ECONOMICS OF SMALL HOLDER COMMON BEANS PRODUCTION IN MBEYA, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

Common bean is a major source of food and income for smallholder farmers in Tanzania.The national average yield for common beans which ranges from 0.72 to 1.10 tone/ha, is far below potential yields recommended by agricultural research (1.5 – 3 tones/ ha) using improved varieties. Low common bean yield is contributed by several factors which lower farmers` profit. This study examined the economics of smallholder common beans production in Mbeya, Tanzania. Descriptive and inferential statistics were employed to analyse the data collected from a sample of 120 bean farmers. Gross margin was used to estimate profitability of common beans production. On the other hand, multiple linear regression and logit models were used to determine the influence of socio-economic factors on common beans profitability and the factors influencing improved common bean varieties adoption respectively. The results show that the average gross margin was TZS 309 214per acre which indicates that common bean farming in Mbeya district is profitable and contributes significantly in creating cash income and employment.Multiple linear regression results indicate that farming experience, land size, access to credits and household size have significant influence on profitability of common beans in the study area. Moreover, the results of binary logistic regression show that age, household size, land size, access to extension services, off-farm income activities and distance to the nearest market have significant influence on the adoption of improved common bean varieties. Moreover, the results show that the crop pests and diseases, unreliable rainfall, high price of farm inputs, unreliable market, shortage of land, price fluctuation and low capital are the major challenges faced beans producers in the study area.The present study concludes that common beans production is profitable and contributes significantly in creating cash income and employment in the study area. It is recommended that extension services and credit systems should be

improved by the governmentso as to expose farmers to modern improved agricultural production technologies.

DECLARATION

I, **JOSHUA JULIAS MUSIMU**, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being currently submitted for a degree award in any other institution.

_____ _____

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The above declaration is confirmed by;

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Dr. Damas Philip Date

(Supervisor)

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DEDICATION

This dissertation is dedicated to the Almighty God and my beloved father Mr. Musimu Julius who built the foundation of my education.

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LIST OF ABBREVIATIONSAND ACRONYMS

r^2	Coefficient determination
CAN	Calcium ammonium nitrate
DAP	Diammonium Phosphate
Df	Degree of freedom
Exp (B)	Expected Beta
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GI	Gross Income
GM	Gross Margin
Ha	Hectare
H-L	Hosmer and Lemeshow Test
kg	kilogramme
km	kilometer
MAFC	Ministry of Agriculture Food and Cooperatives
MALF	Ministry of Agriculture Livestock and Fisheries
N.P.K	Nitrogen, Phosphorus and Potassium
NBS	National Bureau of Statistics
PAC	Percentage Accuracy in Classification
SPSS	Statistical Packages for Social Science
TR	Total Revenue
TSP	Triple Super Phosphate
TVC	Total Variable Costs
URT	United Republic of Tanzania
VIF	Variance Inflation Factor

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

The common bean (*Phaseolus vulgaris* L.) is a major grain legume produced and consumed worldwide for its edible seeds and pods. According to Mauyo *et al.* (2007), BTC (2012) and Binagwa *et al*. (2016) the crop is grown in East and South African countries and it is the second staple food after maize. Bean production in Sub-Saharan Africa is largely done by small-scale farmers (less than 2 ha), predominantly by women for both household food security and cash (Rubyogo *et al.*, 2015, Larochelle and Alwang 2014, Ronner and Giller, 2013, Rapsomanikis, 2014).The common bean (*Phaseolus vulgaris* L.) was introduced from South America into Tanzania about 300 years ago (Fivawo and Msolla, 2011). Common beans are produced mainly by small-scale farmers with farming area of less than 2 ha and they account for about 80% of total pulses produced in Tanzania (Ronner and Giller, 2013, Rapsomanikis, 2014).

Common beans in Tanzania are mainly grown in Southern Highland Zone (Mbeya, Ruvuma, Iringa and Rukwa regions), Great regions in the West, Lake Zone (Kagera region) and Northern Zone (Arusha, Kilimanjaro, Manyara and Tanga regions) (Larochelle *et al.*, 2017; BTC, 2012).

Yields forcommon beans are poor and far below potential yields recommended by researchers (1.5 to 3 t/ha for common bean (Ronner and Giller, 2013). Despite the low yields, Tanzania ranks seventh worldwide in bean production and is the leading producer of common beans in East Africa and largest producer in Africa with 950 000 MT (Ronner and Giller, 2013, Kilimo Trust, 2013, BTC, 2012, Larochelle *et al.*,

2017).Common beans are the most exported pulses from Tanzania contributing about 62% of all Tanzanian pulse exports (URT, 2016). Common beans from Tanzania are mainly exported to Netherlands and India (URT, 2016, Karanja, 2016, Ronner and Giller, 2012). The country also exports beans to neighbouring countries like Kenya, Uganda, Rwanda, Burundi, DR Congo, Zambia(Kilimo Trust, 2013, Ronner and Giller, 2012).

Common bean (*Phaseolus vulgaris* L.) is an important cropmainly for smallholder farmers in Tanzania, for home consumption and cash income (Letaa *et al.*, 2015, Mishili *et al*., 2011 and BTC, 2012, Kasuburil *et al.*, 2016). The crop is an important source of protein for low-income families in rural and urban areas providing about 38% of utilisable protein and 12-16% of daily calorific requirements (Kalyebara and Buruchara, 2008, Sibiko *et al.*, 2013).

However, Bean productivity is constrained by diseases, pests, poor soil fertility and drought, price instability, inadequate market, lack of capital , taxes, low price of the commodity, shortage of extension services,(Kanyama and Damian, 2015; Hillocks *et al*., 2006; Birachi *et al.*, 2012,Beebe *et al*., 2012, Andrew and Philip, 2014.), lack of high yielding varieties, inadequate information about new production technology and insufficient basic agricultural inputs, low utilization of appropriate technology (Ronner and Giller, 2013). This may lead to low agricultural productivity per given inputs and reduces potential for smallholder farmers to meet the growing demand of consumers in the urban centers (Mkonda and He, 2016).

1.2 Problem Statement and Justification

The national average yield of common beans which ranges from 0.72 to 1.10 tone/ha, is far below potential yields recommended by agricultural research (1.5 – 3 tones/ ha) using improved varieties (Ronner and Giller, 2013, Bucheyeki and Mmbaga, 2013, Rubyogo *et al.*, 2007). The low national average yield of common bean is contributed by several factors including low adoption of improved agricultural technologies, insufficient use of basic agricultural inputs, lack of improved varieties, poor agronomic practices, pests and disease, and inadequate use of improved production technologies by farmers (Mkonda and He, 2016).Likewise Venance *et al*. (2016) noted that production and profitability of common beans is low due to the factthat smallholder farmers at the farm level lack information on costs and benefits associated with the utilization of new technology.Low adoption of improved common bean varieties amongst farmers has been identified as one of the main reasons for the low agricultural productivity in Tanzania. Therefore, increasing productivity and production of common beans will be realized if and only if the farmers adopt the improved common bean varieties that are developed and recommended by researchers.

Several studies have been conducted in common beans sector in Tanzania (e.g. Romer and Giller, 2013, Mishili *et al.*, 2009, Letaa *et al*., 2016, Fivawo and Msolla, 2011 and Letaa *et al.*, 2015), from the economic analysis point of view none of these went to as far as production, profitability and adoption of improved common bean varietiesis concerned. Based on the review of relevant literatures, it shows that there has been little or no information on the economics of common bean production in the study area. Empirical data is lacking from available literature on costs- benefits and application of improved technology of beans production at small holder level. Thus, the present study intends to fill this gap of knowledge.Addressing this knowledge gap will provideuseful

knowledge and information to development planners,policy makers, and other stakeholders in the beans sectorin solving the problems of food security, poverty, as well as increase income generation and employment to smallholder farmers.

1.3 Research Objectives

1.3.1 Overall objective

To examine the economics of small scale common beans production in Mbeya.

1.3.2 Specific objectives

i. To estimate profitability of common beans production.
ii. To determine the influence of socio-economic factors on commonbeans profitability.
iii. To identify the determinants of improved common bean varieties adoption.
iv. To identify challenges facing smallholder common bean producers.

1.3 Research Hypotheses

i. The average Gross Margin for common beans is not different from zero (μ=0)
ii. Socio-economic factors do not have significant influence on common beans profitability.
iii. Socioeconomic factors have no significant influence on improved common bean varieties adoption.

1.4 Research Question

What are the challenges facing smallholder common beans producers?

1.5 Organisation of the Dissertation

This dissertation is organized into five chapters. Chapter one presents the background information, problem statement and justification, objectives of the study and research hypotheses. Chapter two is a review of relevant literature. Chapter three presents the

methodology used in the study. Empirical results of the study are presented and discussed in chapter four. Chapter five presents the conclusion and recommendations based on the findings of the present study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

The present study was guided by production and profit maximization theories in which farmers make a decision on the choice of production technology that maximizes profit subject to resource constraints.Productivity and profitability are some of the basic concepts in economics of agricultural production.

2.1.1 Production theory

Production theory explains the relationship between inputs and outputs, which is the transformation of factor inputs into outputs (Thomas and Maurrice, 2008).Debertin (2012) defines Production function as the technical relationship that transforms inputs (resources) into outputs (commodities). According to Rasmussen (2012) the theory of production economics is special in that the limits of economic behaviour are defined by the technical production possibilities. Production technology is the decisive factor regarding the quantity produced and how it may be produced. Therefore, a very important part of the theory of production economics consists of describing the production technology which defines the framework for the economic behaviour. Production technology is, in its most general form, a description of the relationship between input and produced output. The description of production technical relationships is based on empirical observation of relationships between inputs and outputs. Generally, production always includes at least two, and often more, inputs. A complete description

of the production technology for a given product will therefore assume a multi-dimensional illustration providing a simultaneous illustration of the relationship between output and all inputs (Rasmussen, 2012).

2.1.2 Productivity

Productivity can be briefly defined as production (output) divided by input. In a situation where only one input X is used to produce one output Y, the description is simple, as productivity will then be Y/X(Rasmussen, 2012).It is the ratio of farm outputs to the values of inputs used in farm production (Farrell, 1957).

According to Hailu (2003) agricultural productivity is identical with resource productivity which is the ratio of total output to the resource or inputs used. Productivity is measured as the market value of final output. This output value may be compared to different types of inputs such as labour and land. The importance of agricultural productivity include providing more food, increasing the productivity of farms affects a nation's prospects for growth and competitiveness on the agricultural market, income distribution and savings, and labour migration. Also increases in agricultural productivity lead to agricultural growth and can help to alleviate poverty in poor and developing countries, where agriculture often employs the greatest portion of the population (Hailu, 2003).

2.1.3 Marginal productivity theory

A theory used to analyse the profit-maximizing quantity of inputs (that is, the services of factor of productions) purchased by a firm in the production of output. Marginal-productivity theory indicates that the demand for a factor of production is based on the marginal product of the factor. In particular, a firm is generally willing to pay a higher price for an input that is more productive and contributes more to output. The demand for an input is thus best termed a derived demandas indicated by King and Regan (1976).Marginal productivity theory is a cornerstone in the analysis of factor markets and

the input side of short-run production. It provides insight into the demand for factors of production based on the notion that a profit-maximizing firm hires inputs based on a comparison between the productivity of the input and the cost of the input.Under perfectly competitive conditions, individual firms are price-takers in both factor and product markets and profit-maximising behaviour induces them to employ inputs until the long-run equilibrium rate of reward of each input is equal to its marginal physical product valued at the output price (King and Regan, 1976).

Tobin (1985)observed that as a firm hires increasing amounts of a variable factor to a combination of fixed amounts of other factors, the marginal productivity increases up to a certain stage of production and then it begins to decline. The buyers of a factor of production while deciding whether one more unit of factor should be employed or not, compares the net addition which it makes to total revenue and the cost which has to be incurred on engaging it. If the marginal revenue product of a factor is greater than its marginal cost, the entrepreneur will employ that unit because it earns more than what he has to spend on employing the additional unit. As he employs more and more units of factor of production, the marginal revenue productivity increases up to a certain limit and then it begins to decrease. On the other hand, marginal cost decreases as production is expanded. After a certain point, when business becomes difficult to manage, marginal cost begins to increase. When both marginal revenue productivity of a factor and its marginal cost are equal, (MRP = MC) the entrepreneur stops giving further employment to a factor of production.

2.1.4 Profit maximization theory

The objective of the firm is to maximise its profits where profits are the difference between the firm's revenue and total costs. Therefore, economic profit is defined to be the difference between the revenue a firm receives and the costs that it incurs (Varian*et*

al., 2004). According to Derbetin (2012) the farmer's profit is equal to total revenue (*TR*) minus total cost (*TC*).

A profit-maximizing firm chooses both its inputs and its outputs with the sole goal of achieving maximum economic profits. That is, the firm seeks to make the difference between its total revenues and its total economic costs as large as possible. To maximize economic profits, the firm should choose that output for which marginal revenue is equal to marginal cost (Nicholson and Snyder, 2008).

Derbetin (2012) reported that profits are at maximum when the necessary and sufficient conditions for a maximum have been met and the necessary conditions for profit maximization require that the profit function have a slope of zero. The necessary condition for profit maximization can be determined by finding the point on the profit function where the first derivative is zero. The sufficient condition, ensuring profit maximization, holds if the first derivative of the profit function is zero and the second derivative of the profit function is negative. Profit is a main indicator of viability of an enterprise. It is the difference between total revenue and total costs.

2.2 Ways of Determining Profitability

2.2.1 Gross margin analysis

Gross Margin analysis involves determining all variable costs and revenue associated with an enterprise. The difference between revenue and total variable costs is the gross margin for the enterprise (Leslie, 2013). It provides a simple method for comparing the performance of enterprises that have similar input requirements for capital and labour (Heaslip *et al*., 2013). A gross margin analysis examines separate enterprise in isolation

from other enterprises, and ignores the fixed costs of the farm. For this reason gross margins are not a measure of the profit of a particular enterprise (Leslie, 2013). However, they do provide a useful tool in terms of farm budgeting and estimating the likely returns or losses of a particular technology. Mkude (2003) claimed that although gross margin is not a good measure of profitability, it remains to be most satisfactory measure of farmer's profitability in small scale agriculture.

2.2.2 Strength and limitation of the gross margin technique

2.2.2.1 Strength of gross margin

According to Leslie (2013) gross margins allow comparison to be made of the relative profitability of alternative cropping options that have similar land, machinery and equipment requirements. They indicate the costs of production of alternative enterprises, which helps with farm management decisions. They can be used to analyse the performance of individual enterprises and may indicate areas where possible improvements can be made.

2.2.2.2 Limitations of gross margins

Difficult in allocation of labour: Labour can be difficult to allocate as most businesses have permanent labour and casual labour. In a gross margin analysis we tend to focus on the casual labour associated with that particular activity such as harvesting or packing labour (Leslie, 2013).

According to Philip (2016), gross margins do not take into account any changes that may occur in fixed cost structure of the business. A gross margin analysis may show a good result for one particular crop. However, gross margin of an enterprise is not necessarily an indication of its profitability. Increasing the intensity of enterprises on a farm may

increase the total farm gross margin but will not necessarily increase the farm profit since the fixed cost may also rise in greater proportion.Profit is not proportional to gross margin. A higher gross margin may be achieved on a farm but this could lead to a lower profit if the resultant increase in fixed costs were greater than the increase in gross margin (Philip, 2016, Heaslip *et al*., 2013).

2.3 Factors Affecting Smallholder Farmers' Adoption of Improved Production Technology

Education level plays an important role in adoption of improved technologies. Challa and Tilahun (2014), Ume and Ochiaka (2016) and Raphael (2014) reported that education has positive influence on adoption of improved varieties and other modern agricultural technologies. This means that educated farmers are more likely to be more efficient to adopt new innovation in a short time compared to uneducatedfarmers.

Siri *et al*. (2016) indicated thatthe adoption of improved common beans varieties increase with the experience in the cultivation of improved common beans varieties. The result further show that the production factors that affect adoption of improved common beans varieties are sources of land ownership, access to labour and credit facilities as well as prices of improved varieties during planting and harvest period. The adoption of these varieties was highly affected by low use of extension services and lack of financial capacity of farmers.

According to Challa and Tilahun (2014) age has a significant influence on the decision making on adoption of improved agricultural technologies, and other production-related decisions. Young people tend to withstand stress, put more time in agricultural

operations which can lead to increased output. The age of the farmer specially related to farm experience affect the decision of adopting modern agricultural technology positively.

Farmers who have access to formal credit are likely to adopt improved technology than those who have no access to credits (Venance *et al.*,2016; Akudugu*et al.*, 2012). Credits help farmers to have extra money for purchasing agricultural inputs which facilitate a farmer to adopt a new technology.

Extension services are another factors affecting adoption of new technology. Idrissa*et al.* (2012) and (Raphael, 2014) argue that access to extension services provided to the farmers play important role in the adoption of new agricultural technologies. Extension contact determines the information that farmers obtain on production activities and the application of innovations through counselling and demonstrations by extension agents (Idrissa*et al.*,2012). Farmers who are exposed to information about new technologies by extension agents through training, group discussion, plots demonstration, and other form of information delivery tend to adopt new technologies.

2.4 Factors Influencing Agricultural Productivity and Profitability

2.4.1 Experience in farming

Experience in farming to has a positive influence on profitability. Masuku and Xaba (2013) reported that as farmers become more experienced in production and marketing of vegetables through their involvement, their probability to participate in economic transactions will be higher, thus becoming more profitable.

2.4.2 Technology

Doss (2006) showed that technology adoption leads to the improvement of agricultural productivity in developing countries. Adoption of technologies provides force in improving productivity and eventually improving the lives of farmers.

2.4.3 Access to credit

Access to credit has positive influence to profitability. Raphael (2014) reported that provision of credit to smallholder farmers alleviates the capital constraint on small holders enabling them to acquire inputs for investing into their production which consequently improves their gross profit. Also those who had access to credit had better gross margin because they were able to by improved varieties for planting. Improved varieties increase gross margin because they are drought resistant and high yielding.

2.4.4 Education level

Liberio (2012) and Adegbola and Gardebroek (2007) reported that educated farmers can easily allocate inputs more efficiently accurately to assess the profitability of new technology, compared to farmers with no education. Farmer's education is an important factor in determining the readiness to accept and apply new technologies which leads to the increase beans productivity and income of the small holder farmers.

2.5 Situation of Bean Production in Tanzania

Beans are produced mainly by small-scale farmers with farming area of less than 2 ha and they account for about 80% of total pulses produced in Tanzania (Ronner and Giller, 2013, Rapsomanikis, 2014).In Tanzania, beans occupy about 12 % of the land cultivated for annual crops (URT, 2016).The national average yield decreased from 1.10 tons/ha in 2006 to 0.72tons/ha in 2010. However, the national average yield of beans increased from 0.92 tons/ha in 2011 to 0.98 tons/ha in 2014 (FAOSTAT, 2017) as shown in Table

1.Tanzania ranks seventh worldwide in bean production and is the leading producer of common beans in East Africa and largest producer in Africa with more than 950 000 MT (FAOSTAT, 2017, Ronner and Giller, 2013, Kilimo Trust, 2013). Production of common beans in Tanzania is higher than any other pulses representing 80% of the total pulse production (Ronner and Giller, 2013).

Common beans are the most exported pulses from Tanzania contributing to 62% of all Tanzanian pulse exports.Common beans are exported to Europe particularly Netherlands, Belgium and France. Tanzanian beans are also exported to India, China and Kenya, Uganda, Rwanda, Burundi and DR Congo as well as to Zambia, but in all cases the rate of export seems to a have declined from the peak year of 2003 (Kilimo Trust, 2013, URT,2016, Ronner and Giller, 2013). On average, Tanzania exports about 11 105 MT annually of common beans fetching the nation about USD 5 706 000 (Kilimo Trust, 2013).

Table 1: National Beans Area ('000'ha), Production ('000'tons) and Yield (tons/ha)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
National Beans Area ('000'ha)	646.9	845.96	749.54	868.31	1 208.69	737.66	1 265.40	151.38	1 134.94
National Beans Production ('000'tons)	707.62	889.29	570.75	773.72	867.53	675.95	1 199.27	1113.54	1 114.50
National Beans Yield (tons/ha)	1.10	1.05	0.76	0.89	0.72	0.92	0.95	0.97	0.98

Source: MAFC (2008) and FAOSTAT(2017)

2.6 Situation of Beans Production in Mbeya

MAFC and NBS (2012) reported that average beans yield in Mbeya region declined from 1.09 tons/ha in 2005/06 to 0.97 tons/ha in 2006/07. Also average yield decreased by 0.81 tons/ha in 2007/08 and increased in 2008/09 by 1.44 tons/ha. Moreover, the average yield decreased from 1.44 tons/ha in 2009 to 0.99 tons/ha in 2010. Generally the production of beans has been reported that it is just fluctuating and somehow remains

flat. The average yield of common beans is still low which is far below potential yields recommended by agricultural research (1.5 – 3 tones/ ha) using improved varieties (Ronner and Giller, 2013, MAFC, 2012).

Table 2: Situation of common beans production in Mbeya

Year	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
Mbeya Area ('000' ha)	80.88	84.92	86.33	88.58	200.74
Mbeya Production ('000' tons)	90.74	90.18	58.28	140.08	96.67
Mbeya Average of Yield (tons/ha)	1.09	0.97	0.81	1.44	0.99

Source: MAFC and NBS (2012)

Table 3:Some of Improved common bean varieties grown in Tanzania

Bean varieties	Grain Yield	Reasons for growing the variety
Lyamungu 85	2.0 - 3.4 t/ha.	High yield, good color, resistant to diseases& pests and early maturity
Lyamungu 90	2.0 - 3.0 t/ha.	High yield, palatable, good colour, medium maturity and resistant to disease and pests.
Selian 94	2.0 - 3.0 t/ha.	Early maturity, high yield, marketable
Jesca	2.0 - 3.4 t/ha.	Resistant to diseases, early maturity, high yield
Selian 97	2.0 - 3.4 t/ha.	Early maturity, large grain ,high yield,marketable,resistant to disease
Kabanima	2.0 - 2.5t/ha.	High yield, good market ,resistant pest &diseases, drought resistant,
Uyole 84	3.0 - 4.5 t/ha.	Tolerant to disease, high yield.
Uyole 94	2.0 -2.5 t/ha.	High yields, tolerant to diseases, fast to cook, very palatable attractive colour, liked for consumption and market.
Uyole 96	2.0 -2.5 t/ha.	High yields, tolerant to diseases, fast to cook, very palatable attractive colour, liked for consumption and market.
Uyole 98	1.5 -2.0 t/ha.	High yields, tolerant to diseases, very fast to cook, very palatable liked for food and market.
Wanja	1.5 -2.0 t/ha.	Fair yields very early maturity, good performance under poor conditions, fast to cook, palatable, liked for food and market.
Uyole 03	1.0 -2.0 t/ha	High yields, tolerant to diseases, fast to cook, very palatable attractive colour
Uyole 04	1.5 – 3.0 t/ha	High yields, tolerant to diseases, drought resistant, fast to cook, palatable,good market
Bilfa Uyole	1.2 -2.5 t/ha	High yields, Fair tolerance to disease, tolerant poor soil, fast to cook, palatable, attractive seeds, liked for consumption and market
Selian 05	1.5-2.5 2 t/ha	Resistantto disease, good market, pleasant colour,mmedium

		maturity
Urafiki	2.0-3.0 t/ha	High yields, tolerant to drought, fair tolerance to diseases, fast to cook, palatable, liked for consumption, good colour

Source: MAFC (2007, 2012)

2.7 Challenges Facing Smallholder Farmers in Beans Production

The challenges facing beans farming in Tanzania include poor capital, poor yields, pests and diseases, poor agricultural equipment, lack of knowledge on climate change, poor quality of seeds, inadequate and unpredictable markets, taxes, low price of the commodity, shortage of extension services, pests and diseases are also a main challenge facing smallholder farmers in Tanzania (Kanyama and Damian 2015, Birachi *et al*., 2011; Hillocks *et al*., 2006, Andrew and Philip, 2014).

Similarly,Rodriguez and Creamer (2014) indicated that diseases were the principal constraint of common bean production, pests are the second principal constraint; followed by market constraints, such as: access to and the high cost of inputs; the low prices received by farmers, the appropriation of a large percentage of profits by dealers, lack of credit, lack of market access, price instability. Issues related to extension and production technologies such as low rates of technology adoption, limited technical assistance to farmers, and poor agronomic practices are also seen as important.Mkonda and Xinhua (2016) in their study indicated that poor agronomic practices and infrastructures, shortage of capital and political will are among the human factors affecting agriculture. Climate change impacts are regarded as a principal natural factor affecting rain-fed agriculture. However, other factors such as shortage of advanced farm inputs, fertilization and organic farming can be the barriers to spearhead the production.

According to Philip (Year not stated) one of the challenges facing agriculture sector in Tanzania is inability of smallholder farmers to access and use inputs like seeds and

fertilizers, inadequate market access for both crops and livestock products and problems in accessing credit for Agricultural production and marketing.

2.8 Empirical Studies on Profitability

Andrew and Philip (2014) conducted a study using gross margin analysis on profitability and constraints of coffee production in Kigoma region, Tanzania and the results indicated that coffee production was profitable.

Mgeni and Temu (2010) use gross margin analysis to examine the profitability of fresh fruits and vegetable export marketing channel of small-scale farmers in Tanzania they found that, selling fresh fruit and vegetable to export market was more profitable for small scale farmers than selling to a domestic market.

The study conducted by Venance*et al*. (2016) on the factors Influencing on-Farm CommonBean Profitability in Babati, Tanzania using multiple linear regression revealed that age of respondents; gender; yield; selling price (farm-gate price); access to credit; and off-farm income affected the gross margin realized by smallholder farmers.

Katungi *et al.*(2011) conducted a study on profitability of farmer based bean seed productionusing gross margin analysis**.** From this study the result indicates that farmer based seed production is a profitable enterprise. However, the study results indicate that the average profits from the farmer based common bean seed production were much lower than the profits earned from the certified seed production by seed companies .The big difference in profits was due to two major factors; namely, high productivity originating from use of irrigation and relative high price for certified bean seed.

Tschering (2002), conducted a profitability analysis of bean production in Honduras ,the study was based on record keeping data collected from Honduran bean farmers during the period 1998- 2000. His study focused on assessment of profitability analysis of bean production for farmers growing traditional and improved bean varieties. It was observed that farmers growing improved varieties had higher average yields and got higher profit compared to traditional varieties.

Ehinmowo and Ojo (2010) conducted a study on economic analysis of Kola-nut production in Nigeria using gross margin analysis. The result revealed that Kola-nut production was a profitable enterprise.

Olorunsanya *et al*. (2009) used cost and return analysis in the economic analysis of soyabean production in Kwara State, north central Nigeria. The result obtained shows a gross margin gives an indication of high profitability of soybean production in the study area.

Masuku and Xaba (2013) conducted a study on factors affecting the productivity and profitability of vegetables production in Swaziland using multiple linear regression, the results showed that the factors that significantly affected productivity of vegetable farmers were access to credit, selling price, fertiliser quantity, distance to market and gender of the farmer and had a positive relationship with the productivity of vegetable farmers. The same study revealed that the determinants of profitability of vegetable production were level of education, land under vegetable production and type of marketing agency and had a direct influence on profitability of vegetables.

Masuku and Dlamini (2012) conducted a research on profitability of smallholder sugarcane farming in Swaziland using linear regression the results indicated that

variables such as farm size, farming experience, sucrose price, labour cost per hectare and fertilizer cost per hectare significantly influence the profitability of smallholder sugarcane farmers' associations in the study area. Similarly, Zulu (2011) in her study of Profitability of Smallholder Cowpea Production in Zambia using gross margin and regression analysis found that production of smallholder cowpeas in Zambia was found to be profitable.

The study conducted by Birachi *et al*. (2011) revealed that production losses, land size allocated to bean production, production assets, group membership and type of seed variety planted significantly influence output. Moreover, Hoqueand Haque (2014) conducted a study onsocio-economic factors influencing profitability of rice seed production in Bangladesh using multiple linear regression, the resultsshowed thatfarm size, contact withinformation sources, knowledge on quality rice production and age of the respondents were identifiedas significant contributors in profitability of rice seed production.

2.9 Empirical Studies on Adoption

Idrisa *et al*. (2012) in their study examined the determinants of adoption of improved soybean seeds among farmers in southern Borno State, Nigeria employed Logit model and Tobit model, they indicated that yield of soybean and distance to source of improved seeds were statistically significant factors that influenced the likelihood of adoption of improved soybean seeds among the respondents. Also they reported that farm size and distance of respondents to source of improved soybean seeds were statistically significant factors ($\rho \leq 0.01$) that influenced the extent of adoption of improved soybean seeds among the respondents.

The research carried out by Challa and Tilahun (2014) on the determinants and Impacts of Modern Agricultural Technology Adoption in West Wollega, Ethiopiausing the logistic regression showed that household heads' education level, farm size, credit accessibility, perception of farmers about cost of the inputs and off-farm income positively and significantly affected the farm households' adoption decision; while family size affected their decision negatively and significantly.

A study conducted in Tanzania by Letaa *et al*.(2015) using probit model on Farm Level Adoption and Spatial Diffusion of Improved Common Bean Varieties in Southern Highlands of Tanzania revealed that factors such as perceptions about soil fertility status and plot distance from residence, agricultural wealth, number of dependents, access to off farm income and years of experience in bean growing, distance from the village to main road, agricultural credit, significantly influenced the adoption of the improved varieties. The results further show that the improved varieties have extensively diffused in the study area, with new improved bean varieties replacing old ones.

Teferi *et al.* (2015) conducted a study on factors that affect the adoption of improved maize varieties by smallholder farmers in Central Oromia, Ethiopia using logit model, the findings revealed that adoption of the improved maize varieties among households was found to be positively influenced by adult-literacy, family size, livestock wealth, access to output market and credit access for the new varieties. On the other hand, farmer associations, distance to main markets and fertilizer credit negatively influenced adoption.

Lopez (2010) in his study about adoption of improved maize and common Bean varieties in Mozambique using probit model found that household head's education, access to extension services and credit are associated with the household's adoption decision. However, association membership is negatively associated with the adoption decision.

Temu (2013) in his study on adoption of sustainable land management technologies,revisiting impact to community livelihood in West Usambara mountains, Tanzania using binary logistic regression model revealed that total number of household members; farm total size and average income per year have significant positive impact on the adoption of sustainable land management. Furthermore, multiple linear regression model revealed that household head age, farmland ownership and household income have significant positive impact on improving community livelihood.

2.10 Conceptual Framework

The conceptual framework presented in Fig. 1 used in the present research was adopted and modified from Engel (2010). It shows the inter-link and relationships between independent and dependent variables. The independent variables are presumed to influence the dependent variable (adoption and profitability of improvedbean varieties) among smallholder farmers. It is based on the assumption that, after technologies have been developed from research institutions, is then disseminated to farmers. Thereafter, farmers will adopt technologies that will lead them to increase productivity to earn high revenue and profit. Further, this study assumed that the chances of change in the dependent variable are highly dependent on changes in the explanatory variables.

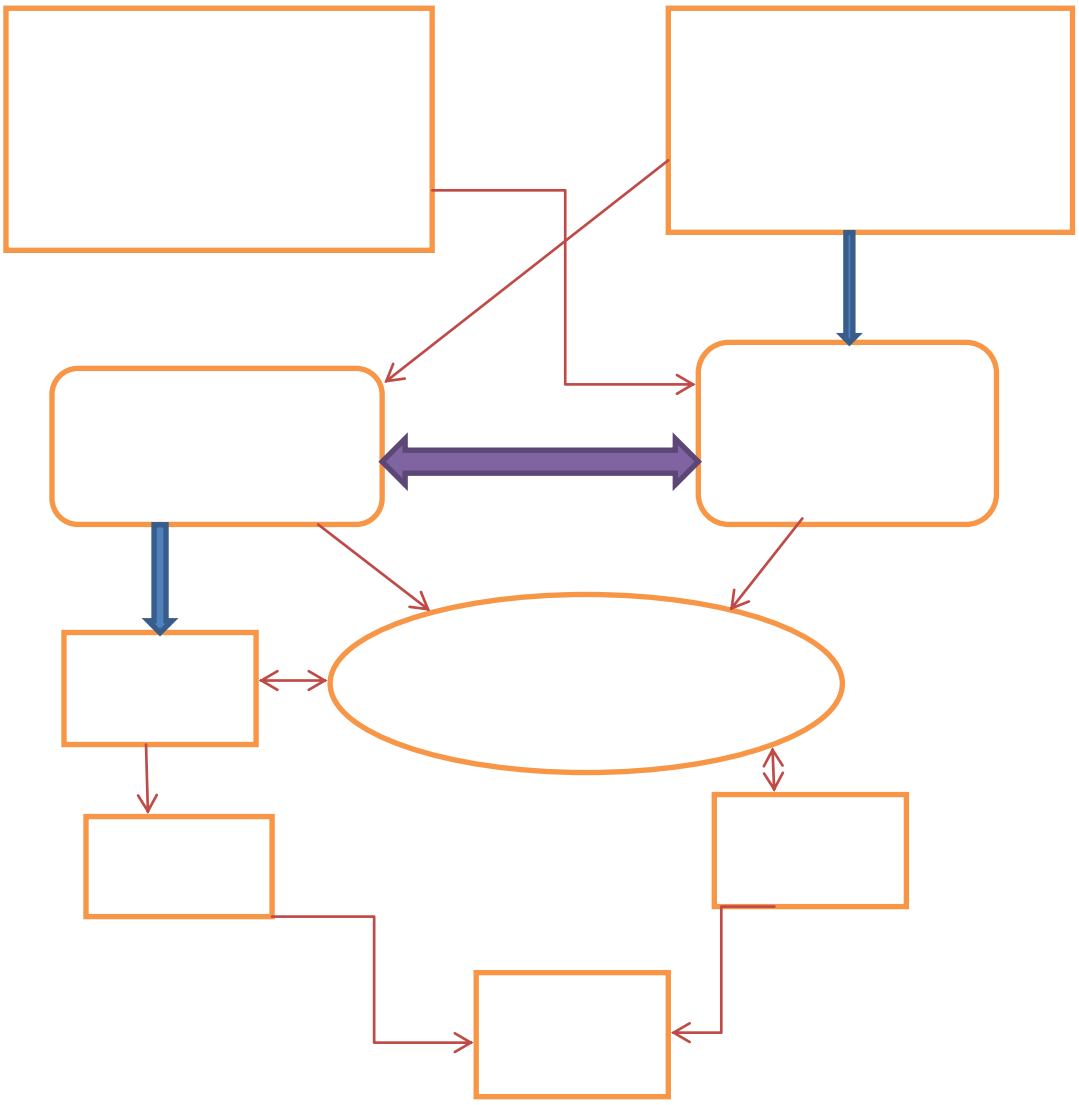

Figure 1: Conceptual framework

Source: Modified from Engel (2010)

CHAPTER THREE

3.0 METHODOLOGY

3.1Study Area

The present study was conducted in Mbeya district Mbeya region. The district was selected due to its high potential for producing common beans. The statistics shows that Mbeya region recently produces an average common beans yield of 0.99 tons/ha and total production of common beans is about 95.19 tons/ha per annum (MAFC, 2012).

3.2Research Design

A cross sectional research design was used for this study in line with Babbie (2010). The design allows for data to be collected from a sample selected at single point in time. The reason for choosing this design is due to its suitability for description purposes as well as the determination of the relationship between the variables (Bryman, 2015).

3.2.1 Sources of data, collection methods and types of data

The research study used both primary and secondary data which were obtained by administering a semi structured questionnaire, checklist and observation during field survey. A structured questionnaire was designed to capture both quantitative and qualitative data. This consisted of both closed and open-ended questions. Secondary data were collected through review of publications and official reports.

3.2.2 Sampling techniques

The study population was smallholder farmers growing common beans in the study area.A multi-stage (three stages) sampling involving a combination of purposive and random sampling procedures was used to select a representative sample of respondents.

The first step involvedpurposive selection of wards followed by selection of villages within the selected wards. The final stage was the use of simple random sampling for the selection of respondents from selected villages. A sample size of 120 was appropriate for this study, it has been documented that in most of cases, sample size with at least 120 observations to be satisfactory for having good analysis (Kothari, 2004). Further, Kothari (2004) indicated that if the items of the universe/population are homogeneous regardless of the population size a sample of 100 cases is sufficient. Common bean smallholder framers in the study area were homogeneous since they all operate under the same geographic characteristics, same market conditions and same farming practices.

3.3 Methods of Data Analysis

Data were coded, edited and analysed using appropriate computer software that included Statistical Package for Social Sciences (SPSS). Descriptive statistics such as mean, frequency and percentages were computed. Gross margin analysis was used in estimating profitability of bean production. Multiple linear regression model was used in determining the influence of socio-economic factors on common beans profitability. On the other hand binary logistic model was employed in finding determinants of improved bean varieties adoption.

3.3.1 Descriptive statistics

Descriptive statistics such as frequency distribution tables, percentage, mean, standard deviation were used to analyze the respondent’s socio-economic characteristics and identify challenges facing smallholder beans producers.

3.3.2 Gross margin analysis

Gross margin analysis was used to estimate the profitability of common beans production.Gross margin is the difference between the annual gross income for the

enterprise and total variable costs directly associated with the enterprise (Leslie, 2013). Gross margin analysis was chosen because it is the most satisfactory measure of farmers' profitability in small scale agriculture and suitable for crops estimation that mature within short time common beans inclusive (Leslie, 2013). However, gross margin ignores fixed costs since it is very difficult to estimate costs of annual crops. For a farm enterprise gross margin is one measure of profitability and can be used in determining the relative profitability of farm enterprises.

Gross margin analysis was used to estimate the profitability of common beans production. The Gross Margin analysis used to achieve objective (i) and it is expressed as:

$$GM = GI - TVC \quad \ldots\ldots (1)$$

GM = Gross Margin (TZS/acre),

GI = Gross Income (TZS/acre),

TVC = Total Variable Cost (TZS/acre).

The null hypothesis that "gross margin is not different from zero" that is (μ=0) was tested by using a single sample *t* test procedure as indicated in the following formula.

$$\frac{\bar{x} - \mu}{\frac{s}{\sqrt{n-1}}} \sim t_{\alpha,(n-1)}$$

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n-1}}}$$

Where t is single sample test statistic to be computed

$\bar{x}$ is the average Gross Margin per acre from beans production (TZS/acre)

μ is the average gross margin if the null hypothesis is true that is $\mu = 0$

s is a sample standard deviation for beans gross margin (TZS/ acre)

n is a sample size

α is level of significance (that is 5%)

$n-1$ represents the degrees of freedom

The average Gross Margin ($\bar{x}$) and Sample Standard Deviation (s) were computed from individual farmer's Gross Margins and then used to compute a *t* statistic for hypothesis testing. In order to decide on whether to reject a null hypothesis, the computed *t* statistic was compared with tabulated *t* statistic at 5% level of significance.

3.3.3 Regression analysis

Multiple linear regression model was used to achieve objective two which was based on the influence of socio-economic factors on common beans profitability. It has been used to examine the functional relationship between factors that were assumed to have significant effect on profitability. The socio-economic variables included in the model were those thought in advance to be capable of affecting level of profitability.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

Y= Profitability of beans production, measured by gross margins per acre

X_1 =sex of the respondents

X_2= Education level of the respondent in years

X_3=Farming experience

X_4=land size (acre)

X_5=Extension services

X_6=Access to credits

X_7=Household size

β_0= Intercept (constant)

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$,= Represent coefficient values of independent variables

ε_i= disturbance term

Table 4: Description of the explanatory variables used and their prior signs in determining the influence of socio-economic factors on common bean profitability

Variable	Coding	Category	Expected signs
X_1 = Sex of the farmer	1 if male, 0 if female	Dummy	+/-
X_2= Education level of farmer	1 if literate, 0 if illiterate	Dummy	+
X_3=Farming experience	Number of years in farming	Continuous	+
X_4 = Total land cultivatedunder beans	Number of hectares	Continuous	+
X_5 = Access to extension services	1 if access, otherwise 0	Dummy	+
X_6= Access to credit	1 if access, otherwise 0	Dummy	+
X_7 =Household size	No of family members	Continuous	+

3.3.4 Logit regression model

Logit regression model was used to identify the determinants of improved common bean varieties adoption extent. The model was chosen due to its resolution of problem of heteroscedasticity (Greene, 2008). The theoretical outline of the model employed in the present study is similar to the model that Challa and Tilahun (2014), Teferi *et al.* (2015) employed to determine households' decision about the adoption of a technology. A logit model identified factors that determine the adoption or non-adoption decision of farmers to use improved common bean varieties.The dependent variable which was used with logit model is adoption of improved common bean varieties, taking the values 1 or 0. The value 1 indicates a farmer who adopted improved common bean varieties while the value 0 indicates a farmer who did not. Adopters of improved common bean varieties

were defined as farmers who planted at least one of the improved commonbean varieties and non-adopters were defined as farmers who did not plant the improved varieties.

The probability (Pi) that a farmer adoptedimproved commonbeans varieties is as follows:

$$Z_i = \beta_0 + \sum_{i=1}^{n} \boldsymbol{\beta_i} X_{i,} \quad \text{.....(3)}$$

Where $\beta_0$is constant and Zi is equal to one (1) when a choice is made to adopt and zero (0) otherwise; this means: The equation represents a binary choice model involving the estimation of the probability of adoption of a given technology (Z) as a function of independent variables (X). Mathematically, this is represented as:

$$Prob(Z = 1) = F(\beta' X_i) \quad \text{.....(4)}$$

$$Prob(Z = 0) = F(1 - \beta' X_i) \quad \text{.....(5)}$$

Where, Zi is the observed response for the ith observation of the response variable, Z. This means that Zi =1 for an adopter (i.e. farmers who adopt modern agricultural production technologies) and Zi = 0 for a non-adopter (i.e. farmers who do not adopt modern agricultural production technologies). Xi is a set of independent variables such as farm size, family size, education of household head, among others, associated with the ith individual, which determine the probability of adoption, (P). The function, may take the form of a normal, logistic or probability function. The logit model uses a logistic cumulative distributive function to estimate, P given z by,

$$P\left(Y = \frac{1}{X}\right) = \frac{e^z}{1 + e^z} \quad \text{.....(6)}$$

$$P\left(Y=\frac{0}{X}\right)=1-\frac{e^{z}}{1+e^{z}}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..\ldots(7)$$

$$Z=\beta_1X_1+\beta_2X_2+\cdots+\beta_kX=\sum_{i=1}^{k}\beta_i\,X_i,\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots\ldots\ldots..\ldots..(8)$$

Where, k represented number of independent variables to be analysed in the study.

The empirical model for the logit model estimation is specified as follows:

$$Z=Ln\left(\frac{P_i}{1-p_i}\right)=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+$$

$$\beta_9X_9+\beta_{10}X_{10}+\boldsymbol{\varepsilon}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

Where:

$Ln(\frac{P_i}{1-p_i})$= The log-odds in favour of farm households' decision to adopt modern agricultural production technologies. Log-odds in favour of farm households" decision to adopt modern agricultural production technologies or not to adopt. It is the logarithm of the ratio of probability of adopting the technologies (p) to probability of not adopting them (1-p). The ratio $Ln(\frac{P_i}{1-p_i})$ shows the odds ratio of probability of adopting the technology to not adopting it. That means it is the ratio of probability of adopting the technology (p) to not adopting the technologies (1-p).

$\beta_{1,}\beta_{2,}\beta_{3,}\beta_4,\beta_5,\beta_{6,}\beta_7,\beta_8,\beta_{9,}\beta_{10}$ =The estimated regression coefficient.

X_1 = Age (years), Sex (male= 1 and 0 otherwise), X_3 = Household size (in number), X_4=Education level,$X_2=X_5$ = land size (acre), X_6 = Access to credit (yes=1 and 0 otherwise), X_7 = Extension services (yes=1 and 0 otherwise), X_8 =distance to the nearest market (Km),

$X_{9=}$ farm income (Yes=1 and 0 otherwise), X_{10}=off-farm income (Yes=1, and 0 otherwise).

Table 5: Prior expectations signs of determinants affecting adoption of improved common bean varieties

Variable	Expected Sign	Description
X_1=Age	+/-	There is an argument that as a farmer grows older; might find it too risky to adopt new technology. On the other hand, young aged in most cases might deny taking innovations including improved beans varieties due to lack of experience and socio-economic circumstances. Yet they can easily take on risky decisions due to their aggressiveness and motivation to accomplish their life goals earlier. Hence both signs
X_2=Sex	+/-	Male headed household is associated with stronger financial and ownerships of resources. They are likely to adopt new technology .On the other hand female heads household have less access to external inputs, services, and information due to socio-cultural values
X_3=Household size	+	Technology adoption requires labor. This is because labor is one of the inputs that influence positive adoption of improved common bean varieties.
X_4=Education	+	Educated farmers are associated with high understanding of new technology and able to access information, allocate inputs more efficiently, and more accurately assess the profitability of new technology, compared to farmers with no education.
X_5= Land size	+	Farmers with large farm size are expected to demand more new technology because they have enough space to expand beans production. Farmers with larger farms are more likely to adopt an improved technology (especially improved bean varieties) compared with those with small farms.
X_6=Access to credits	+	The influence of credit on technology adoption to expand production and earn farm profit.
X_7=Extension service	+	Extension services enable the farmer be aware of improved technology and how such technology can be applied in their farming. This can lead the farmers to improve their beans quality and quantity through skills and knowledge from extension worker.
X_8 =distance to the nearest market	+/-	Farmers living a distance nearest the market are more likely to adopt the improved bean varieties than those who are located far from the market. On the other hand, farmers living far away from the market they are less likely to adopt technology this may due to the increase of transportation costs, tracking time and loss due to spoilage, hence discourage the farmers from adopting improve production technology.
$X_{9=}$farm income	+	Income received from other crops and livestock have positive influence on the adoption of improved bean varieties decision since farmers get additional income to purchase agricultural inputs.
X_{10}=off-farm income	+	Increase in off-farm income enables a farmer to purchase inputs hence a farmer is likely to adopt improved beans.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Social-economic Characteristics of the Respondents

4.1.1 Age of the household head

Table 6 indicates that 45% of bean farmers in the study area were between 35-49 years of age, 29.2% were aged between 20-34 years, 24.2% were aged between 50-64 years and the respondents who were above 60 years were 0.8%. This implies that common beans farming in the study area is mostly carried out by middle-aged farmers aged between 35 and 49 years (45%) who are still in their economically active age. The findings are supported by Babangida (2016)who reported that middle aged group of farmers has a significant influence on the decision making on adoption of improved agricultural technologies. Middle aged farmers tend to withstand stress, put more time in agricultural operations which can lead to increased productivity.

4.1.2 Sex of household head

The results presented in Table 6show that most of the household heads in the study area were male who constituted about 70%. On the other hand, female-headed households constituted about 30% of the households. The distribution of the farmers by sex shows that there were a larger proportion of males than females. This is due to the fact that male headed household is associated with stronger financial and ownerships of resources. They are likely to adopt new technology. On the other hand female headed households have less access to external inputs, services, and information due to socio-cultural values.

4.1.3 Marital status of household head

Table 6 shows the distribution of respondents based on marital status. The findings show that the household heads who are married accounted for 68.3% of all respondents. It was

also found that, 11.7% of the household heads are single, 9.2% widowed, 1.7%divorced and 9.2% separated. The large proportion of married respondents indicates that marriages provide an extra household labour for the farmers to engage in farming activities. The findings are consistent with Siri *et al*. (2016) who reported that married famers are more likely use family labour in productive activities.

4.1.4 Household size

Findings in Table 6show the distribution of respondents in the study area based on household size. About 58.3% of the respondents had between 1 and 4 members. 39.2% of the farmers had household size that ranged from 5 to 8 members while the households above 8 members constituted about 2.5%. This has an implication in accomplishing various agricultural activities as well as adopting improved production technologies. Household size has a great role to play in family labour provision in the agricultural sector (Raphael, 2014). However, the number of people in a certain household cannot be used to justify the potential for productive farm work this is due to the fact that it can be affected by some important factors such as age, sex and health status.

4.1.5Education level of the household head

The findings from the study area also show that about 8.3% of the household heads had no formal education, 44.2% had primary education, 20.0% of the household heads had secondary education and 27.5% attained tertiary education. This implies that majority (91.7%) of the household heads had formal education, meaning that they are literate. Literacy level enables farmers to adopt improved technology, which may bring about increase in productivity. Gichangi *et al*. (2012), Liberio (2012) indicated that education has a positive impact on adopting new agricultural technologies that can influence farmers to use improved varieties which leads to the increase of productivity.

Table 6: Socio - economic characteristics of respondents

Variables	Frequency	Percent (%)
Age categories		
less than 20	1	0.8
20 – 34	35	29.2
35 – 49	54	45.0
50 – 64	29	24.2
65 and above	1	0.8
Total	**120**	**100.0**
Sex of household head		
Female	36	30
Male	84	70
Total	**120**	**100**
Marital status		
Married	82	68.3
Single	14	11.7
Widowed	11	9.2
Divorced	2	1.7
Separated	11	9.2
Total	**120**	**100.0**
Household Size (in numbers)		
1 – 4	70	58.3
5 – 8	47	39.2
Above 8	3	2.5
Total	**120**	**100.0**
Education level of the household head		
Non formal education	10	8.3
Primary education	53	44.2
Secondary education	24	20.0
Tertiary education	33	27.5
Total	**120**	**100.0**

4.2 Profitability of Common Beans Production

The results in Table 7 show that the average yield of common beans for farmers in the study area was 706.6 kg/acre. The average yield is below the potential yield which ranges between 800kg/acre and 1200kg/acre. Total Variable Cost is the operating costs of the respondent which are the day-to-day cost incurred for producing common bean.

The Total Variable Cost (TVC) incurred by the respondents averaged TZS 670 840/acre, with an average Gross Income (GI) of TZS 980 054/acre, which resulted in a Gross Margin (GM) of TZS 309 214/acre. This indicates that beans production in the study area is profitable. Comparatively, the gross profit of beans is higher in Mbeya district (TZS 309 214) than in Babatidistrict with TZS 307 284 /acre (Venance*et al.*, 2016) and Mpanda districtvalued at TZS192383 /acre (Ntibiyoboka, 2014).

Labour used in common beans production was from both family and hired. Family labour was valued using the principle of opportunity cost and it was assumed that family labour served as a substitute for hired labour. As it was reported by Leslie (2013) that the estimated cost of labour used for family labour equals the prevailing wage rate of hired labour, this may well influence the decision as to whether to grow the crop.

Test of hypothesis for the profitability associated with common bean production was conducted based on gross margin results per acre Ho: $\mu = 0$as shown in Table 8.The resultson hypothesis testing show that the computed single sample test statistic (t) is significant at 1% level of significance and 119 degrees of freedom. In that regards, the study rejects the null hypothesis that “The average farmer’s Gross Margin is not different from zero” which means that the average gross margin is statistically greater from zero at 1% level of significance which in turn signifies that beans production is profitable.

Table 7: Gross margin results per acre for common beans production for year 2015/2016

Variable	Units/acre	Amount in TZS/acre
A: Gross revenue		
Average yield (Kg)	706.6	
Average farm gate price per kg (TZS)	1387	
Total Revenue		**980054.20**
B: Variable costs		
Cost of materials		
Seed	45.52 Kg	78 066.26
Land hire	1 Acre	94 738.52
Fertilizer	68.8 Kg	94 729.74
Herbicides	1 litre	19 281.80
Insecticides	0.91 Litres	15 528.30
Bags	6 Bags	6 521.26
Total Cost material		**308 865.88**
Labour Costs		
Land clearance	4 Mandays	21 392.28
First ploughing	12 Mandays	68 051.11
Second Ploughing	7 Mandays	37 184.30
Planting and fertilizer Application	9 Mandays	49 411.76
First Weeding	10 Mandays	58 265.56
Second Weeding	5 Mandays	17 687.88
Pesticide/herbicide Application	1 Manday	10 888.07
Harvesting and Threshing	9 Mandays	53 228.39
Sorting and packaging	4 Mandays	23 698.53
Packing in store	2 Mandays	8 711.40
Transportation	1 Trip	13 455.36
Total labour Costs		**361 974.66**
Total Variable Cost/acre = Total material costs + Total labour costs		**670 840.54**
C: Gross Margin/acre = Gross Income - Total Variable Costs		**309 213.67**

Table 8: One-Sample Test results for a null hypothesis that "average gross margin is not different from zero"

t	df	Sig. (2-tailed)	Mean Gross Margin	95% Confidence Interval	
				Lower	Upper
6.716	119	.000	309 213.67	74359.78	365263.84

4.3 The Influence of Socio-economic Factors on Common Beans Profitability

4.3.1 Tests of goodness fit

The regression results provided in Table 9show the adjusted R^2 of 0.5872 which indicates that 58.7% of the variation in bean profitability per acre is explained by all independent variables included in the model. This implies that the explanatory variables explain about 58.7% of variation in dependent variable i.e. common beans gross margin per acre. The overall F-test is 22.16 which statistically significant ($p< 0.000$). This shows that the independent variables added are the good predictor of the dependent one. A mean variance inflation factor (VIF) of 1.46 indicates no multicollinearity since VIF values are below 2.5 for independent variables as shown in Table 9. A variance inflation factor (VIF) greater than 2.5 is commonly considered problematic as reported by Belsley *et al*. (2005).

Table 9: Multiple linear regression analysis results for the influence of socio-economic factors on common beans profitability

Variables	Coef.	Std. Err	T	p> (t)	VIF
Sex	17728.66	291168.6	0.06	0.952	1.68
Education	7008.087	241498.3	0.03	0.977	1.63
farm experience	37242.48	17271.65	2.16	0.033**	1.63
Land size	902679.5	81717.8	11.05	0.000***	1.26
Extension services	511692.8	286345.2	1.79	0.077	1.26
Access to credit	-610575.3	279070.8	-2.19	0.031**	1.24
Household size	-152862.2	58950.67	-2.59	0.011**	1.21
Constant	221458.8	540582.3	0.41	0.683	

R-squared=0.6150 Adjusted R-Squared=0.5872 F=22.16*** Root MSE =1.1e+06

Mean VIF=1.46 n=120

** and *** statistically significant at 5% and 0.1% significance levels respectively.

4.3.2 Description of the estimated coefficients of the influence of socio-economic factors common bean profitability

Multiple linear regression was used to identify determinants of profitability of common bean. Gross margin per acre was regressed and used as a proxy for profitability as it measures relative profitability of common beans. The results presented in Table 9 show that farming experience, land size, access to credits and household size were statistically significant in determining bean profitability.

The results indicate that farmer experience had a positive relationship with profitability and was significant at 5% significance level. This may due to the fact that with more years of farming experience higher output is obtained which economically imply higher profit. The findings are supported by Masuku and Dlamini (2012) who reported that farming experience was statistically significant and had positive relation with profit margin.

The results also indicate that the land size had positive and significant relationship ($p<0.001$) with profit of beans per acre. This means that an increase of land under bean production would result to an increase of profitability. The positive relationship between land size and gross margin maybe attributed to the fact that farmers who afford to have larger farms are also capable of accessing other productivity enhancing inputs. The results are consistent with those of Masuku and Xaba (2013) who reported that land size has significant influence on crop profitability.

Household size was negatively related to the profitability of beans but it was significant at 5% significance level. This showed that a unit increase of household size would result in decrease of bean profitability by 152862.5 when other factors are kept constant. These

results are in consistent with the findings of Challa and Tilahun (2014) who reported that the family size is significantly and negatively influenced by the adoption of technology that has impact to profit of a particular crop. This may due to the reason that the household members are dependent on the household head's income. Hence house hold with such large number of members use its income more on consumption expenditure rather than generating income and profit. The results further indicates that access to credits was significant ($p<0.05$) and negatively related to profitability.

On the other hand, education level, sex and access to extension services were found to be insignificant.

4.4 Determinants of Improved Common Bean Varieties Adoption

4.4.1 Descriptive results of determinants of improved common bean varieties adoption

The descriptive results indicate that adopters of improved common bean varieties in the study area constituted about 73% of sampled farmers, while 27% of farmers were non-adopters. The factors identified as key determinants of adoption of improved bean varieties include but not limited to age, sex, marital status, family size, education, land size, farm experience, access to credits, access to extension services, distance to the nearest market, other farm source of income and off-farm activities.

4.4.1.1 Age of the household head

The results presented in Table 10show that about 45.5% of improved bean adopters were aged between 35 and 49 years while farmers whose age ranges from 50 to 64 were about 25% adopters of improved bean varieties. The results further show about 2.3% of the respondents above 65 years adopted improved bean varieties. This means that

adoption is influenced by middle aged farmers who are economically active group. This is argument is similar to Adeogun *et al*. (2010) who reported that middle aged farmers are most willing to spend more time to obtain information on improved agricultural technologies compared to older farmers. This implies that as a farmer grows older; might find it too beneficial to adopt new technology and is willing to accept change.Ramaekers*et al*. (2013) reported that innovativeness and adoption of improved technology of the farmer become more as the age of the farmer specially related to farm experience is likely to affect the decision of adopting modern agricultural technology positively.

4.4.1.2 Sex of the household head

The distribution of the farmers by sex as shown in Table 10show that about 76.1% of the respondents who had adopted improved bean varieties were male compared to 23.9% of females who adopted improved varieties. This implies that male headed household is associated with stronger financial and ownerships of resources compared to female heads household that have less access to external inputs, services, and information. Males are likely to adopt new technology compared to female headed households. These results are supported by the findings reported by Akadugu *et al*. (2012) that male farmers are more likely to adopt modern agricultural productiontechnologies than their female counterparts. The reason for this is that males control more productive resources such as land, labour and capital which arecritical for the adoption of new technologies.

4.4.1.3 Household size

The results presented in Table 10 show that about 64.8% of respondents with household size ranging from 1 to 4 hadadopted improved varieties compared to 35.2% of the

respondents with household size ranging from 5 to 8 who adopted improved common bean varieties.This shows that as number of members of households increases, they are less likely to adopt improved bean varieties. This may due to the reason that the household members are dependent on the household head's income. Hence a household with such large number of members use its income more on consumption expenditure rather than investing in the new technology. This study is consistent with Nmadu *et al*. (2015) who reported that household size had a negative influence on the adoption of innovations by cocoa farmers.

4.4.1.4 Education level of the household head

Table 10shows that 39.8% of the respondents with primary education had adopted improved varieties compared to 5.7% of the respondents with no formal education who adopted improved varieties. Also 35.2% of respondents with tertiary education had adopted improved bean varieties compared to 19.3% of respondents with secondary education who adopted improved varieties. This implies that educated farmers are more likely to adopt improved technologies because education helps farmers to obtain and understand the technology more easily than non-educated farmers. These findings are in agreement with Teferi *et al*. (2015), Liberio (2012) who reported that educated farmers are more likely to be efficient to adopt and apply new agricultural innovation than non-educated farmers. Therefore, education has positive influence on adoption of new agricultural production technologies that can influence farmers to use improved varieties which leads to the increase of productivity.

4.4.1.5 Land size

Table 10 shows that when the land size ranges from 0-3.9 acres the proportion of improved common bean adopters was 93.2% while when the land size ranges from 4 to 7.9 acres the proportion of adopters was 5.7%. Also about1.1% of the respondents with

land size above 8 acres had adopted improved bean varieties**.** This indicates that farm sizes have positive influence on adoption of improved bean varieties.This agrees with the findings of Idrisa *et al.* (2012) that small farmers adjust quickly and adopt new innovations at a faster rate than large-scale farmers. This is due to the fact that small farmers live at subsistence level that attracts them to adopt improved varieties which give better yields, earn more income and thereby helping in raising their standard of living Idrisa *et al*. (2012).

4.4.1.6 Distance to the nearest market

Table 10 shows that when the distance ranges from 1km to 5 km the proportion of adopters was only 59.1% while when the distance is above 11 km the proportion of adopters was 6.8%. The Table shows that a large proportion of adopters in the study area were found at the distance ranging from 1-5km. Adopter percentage decreases as the distance to the nearest market increases. This implies that the shorter the distance to the nearest market the higher the rate of adoption. On the other hand the proportion of adopters of improved bean varieties decreases as the distance to the nearest market increases. This is consisted with Teferi *et al.* (2015) who reported that farmers who are close to markets are more likely to adopt the improved maize varieties than those who reside far from the main market. The findings are further supported by Challa and Tilahun (2014) that as farmers farm lands get closer to the main road or market centre; they can have access to transportation facilities and better support from concerned bodies to their seed multiplication which might increase the use of technology.

4.4.1.7 Farming experience

Table10shows that when farming experience ranges from 1 to 5 years the proportional of adopters of improved common bean varieties was 56.8% while when the farming experience ranges from 6-10 years proportional of adopters was 20.5%.Alsoabout 19.3%

of respondents with farming experience above16 yearshad adopted improved common bean varieties compared to 3.4% of respondents with farming experience ranging from 5 to 10 years who had adopted improved varieties.The study is consistent with Siri *et al*. (2016) who indicated thatthe adoption of improved common beans varieties increase with the experience in the cultivation of improved common beans varieties.This implies that more experienced farmers may have better skills and access to new information about improved technologies. It could also imply that knowledge gained over time from working in uncertain production environment may help in evaluating information thereby influencing their adoption decision (Idrisa*et al*., 2012).

4.4.1.8 Access to credit

About 19.3% of respondents with credit access adopted improved common bean varieties. Access to credit plays a great role in adoption of improved technology because farmers will have additional money to purchase inputs like fertilizers, improved seeds and pesticides, thus enables the farmer to expand and maximize profit (Akudugu *et al*., 2012). There is therefore need for policy makers to improve current small holder credit systems to ensure that a wider range of small holders are able access credits.

4.4.1.9 Access to extension services

The results presented in Table 10 show that about 78.4% of respondents with access to extension services adopted improved varieties. This implies that access to extension services by farmers has significant influence on improved bean varieties. Ume and Ochiaka (2016), Lopez (2010) and Raphael (2014) argue that access to extension services plays important role in the adoption of improved agricultural technologies and farmers who are exposed to information about new technologies by extension agents

through training, group discussion, plots demonstration, and other form of information delivery tend to adopt new technologies.

4.4.1.10 Other sources of farm income activities

The results in Table 10 show that about 92% of the respondents with other sources of farm income activities adopted improved common bean varieties in the study area. This implies that having income from other crops and livestock have positive influence on the adoption of improved bean varieties decision since farmers are engaged in multiple farming activities are better get additional income to purchase agricultural inputs. This is consisted with Mulugeta (2011) who reported that farm income is the main source of capital to purchase farm inputs and other household inputs.

4.4.1.11 Off-farm income activities

Off farm income is the amount of income generated from activities other than crop and livestock production. The results in Table 10 show that about 63.6% of the respondents with off-farm income activities adopted improved common bean varieties.This implies that off farm income activities has a direct impact to the adoption of improved common bean varieties because farmers get additional income to purchase inputs like fertilizers, seed, machinery and pesticides. This is in line with the findings reported by Challa and Tilahun (2014) that having non-farm income has positive influence on the adoption decision of farm households.

Table 10: Descriptive statistics on determinants of adoption of improved common bean varieties (Adopters and non-adopters)

Variables	Adoptors		Non- Adopters	Total
	Frequency	%	Frequency	
Age categories				
less than 20	0	0	1	1
20 – 34	26	29.5	9	35
35 – 49	40	45.5	14	54
50 – 64	20	22.7	7	29
65 and above	2	2.3	1	1
Total	**88**	**100**	**32**	**120**
Sex of household head				
Female	21	23.9	15	36
Male	67	76.1	17	84
Total	**88**	**100**	**32**	**120**
Household Size (in numbers)				
1 – 4	57	64.8	13	70
5 – 8	31	35.2	16	47
Above 8	0	0	3	3
Total	88	100	32	**120**
Education level of the household head				
Non formal education	5	5.7	5	10
Primary education	35	39.8	18	53
Secondary education	17	19.3	7	24
Tertiary education	31	35.2	2	33
Total	**88**	**100**	**32**	**120**
Land size				
0 - 3.9 acres	82	93.2	32	114
4 - 7.9 acres	5	5.7	0	5
8 and above	1	1.1	0	1
Total	**88**	**100**	**32**	**120**
Distance to the nearest market (Km)				
0 - 5.9 Km	52	59.1	23	75
6 - 10.9 Km	30	34.1	9	39
11 and Above	6	6.8	0	6
Total	**88**	**100**	**32**	**120**
Experience in common bean production (Years)				
1 - 5 Years	50	56.8	19	69
6 - 10 Years	18	20.5	6	24
11 - 15 Years	3	3.4	1	4
16 and above	17	19.3	6	23
Total	**88**	**100**	**32**	**120**
Access to credit				
Yes	17	19.3	25	42
No	71	80.7	7	78
Total	**88**	**100**	**32**	**120**
Access to extension				
Yes	69	78.4	13	82
No	19	21.6	19	38
Total	**88**	**100**	**32**	**120**
Other sources of farm income				
Yes	81	92	30	111
No	7	8	2	9
Total	**88**	**100**	**32**	**120**
Off farm income				
Yes	56	63.6	4	60
No	32	36.4	28	60
Total	**88**	**100**	**32**	**120**

4.4.2 Econometrics results of determinants of improved commonbean varieties adoption

The results in Table 11show that the predictor variables which are statistically significant determinants of improved bean varieties adoption include: age ($p<0.05$), family size ($p<0.001$), Land size ($p<0.05$), access to extension size ($P<0.01$), distance to the nearest market ($p<0.05$) and off-farm income ($p<0.05$). The rest of the predictors as shown in Table 11 were not statistically significant.

Table 11: Binary Logistic Regression for the determinants of improved common bean varieties adoption

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
							Lower	Upper
Age	0.103	0.048	4.693	1	0.03*	1.109	1.01	1.217
Sex	1.007	0.736	1.875	1	0.171	2.738	0.648	11.573
Household Size	-0.983	0.274	12.878	1	0.0001***	0.374	0.219	0.64
Education level	0.154	0.586	0.069	1	0.793	1.166	0.37	3.679
Land size	1.451	0.62	5.482	1	0.019*	4.269	1.267	14.386
Access to credits	-0.529	0.94	0.316	1	0.574	0.589	0.093	3.723
Access to extension services	2.124	0.792	7.198	1	0.007**	8.366	1.772	39.485
Distance to nearest market	-0.386	0.185	4.347	1	0.037*	1.471	1.023	2.116
Other farm source of income	1.139	1.537	0.549	1	0.459	3.124	0.153	63.589
Off-farm income	2.693	1.071	6.323	1	0.012*	14.778	1.811	120.566
Constant	-5.602	3.027	3.425	1	0.064	0.004		

* Statistically significant at $\alpha = 0.05$

** Statistically significant at $\alpha = 0.01$

*** Statistically significant at $\alpha = 0.001$

Model test

-Log likelihood = 63.52

Number of observations = 120 Cox & Snell R^2= 0.46 Nagerkerke R^2 = 0.68

H-L test (X^2) = 6.04 PAC: Null model = 73.3; Model with descriptors = 89.2

4.4.2.1 Tests of goodness fit

The results presented in Table 11 show that the model with descriptors (PAC=89.2) performs better than the null model (PAC=73.3), this is due to the fact that model with descriptors is higher than null model. Furthermore, the results show that the test for Hosmer and Lemeshow (H-L) supports the model as being worthwhile which indicates that the model fits well with Chi-square statistic of 6.04 which is larger than 0.05, this means that the model fits well the data. Also Cox & Snell R^2 and Nagerkerke R^2 were used to test goodness of fit of the model (Cox and Snell $R^2 = 0.46$ &Nagerkerke$R^2 = 0.68$), suggesting that between 46% and 68% is explained by this set of variable.Thus indicate the model fit is good because Nagerkerke R^2 is higher than Snell R^2 as reported by Garson (2013) that Nagerkerke R^2 is normally higher than Cox-Snell R^2 and is the most-reported of the pseudo R^2 estimates.

4.4.2.2 Description of the estimated coefficients of determinants of improved common bean varieties adoption

The results in Table 11 indicate that age of the household head has positive influence on improved common bean varieties at 5% significant level ($p<0.05$). It is estimated that unit increase of age of household head leads to the increase odds ratio on adoption of improved common bean varieties by 0.103 when other factors are kept constant. Therefore the result is statistically significant at 5% level of significance.The results agree with Ramaekers *et al*. (2013) that age of the household head has a positive influence on climbing beans suggesting that older households have higher chances to adopt climbing beans compared to younger households.

The Total land size was also a positive and has significant effect for households to adopt improved bean varieties at 5% significance level. This shows that when farmers have

larger land sizes; they are more likely to adopt improved common bean varieties and other farm technologies. The positive coefficient of the binary logistic regression result indicates this fact as shown in Table 11. That is, a unit increase of land size increases the odds ratio of extent of adoption of improved bean varieties by 1.451 holding other factors constant and the result is statistically significant ($p<0.05$). This result is consistent with the findings of Akudugu *et al.*(2012), Idrisa *et al.*(2012), Challa and Tilahun (2014) who reported that land size has positive and statistically influence on the adoption of improved agricultural technology.

Access to extension services was also found positive and significant at 1% significance level as shown in Table 11. This means that farm households are more likely to adopt improved bean varieties and other improved agricultural technologies if they have access to extension services. Therefore binary logistic regression results presented in Table 11show the increase of extension services leads to the increase of odds ratio or probability of adopting improved bean varieties by 2.124. This result is in line with Ume and Ochiaka (2016), Lopez (2010) and Raphael (2014) who reported that access to extension services plays important role in the adoption of improved agricultural technologies and farmers who are exposed to information about new technologies by extension agents.

Distance nearest to market was found to be negatively significantly associated with the adoption of improved common bean varieties. From the Table 11 it indicates that unit increase in distance to the nearest market will lead to the probability decrease of

improved bean varieties adoption by 0.386 at 5% significant level when other factors are kept constant. This implies that farmers living far from the market are less likely to adopt the improved bean varieties compared to farmers that are near to the market. This result is consistent with Idissa *et al*. (2012) who reported that there is association between the distance to market and adoption of modern technology. On the other hand, farmers that are close to sources of improved technologies take the advantage of their closeness and tend to adopt the innovations compared to farmers that are far away from the sources of the technologies.Poor road network coupled with difficult terrain make movement difficult that inhibits communication and accessibility of farmers to technologies. As such, bringing technologies closer to farmers will increase the likelihood of adoption of such technologies Idissa *et al*. (2012).

Moreover, there was sufficient evidence that off-farm income has positively and strongly influences the adoption of bean varieties at 5% significance level. This implies that farmers, who have income outside farming activities, are more likely to become adopters of the improved bean varieties and other improved production technologies than the one with no such opportunities. In this regard farmers are able to use off-farm income to expand farm production by purchasing agricultural inputs like improved seed, fertilizers and agricultural chemicals. As shown in Table 11, it is estimated that an increase off-farm income leads to the increase probability of the farmer to adopt improved bean varieties by 0.386 holding other factors constant. This study is in consistent with the findings of Letaa *et al*. (2015) who found that participation in off-farm employment had a positive and significant influence on the adoption of new improved bean varieties. Off-farm income activities reduce the cash constraint, thus enabling farmers to purchase seed of new improved varieties and other farm inputs.

On the other hand, the household size had a negative influence on the adoption of improved common bean varieties adoption of the households of the study at 0.1% significant level ($p < 0.001$) in the study area. This implies that that as number of members of households increases, their adoption decision becomes low. This may due to the reason that the household members are dependent on the household head's income. Hence a household with such large number of members use its income more on consumption expenditure rather than investing in the new technology. As shown in Table 11 it is estimated that the increase number of household members will lead to the decrease odds of probability of improved bean at significant level of $p<0.05$ holding other factors constant. This study is consistent with Nmadu *et al*. (2015) who reported that household size had a negative influence on the adoption of innovations by cocoa farmers. However, the results show that sex, education level, farming experience, access to credits and other farm source of income were found to be insignificant.

4.4.3 Main improved common bean varieties grown in the study area for year 2015/16

Figure 2 highlights major improved bean varieties production in order of their importance in the study area. From the findings as shown in Figure 2 show that farmers in the study area are well aware with some of improved common varieties mostly they engage in growing Uyole 96 which constitutes about 29%, Uyole 03 constitutes about 20% and 14% for Njano Uyole. Observation showed that most of the farm households in the study area are mainly growing improved bean varieties especially Uyole 96, Uyole 03, Njano Uyole and Uyole 84, this is due to the fact that they are high yielder varieties, resistant to pests & diseases, good market and they mature earlier. On the other hand

bean varieties such as Kipapi, Masusu and other varieties are grown by few farmers because of lack of awareness of some of improved varieties. Both researchers and extension agents should disseminate knowledge and create awareness of improved bean varieties to farmers.

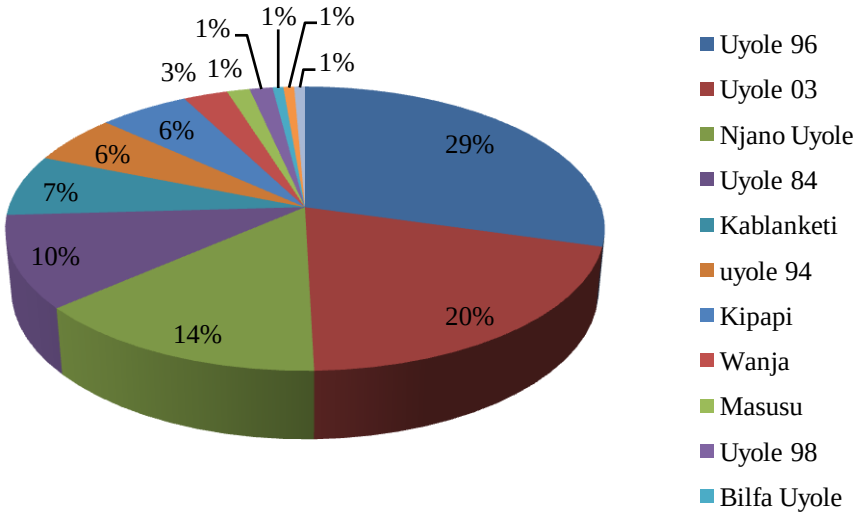

Figure 2: Some of improved bean varieties grown in the study area for year 2015/16 in order of their importance(%).

4.5 Challenges Facing Smallholder Common Bean Producers

Common bean farmers face some challenges in their attempt to produce beans. Table 12 presents a summary of challenges faced by smallholder common bean farmers in the study area.

4.5.1Crop diseases

About 72% of the respondents sampled in the study area highlighted diseases as a serious constraint affecting beans production and it was ranked 1st among the challenges identified. Diseases lower the yield of beans. Diseases in the study area have harmful effects to beans and hence lower the crop yield. The study is supported by Rodríguez and Creamer (2014) who noted that the principal constraints that face common bean

production and commercialization include both diseases and pests. The diseases, including angular leaf spot (*P. griseola*), common bacterial blight (*X. axonopodis*), anthracnose (*C.lindemuthianum*) and some diseases of the roots such as bean root rot (*R. solani*, *Pythium* sp. and *F. solani*).

4.5.2 Insect pests

Table 12 rates insect pests as a second serious challenge in the study area accounted for 70%.This implies that pests lower the yield and quality of the crop. As reported by Rodríguez and Creamer (2014), pest is a second serious constraint after diseases facing common beans production. Moreover, the study is consistent with Karanja (2016) who reported that most of the legumes are vulnerable to insect pests in the field and in storage .Pod sucking bugs, bean stem fly, bean bruchids, pod borers, aphids and thrips are major legume pests in Tanzania that lead to reduced yields and low quality grain. Also, the field and storage pests are responsible for losses in excess of 40% every year (Hillocks *etal*., 2006, KILIMO Trust,2013).

4.5.3 Unreliable rainfall

Unreliable rainfall ranks 3rd among the challenges faced by bean farmers in the study area constituted of 38.3% as shown in Table 12. In a study area bean production is largely subsistence and rain fed. Because most beans are grown under rain fed agriculture, the rainfall patterns have changed recently and rains rarely occur during the supposed off season periods. This increases supply and production risks as the rains over the last decade have become increasingly unreliable. This implies that farmers end up with getting poor yields due to the erratic rainfall. The results is consistent with Kanyama and Damian (2015) andMkonda and Xinhua (2016) who reported that unpredictable and unreliable rainfall is a serious problem in Tanzania that decreases crop yields of smallholder farmers.

4.5.4 High price of farm inputs

High price of inputs was ranked 4th among the constraints identified by the respondents in the study area as shown in Table 12. The findings show that about 35.8% of sampled farmers incur high cost of farm inputs. The price of fertilizers, improved seeds and agrochemicals is too high in the study area which leads to the increase of the production costs that disturbs production and marketing effectiveness of the beans. For example the price of fertilizer (DAP, TSP, Urea, N. P. K and CAN) in the study area ranges from Tshs 62 000 to 70 000 per bag of 50kg and the price of agrochemicals was between TZS 15 000 and TZS 30 000 per litre. This shows that the smaller holder farmers incur a lot of costs in producing beans. This constraint is supported by report of MALF (2016) that farmers in Tanzania are still forced to pay higher prices for farm inputs even as the government has exempted taxes on fertilizers and pesticides. The study revealed that high prices of agricultural inputs were responsible for the reduction of production and profitability bean producers through reduced area of cultivation. The government has to impose polices to subsidy farm inputs by reducing taxes on fertilizers and agrochemicals.

4.5.5 Unreliable market of beans

Unreliable market of common beans was identified as a constraint to the sampled bean farmers in the study area as 23.3% of the respondents highlighted it as a challenge and it was ranked 5th among the identified challenges in the study area. There is a poor market of beans in the study area in which most of the farmers sell their produces after harvesting by low price. It is estimated that only 10 % of the farmers can hardly wait for market prices to go up, 30% wait until the buyer is found while 60% sell immediately after harvest due to immediate family cash demands (Kilimo Trust, 2013). In order the market price to be stable, the farmers should organize themselves to form group

networks for seeking market price information and the government should stabilize the price based on demand and supply.

Table 12: challenges facing smallholder farmers bean production.

Challenges	Score (%)	Ranking base
Crop diseases	72	1st
Insect pests	70	2nd
Unreliable rainfall	38.3	3rd
High price of farm inputs	35.8	4th
Unreliable market	23.3	5th
Shortage of land	19.2	6th
Low capital	17.5	7th
Price fluctuation	16.7	8th
Inadequate extension services	10	9th
Poor quality (fake) agrochemicals	3.3	10th

4.5.6 Shortage of land

The results in table 12 show that about 19.2% respondents identified land shortage as one of the constraints of common beans production and it was ranked 6th. Smallholder farmers live in farms which are significantly smaller than 2 hectares and the same land is used for growing multiple crops and raising livestock. Therefore the land is a scarce resource and it inhibits agricultural farming beans inclusive. Moreover, land ownership is a critical problem in agricultural production and is not limited to age or gender. Rodríguez and Creamer (2014) highlighted that a larger proportion of the smallholder farmers in African countries work in family farms and do not possess any title hold to the land and this discourages them from continuing the agricultural or rural work.

4.5.7 Low capital

About 17.5% of respondents in the study area highlighted inadequate capital as a challenge that inhibits beans production. Most of smallholder farmers still use hand hoes

and ox plough for running farm operations, this is due to limited capital in which farmers do not have enough capital to purchase machinery and equipment for increasing production. Availability of adequate capital could enable adoption of a technology in the sense that farmers will be able to purchase improved seeds, fertilizer and agro-chemicals, pay for hired labour and purchase or hire modern farm implements and machines. This constraint was also identified by Kanyama and Damian (2015) where they stated that lack of access to capital impedes investment in important agricultural technologies such as improved seeds, agricultural chemical and irrigation, whereas these are keys to modernization of agriculture.

4.5.8 Price fluctuation

About 16.7% of the respondents identified price fluctuation of beans as one of the challenges facing common bean producers in the study area and it was ranked 8th. This is due to the fact that prices for staple foods rise significantly during the period between harvests. Prices are lowest immediately after harvest and highest in the huger period before the next harvest; the change in price can be quite significant. This is a huge constraint on farmers because they are often forced to sell early in the season when they take a loss rather than later in the season when they would make a profit. This result is in agreement with Venance *et al*. (2016) who reported that small scale farmers production of all grain legumes is still low and far below potential and this has impacted on profitability which makes farmers end up getting the losses as they are exploited by the buyers thus do not reap the profits.

4.5.9 Inadequate extension services

This challenge ranks ninth among the constraints faced by common bean farmers in the study area and it constituted about 10% of the respondents. Inadequate extension services

limit awareness of the availability of improved bean varieties and improved production technology currently available at the research stations. Extension agents play vital roles in disseminating new technologies, practices and information on modern farming techniques to help boost farmers' level of production.

4.5.10 Poor quality of agro-chemicals (fake agricultural chemicals)

About 3.3% respondents responded that fake chemical is among of the constraints in the study area. This is due to the fact that the effectiveness of agricultural chemicals like insecticides, herbicides and fungicides is too low. Due to inability of agrochemicals of not controlling pests and diseases, farmers end up with getting low yield. The government is advised to impose the policies and regulations to prevent the entrance of poor quality of agrochemicals in Tanzania.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study examined the economics of smallholders' common beans production in Mbeya. The conclusions drawn basing on findings to answer the objectives are as follows:

From the present findings it was concluded that common beans production is profitable in the study area. The average gross margin was TZS309 214per acre. This indicates that, common bean farming in Mbeya district is profitable and contributes significantly in creating cash income and employment to small scale farmers in the study area.

Multiple linear regression results further indicated that farm experience, land size, access to credits and household size had significant influence on profitability of common beans implied that these variables would likely influence profitability of common bean farming in the study area.

Moreover, the results of binary logistic regression show that age, household size, land size, access to extension services, off-farm income activities and distance to the nearest market were found to have significant influence on the adoption of improved bean varieties.The present study concludes that provision of adequate extension services and credits to smallholder scale farmers is very significant in creating awareness of the new technology to improve farm productivity.

Furthermore, the main challenges to beans production in the study area were identified and showed that pests and diseases, unreliable rainfall, high price of farm inputs,

unreliable market, low capital, inadequate extension services and poor quality of agrochemicals were the main challenges encountered by farmers.These challenges as reported by farmers make reasons to conclude that they lower the yield, quality and profit of the beans in the study area.

5.2 Recommendations

Extension services should be strengthened so as to expose farmers to modern farming techniques and improved agricultural production technologies. Government and other stakeholders need to also invest in extension service in sensitizing bean farmers in the study areas of new innovations as this have the potential to increase adoption rate as well as farmer's productivity and income.

Small scale farmers should be exposed to and given opportunities to access credits. There is clearly a case for improving current smallholder credit systems to ensure that a wider range of smallholders are able to access credit that will allow them to get the working capital to purchase farm inputs and other farm requirements. This will enable farmers to adopt improved production technologies.

The government and development partners should continue to fund research to develop and produce high quality of improved bean varieties. It is also recommended that policies should be developed to enhance productivity of bean farmers through the provision of seminars and workshops where farmers would acquire more training on improved bean varieties production. This would enable farmers to improve their productivity and hence profitability.

In order the market price to be stable, the farmers should organize themselves to form group networks for seeking market price information and the government should stabilize the price based on demand and supply.

The government should reduce tax on agricultural inputs to ensure that smallholder farmers access and use inputs in affordable price and on right time. Using improved farm inputs will facilitate farmers to adopt technology and able to increase farm productivity and production which will lead to the increase of their farm income and profitability.

From the study it was found that crop pests, diseases and unpredictable rainfall are serious challenges in the study area, it is recommended that farmers should use and grow improved common bean varieties which are resistant to pests and diseases, this will reduce high costs of agrochemicals and seeds.

5.3 Propositionfor the Future Research

This research did not focus on the assessment of the impact of adoption of improved common bean varieties among smallholder farmers, it may also be important forthe future research to evaluate the impact of adoption of improved common bean varieties among bean producers not only in the study area but also in other bean producing regions in Tanzania.

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APPENDIX

Appendix 1: Respondent's Questionnaire

Dear respondent,

This questionnaire will be used by a student of the School of Agricultural Economics and Business Studies, Sokoine University of Agriculture. In this interview schedule there is no wrong or correct answer. What is required is just your opinion on practices you use in beans production. This will assist in formulation of policies, research and extension programs that are appropriate to your area. Your cooperation will be therefore highly appreciated.

NB: The information provided herein will remain strictly confidential.

A. General Information

1. Date of interview…….

2. Name of respondent…….

3. Village name…….

4. Ward……..

5. District……..

6. Phone contacts……

B. Socio- economics factors

B1. Age of the household head (in years)……

B2. Sex of household head……

1= Male,

2= Female

B3. Marital status of household head……

1=Married,

2= Single,

3= Widowed,

4= Divorced,

5=Separated

B4. What is your family size (in number).....

B5. Highest Education level attained

1=Non formal education

2=Primary education

3=Secondary education

4=Tertiary education

B6. What is the total land cultivated under beans (ha)…….

B7. How long have you been in common bean farming (in years)……?

B8. Do you have access to credit? 1. Yes ( ) 2. No ( )

B9. If yes, where did you get the credit? Tick where appropriate

1= Cooperatives 2= Banks

3=. Microfinance 4= Others (Specify)

B10.If

not,why?.....

.....

B 11: Do you have access to extension services as regards common bean production? 1.

Yes ( ) 2.No ( )

B12. If yes, how do you evaluate the relevance of extension services?

1=poor, 2=good, 3=very good.

B13. If not,

why?.....

.....

B14. **Market centres accessible to you**

Distance to nearest market (km)	Mode of transport to the nearest market	Time it takes to get to the nearest market (hrs)
Mode of transport; 1=feet 2= bicycle 3=motorcycle 4=motor vehicle 5=0thers (specify…)		

B15: Apart from income received from beans production, do you have any other farm source of income? 1=Yes, 2 = No

B116: If yes, specify the source (s)

1. Crop produce sales ( ) 2. Livestock/livestock sale products ( ) 3.Others (Specify)……

B17.For what purpose do you use the income from farm activities?

1. To buy Agricultural inputs ( ) 2. To settle debts ( ) 3. Others (Specify)…….

B18. Do you have off-farm activities?

1. Yes □ 2. No □

B19. If yes, for what purpose do you use the income from off-farm activities?

1. To purchase household items □ 2. To purchase farm inputs □ 4. To settle debts □

5. To buy food □ 6.Others (Specify)…….

C: PRODUCTION COSTS AND REVENUES (Last production cycle)

C1: What are the costs of materials used in production of beans per acre?

Material	**Quantity (unit in kg, pieces ,litres, etc)**	**Unit Price (Tshs)**
Seeds		
Land Hire For One Season		
Store Hire		
Fertilizers/ Manure (kg)		
Insecticides (litres)		
Herbicides (litres)		
Bags		
Others(Please specify)		

C2: What are the labour costs for the full season? Take standard unit of an acre/ha

Activity	Family labour				Hired labour			
	No of person	Days spent	Cost per day	Total costs	No of person	Days spent	Cost per day	Total costs
Land Clearance								
1st Ploughing								
2nd Ploughing								
Digging Ridges								
Planting/sowing								
First Weeding								
Second Weeding								
Third Weeding								
Fertilizer application								
Pesticide/herbicide application								
Harvesting								
Threshing								
Washing								
Sorting And Packaging								
Packing in Store								
Transportation								
Others Specify:								
Total								

C3: OUTPUT and REVENUE

Quantity of beans harvested	Price per quantity (Tshs)	Gross income/total value (Tshs.)

Unit = Kg, bags, debe,

D: ADOPTION OF IMPROVED BEANS VARIETIES

D1: Do you grow improved bean varieties?

1. Yes ( ) 2. No ( )

D2: I f yes, give the name of the variety you grow, the area (size of the land) on which each of the varieties you grow is planted, the number of season(s) and the reasons for selecting a particular bean variety.

Name Bean Variety	**Area(size of the land) on which each of the varieties you grow is planted (in acre)**	**Number of season(s) you have been growing the various bean varieties**	**Reasons for selecting a bean variety**
1.			
2.			
3.			
4.			
5.			

Reasons for selecting the improved beans varieties (**Please tick all applicable**).

1. High yield

2. Early maturity

3. Resistance to drought

4. Resistance to diseases and pests

5. Easy to harvest

6. Good taste

7. Others (specify)…….

D4: If you don't use improved bean varieties what are the reasons?

.....

.....

.....

D5: CHALLENGES AND POSSIBLE SOLUTIONS

What are the major challenges you face in bean production? Suggest possible solutions to the challenges in beans production.

Challenges	**Possible solutions**

Thank you for your kind cooperation