16. Imbonerahamwezikurikiraniibigorin'ibishtimbotangaigereranyakuriburikimwe

IBIGORI

UMWAKA	**INGANO Y'IBYACURUJWE**	**AMAFARANGA YOSE YINJIYE**
2016		
2017		

IBISHYIMBO

UMWAKA	**INGANO Y'IBYACURUJWE**	**AMAFARANGA YOSE YINJIYE**
2016		
2017		

6.1 UBURINGANIRE

6.1.1

Imbonerahamwezikurikiraziragaragazaibikorwabitandukanyebyakozwemberenanyumayu mushinga (PASP) kubanyamuryango mu bigorin'ibishyimbo, erekanauwagizeuruhareshingiromberenanyumay'umushingandetse no mugihecy'irigenzura.

MBERE YA PASP

IBIKORWA	**IGITSINA**
Gusarura	
Gupakira mu murima	
Ubwikorezibujyamurugo no kubuhunikiro	
Kugosora	
Gusukura/gutoranya	
Gusahakaamasoko no vuganaibiciro	
Gufataimyanzurokubyinjiye	

UBUNGUBU

IBIKORWA	**IGITSINA**
Gusarura	
Gupakira mu murima	
Ubwikorezibujyamurugo no kubuhunikiro	
Kugosora	
Gusukura/gutoranya	
Gusahakaamasoko no vuganaibiciro	
Gufataimyanzurokubyinjiye	

Bihinduwekdibishyizwe mu Kinyarwanda na ASIIMWE Samuel

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APPENDIX 5

ENGLISH VERSION OF THE QUESTIONNAIRE

FARMERS SURVEY QUESTIONAIRE

1.0 INTRODUCTION

This survey instrument is designed to collect information on project activities under the Climate Resilient Postharvest and Agribusiness Support Program (PASP) implemented in your district by the **International Fund for Agricultural Development (IFAD).** It is essentially meant to conduct research and evaluate project performance with a view to identifying strengths and weaknesses as well as offering suggestions on further improvement where necessary. Your name is not required but your honest responses are while all information given will be treated with utmost confidentiality.

2.0 **ADMINISTRATIVE INFORMATION**

Household number.....

District.....

Sector .....

Cell .....

Village .....

2.1 RESPONDENTS' SOCIO-DEMOGRAPHIC DATA

Tick as may be appropriate

2.1.1 Sex: 1 Male 2 Female

2.1.2 Age: 1.15-30 years 2. 31-46 years 3. 47-62 years 4. Above 62 years

2.1.3 Marital Status

1. Single 2. married

3.Divorced 4. Widowed

2.1.4 Level of education

1. None 2.Primary school
3. Secondary 4. above secondary

2.1.5 How many are you in this household including you? Indicate number.

2.1.6 Head of household

1. Male 2. female

2.1.7 Age of household head……years

2.1.8 Employment status in the last 1 year

1 unemployed 2 student

3 family grower 4. Artisan

3.1 ACCESS TO PRODUCTIVE RESOURCES, POST-HARVEST LOSSES AND POST-HARVEST MANAGEMENT

3.1.1 What is the size of your farm land?

1. Less than 0.5 ha 2. Between 0.5-1.0 ha 3. Between 1-2 ha

4. More than 2 ha

3.1.2 Which of the following PASP-supported crops did you plant during the last cropping season? 1. Maize 2. Beans 3. Both

3.1.3 Did you use improved seeds/seedlings? 1. Yes 2. No

3.1.4 If yes, what quantity in KG did you buy and at what cost? 1.KG.. 2 Rwf

3.1.5 Do you normally apply fertilizer to your land? 1. Yes 2. No

3.1.6 If yes, what quantity in KG and at what cost?

3.1.7 Did you engage daily paid labor during the last planting season? 1. Yes 2. No

3.1.8 If yes, how much did you spend on them in all? Rwf…..

Use the table below to answer question

3.1.9

Crop	Quantity harvested	Quantity at home	Quantity sold	Total amount
Maize				
Beans				

3.1.10 Did you experience any product loss at the last harvest? 1. Yes 2. No

3.1.11 If yes, how much in KG did you lose?

3.1.12 At what stage did you experience this loss most?

1. On the field 2. Harvesting or handling (drying, winnowing and storage)

3. Processing 4. Transport and marketing

3.1.13 How are the following operations done at HH level?

1. Manually 2. Mechanically 3. Does not apply

OPERATIONS	MAIZE	BEANS
Harvesting		
Cleaning		
Washing		
Handling		
Threshing		
Shelling		
Winnowing		
Sorting		

3.1.14 For the following value addition operations done at HH level, indicate how made:

1. Manually 2. Mechanically 3. Does not apply

VALUE ADDITION	MAIZE	BEANS
Sorting		
Washing		
Grading		
Packaging		

3.1.15 Which of the following causes of product loss do you commonly experience?

1. Too much rain 2. Prolonged drought 3. Pests and diseases

4. Lack of PHHS equipment/infrastructure

5. Lack of adequate means of transportation

6. Poor market access 7. Untimely harvesting 8. Others (specify)

3.1.16 Before the beginning of this project, indicate the major harvesting and handling practice applied at your household for the following crops.

1. Bury under the ground 2. Use of sheetings 3. On roof tops

4. Inside the house below the roof 5. In-house shade

CROP	HANDLING PRACTICE
Maize	
Beans	

3.1.17 Has there been any change since this project started? 1. Yes 2. No

3.1.18 If yes, please explain?

3.1.19 Do you belong to any crop cooperative? 1. Yes 2. No

3.1.20 To which of these do you belong? 1. Maize 2. Beans 3. Both

3.1.21 Do you have a drying facility in your area? 1. Yes 2. No

3.1.22 Do you use the facility to dry your crop? 1. Yes 2. No

3.1.23 If no, why?

1. Too far from my home 2. Very small in size 3. Takes long to dry

4. Others (specify)

3.1.24 Do you have a storage facility in your area? 1. Yes 2. No

3.1.25 If yes, do you use the facility? 1. Yes 2. No

3.1.26 If no, why?

1. Too far from home 2. Very small in size 3. Others (specify)

4.1 TECHNICAL SUPPORT AND EXTENSION SERVICES

TRAINING SERVICES	**1. YES**	**2. NO**
Crop production practices and technology		
Post-harvest operations		

Post-harvest infrastructure or equipment management		
Value addition/Processing		
Product cost calculation and price determination		
No training received		

4.1.1 The above table contains a list of training services rendered under PASP.

Tick either yes or no for the ones you have received or receiving

4.1.2 Which of the skills above are you still using now?

1. crop production practices and technology 2. Post-harvest operations
3. post-harvest infrastructure or equipment management 4. Value addition/processing 5. Product cost estimation and price determination

4.1.3 The table below contains a list of extension agents expected to visit or contact you at specific time intervals. Tick which of the agents and intervals are applicable to you

SERVICE PROVIDER	1.WEEKLY	2.MONTHLY	3.EVERY 2 MONTHS	4. NOT AT ALL
District agronomist				
District veterinary officer				
District cooperative officer				
Sector agronomist				
Sector veterinary officer				
Sector				

cooperative officer				

5.1 FINANCIAL SERVICE AND MARKETING SYSTEM

5.1.4. Are you a member of any savings and loans group? 1. Yes 2. No

5.1.5. If yes, which of these applies? 1. Savings and Credit Cooperatives

2. Microfinance bank 3. Informal Self-help group 4. Commercial bank

5. Farmers' cooperatives

5.1.6 Have you ever needed money for your agricultural business? 1. Yes 2. No

If yes, answer questions 4.1.7 to 4.1.11

5.1.7 What type of business was this? Please explain

5.1.8 Did you develop a business plan? 1. Yes 2. No

5.1.9 If yes, was any training given to you before developing the plan? 1. Yes 2. No

5.1.10 How much were you given?

5.1.11 What was the source of this loan?

1. SACCO 2. Microfinance Bank 3. Commercial Bank 4. Self-help group

5. Farmers' cooperatives

5.1.12 Before this project started, to which of the following were you selling your product? 1. Neighbours 2. Local market 3. Traders 4. Cooperatives 5. Others

5.1.13 To which of the following are you selling the crop now?

1. Nighbours 2. Local market 3. Traders 4. Cooperatives 5. Others

5.1.14. Who determines the price at which you sell your product?

1. Buyers 2. Government 3. Producers 4. All

5.1.15 Did you ever have problem with the marketing of your product before? 1. Yes

2. No

5.1.16 If yes, please explain.

5.1.17 Are you still having the same problem now? 1. Yes 2. No

5.1.18 Below are two tables for maize and beans respectively. Give a rough estimate with respect to each portion.

MAIZE

YEAR	QUANTITY SOLD	TOTAL INCOME
2016		
2017		

BEANS

YEAR	QUANTITY SOLD	TOTAL INCOME
2016		
2017		

6.1 GENDER INTEGRATION

6.1.1 The under listed tables show a number of value chain activities carried out by household members for both maize and beans. Indicate who plays the major role against each of these activities both before the start of PASP and the time of this study

BEFORE PASP

VALUE CHAIN ACTIVITIES	SEX
Field harvest	
On-farm packaging	
Transport home for storage	
Winnowing	
Cleaning/Sorting	
Shelling	
Market identification and price negotiation	
Decision on utilization of	

farm income	

NOW

VALUE CHAIN ACTIVITIES	**SEX**
Field harvesting	
On-farm storing/packaging	
Transportation home for storage	
Cleaning/Sorting	
Winnowing	
Shelling	
Marketing	
Decision on utilization of proceed	

Open drying ground at Nyabugogo

Picture 6: Inside view of a storage facility in Rabeza, Tabagwe Sector