

ANALYSIS OF BEAN COMMERCIALIZATION AND FOOD SUFFICIENCY

TRADE-OFF: A CASE OF SMALLHOLDER FARMERS IN RWANDA

KIMEI STEPHEN

**A Thesis Submitted to the Graduate School in Partial Fulfillment for the Requirements of
the Award of Master of Science Degree in Agricultural and Applied Economics of Egerton
University**

EGERTON UNIVERSITY

OCTOBER 2016

DECLARATION AND APPROVAL

Declaration

This thesis is my original work and has not been presented for any degree at any other university.

Signature: Date:

Kimei Stephen

KM17/3016/11

Approval

This thesis has been presented to the Graduate school for examination with our approval as university supervisors.

Signature: Date:

Prof. Patience Mshenga, PhD

Senior Lecturer, Department of Agricultural Economics and Business management,

Egerton University

Signature: Date:

Dr. Eliud A Birachi, PhD.

Market Economist with the International Center for Tropical Agriculture (CIAT), Nairobi

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DEDICATION

I dedicate this work to my parents Simotwo Kimei and Susan Chepyosi, my siblings, Kimeto, Ndiwa, Elly, Keziah and friends; for their love and encouragement to realize culmination of this work. Thank you all for your sincere support. Lastly, to my Lord who has always reminded me the reason of my existence.

ACKNOWLEDGEMENT

I wish to sincerely thank Almighty God for His providence to me throughout the entire course of study. I also extend my gratitude to Egerton University and Department of Agricultural Economics and Agribusiness Management for the chance to pursue Master of Science degree and necessary guidance associated.

My special gratitude also goes to my supervisors Prof. Mshenga Patience and Dr. Eliud Birachi, for their excellent academic advice, tireless guidance and support in every step of the whole research work. They linked me to the International Center for Tropical Agriculture, the organization that facilitated my fieldwork and conveyed data from Rwanda for my research.

My sincere gratitude also goes to African Economic Research Consortium (AERC) who funded part of my studies and gave us a chance to study in the University of Pretoria. I cannot forget to thank my colleagues George, Japheth, Emuria, John, Miriam and others for their constructive criticism and assistance to successful completion, may God bless them abundantly.

ABSTRACT

Commercialization of agriculture provides farm households with a means to alleviate poverty and food insecurity in rural areas. This is due to the fact that commercialization increases farm household income and widens the ability to attain food diversity. In Rwanda, common bean is grown by a large proportion of the rural population for both domestic and market purposes. Based on the nutritional and agronomic attributes, there is rising national and regional demand for common bean. Since many households in Rwanda produce beans for consumption as well as for the market, this poses a tradeoff at the household level as to what proportion of bean produce to consume and market. There was need therefore, to determine factors influencing commercialization of common bean and its effects on household food sufficiency. The study used secondary data from 252 respondents chosen from five districts across the country. Data analysis was done using descriptive statistics, ANOVA and Double Hurdle model using SPSS 18 and STATA12 statistical packages. The results revealed that 41% of the farmers engaged in common bean commercialization where majority sold less than 100 kilograms. There were no significant effects of common bean commercialization on food self-sufficiency among farm households in different levels of commercialization. The study found out that age, number of livelihoods a household head engages in and quantity of beans produced influenced the decision to commercialize at 1% significance level. Further, level of satisfaction with market information and type of common beans influenced decision to commercialize common beans at 5%. The study revealed that quantity of beans produced, number of livelihoods of a household head, price per kilogram, distance to the market, duration of bean storage and group membership positively influenced the level of bean commercialization. On the other hand, number of crops a household cultivated and higher monthly income had negative influence on commercialization. The study recommends that stakeholders explore measures to improve skills of farmers to engage in other livelihood activities, increased beans production, collective action among farmers and effective flow of market information. Through these measures, smallholder farmers would offset pressure mainly piled on available food stock while farmers acquire enough agricultural income to ensure food sufficiency among households.

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ACRONYMS AND ABBREVIATIONS

ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
BizCLIR	Business Climate Legal and Institutional Reform project
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CIAT	International Centre for Tropical Agriculture
CIP	Crop Intensification Program
EAC	East Africa Community
ECABREN	Eastern and Central Africa Bean Research Network
FAO	Food and Agriculture Organization
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government
MINECOFIN	Ministry of Commerce and Finance
USAID	United States Agency International Development

CHAPTER ONE

INTRODUCTION

1.1 Background information

Agriculture is the mainstay of the economy of Rwanda only seconding service sector. The sector supports close to 40% of the Gross Domestic Product (GDP), employs 90% of the country's active population and accounts for well over 60% of all exported goods in the country (BizCLIR, 2009; World Bank, 2011). The sector is the major player in the poverty reduction strategy in the country due to its role in national food self-sufficiency by producing almost 91% of food consumed (IMF, 2011). Agriculture, therefore, has contributed much to the exemplary economic performance of Rwanda's economy.

Over the years, the Government of Rwanda (GoR) has immensely supported the growth of the sector through increasing budgetary allocation and strategically positioning the sector in both medium and long term national goals. For instance, Rwanda Vision 2020 has half of its pillars aimed to directly boost agricultural production and widen markets (MINAGRI, 2011), the implementation of Crop Intensification Programs (CIP) and National Economic Development and Poverty Reduction strategies. Since the inception of the Comprehensive Africa Agriculture Development Program (CAADP); Rwanda committed itself to spend 10% of its budget on agriculture in order to grow the industry by 6%. This target has been achieved so far being the first country in Africa (CAADP, 2011).

Despite the vital role agriculture contributes in the welfare of the Rwandans; the sector still experiences some challenges. The main challenge is high pressure exerted on land due to the rising population. This has reduced the average household land size to about 0.7 hectares per household (MINAGRI, 2009). The other challenge is over cultivation of land which has led to soil degradation and an estimated 40% of the cultivated land is in the steep slopes classified as soil erosion prone (MINAGRI, 2009). Like other Sub-Saharan countries, agriculture is still rain-fed hence the smallholder farmers face unpredictable rainy seasons and prolonged droughts. These pose major agricultural challenges to smallholder farmers who depend on agriculture as a major source of livelihood.

1.2 Common bean production and consumption in Rwanda

Common bean is among the most essential food crops in the entire Sub-Saharan Africa especially Rwanda. The pulse is considered as the staple food crop for more than 200 million

people in Sub-Saharan region (Wortman *et al.*, 2004). Broughton *et al.* (2003) estimated that a total of 2.8 million tons is produced from 4 million hectares planted annually across Africa. It is however recorded that 80% of the total produce is concentrated in only ten countries in Africa, (FAO, 2009). The leading producer countries are Tanzania, Uganda, Kenya, Rwanda, Angola and Burundi among others. It is estimated that close to 95% of the Rwandan households engage in common bean production thus making the country among the countries with high yields (FAO, 2008; FAO, 2011).

In Rwanda, common bean occupy the largest area under food crop production cumulatively from many smallholder farmers. In 2013, a total of 438,236 tons of common bean was cultivated in an area of about 440,000 hectares which translates to 23% of total land under cultivation (MINAGRI, 2013). This is illustrated in Table 1 below. The rising common bean production is as a result of the shift from bush bean to high yielding and disease resistant climbing beans introduced in 1984 by CIAT and ISAR (Sperling and Muyaneza, 1995, MINAGRI, 2013). Smallholder farmers produce common bean, just like other food crops, with the purpose of home consumption, selling or both in order to boost their low incomes and food security (CIAT, 2008; CFSVA, 2012).

Table 1: Area under production and level of production

Bean/ year	2010	2011	2012	2013
Production level (tons)	327708	331166	432857	438236
Area under production(ha)	319252	341819	479899	480012

Source: FAOSTAT, (2013)

The common bean market in Rwanda is competitive and risky due to its link to international market shocks (Rwirahira, 2009). It is documented that markets are functioning relatively well and food is flowing easily within and outside the country in great lakes regions (BizCLIR, 2009; CFSVA, 2012). Common bean is the highest food crop that has high net value. For instance Rwanda exported 20,000 tons of beans to Uganda out of the total 35,000 tons exported (USAID, 2013). With the integration of the country into East Africa Community, the demand is expected to increase. Some countries in the community have had common bean deficits like Kenya which goes to an extent of -362,899 tons in some period (MoA; 2009, Waluse, 2012).

Further, the country observes high cross-border trade of commodities from the Democratic Republic of Congo (DRC) which is experiencing political instability. For instance it is recorded that Eastern provinces of DRC have daily consumption estimated at 300 grams per capita per day, which is higher than Rwanda's per capita consumption of about 200 grams per day. This implies that local production faces extra demand pressure from outside the country. The smaller towns serve as collection centers and small markets in their own right (Blair *et al.*, 2010). These movements of the grains across the region do not warrant storage of common bean due to comparative advantage.

Common bean has special nutritional values that necessitate many households to adopt it as a major staple food for domestic purposes. The pulse is rich in quality globulin protein, energy, fiber and micronutrients especially iron, zinc and vitamin (ASARECA, 2012). It is further noted that the proteins found in common bean possess significant nutritional and health advantages for its consumers. Due to its nutritional value and affordability, the pulse is preferred more than the relatively expensive animal proteins. Furthermore, common bean provide close to 30% of dietary needs to all household income categories (ECABREN, 2000; Wortman *et al.*, 2004; Kara *et al.*, 2009). Besides, the pulse is served in meals with other foods like tubers, maize, plantains and rice among others. Separate parts of common bean crop like leaves, pods and grains are used as food while ashes from burned dried leaves and stems are used as ingredient in cooking (Katungi *et al.*, 2009). From these attributes, common bean significantly help boost surging household food security and malnutrition cases (Ferris and Kaganzi, 2008).

Apart from the pulse's nutritional value, common bean matures relatively faster than other food staples and some species of beans are drought resistant and do well in areas of low rainfall (Natasha, 2011). The dried grains have long shelf life of about 3-4 years. This implies that grains can be utilized in almost every season and if in adequate supply can enable the household to reach the next season's harvest. It is however noted that the quality of the prolonged shelf life reduces the nutritional value; therefore green or freshly harvested beans have relatively more value (Njugunah *et al.*, 1980; Katungi *et al.*, 2009).

Despite the pulse's attributes as a potential food crop to alleviate food security, food insecurity and malnutrition is still felt among the smallholder farmers cultivating common beans. It is recorded that more than one-half of all Rwandans still live below the poverty line with the widening inequality gap (World Bank, 2005; MINALOC, 2011). Consequently, anemia and

malnutrition still affect a large proportion of the population (CIAT, 2008; MINECOFIN, 2008). For instance, in 2010, 44% of children experienced stunting and 11% of children were underweight in Rwanda (NISR, 2011). Further it is revealed that more than half of all households report some type of difficulty in accessing food, close to 20% of households experienced acute difficulties in accessing food (CFSVA, 2012). This study sought to establish the interaction between commercialization and household food security among the smallholder farmers cultivating common beans.

1.3 Statement of the problem

There has been increasing demand for common beans as a source of protein both in Rwanda and the neighboring countries in the region. This is as a result of rising national population and the country's integration into the East African Community (EAC) economic bloc. High demand has created the ready market for the farm produce of the households which consequently sustained increase in bean prices. As a result, smallholder farmers characterized by low household income have a tendency of engaging in commercialization of beans as source of income. On the other hand, common beans possess both important nutritional and agronomic values that could help mitigate the malnutrition and food insecurity experienced among these households. The demarcation between marketable surplus and produce for domestic use is not clear in most households. This is further aggravated by recent emphasis of market linkages and commercialization of agriculture that poses growing concerns that commercialization may take food away from the farm household. However, there is limited information as to the effect of common bean commercialization on household food sufficiency especially in areas where common bean is the main staple food in Rwanda. The study thus sought to explain this tradeoff while establishing factors that influence the decision to commercialize and the extent of commercialization in the pursuit of food security and household income.

1.4 Objectives

1.4.1 General objectives

The general objective of this study was to contribute to the small household food security through analysis of commercialization and food sufficiency trade-off in Rwanda.

1.4.2 Specific objectives

1. To evaluate the utilization patterns of common beans among the smallholder farmers in Rwanda.
2. To determine the effect of common bean commercialization on the household food sufficiency among the smallholder farmers.
3. To determine the factors influencing decision to commercialize and level of common bean commercialization by smallholder farmers.

1.5 Research questions

1. How do the smallholder farmers utilize their common bean produce in Rwanda?
2. What is the effect of common bean commercialization on household food sufficiency among smallholder farmers?
3. What are the factors that influence the decision to commercialize and level of common bean commercialization among smallholder farmers?

1.6 Justification of the study

Rwanda is among the countries with efforts geared to alleviate food insecurity in its population and hence achieving millennium development goals. Bean production and consumption stand a better chance as a means towards achieving food security. With the recently launched East Africa Community (EAC) most farm households are subjected to international market shocks with multifaceted effects. This study was among the few studies which ventured into evaluating the effects of agricultural production for market and consumption tradeoffs. There was need to understand the effects of the markets on the food stock and its implication.

The study aimed to evaluate the effect of farm household decision to either consume or sell the common bean produced on their household's welfare. The study revealed the importance of drawing a balance between commercialization effect on a staple food and its role in food security needs as the nation gears towards increased exportation.

The study targeted to benefit farmers, policy makers and other development agencies which are addressing issues on food security among small holder farmers in the region. This was envisioned to be achieved by identifying the critical factors that influence the opportunity cost of selling beans over consuming. The result is expected to lead to improved household food sufficiency while achieving improved household income.

1.7 Scope and limitation of the study

The study featured on common bean smallholder farmers in selected districts across Rwanda. The sampling units were farm households whose some socio-economic and institutional features were selected for study in 2014. The decision on whether to commercialize beans or not and extent of commercialization were assumed to be in stages.

1.8 Operational definition of terms

Commercialization: is used to refer to the market oriented common bean production that leads to increased sales volume in relation to total common bean production

Cross border trade: this refers to the exchange/movement of common beans from one region to the other that involves markets in the neighboring countries

Crop diversification: is the farm practice where a farmer grows two or more crops on a piece of land.

Food security: defined as a condition in which a farm household at all times, have physical and economic access to sufficient food stocks to meet every individual food needs in the household.

Food sufficiency: the study defines food sufficiency to imply household's physical and monetary access to food stock to meet household food consumption needs.

Household: defined as group of people bound together by joint production and consumption decision, living under same compound but answerable to one head person as decision maker.

Malnutrition is a condition characterized by inadequate intake of protein, energy and micronutrients and by frequent infections and diseases.

Smallholder farmers: are common bean farmers who own and/or lease land less than two acres.

Tradeoffs: this refers to opportunity cost of either more consumption or marketing of the produce on household food sufficiency and household income.

CHAPTER TWO

LITERATURE REVIEW

2.1 Food crop production and consumption in Rwanda.

Rwandan agro-ecological conditions favor the growth of many agricultural crops that comprise both cash crops and food crops. The main cash crops include tea, coffee and sugarcane which constitute about 80% of total exports. On the other hand, food crops include beans, maize, sorghum, potatoes, bananas, and fruits. Table 2 below shows the comparative production levels of selected crops.

Table 2: Annual productions of selected crops (tons)

Crops/ year	2008	2009	2010	2011	2012	2013
Cereals	461163	615059	738080	848658	871725	989202
Roots and tubers	3815126	4264961	5192652	5783263	6189937	6363451
Vegetables and fruits	961645	950122	1022421	1122814	933094	943703
Beans	308563	327728	327497	331166	432857	438236
Bananas	2603949	2993482	2749152	3036273	3219466	3291853

Source: National Institute of Statistics of Rwanda, (2014)

From Table 2, there is a general increase in production attributed to the increased area of arable land. Common bean production is observed to be far more than other pulses produced in the country. According to Blair *et al.* (2010), the average common bean yields in the country range at 900-1200 kg/ha. Low application of modern agricultural inputs, public and private investment and land fragmentation hinders maximum potential production.

Tubers and pulses are the most consumed food crops by close to 100% of the population in Rwanda. It is estimated that on average, 52% of the total annual household food consumption is supplied by the markets (CFSVA, 2009). At the household level an average of 68% of the consumed beans is produced by the households while the rest is either bought or acquired as a result of assistance from other entities like government or relatives (CIAT, 2008).

Rwanda has the highest per capita bean consumption in the world. It is estimated that consumption per capita goes to as high as 0.919 kg/capita (Kalyebara and Buruchara, 2008). On

average households consume 197 kilograms out of 285 kilograms produce of their beans annually and trade the surplus. Rubyogo (2004), estimated that in 1990, 16% of beans produced were traded while in 2000, about 74% of the total beans produced (148,000 metric tons) were traded generating a total income of US\$ 30 million. Bush bean and climbing bean varieties of common beans are the most important traded crop in rural areas of Rwanda, and third most important in urban areas in terms of value (USAID, 2010). Following this, bean production in Rwanda is not only geared towards subsistence needs but also for local and regional markets (ECABREN, 2000; Kimani, 2004). Consequently, production of beans has shifted from subsistence production to semi-commercialized or even commercialized production. The large proportion of the sales of any quantity of beans in a year is used to purchase other household goods.

2.2 Agricultural commercialization

Agricultural commercialization is defined as the proportion of agricultural production that is marketed (Govere *et al.*, 1999). Commercialization, therefore, implies transition of agriculture from production solely for domestic consumption to the market oriented production focused on agricultural income (Hazell *et al.*, 2007; Sokoni, 2007). In literature, commercialization takes various forms.

According to von Braun and Kennedy (1994), agricultural commercialization can take place on the output side as well as on the input side of production. Agricultural commercialization on the output side refers to production focusing more on increased marketed surplus while commercialization on the input side is manifested by increased use of purchased inputs. The introduction of commercialization among farm households' changes their production goals to utility maximization as both consumers of goods and as producers. As producers they need to maximize profits and as consumers to maximize utility in consumption of the harvest.

Initially, food crops were not included in the commercialization discussion. It was only cash crops like tea, coffee, cotton, tobacco among others that were considered (Kennedy and Cogill, 1987; Govere and Jayne, 2003; Lang'at *et al.*, 2011). But recently, studies have burgeoned that include food crops, horticultural crops and even livestock (Sarkar and Golam, 2009). Wolter (2008), suggested that food crops are commercialized if these crops are meant to make profits through markets. The focus of this study was on common bean commercialization from the output side of production.

2.3 Benefits and demerits of commercialization

In developing nations, subsistence agriculture is a major strategy used by smallholder farmers in ensuring better welfare of farmers in rural areas. The major concern of farmers in developing nations is to increase per capita food production and raising rural incomes. Agricultural productivity growth has registered tremendous economic development among farmers in other regions of the world (Strasberg *et al.*, 1999). The role that commercialization of agriculture plays has drawn mixed reactions from various stakeholders from all parts of world including developing nations. Since the whole process of agricultural commercialization involves allocation of farm household resources, there is critical need for consideration to ensure that commercialization improves welfare of farmers (Bouis and Haddad, 1990).

The proponents of commercialization have advanced that cash crops enable households to access more income that can help them meet food consumption needs, nutritional adequacy, diversify production and reduce risks of food shortfalls. Braun and Kennedy, (1994), opined that increased household's income widens food diversity which consequently improves nutritional status of household members through higher energy and nutrient intake. This view is also held by Hendriks and Msaki, (2009) who studied the effects of commercialization on food security among farm households in South Africa. Their study showed that participants in commercialization program were found to be better off nutritionally and adequately nourished

Agricultural commercialization has a tendency of increasing agricultural incomes of farmers. Higher incomes accrued from commercialization have high possibility of improving farm productivity of the household. It is also put forth that commercialized households have the potential of using increased labor and mechanization in production made possible by higher incomes from the previous sales (Govereh and Jayne, 2003). As such, commercialization can be viewed as both cause and effect of increased household income.

Increased income levels leads to high food and non-food expenditures like expenditure on health and sanitation which have positive effect on livelihoods of households (Kennedy and Haddad, 1994). The implication of increased income is that households attain better welfare indicated by positive health effects and other income needs in the household.

Nevertheless, the benefits of agricultural commercialization are not conclusively consented. Hendricks and Msaki (2006), argue that hunger or malnutrition cannot separately be

solved by trade and commercialization alone instead it can even harm rural households who have little access to technology.

According to Lang'at *et al.* (2011), the increased household income from cultivation of tea, does not necessarily guarantee improved food security and subsequent reduction of poverty among the smallholder farmers in Kenya. The households who practice commercialization still struggle to put food on the table. Therefore optimal allocation of the crop enterprises between cash crop and staple food crop is critical in ensuring food security. Food crop commercialization has other multi-dimensional effects on the household's welfare.

Increase of household income may not be deterministic of welfare improvement of the household. Most rural households in developing nations have common characteristic of male leadership in decision making ranging from production, sales and uses of agricultural produce. Commercialization has the tendency of transferring the household control of income solely to men who may not be relatively conversant with household's food security and children malnutrition (Kennedy and Cogill, 1987).

Adenegan *et al.* (2013), argued that commercialization of subsistence agriculture in developing countries has led to different levels of production and consumption changes for men and women in Nigeria. The study explains that there is interrelationship between agricultural commercialization and gender dynamics on farm household resource allocation in Nigeria. They observed that gender affects small-scale farm household commercialization of food crops. Male headed farm households had large tracts of land for production compared to female headed households. Fischer and Qaim (2011), explained that women are disadvantaged and do not participate in groups that facilitate commercialization in Kenya. This transcends further to food nutrition where male controlled households do not affect household calorie consumption but it negatively impacts dietary quality.

According to Pingali (2001), agricultural commercialization can have both negative and positive impacts on the natural resource base. For instance intensive input commercialization suggests heavy reliance on the use of herbicides, insecticides and fungicides which may have human health issues. On the positive note commercialization maintains ground water levels in irrigated fields and reduce rate of salinity build up.

2.4 Factors influencing commercialization

There are many socioeconomic and institutional factors that are postulated to influence both the decision and level of commercialization. Among them is food security situation of the household. Chirwa and Matita (2012), found out that depending on stability of the food markets, the food secure households participate more in commercialization in Malawi. This is because more food secure households have a high likelihood of surplus production unlike the food insecure households who strive to put food on their tables. Fafchamps (1992), explains that a household's decision to commercialize depends on the sum of consumption and income effects of market shocks. If the markets which are alternative sources of household's food are stable, then a household can sell with a mind of acquiring food at a future date using the same income. He further revealed that households with plenty of household labor, relatively wealthier households, those who access agricultural inputs and goods market preferred commercialization. On the other hand, age and household size have negative effects on commercialization. Food security is seen to play dual roles as both cause and effect in relation to commercialization.

Omiti *et al.* (2009), pointed out that the location of the household in relation to the market influences the decision and level of market participation. The study showed that peri-urban households have the tendency of selling more proportions of their produce compared to those in rural areas in Kenya. Key *et al.* (2000) and Makhura, (2001) found that distance to the market negatively influences both the decision to participate and extent of agricultural commercialization due to transportation costs and inadequate market information. Markets act as a source of food to households without farms and with low food production. Baiphethi and Jacobs, (2009) point out that in South Africa, people living in the urban areas spent a huge percentage of income to acquire food from the markets with less than 10% from own production.

Birachi *et al.* (2011), cited transportation problems and low levels of production as constraints that affect bean marketing. Since the Great lakes region is mountainous and full of small hills, movement of goods is difficult. They also found that an increase in quantity produced had significant increase in marketed quantities. However, an increase in quantity of beans stored for food was observed to reduce marketed beans by about 19 percent. This implied that storage of beans may not be targeted at the market but for food security purposes.

Education level and farming experience of the household head are also important factors influencing commercialization. Govereh *et al.* (1999), showed that education level of household head influenced crop productivity through fertilizer use. The educated farmers utilize the market information and production inputs more efficiently thus have more marketed surplus and can negotiate for higher profits. High profits induces farmer to increase the level of participation in markets.

Ochieng' *et al.*, (2014) used linear regression model to analyze factors influencing commercialization of beans among farmers in Burundi. After performing tests on multicollinearity and autocorrelation, the study found among other factors quantity of beans stored for food and seed, access to market information and knowledge of bean network. The study does not necessarily disaggregate the decision to commercialize and levels hence addressed in the current study.

2.5 Empirical studies on the relationship between agricultural commercialization and food security

Literature contains some insights on the commercialization effects of agriculture on household food security. Though there is no conventional method to measure food security, analysts have come up with various techniques that involve the use of food security indicators as proxies. The most commonly used proxies are food accessibility and dietary diversity intake, food crop productivity and input use (Strasberg *et al.*, 1999).

Goitom (2009), established that farm households with a high degree of commercialization were better off in welfare than those with low level of commercialization among smallholder farmers in Ethiopia. The study used analysis of variance (ANOVA) based on household expenditures on basic non-grain food, education, durable goods and housing. Further, the study used two-stage Heckman model to determine the decision and extent of commercialization. The first stage involved the use of Probit model to determine decision to participate in commercialization then ordinary least square (OLS) was applied in the second stage. The study showed that the factors influencing commercialization and intensity include level of crop production, use of improved seeds, and total land size.

In line with Goitom (2009), Hendriks and Msaki (2009), used dietary diversity technique to determine the effect of commercialization on food security. The study grouped households according to the levels of commercialization and used analysis of variance (ANOVA) to observe

the differences in dietary diversity as impact of commercialization on food consumption in South Africa. This was done by analyzing consumption and nutrition trends from the data. The study indicated that smallholder commercialization positively impacts food diversity and adequacy. This approach has appealed to a number of studies like Osmani *et al.* (2014) who carried out commercialization outcomes on welfare among Bangladeshi.

Another approach involves the use of per capita calories as proxy to measure food security. Tembo and Simtowe (2009), used the recommended per capita calories of 2200 kcal as a proxy indicator for food as they analyzed the effect of market accessibility on household food security in Malawi. The study found that households without market access and households living in the rural areas consumed more calories from their own production and gifts as compared to purchases. They further cite that sex, age of the household head and income had significant effect on daily per capita calorie intake for rural households. Contrary to expectations, total land under cultivation showed insignificant effect on household food security for both rural and urban households.

Kirimi *et al.* (2013) also used sufficiency of available household income to meet the dietary needs of household members as measure of food security. This was done through computing household income with respect to poverty line and then three groups of poverty levels were generated. The study found that market commercialization in both input and output can play a significant role in reducing risk of being in food poverty.

Gibreel (2002), examined the effect of cash crop commercialization on household food crop production in Western Sudan. Ground nuts were taken as a cash crop. The study used the commercialization index function as endogenous variable in gross value of food output. By the use of two stage least square estimation, the study found that household size and technological factors were important determinants of household level of commercialization. Households with higher livestock income relied more on livestock as source of investment and cash income than on groundnut production. The study concluded that agricultural commercialization had a positive and significant impact on household food crop production and hence household food security.

Ruhangawebare (2010), sought to determine the factors affecting the level of commercialization among cattle keepers in Uganda. The study found that cattle were kept as a form of insurance and store of wealth rather than for commercial purposes. Consequently livestock markets were not significantly driven by market demand but to satisfy the specific

needs of the livestock keeper where culled cows dominated the sold cattle. The other significant factors influencing level of commercialization included distance to the market, cattle prices, market information access and alternative sources of income. The results of the study implied that livestock market participation does not directly affect food security.

Nwachukwu *et al.* (2014) derived an index involving per capita food expenditure in relation to two-thirds of mean per capita food expenditure. The study analyzed effects of commercialization of cassava being one of major food crop on food security of small households in Nigeria. The study suggested that there was no significant disparity in food security among farmers in different level of commercialization. The current study focuses on similar food crop that contributes on food security among small holder households.

From the preceding studies, there is no conventional measure of agricultural commercialization effects on food security and food sufficiency among farm households. This, therefore, leaves analysis of effects of commercialization on food security open to different measuring techniques. Some studies used comparative analysis where a program facilitating commercialization is analyzed and participants and non-participants welfare is considered (Chirwa and Matita, 2012). In other studies food crop productivity and input use is used as a proxy for food availability and hence food security. This study disaggregated farmers into three categories using the level of commercialization and then compares their food security attributes. The attributes included expenditure on food, number of months a household had food stocks in years 2013 and 2014.

2.6 Theoretical framework

The theories of farm household and utility maximization were used to explain the economic behavior of farm households. The theories explain farm household's decisions on resource allocation, production and consumption patterns. The farm household theory was formulated back in 1925 by Chayanov and has since been reviewed further by agricultural economists (Barnum and Squire, 1979; Ellis, 1992). The agricultural household is faced with decisions with regard to subsistence production, semi commercial and commercialized production.

The theory of the farm household allows the separation of a household into a producer and a consumer depending on the level of the household's level of commercialization. For

subsistence production, a farm household will first maximize household utility as consumer and then maximize profits as a produce depending on the availability of marketable surplus. For the commercialized production; profit maximization is pursued. This study adopts the farm household theory to observe the joint decisions and outcomes regarding household production and consumption as observed by Singh *et al.* (1986). The theory assumes that since land size of the household is fixed, then the households have to choose from own production what to consume and what to sell of output. The incomes from agricultural sales are then used to purchase non-farm consumption goods.

According to Barret, (2008) agricultural household is assumed to face decision to maximize utility. The utility is defined as a function of common beans and a vector of other tradables \mathbf{X} . But beans are produced using technology, $f(A, G)$ where A is vector of privately held assets and G is vector of public goods. The household further faces market price P for each crop. Let household's decision to engage in common bean commercialization be represented by X . Therefore

$$Y = f(A, G, W, P) \dots\dots\dots (1)$$

Where

A is privately held assets e.g. land, machinery,

G is vector of public goods and services e.g. road accessibility,

W is liquidity from non-farm activities

P is output price of crop

The relationship can be specified as:

$$Y = f(\text{Age, household size, farmsize, offfarm income, market info, price})$$

Since commercialization takes different levels, the household chooses the level rationally considering what will maximize the household's utility. Suppose U_j and U_k represent perceived utility of commercializing or not respectively. Then utility model could be specified as

$$U_{ij}(\beta_j X_i + \varepsilon_j) > U_{ik}(\beta_j X_i + \varepsilon_k) \quad \forall i \neq j \dots\dots\dots (2)$$

Where X is vector of explanatory factors influencing choice of utilities, β_i and β_j are parameters to be estimated ε_i and ε_j are the independently and identically distributed error terms

(Greene, 2000). The probability that a household will choose U_j instead of U_k is defined as $P(Y = 1 | X) = P(U_j > U_k)$ where P is the probability function

$$P(\beta_j X_i + \varepsilon_j - \beta_k X_i - \varepsilon_k > 0 | X)$$

$$P(X^* X_i + \varepsilon^* > 0 | X) = F(\beta^* X_i) \dots\dots\dots (3)$$

Where $\varepsilon^* = \varepsilon_j - \varepsilon_k$ is a random disturbance term, $\beta^* = (\beta_j - \beta_k)$ is a vector of parameters of net influence and $F(\beta^* X_i)$ is cumulative distribution function of ε^* evaluated at $\beta^* X_i$.

Depending on the assumed distribution that the random disturbance term follows, several qualitative choice models can be estimated (Greene, 2003).

2.7 Conceptual framework

Farm households practicing common bean production have almost inseparable production and consumption decisions. The choice of crop enterprise, amount of common bean to be cultivated and amount to be commercialized depend on the farmers' socioeconomic characteristics, institutional factors and household endowments. These factors include household size, land size, occupation, age and gender of the household head, education, extension services, access to credit and group membership.

Depending on the availability of market information, type of buyers, distance to the market and price of beans the farmer decides to sell or not and the quantity to be sold. Household food security status also determines the quantity to be sold. Households with low food sufficiency using beans as staple food will prioritize retaining high proportion for food and sell the surplus. The income from sale of beans can be used to buy other food products or other expenditures. Off farm income and income from other agricultural enterprises are conceptualized to be used in food budget and thereby influence food and nutrition status of the household. It is put forward that household food status affects the level of production and what is offered to the market. Figure 1 below shows the illustration of the factors that influence a household's decision to commercialize and effects on food sufficiency.

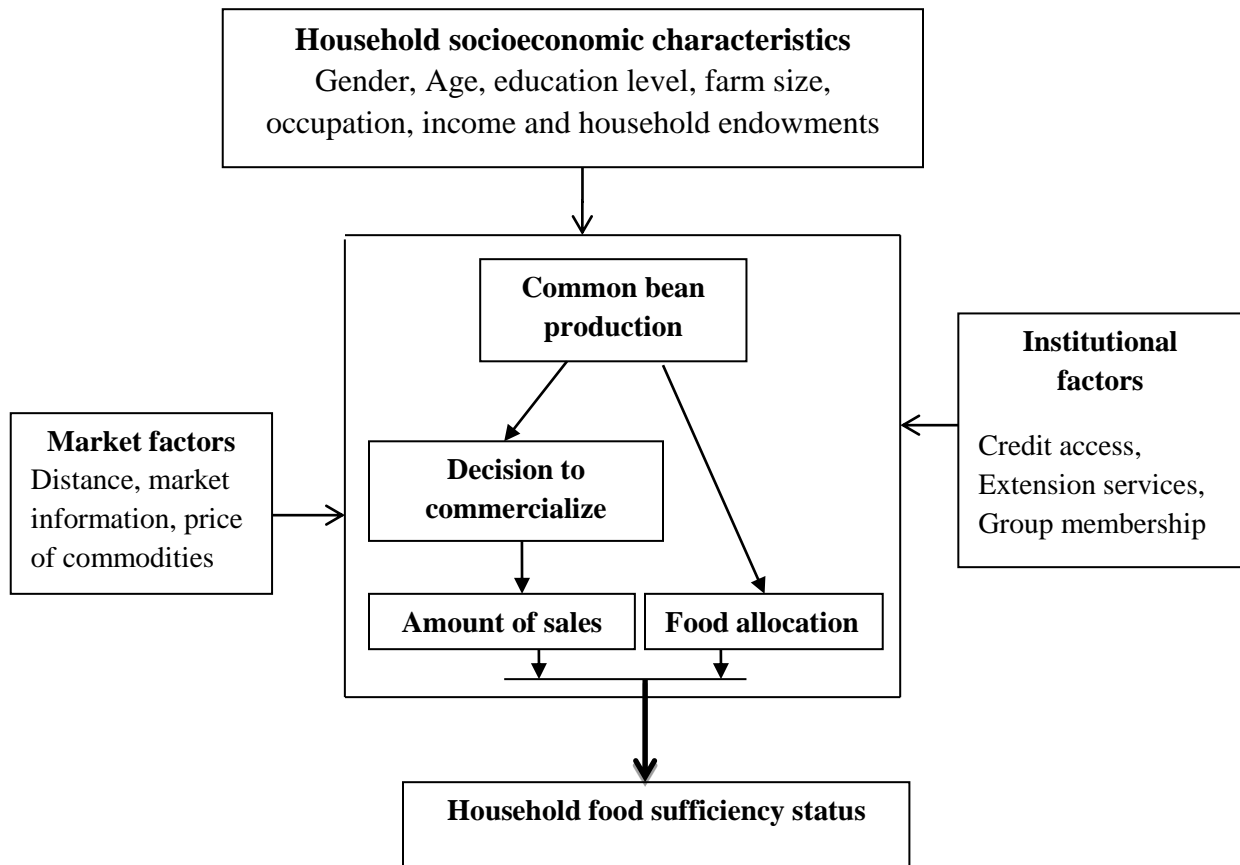


Figure 1: Conceptual framework showing bean commercialization and food sufficiency trade-off

Source: Own compilation

CHAPTER THREE

METHODOLOGY

3.1 Study area

Rwanda is situated in the Great Lakes region of Eastern Africa. It is one of the smallest countries in Africa with a total area of 26, 338 Km². This landlocked country is situated south of Uganda, east of DR Congo, west of Tanzania and north of Burundi. The country's geographic coordinates are 2°00' S, 30° 00'E and lies 75 miles south of Equator. It is locally referred as land of thousand hills depicting rugged terrain of the country. Rwanda has approximately 12 million people making it the most densely populated country in Africa.

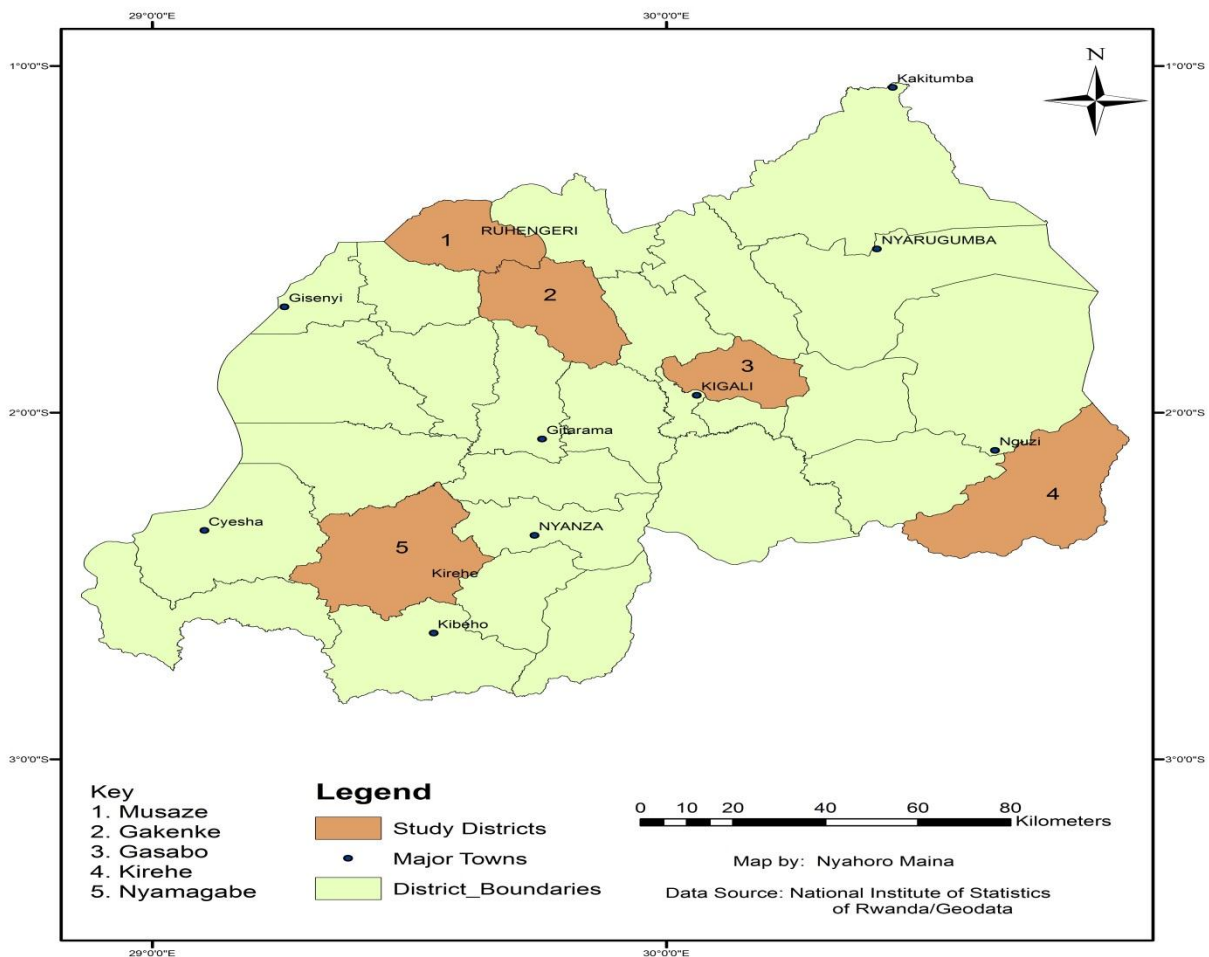


Figure 2: Map of the study area (the shaded regions).

Source: Adapted from www.statistics.gov.rw/geodata.

Rwanda has three seasons in an agricultural year. The first season begins in September till February of the following year, the second starts in March and ends in July. The last season is quite short starting in August and ends in September (NISR, 2013). The average yearly rainfall is 1400 mm with important geographic variations. Precipitation is heaviest and most regular in the western and north-western areas, while the eastern region has less abundant and more erratic rains. The average temperature is 24-27°C (CFSVA, 2012). The study was carried out in five districts in different provinces of Rwanda

3.2 Source of data

Secondary data from The Centre for Tropical Agriculture (CIAT) was used. Data was collected in 2014 drawn from 252 respondents chosen from five districts across the country.

3.3 Data Analysis

The data was analyzed using STATA 12 and SPSS statistical programs.

Objective one: Descriptive statistics were used to analyze the utilization patterns of beans in Rwanda. This involved the use of percentages, frequencies, mean and standard deviations.

Objective two: To establish the effect of common bean commercialization household food sufficiency among smallholder bean farmers.

The study used analysis of variance (ANOVA) and t-test to draw differences in the number of months food stocks lasted in 2013 and 2014, and household food expenditure (Hendriks and Msaki, 2009). Household bean commercialization index was used to draw different levels of commercialization among households (Govereh *et al.*, 1999, Martey, *et al.*, 2012). For this study, the ratio of the gross value of bean sales by the household in season *j* to the gross value of all common beans produced by the same household was calculated. That is:

$$HCI = \frac{\text{gross annual value of beans sold}}{\text{gross annual value of all beans produced}} \times 100 \dots\dots\dots (4)$$

Proportion of total crop income reveals the dependency ratio of farm households on income derived from common bean sales and the possible household uses. The household commercialization index lies between 0 -100 percent, that is $0 \leq HCI \leq 100\%$. Where 100% implies that all common beans are sold while 0% indicates that the household is totally subsistent or does not sell any beans output. In order to analyze the effects of commercialization, the

indices were divided into three groups. The first category involved non-commercialized households with HCIs equal to 0% implying they did not sell their beans; the next group was semi commercialized farmers with HCIs less than 50%. Last category involved commercialized farmers who had HCIs above 50%. The proxies for household food sufficiency were examined and any difference between the categories was noted. The proxies for food sufficiency included number of months that food stocks lasted in years 2013 and 2014, household food expenditure and expenditure on non-food items.

Objective three: To establish factors influencing the decision to commercialize common bean and extent of commercialization among the farmers.

The study used the double hurdle model to analyze this objective. The factors influencing the decision to commercialize and those influencing level of commercialization are taken to be different (Goetz, 1992). This excludes use of Tobit model which assumes that same factors influence decision to commercialize beans as well as factors influencing the extent of commercialization of beans. Heckman, (1979) suggested a solution to selectivity bias that involves two stage model commonly known as Heckman model. The Heckman model has almost similar results with the double hurdle model. The difference is that Heckman regression models takes zeros to imply unobserved values, unlike double hurdle which considers observed zeros as optimal choice by farmers not to commercialize (Ricker-Gilbert *et al.*, 2011). The Heckman model best suits the data from non-random samples as result of survey designs and sample attritions. The current study used data from random samples; hence the use of double hurdle model.

In the double hurdle model, decisions are divided into two sequential tiers/ hurdles. In the first stage, Probit regression model is used to determine whether the farmer decides to commercialize or not. The second stage involved use Ordinary least Square (OLS) regression where farmers who engaged in commercialization were considered. The empirical model can be specified as follows:

$$y_i^* = X_{i1}\beta + \mu_i, \mu_i \sim N(0, \delta^2) \text{ where } y_i = \begin{cases} 1 \text{ if } y_i^* > 0 \\ 0 \text{ if } y_i^* \leq 0 \end{cases} \dots\dots\dots (5)$$

$$Z_i^* = X_{i2}\alpha + \varepsilon_i, \varepsilon_i \sim N(0, \delta^2)$$

$$Z_i = \begin{cases} Z_i^* & \text{if } Z_i^* > 0 \text{ and } y_i = 1 \\ 0 & \text{otherwise} \end{cases} \dots\dots\dots (6)$$

Where y_i^* in equation (5) is latent variable describing farmer's decision to commercialize beans, β_{is} and α are vector of parameters, X_{i1} and X_{i2} represents the vector of variables explaining the decision to commercialize and the variables explaining the extent of bean commercialization respectively (Cragg, 1971). In equation (6) Z_i represent the level of commercialization which depends on latent variable Z_i^* being greater than zero and conditional to decision to commercialize y_{i*} .

According to Wooldridge, (2002), the likelihood of commercialization is given as:

$$\varphi(x_{1i}\gamma)\sigma^\tau(-1)\vartheta\left(\frac{y_{1i}-x_{1i}\beta}{\sigma}\right)\dots\dots\dots (7)$$

The log-likelihood function of the double hurdle model is:

$$\ln L = \sum_{i=0}^n \ln \left\{ 1 - \varphi(x_{1i}\gamma)\varphi\left(\frac{x_i\beta}{\delta}\right) \right\} - \left(\frac{n_+}{2}\right) \ln \sigma^2 + \sum_+ \ln \varphi(x_{2i}\gamma) + \sum_+ \ln \varphi\left(\frac{y_{1i}-x_{1i}\beta}{\sigma}\right) \dots (8)$$

In order to assess the effects of regressors' on the level of commercialization marginal effects of the variables was analyzed.

The empirical model to assess the objective was;

$$\text{Commercialize (yes/no)} = \beta_0 + \beta_1 \text{age} + \beta_2 \text{ household size} + \beta_3 \text{ income} + \beta_4 \text{ land size} + \beta_5 \text{ number of crops cultivated} + \beta_6 \text{ number of livelihoods} + \beta_7 \text{ bean type} + \beta_8 \text{ quantity of beans} + \beta_9 \text{ group membership} + \beta_{10} \text{ time taken to market} + \beta_{11} \text{ bean storage} + \beta_{12} \text{ market information} + \beta_{13} \text{ distance to market} + \varepsilon_i$$

The empirical model to determine the factors influencing the level of commercialization is as follows:

$$\text{Level of commercialization} = \beta_0 + \beta_1 \text{age} + \beta_2 \text{ household size} + \beta_3 \text{ land size} + \beta_4 \text{ total income} + \beta_5 \text{ number of livelihoods} + \beta_6 \text{ number of crops cultivated} + \beta_7 \text{ Quantity of beans} + \beta_8 \text{ price per kilogram} + \beta_9 \text{ group membership} + \beta_{10} \text{ bean storage} + \beta_{11} \text{ market information} + \beta_{12} \text{ distance to market} + \varepsilon_i$$

Table 3: Description of variables used in the double hurdle model

Variable	Description of the variables	Expected sign
Dependent variable	Decision to commercialize Level of commercialization	
Independent variable		
Age in years	Age of the household head in years	-
Householdsize	What is the size of the household?	+/-
Income	Amount in Rwf (continuous)	-
Land size	Size of the household land size (ha)	-
Livelihoods	Number of livelihoods	+/-
Cultivated crops	Number of crops cultivated	+/-
Type of bean	Type of bean variety (0= bush beans,1= climbing beans)	+
Quantity of beans	Total kilograms of beans produced	+
Bean storage	Did you store any beans?	+
Group membership	Member in any farmer group (0= No, 1= Yes)	+
Market information	Satisfied with market information (1= very satisfied, 2= satisfied, 3= indifferent, 4= unsatisfied, 5= very unsatisfied)	-
Time	Time taken to near market in hours	-
Distance	Distance to the near markets in kilometers (continuous)	-

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results and discussions of the study. Socioeconomic characteristics of the farm households and bean utilization patterns are discussed in the first section. The second section presents discussions on the effects of common bean commercialization on food sufficiency. Lastly the results from Double-Hurdle model are discussed.

4.1 Socioeconomic characteristics of bean farmers in the study area

This study was based on a sample of 252 farm households who cultivated beans as the major crop in their farm plots. From the results many farmers cultivated more yielding and space maximizing climbing beans compared to bush beans. Only 34.9% farmers cultivated bush beans among the sampled households. It was found that 41% of sampled bean farmers sold part or their entire bean produced while the rest kept their harvests majorly for food and seed stocking.

4.1.1 Age and household sizes

The overall youngest bean farmer was 19 years old while the oldest was 85 years old which reveal that beans are highly valued by all age groups in the study area. The average age of the household head was found to be 36 years, as shown in Table 4 below.

Table 4: Age of household head and household sizes

Variable		Overall	Commercialized	Non- commercialized
Age in years	Mean	36.08	32.93	38.30
	Std deviation	11.43	10.27	11.71
Household size	Mean	5.02	4.68	5.26
	Std deviation	2.00	1.82	2.09

Source: CIAT, 2014.

Farmers who commercialized their beans had relatively lower average age compared to those who did not sell beans. The average age of commercialized bean farmers was recorded at age of 32.93 years falling 6 years less than their non-commercialized counterparts. The differences may be attributed to the risk-averse nature of older farmers who place more

importance on food crops and their low tendency to engage in markets compared to the young farmers. Aged farmers are risk averse and would prefer subsistence farming to ensure food supply in the households. Relatively younger household heads are endowed with more production potential thus gearing towards commercial production.

The overall average number of members in a typical household was found to be 5 persons. The largest household size was 12 persons while the household with lowest number of persons only recorded 2 persons. The findings are similar to the general population statistics as recorded in 2012 population census (MINAGRI, 2013). The study found that average non-commercialized households had one extra person in their household compared to commercialized households. The results of a t-test were statistically significant at 5%. This may be attributed to the fact that high household size leads to high domestic consumption needs especially among low income smallholder farmers who mostly rely on agricultural activities for their livelihood. High consumption of food produced by the farm household has a tendency of low surplus production and hence low or no commercialization of beans.

The study found that 72% of farmers were married to a single spouse while the rest were polygamous, divorced or widowed. Family with more than two adults has higher chances of more labor compared to those divorced or separated. It was found further that 91% of the households were headed by male while distant 9% households had the female headship. This depicts patriarchal nature of family set up in the region

4.1.2 Household income levels

The average monthly income per household was found to be RwF 23181.52 with a standard deviation of 19355. Table 5 below shows high standard deviation of the average income thus implying some income inequality among the farm households. The findings are similar to national inequality recorded at gini coefficient recorded at 0.49 (CFSVA, 2012). However there were no monthly income differences between commercialized and non-commercialized farm households as revealed by the t-test results. The difference was insignificant at 1%, 5% or 10% levels. The findings revealed that participation in commercialization did not have effect on the income levels of the households.

Table 5: Household income levels in Rwandan francs

		Mean	Standard deviation	Minimum	Maximum
Commercialize	Yes	35533.65	99250.25	1000	150000
	No	27730.85	44913.72	2000	230000
Overall		30951.06	72377.56	1000	230000

Source: CIAT, 2014.

The results indicated that food purchases and agricultural expenses were the major uses of income in many households recorded at 67% and 22% respectively. High expenditure on food indicates that production level was lower than food demands in the households and hence farmers counter the deficit by food purchases. Both commercialized and non-commercialized bean farmers engaged in food purchases in their households. The high level of food purchases compared to other income needs can be attributed to the high poverty level and food insecurity experienced in the country (CFSVA, 2012). On the other hand, high expenditure on agriculture explained vulnerability of farmers to the food insecurity and hence income is expended to ensure continuity of food availability in the preceding seasons.

4.1.3 Education level of the household head and spouse

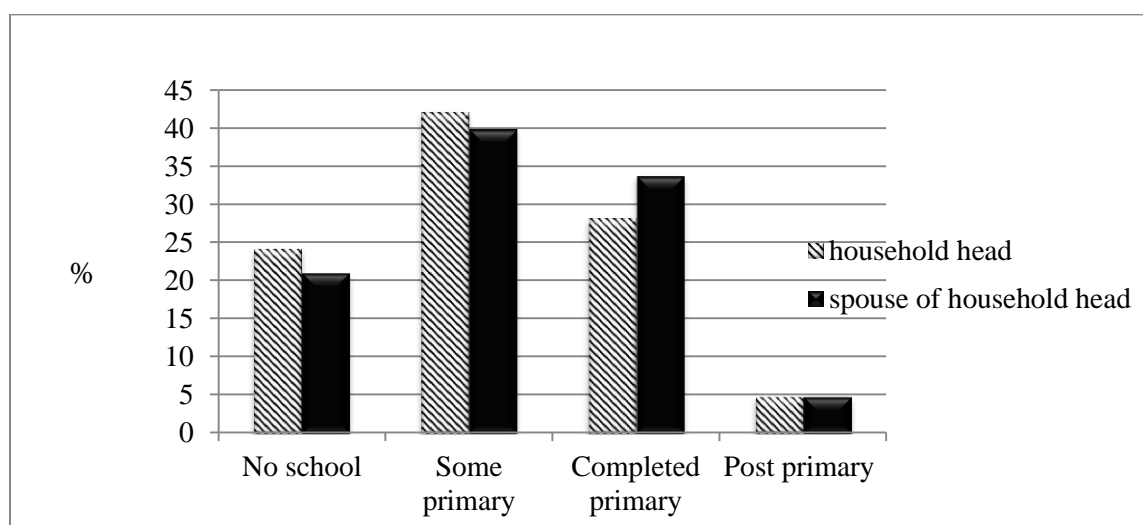


Figure 3: Level of education

The majority of the household heads either did not attain any basic education or did not complete their primary school education. As shown in Figure 3 above, 27% of household heads did not attend any formal school while 42% had attained some primary schooling. There were only 28% of the sampled households who had completed their primary education while less than 5% had completed secondary and tertiary education. The education level of spouses was similar to that of the household heads as illustrated in Figure 3. Chi-square tests of household heads education level did not reveal any significant differences between market participants and non-participants.

4.1.4 Major livelihood activities

Agricultural production provides a means of livelihood to most of the households as shown in Figure 4 below. Self-employment on one’s own farm accounted for 75% of farmers’ livelihoods while working on other farmer’s farms for income was recorded at 12%. In general, the results revealed the importance of agriculture to households who depend on agriculture as their main and only source of livelihood. The remaining 13% relied on provision of unskilled daily labor in non-agricultural sector and other jobs.

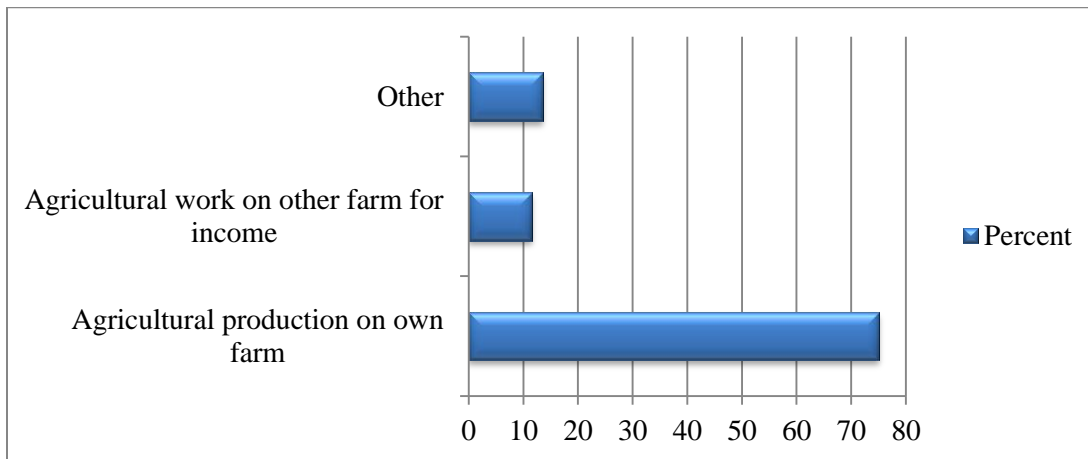


Figure 4: Distribution of major livelihood activities among household heads

High reliance on agricultural work may have been largely contributed by the low level of education among farmers where close to 95% had less than a secondary education leaving them to engage in activities that do not require many skills. Jayne *et al.* (2003) argued that the poor generally lack land, capital and education to respond quickly to technological innovation and agricultural market opportunities. The argument, however, was contrary to the findings of the

current study because there were no significant statistical differences on land sizes and education levels yet some farmers participated in commercialization while others did not.

The study found that 49% of farmers engaged in collective action through joining one or more farmers groups. High membership fee and unavailable farmer groups were the major hindrance for group membership. From the findings most farmers who had joined groups had not harnessed the benefits of their collective action. Very low percentage of farmers (4.76%) indicated farmer groups as their source of market information. Membership to farmer groups should accrue many benefits to farmers including price negotiations, sharing of market information among others.

4.1.5 Farm sizes and farming systems among households

Majority of farmers owned less than one hectare pieces of land whereas less than 2% owned more than one hectare as illustrated in Figure 5 below. Low landholding can be attributed to population pressure on land which has reduced cultivated plots to about 0.5hectares per household (CFSVA, 2012). Farm households which own large pieces of land have high potential of surplus production and hence high chances of output commercialization.

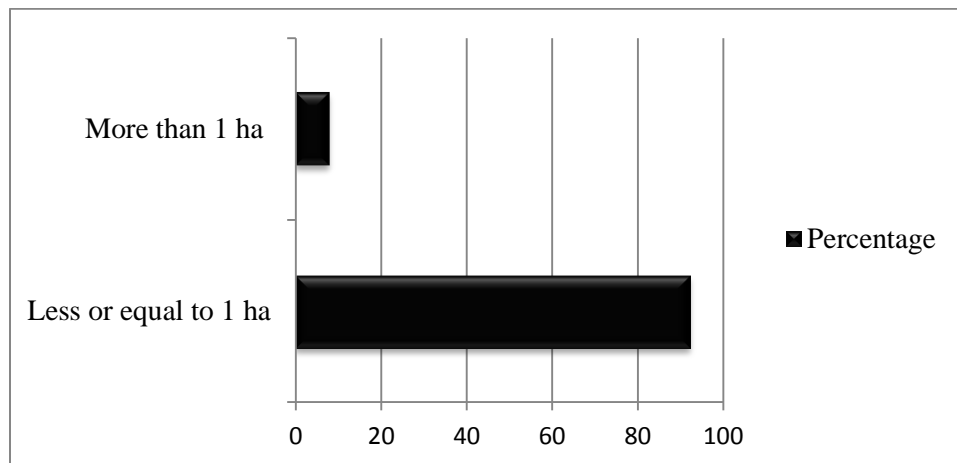


Figure 5: Distribution of land sizes among farmers

This study found that there were no significant land size differences between farmers who participated in bean commercialization and those who did not as indicated by the Chi square tests results given in Table 6 below.

Table 6: Land size comparisons among households

Land size	Total	Commercialized	Non-commercialized	Pearson Chi sq	Sig.
Less or equal to 1 ha	232	99	133		
More than 1 ha	20	5	15	2.3895	0.496.

Source: CIAT, 2014.

The current study found that 44% of farm households cultivated beans as the only type of crop in their plots while 43% of the farmers included another type of crop. The rest of the farmers cultivated more than two crops. Crop diversification enhances income levels and food security and nutrition and mitigates crop-specific failure risk, especially for farmers who rely on agricultural activities as their main livelihood (Sichoongwe *et al.*, 2014). In order to boost their income farmers who practice mono-cropping tend to sell some portion of their produce as their source of income.

Less than half of farm households owned some kind of livestock in their respective farms. Amongst those who owned animals; dairy cows and goats were the most popular. Dairy cows may have been largely owned as an alternative source of proteins to the farmers. On the other hand, goats may have been kept due to their high reproductive nature and hence are easy alternative source of income. The result on types of livestock owned corroborates the national statistics on livestock production (CFSVA, 2012).

4.2 Utilization patterns of Beans

4.2.1 Amount of beans produced and marketed

The total harvests among individual farm households ranged below 500 kilograms. Seventy seven percent of the surveyed households produced less than 100kgs of beans while 23% produced between 100 and 500kgs of beans. The results are as shown in table 7 below. The relatively low production levels could be attributed to the low land sizes among the farm households. It was further revealed that amongst farmers who participated in bean commercialization; 85.6% of farmers sold less than 100kgs of the beans they had harvested while 14.4% farmers sold between 100 – 500kgs. Farmers did not sell their entire bean produced;

some were retained for domestic consumption and stocked as seeds for the next season as illustrated below.

Table 7: Amount of beans produced and marketed

Beans produced	Beans produced		Beans sold	
	Frequency	Percentage	Frequency	Percentage
Less than 100kgs	195	77.38	89	85.6
100-500kgs	57	22.62	15	14.4
Total	252	100	104	100

Source: CIAT, 2014.

4.2.2 Household decision making on bean commercialization and use of income

Joint decision between the household head and spouse characterized most household decisions on when to sell and point of selling their bean. Joint decision between the household head and spouse accounted decisions of about 63% of the farm households. On the other hand, single handed decisions by the spouses of the households only accounted 15% of decisions made. This study found relatively positive participation by both genders in the decision to sell beans and the choice of market. The implication of both genders participation ensures effective and considerate allocation of agricultural income to agreed expenditure types. There is a shift from male headed decision making to joint decision making between husband and wife. Participation of both sexes in agricultural commercialization decision is vital for better welfare outcomes in the household (Adenegan *et al.*, 2013).

Table 8: Decision maker for bean commercialization and place of sale

Who decides	To sell		Where to sell	
	N	%	N	%
Head of household only	23	21.9	19	18.1
Spouse of head of household only	16	15.24	16	15.24
Household head and spouse jointly	65	62.86	69	66.67
Total	104	100	104	100

Source: CIAT, 2014.

4.2.3 Characteristics of common bean marketing

More than half of the sampled households alluded to household needs as the major reason for selling beans. Household needs such as purchases of consumer goods accounted for a large percentage of reasons as to why some common bean farmers did not engage in bean commercialization. Further, the results showed the other purposes for bean sales were: medication at 11.5%, agricultural income (9.62%), education (4.8%), purchases of agricultural inputs (2.9%) and other purposes 13.7%. The results indicate the importance of common beans among the various households in Rwanda.

Table 9 below shows the average time used to transport beans from where farmers stored their produce to the nearby market. This study reveals that there was no significant difference on time taken to the market among market and non-market participants. Distance to the market has drawn mixed implications on market participation in different studies. For instance, Randela, *et al.* (2008) argued that longer distance prompts higher prices for surplus produce especially when one is endowed with transportation means. On the other hand long market distance leads to additional transportation and storage costs.

Table 9: Time taken to the nearest market

Time taken	Commercialized	Non- commercialized	Total	Chi	Sig.
< 30 minutes	26	36	24.60		
Between 30 - 60 minutes	37	53	35.71		
> 60 minutes	41	59	39.68	0.0153	0.992
Total	104	148	100		

Source: CIAT, 2014.

The longer time used to move commodities to the market may be explained further by means of transport used. Most parts of the road were earth road and only about a quarter tarmacked. Transportation of beans to the market on foot using human heads was the most popular means of transport accounting to 82%. This may be attributed to the terrain in Rwanda characterized by hills. Bicycle and vehicle were only used by 8% and 5% of producers respectively as illustrated in Figure 6 below.

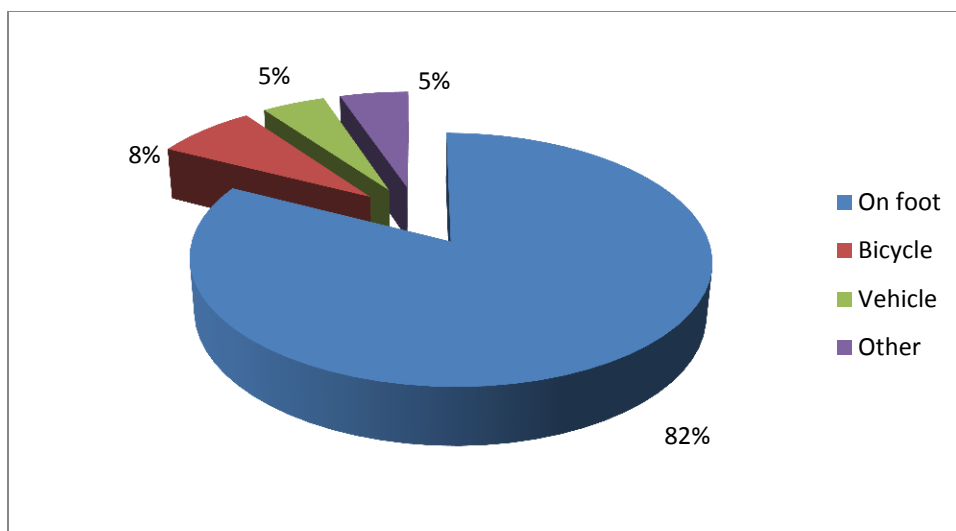


Figure 6: Common means of transport for beans to the market

Vendors and traders were the major buyers of beans. It was found that they bought 87% of beans sold at their stalls in the local market and from farm gate. Farmers opt for marketing channels that would reduce transaction costs. It is noteworthy that other farmers and neighbors nearby accounted for 8% of bean sold. This may be attributed to the high percentage of farmers engaging in food purchases to buffer their food stock. The average selling price per kilogram was Rwf 351.15 whereas the least price was Rwf 180 and highest price was Rwf 600. Apart from the local market which accounted for 65% of sales, 32% of beans sold were bought at the respective farm gates after harvests.

Close to half of the sampled farmers, that is, 44% relied on traders and other market authorities as their major source of market information. This may be attributed to the fact that most farmers would prefer going by foot to the market to sell their produce while having face to face communication with the buyers of beans. Contrary to the general expectation that mobile phones could be the major source of market information; less than 1% of sampled farmers cited mobile phones as means of accessing market information. It was further revealed that 5% sampled farmers cited farmer groups as their reliable source of market information. This may be attributed to low farmer group membership while some groups had been recently initiated before harnessing the benefits. Sufficient market information is critical in marketing farm produce in terms of market price and location of market.

4.2.4 Post harvest management of beans

Nearly half of bean farmers stored their beans after they harvested. The major reason stated for storing beans was to ensure domestic supply of food in the future while others preserved some amount as seeds for next planting seasons. The rest of the farmers did not store any quantity of beans because they had less harvest which was apportioned for domestic consumption only. It is interesting to note that less than 10% of farmers who stored some beans had the intention of future sales. This is further illustrated by the duration in which beans were stored. It was found that 73% of households stored their beans for a period between one and three months while the rest sold their beans after less than 30 days. From these results it can be seen that there was a period when farmers had no stock of beans between seasons in many households. In relation to storage materials, polypropylene bags were the most commonly used storage material by close to 91% households. The other storage equipment included earthen pots, plastic drums and granaries.

4.3 Effects of commercialization on food sufficiency

Three groups of bean farmers were formed based on the levels of commercialization of beans and food sufficiency proxies were analyzed for any differences. Non-commercialized households involved households with zero Household Commercialization Index (HCI), semi-commercialized group were farmers with HCI greater than zero but less than 0.5 and lastly commercialized farmers had HCI greater than 0.5. The number of months that households had food stocks available for consumption was analyzed for both year 2013 and 2014.

Non-commercialized households had relatively longer periods in which their food stock lasted compared to semi-commercialized and commercialized households. On the other hand, semi-commercialized households had shorter period to which their food stock lasted on average. The disparity was evident in the respective seasons within year 2013 and year 2014. In 2013, an average non-commercialized household had three months with enough food stock compared to about two months semi-commercialized households had food stock. Similar results were observed in the year 2014. One way ANOVA test and Lavene statistic, however, revealed that there were no statistical differences among the three groups as indicated in Table 10 below.

Table 10: Comparisons of smallholder on food stock availability in years 2013 and 2014

Number of months households had Food stock	Degree of commercialization			F ratio	Prob>F
	HCI = 0	0<HCI <0.5	0.5<HCI<1		
Season A 2013	1.72	1.06	1.32	2.90	0.0568
Season B 2013	1.28	1.26	1.54	1.10	0.3339
Overall 2013	3.01	2.31	2.87	0.95	0.3871
Season A 2014	1.78	1.69	1.54	0.47	0.6253
Season B 2014	1.47	1.65	1.62	0.50	0.6054
Overall 2014	2.61	2.11	2.31	0.07	0.9364

Source: CIAT, 2014

Since poor households consume food from their own production and some other portion is bought, the study analyzed the expenditure on food among the three categories of households. Results in Table 11 below reveal that non-commercialized households had lower expenditure on food compared to the commercialized households. On average, commercialized households spent Rwf 2253.60 more on food than non-commercialized households. Semi-commercialized households spent on average Rwf 2465.27 less than the average commercialized household expenditure on non-food items. Despite the differences, there were no statistical differences on both expenditures among the different categories.

Table 11: Comparison on food and non-food expenditure

Household expenditure	Degree of commercialization			F- ratio	Prob>F
	HCI = 0	0<HCI <0.5	0.5<HCI<1		
Expenditure on food	21331.577	22408.8	23585.191	0.09	0.9120
Expenditure on non-food items	6728.9262	6516.5714	8981.8382	0.53	0.5899

Source: CIAT, 2014

A t-test comparison of food expenditure between various levels of HCI was done. Results, however, indicated that there was no significant difference on food expenditure among

the households. However it was expected that households who engaged more in commercialization had increased expenditure on food. A number of studies have found that households with a high degree of commercialization are better off in terms of consumption of basic non-grain consumables (Osmani *et al.*, 2014 and Goitom, 2010). Chirwa and Matita, (2012) had suggested that more commercialized farmers tend to be more food secure than the non-commercialized counterparts. Similar tests were done on expenditure related to non-food items like education, expenditure on clothing. The t-test results showed that households in different levels of commercialization had no significant statistical differences on non-food expenditure.

The current study suggests that commercialization of beans does not significantly affect food sufficiency among food insecure households in terms of food availability and food expenditure. Differences in commercialization levels did not translate to more significant differences in welfare and food sufficiency outcomes. This study corroborates with findings of Nwachukwu *et al.* (2014) who found that food security status of cassava producing households in Abia were not different between levels of commercialization. A similar study in Nandi South District in Kenya found that the increased household income from commercialization does not necessarily translate to improved food security (Lang'at *et al.*, 2011).

The minimal effects of agricultural commercialization among households who are generally poor have since attracted attention of many research studies. While investigating on effects of commercialization, Von Braun and Kennedy, (1994), found that the share of income from cash crops did not significantly affect the marginal propensity to spend on food. The study indicated that income that accrues from agricultural sales did not necessarily translate to food security. This is further illustrated by Wood *et al.* (2012) who suggested that differences may be felt among small scale households during price shocks and hence affecting food security status of small scale farmers. Commercialization, therefore, may not explain differences in household food sufficiency situations among households with generally high poverty levels.

4.4 Factors influencing commercialization decision and extent of bean commercialization.

In order to determine the factors that influence the decision and extent of bean commercialization, the double hurdle model was used (Cragg, 1971). The model allows for use of Probit model in the first tier and OLS regression in the second step.

4.4.1 Factors influencing decision to commercialize common beans

The results from Probit model are as shown in Table 12 below. Random effect maximum likelihood was used because independent variables were not correlated as observed in the appendix. The log likelihood for the model was -124.57971 and log likelihood of chi- squared was 91.64. Five explanatory variables were significant at 1%, 5% or 10% significance levels.

Table 12: Factors influencing the decision to commercialize beans

Variable	Marginal effects	Standard Error	$p > z $
Age	-0.0095355	0.0036	0.008***
Household size	-0.0318785	0.01996	0.110
Total income	2.71E-07	0.00000	0.616
Land size	-0.0019236	0.00161	0.233
Number of crops cultivated	0.0146084	0.0516	0.777
Number of livelihoods	-0.1953243	0.06203	0.002***
Bean type	-0.1932464	0.08111	0.017**
Quantity of bean	0.0023139	0.00046	0.000***
Group membership	-0.0844238	0.07295	0.247
Time taken to the market	-0.0796868	0.06811	0.242
Bean storage	-0.08898	0.07311	0.224
Market information	-0.0921258	0.0423	0.029**
Market distance	0.047294	0.06261	0.450

Log likelihood = -124.57971, LR χ^2 (13) = 91.64; Prob> χ^2 = 0.0000

Pseudo R^2 = 0.2403*, **, *** significant at 10% 5% and 1% respectively.

The age of household head had a negative influence on the decision to commercialize beans at 1% significance level. A one year increase in age of the household head had probability of 0.01 of not participating in commercialization of beans. Younger farmers are more receptive to agricultural innovations like adoption of high yielding climbing beans which increase surplus unlike the aged household heads that are risk-averse (Randela *et al.*, 2008). Furthermore, aged farmers tend to have larger household sizes with high domestic use of beans leaving low surplus for sale. This implies that younger farmers are more likely to produce large quantity of beans and

their relatively low level of domestic uses conveys more marketable surplus (Akinlade *et al.*, 2013).

The quantity of beans produced had a positive influence on commercialization at 1% significance level. A farm household with higher volume of bean produce has a high chance of devoting more quantity as marketable surplus and therefore higher probability of commercialization. The findings are in line with the findings of Omiti *et al.* (2009), who found that output quantities of maize, horticulture and dairy product had a positive effect on common bean commercialization. Most of the households who did not sell their produce had very little amount of surplus produce that could be marketed. Quantity of crop harvested plays a vital role in decision to commercialize especially on food crops that are highly utilized among households.

Households with more than one livelihood activity had a higher chance of deciding not to commercialize beans than those with one livelihood. An addition of one more livelihood activity caused a decrease in the probability of commercialization by 0.19 at 1% significance level. Apart from consumption, farm households engaged in crop cultivation for increasing their agricultural income. Agricultural diversification has a tendency of increasing ways at which a farmer can increase the household income. Siziba *et al.* (2011) had observed that alternative sources of income are positively associated with high volume of cereal grain sales. Therefore, smallholder farmers with more sources of livelihoods tend to offset domestic pressure to sell their bean harvests by settling it using off farm income.

The study found that the choice of the type of beans produced had a positive influence on decision to commercialize bean output 5% significance level. This implies that the probability of engaging in bean commercialization was high for farmers who planted bush bean type compared to climbing bean. A change from bush beans to climbing beans reduced the probability of commercialization by 0.19. The findings of the study were contrary to the expectation that farmers with climbing beans would have a higher chance of commercialization since climbing beans have more favorable production attributes than bush beans.

Market information has a vital role in linking farmers and buyers to the market. In this study farmers chose on what best suited their position on market information from a scale of 'very satisfied' to 'not satisfied' about market information. It was found that market information significantly influenced the farmer's decision to commercialize their bean produce at 5% level. This implies that farmers who were satisfied by the information about the market at their

disposal had a high probability of commercialization than others. The study corroborates the findings of Siziba *et al.* (2011) who concluded that access to better and reliable market information on prices and market increases the probability of market participation. Randela *et al.* (2008) also advanced that more information on marketing helps households to reduce transaction costs. The other eight variables were not significant.

4.4.2 Factors influencing extent of bean commercialization

The extent of common bean commercialization was analyzed using the OLS regression model where the dependent variable was HCIs. The R^2 was 88.03% confirming that variables in the model explained more than half of the factors influencing level of commercialization.

Table 13: Factors influencing extent of bean commercialization

Variable	Marginal effects	Standard Error	$p > z $
Age	0.0032554	0.00352	0.354
Household size	-0.0144782	0.01931	0.453
Land size	0.001513	0.00182	0.407
Total income	-6.09E-07	0.0000	0.088*
Number of livelihoods	0.156437	0.05284	0.003***
Number of crops cultivated	-0.0744468	0.04355	0.087*
Quantity of beans	0.0016679	0.00028	0.000***
Price per kg	0.0007621	0.00035	0.029**
Group membership	0.0965468	0.05657	0.088*
Bean storage	0.1614216	0.05528	0.003**
Market information	0.0189939	0.03357	0.571
Market distance	0.0886516	0.03698	0.017**

$R^2 = 0.8803$, Adjusted $R^2 = 0.8647$; *, **, *** significant at 10% 5% and 1% respectively.

The results show that six variables have a positive influence on the extent of common bean commercialization. Total income and number of crops cultivated negatively influenced extent of commercialization.

The number of livelihood activities the household participated in positively influenced the volume of bean sold at 1% significance level. If a household adds one more livelihood activity, the probability of increasing the volume of sales increases by 0.15. Increased number of sources of livelihood increases the sources of household income and thus offsetting pressure on high dependence on agricultural income. A farmer can comfortably sell more beans with anticipation of other income from other sources in future. This study further concurs with the findings of Alene *et al.* (2008) that non-farm income contributes to more marketed output if the non-farm income is invested in farm technology and other farm improvements.

The quantity of beans produced positively influenced the extent of commercialization at 1% significance level. This implied that Households with relatively large quantities of produce had a marketable surplus. Farmers with low output tended to have larger percentage of produce retained for household consumption. The finding of this study corroborates findings of Omiti *et al.* (2009) and Makhura, *et al.*, (2001). For instance, Martey *et al.* (2012), revealed that quantity of cassava produced is associated with a higher level of cassava sales.

The extent of bean commercialization was negatively influenced by the number of crops cultivated by a household at 10% significance. An addition of one more type of crop decreased the probability of increasing volume of bean commercialized by 0.07. The possible explanation to this is that addition of non-food crop or food crop with relatively high output price has tendency of reducing the volume sold due to diversified sources of income in other crops. Further, increased number of crops cultivated in a piece of land subject to constant land size causes low quantity of beans produced and hence decreasing volume of beans sold.

Distance to the market was found to positively influence the extent of commercialization where an increase of distance by a kilometer caused an increase in probability of increasing volume sold by 0.08. This may be attributed to effort made to reduce transportation and transaction costs through lump sum selling. The other possible reasons could be better prices offered at distant markets compared to nearby markets and bulkiness of commodities in selling small portions (Randela *et al.*, 2008 and Siziba *et al.*, 2011). The findings are however, contrary to the findings of Omiti *et al.* (2009) and Olwande and Mathenge (2012) who found negative effect of long distance to the market on market participation among farmers in their respective studies. The discrepancy here could be explained by the modes of transportation in the studies.

The current study sampled farmers who mainly relied on transporting beans on their heads as they walked to the market.

Higher household's income negatively influenced the volume of bean sales at 10% Significance level. A 1% increase in household's income reduced probability volume of commercialization by $-6.09E-07\%$. Households with relatively high income levels tended to sell lesser volumes. In addition crop sales form large portion of small household income. If a farm household has lower incomes it implies that higher volume of sales will help offset more expenditure needs compared to households with higher income. Farmers in the region relied more on beans for agricultural income. Martey *et al.*, (2012) had argued that if household income is not channeled to production it has a tendency of increasing off farm economic pursuits and consequently cause marketed output to drop.

Price per kilogram of beans had a positive influence on intensity of commercialization at 5% significance level. Price is an incentive for farmers to increase the amount of produce engaged in commercialization (Martey *et al.*, 2012; Olwande and Mathenge, 2012). Since farmers are assumed rational in the decisions, farmers would appreciate to gain much from the surplus produce and any marginal increase of common bean prices encourages more commercialization.

Farmers who store their common bean had a tendency to increase the extent of commercialization. The results show that storing beans an extra month increased extent of commercialization by 0.16. This may be attributed to the fact that better storage of beans could give a farmer a chance to sell at a better price compared to time of harvests. The other reason could be postharvest losses are reduced and hence surplus produce for markets are maintained. The findings are in line with findings of Persson, (2003) who argued that farmers who used storage facilities had higher probability of market participation.

A household head that was in a farmer in group membership had a 0.097 chance of 10% increasing the intensity of bean commercialization. Collective action has many benefits ranging from production to marketing decisions because of enhanced bargaining power and information access (Olwande and Mathenge, 2012). Despite the low membership to groups by target population, group membership has been revealed to be important factor in common bean commercialization. The other factors did not significantly influence common bean commercialization.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study established that common beans are among the main food crops that can play vital role in sequestering food insufficiency among households. Both bush and climbing common beans are vastly grown in the region namely by 35% and 65% of farmers respectively. Despite beans' importance, majority of farmers produce less than 100 kilograms which are divided for food consumption and sales. It was established that 60% of farmers engage in commercialization of beans to tap agricultural income while the rest retained their produce mainly for food.

Results indicate that there were no statistically significant differences in household food-sufficiency among household with different levels of commercialization. Food stock availability among non-commercialized households was relatively longer compared to commercialized households. Further commercialized households used more income to purchase food and non-food commodities. The study indicates that food sufficiency of the smallholder farmers in the region were not influenced significantly by level of output commercialization.

Five variables influenced the decision to commercialize beans. Age of household head and number of livelihoods household head participated had negative influence while quantity of beans produced; satisfying market information and quantity produced had positive influence. Bush bean farmers had higher likelihood of commercialization. On the other hand, households which cultivated many crops in their fields and those with better incomes tended to decrease their level of commercialization. The other seven factors had positive influence on extent of commercialization.

5.2 Recommendations

From the results, there is need for interventions from many stakeholders in order to improve welfare of small holder bean farmers. The study revealed that incomes from bean sales are significant in meeting domestic needs like food purchases and non-food expenditure. Policy makers should devise ways to improve bean production, post-harvest management and bring closer markets to farmers.

Since there were no significant differences in food sufficiency status among the commercialized and non-commercialized households, it is implied that commercialization does

not at least negatively affect food sufficiency. Therefore a unilateral approach of increasing agricultural commercialization may be deficient in combating the effects of food insufficiency and generally food security among households. From the findings, stakeholders should encourage multipronged approaches including high common bean production, postharvest management of produce and means to increase the incomes of the households as a way to combat food insecurity.

The study recommends that stakeholders devise means to improve socioeconomic, infrastructural and institutional factors affecting farmers to encourage diversified livelihoods, and free flow of market information. Further, farmers should have cheap options to utilize farmer group membership as a means of effective flow of market information and other agricultural extensions services. Through these, smallholder farmers would offset pressure mainly piled on available food stock while farmers acquire enough agricultural income to ensure food security among households.

5.3 Suggestion for further research

The main aim of this study was to determine effects of commercialization on food sufficiency while establishing factors influencing the decision to commercialize and extent of commercialization of beans. The current study suggests:

1. Further study to determine the effect of crop diversification on commercialization among food insecure households. The aim would be to establish the effect based on more than one crop commercialization unlike the current based on one crop.
2. Further research should also attempt to determine the effect of climbing beans on mitigation of food insecurity among these households. Most households have switched from bush beans to climbing beans suggested to be high yielding and also maximize use of already small land sizes among farm households.

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APPENDIX 1 QUESTIONNAIRE

Household Level Survey Questionnaire 2014

Legume Production, Marketing and consumption

Introduction

The following is the excerpt from the questionnaire The International Centre for Tropical Agriculture (CIAT) survey tool

GENERAL IDENTIFICATION

i)	Questionnaire No:	ii) Date of interview	
iii)	Name of enumerator		
iv)	Province	v) District	vi) Sector
vii)	Village	viii) GPS coordinates	

SECTION A: HOUSEHOLD CHARACTERISTICS

1.01	Name of respondent:		
1.02	Name of household head:		
	Household characteristic	Response	codes
1.03	Sex of household head		1=Male 0=female
1.04	Age of household head in years		
1.05	Highest level of education of Household head		1= No school 2= some primary 3=completed primary 4 post primary
1.06	Highest level of education of the spouse of household head		1= No school 2= some primary 3=completed primary 4 post primary
1.07	Marital status of household head		1= single 2= married 3= divorced 4=widowed
1.08	Main occupation of household head		1=farming; 2=regular non-farm wage; 3=small-scale business; 4=other, specify
1.09	Household size		
1.10	Type of household's main dwelling		1= permanent house 2=semi- permanent 3=temporary house 4= other

SECTION B: LAND TENURE

2.0 Fill in the table appropriately

Description of land	Alternatives	Response
2.01 How much land, in TOTAL , is available to this household?	1. Less than one hectare 2. One hectare 3.More than one hectare 4.All of it 5.None of it	
2.02 How much of the TOTAL land available to this household is inherited?	1. Less than one hectare 2. One hectare 3.More than one hectare 4.All of it 5.None of it	
2.03 How much of the TOTAL land available to this household is purchased?	1. Less than one hectare 2. One hectare 3.More than one hectare 4.All of it	

	5.None of it	
2.04 How much of the TOTAL land available to this household is rented-in?	1. Less than one hectare 2. One hectare 3.More than one hectare 4.All of it 5.None of it	
2.05 How much of the TOTAL land available to this household is rented-out?	1. Less than one hectare 2. One hectare 3.More than one hectare 4.All of it 5.None of it	
2.06 How much of the TOTAL land available to this household is under irrigation or marshland?	1. Less than one hectare 2. One hectare 3.More than one hectare 4.All of it 5.None of it	

2.1 What other agricultural assets does the household own?

Large livestock/Cattle	Alternatives	response
Small livestock (rabbits, goats, sheep, pigs, cavies)	1 yes 2 No	
Poultry	1 yes 2 No	
Fish rearing	1 yes 2 No	
Bee keeping	1 yes 2 No	
Other (specify) _____	1 yes 2 No	
None	1 yes 2 No	

2.2 Is any part of your land consolidated under land consolidation program?

1. Yes 2. No

2.21 If yes, how much of your land is in consolidation (in percentage)?

2.3 Does your household participate in any crop intensification program (CIP)?

1. Yes 2 No

2.31 What percentage of your land is devoted to crop intensification?

SECTION C: AGRICULTURAL PRODUCTION OF KEY FOOD COMMODITIES

3.01 How many crops did your household cultivate last season?

1. None 2. One 3. Two 4. More than two

3.02 How many livestock types did your household keep last season?

1. None 2. One 3. Two 4. More than two

3.03 What are the most important sources of food for your household in the last 12 months?

Source of food	Check
Purchased Food	
Own Food Production	
Food Gift	
Food Aid	
Government program/Food for work	
Others specify	

3.04 By order of importance what are the main crops cultivated by your household?

First	Second	Third

Crop codes 1=Wheat, 2= maize, 3=sorghum, 4= rice, 5= sweet potato, 6= Irish potato, 7= cassava, 8= yam, 9 = tomato, 10= cabbage, 11= banana, 12= passion fruit, 13 =pineapple, 14 = Bush beans, 15= climbing beans, 16= peas, 17 = soya, 18 = ground nuts, 23others specify

3.05 For the household three important crops only, what season did you cultivate this crop?

Crop	Season A 2014	Season B 2014	Season A 2013	Season B 2013	Season C 2013	Perennial or annual
First						
Second						
Third						

Codes 1 = Yes, cultivated 2 = No, not cultivated 88 = Not applicable 99 = I do not know

3.06 How long did your household have food stocks from this crop's harvest to the planting season? Specify number of months for each season

	Season A 2014	Season B 2014	Season A 2013	Season B 2013	Season C 2013	Perennial or annual
First						
Second						
Third						

3.07 Fill the table appropriately

Question	First crop	Second crop	Third crop
What % of your total land do you generally use for this crop?			
What % of this crop do you directly consume (including animal feed and seeds for planting)?			
What % of your production for this crop do you sell or do you give away?			
Approximately what percentage was wasted or become spoilt, as to have no value, after harvesting?			
How do you normally acquire seeds /planting materials for this crop? ¹			
Whom do you sell the majority of this crop to? ²			
What type of labor did you use? ³			

¹**source of seeds codes:** 1= Purchase, 2= from other farmers 3= Gift 4= from previous harvest 5= From NGO, 6= From Government, 7= Cooperatives 9= other, specify 88= not applicable

²**buyers codes:** 1= Purchaser in the field (farm gate), 2= Trader at households, 3= Trader in the village market, 4 = Trader at the sector market, 5= Trader in the district, 6= Trader other country 7 = Cooperative, 8= NGO, 9= project, 10= Government, 11 = Direct to processor/other buyer, 12 = Individual consumer, family, friends 13. Other, specify_____

³**type of labor codes** 1=Family labor, 2=Hired labor, 3=both hired and family 4= labor Exchange 5= Other (specify)

3.08 Who in the household provides labor for the following farm activities¹?

Activity	First crop	Second crop	Third crop
Land preparation			
Planting			
Weeding			
Pesticide and fumigation			
Harvesting			
Selling			
Postharvest storage			

¹codes: 1= Head of household only, 2= Spouse of head of household only, 3= Household head and spouse jointly 4= Men only, 5= Women only 6= Adults only 7= Children only 8= Women and children 9=Men and children 10= everybody

3.09 For each of the crops you grow, how much (in **Rwandan Francs**) did you spend on the following activities in the last crop season?¹

Expenditure on	First crop	Second crop	Third crop
Seeds			
Fertilizer			
Manure			
Labor			
Staking materials			
pesticides			
Postharvest storage			
Other expenses			

3.10 Where did the money to cover the production costs mainly come from?

- 1 From previous crop sales
- 2 From animal sales
- 3 From other employment and trading activities
- 4 From relatives and other assistances
- 5 From credit and other borrowings
- 6 Other (specify)

3.11 Who initiates the following decisions? ¹

Decision	First crop	Second crop	Third crop
Area of land to plant			
Variety of crop to plant			

Codes 1= Head of household only 2= Spouse of head of household only 3= Household head and spouse jointly 4 = other (specify)

3.12 Does any household member have membership in farmer cooperative/group		Check
Head of household only	1= yes, 0=No	
Spouse of head of household only	1= yes, 0=No	
Household head and spouse jointly	1= yes, 0=No	
3.121 If yes, since when as member		
3.13 Does any household member have membership in a SACCO (savings cooperative)?	1= yes, 0=No	
Head of household only	1= yes, 0=No	
Spouse of head of household only	1= yes, 0=No	
Household head and spouse jointly	1= yes, 0=No	
3.131 If yes, since when as member		

SECTION D: SALE OF HARVESTED BEAN PRODUCTS

4.01 Did the household harvest any of the bean crops it planted in the last season (September 2013-January 2014)? 1. Yes 2. No

4.02 How much of the beans did you harvest?

1. Less than a bag (100 kg) 2. One - Five bags 3. Others specify (number of bags) _____
4. Exact kg if known (specify in kg) _____

4.03 Did you sell any of the harvest in the season that ended in January 2014?

1. Yes 2. No

If sold beans	Options	Response
4.03 What quantity did you sell?	1. Less than a bag (100 kg) 2. Two - Four bags 3. Others specify (number of bags) _	
4.04 How did you sell?	1. Individually 2. Collectively with other farmer 3. Other, specify _____	
4.05 Where did you sell from?	1. In field 2. At the house 3. At the local market 4. At the local towns 5. In distant towns 6. Other (specify) _____	
4.06 Who were the major buyer(s)?	1. Other farmers/neighbors nearby 2. Vendors and traders 3. Government organizations/institutions 4. Processors 5. NGO and projects 6. Other (specify)_____	

4.07 What was the price in Rwandan francs per kg of produce?		
4.08 What was the main purpose of selling crop?	1. Household needs 2. School fees 3. Medication 4. Purchase of inputs (fertilizers, seeds, labor) 5. Payment of debts 6. Income generation 7. Other, (specify)	
When do you prefer to sell harvest?	1. Immediately after harvest 2. Prefer to wait longer	
In what form did you mostly sell the product?	1. Fresh 2. Dry 3. Processed, specify _____ 4. Other, specify _____	

4.09 What value addition activities did you undertake before selling? Indicate all that apply.

1. Sorting 2. Grading 3. Packaging 4. Processing 5. None 6. Other, specify _____

Market decisions

Who:	Response ¹
4.10 Decides how much to sell?	
4.11 Decides where to sell the crop?	
4.12 Has access to the money earned from the sale of products?	
4.13 Decides how to use the money earned from sale?	

Codes¹ 1= Head of household only 2 Spouse of household head only, 3 Household head and spouse jointly 4 Other household member (specify) _____

4.14 If you did not sell any product last season, what was the reason?

1. All for food 2. Did not want to sell 3. Wanted to sell but price not good 4. Didn't have someone to sell to /market was far 5. Buyers rejected product because of poor quality 6. Will sell in future 7. Other (specify) _____

SECTION E: PRODUCT STORAGE

5.01 Did you store any crop from the harvest season?

1. Yes 2. No

5.02 Where did you store the produce?

1. At home 2. At communal produce reserve 3. Other, specify _____

5.04 Did you experience any storage problem with the commodity?

1. Yes 2 No

5.05 If yes, what problems did you experience?

1. Weevils/ bruchids 2. Rots/decay 3. Theft 4. Other, specify _____

5.06 How long did your household store products?

1. One month or less 2. More than a month to three months 3. More than three months to six months 4. More than 6 months

5.07 What was the purpose of storing the products?

1. For food only 2. For sale only 3. For seed only 4. Both food and sale 5. Both for food and seed 6. Other (specify) _____

5.08 What storage equipment did you use to store product?

1. Earthen pot, 2. Gourds 3. Tin/metal drum, 4. Plastic drums 5. Polypropylene bag 6. Triple bag/ hermetic storage 7. Wooden pots 8. Granaries/stores 9. Community stores 10. Other (specify) _____

SECTION F: MARKETS ACCESS AND INFORMATION

6.01 How far is the nearest market from your house/village?

1. Less than 1 km 2. More than 1 km but less than 5 km 3. More than 5 but less than 15 km 4. More than 15 km

6.02 What is the type of road from the village to the nearest local market?

1. Earth road 2. Laterite/murram 3. Tarmac road 4 Other (specify) _____

6.03 How long does it take you to get to the nearest market in order to sell product?

1. Less than 30 minutes 2. Between 30 – 60 minutes 3. More than 60 minutes

6.04 What means of transport do you use to get to nearest market when carrying product to sell?

1. On foot 2. Bicycle 3. Motor cycle/tricycle 4. Ox cart 5. Vehicle 6. Public transport 7. Other (specify) _____

6.05 What is the main challenge your household faces when selling harvested food products in the market?

1. Not enough demand (can't sell crops at market) 2. Low food prices 3. Unpredictable price changes 4. Markets are too far 5. Bad road to market 6. Too many taxes or fees in markets 7. Other specify _____

6.06 What is the main challenge your household faces when buying food from the market?

1. Lack of food product diversity 2. Not enough supply (not enough food available on the market) 3. High food prices 4. Unpredictable price changes 5. Markets too far 6. Bad road to market 7. Other, specify: _____

6.07 Do you feel that there is a better market than the one you sold to?

1. Yes 2. No

6.08 If Yes, why do you feel that there could be a better market elsewhere?

1. Better prices elsewhere 2. More buyers 3. More assured markets 4. Less taxes 5. More frequent markets 6. Other, specify _____

6.09 Which was the most important source of market information for you in the last 12 months?

1. Newspaper 2. Farmer cooperatives 3. Radio 4. TV 5. Mobile phone 6. Community meetings 7. From the market place (traders, market authorities) 8. Other specify from list or other (neighbours, friends, family members, church, government extension agents, NGO workers) _____

6.10 Were you satisfied with this source of market information?

1. Very much satisfied 2. Moderately satisfied 3. Indifferent, neither 4. Not satisfied at all

SECTION G: HOUSEHOLD EXPENDITURES IN THE PAST 30 DAYS

7.1 Expenditure on food in Rwandan Francs during the last 30 days

Food item	Check if used	Amount in Rwandan francs
Cereals (grain or flour)		
Roots and tubers (including flour)		
Bread		
Banana (cooking, and fruit)		
Meat/poultry/fish		
Egg		
Milk and other dairy (yoghurt, cheese)		
Oil, fat, butter		
Fresh fruits		
Beans, peas and other pulses		
Vegetables		

Groundnuts/nuts		
Sugar and sweets products		
Salt and spices		
Drinking water		
Other non-alcoholic beverages		
Meals and drinks taken outside home		
Others, specify:		

7.2 Expenditure on non-food items in Rwandan francs in the last 30 days

Non- food item	Check if used	Amount in Rwandan francs
Alcohol & Tobacco		
Soap and other personal hygiene items		
Transport		
Lighting and cooking energy		
Waste disposal		
Rent (house / land)		
Milling		
Communication (mobile phone, me2u, internet)		
Other, specify		

7.3 Expenditure on items in the past 3 months

Item	Check if used	Amount in Rwandan franc
Medical expenses, health care		
Education, school, fees, uniform, etc		
Clothing, shoes		
household furnishings and appliances		
Construction, house repair		
Agriculture and related expenses (tools, seeds, labor, transport, storage, fertilizers insecticides, irrigation, terracing, ...)		
Livestock and related expenditures (livestock purchase, feed, medicine, labor)		
Hiring non-agricultural labor		
Debts/mortgage/ loan repayment		
Fines, taxes		
Ceremonies		
Gifts/donations		
Leisure		
Other, specify		

7.4 What were the important uses of your income from agricultural products sales in the season September- January 2014? Rank the first 3 important uses.

Uses of income	Rank
Food purchases	
School fees	
Health	
Agriculture/farming	
Alcohol/Entertainment	
Other (specify) _____	

7.5 What was the major use of the income?

Uses of income	Rank
Food purchases	
School fees	
Health	
Investment	
Buy new land	
Investment in farm agricultural	
Other (specify) _____	

Thank you!

APPENDIX 2 TESTS FOR COLLINEARITY

VIF Decision for common bean commercialization

Variable	VIF	1/VIF
Market distance	2.43	0.410941
Time taken to the market	2.37	0.42247
Age	1.28	0.778979
Household size	1.25	0.796834
Bean type	1.21	0.828495
Number of livelihoods	1.19	0.840872
Number of crops cultivated	1.16	0.859899
Total income	1.14	0.874859
Quantity of beans	1.13	0.883281
Land size	1.11	0.902248
Market information	1.08	0.922812
Group membership	1.08	0.923026
Duration of bean storage	1.08	0.926828
Mean VIF	1.35	

VIF Extent of common bean commercialization

Variable	VIF	1/VIF
Age	1.56	0.64177
Total income	1.47	0.680219
Household size	1.46	0.687163
Land size	1.39	0.718124
Price per Kilogram	1.28	0.780302
Number of crops cultivated	1.23	0.811705
Market distance	1.2	0.83469
Group membership	1.18	0.845826
Quantity of beans	1.18	0.846203
Number of livelihoods	1.17	0.851831
Market information	1.14	0.873391
Duration of bean storage	1.14	0.880785
Mean VIF	1.28	

Correlation between time to market and means of transport

Spearman's rho = 0.1574 Test of Ho: time to market and means of transport are independent

Prob> |t| = 0.0123