DETERMINANTS OF ECONOMIC EFFICIENCY AMONG SMALLHOLDER COMMON BEANS FARMERS IN IGAMBA AND ITAKA DIVISIONS IN MBOZI DISTRICT, SONGWE REGION

EDWARD MBUGI

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.

2020

ABSTRACT

Common beans are the most exported pulses in Tanzania and contributes about 62% of all Tanzanian pulse exports. This crop has significant importance in the growth of the national economy. The average common bean yield in the country which has been recorded at 991 $kgha^{-1}$ is lower than the potential yield of 1500-3000 $Kgha^{-1}$. Using data from 131 randomly selected smallholder common beans farmers from six villages in three wards of Magamba, Bara and Halungu, this study analyzes the determinants of the economic efficiency of smallholder common beans farmers in the study area. Specifically, the study attempts to estimate the levels of technical, allocative, and economic efficiencies among the sampled smallholder common beans farmers in the study area. The stochastic frontier approach was used to estimate the production function, and from a Cobb-Douglas stochastic frontier function and its dual, enables the estimation of the technical, allocative and economic efficiencies. The efficiency determinants were simultaneously assessed along with the frontier functions through the FRONTIER 4.1 software. The results show that common bean production was positively influenced ($P<0.1$) by plot size, quantity of seeds and planting fertilizers. Furthermore, the results show that, farmers' membership to farmer group, education level, experience in farming and household size were found to be negatively and significantly ($P<0.1$) associated to technical inefficiency. Similarly, farmers' membership to farmer group, experience of the farmer, education level and extension services were found to be negatively and significantly ($P<0.1$) related to allocative inefficiency. Results further show that the mean technical, allocative, and economic efficiency indices of smallholder beans farmers are 64.8%, 52.7%, and 43.62%, respectively, meaning that the sampled farmers were relatively technically efficient than they were allocatively and economically, with 56.38% room to expand productivity with current input use and technology. The study concludes that, inputs such as improved seeds and fertilizers which were the major inputs that increase the output of common bean production in the study area should be made available by all stakeholders (government and private sectors) on time, in right amounts and at affordable prices to the farmers. The study recommends that policies should be developed to improve the provision of extension services to the farmers.

DECLARATION

I, **Edward Mbugi**, 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 concurrently submitted at any other institution.

Edward Mbugi	**Date**
(M.Sc. Candidate)	

The above declaration is confirmed by;

Dr. Damas Philip	**Date**
(Supervisor)	

COPYRIGHT

ACKNOWLEDGEMENTS

I am very thankful to God the Almighty who enabled me to carry out this study. He granted me health, strength, courage and perseverance besides walking all along my footsteps to overcome every obstacle in the drive to carry out this study. I would like to express my sincere appreciation and deep gratitude to my esteemed supervisor Dr. Damas Philip, for his excellent suggestions, scientific advice, corrections and comments during write-up of the dissertation. I am very thankful to him for being always ready to guide and provide technical help I needed. I feel privileged to work with him

I feel highly obliged and have immense pleasure in expressing my sincere thanks to the staffs and my fellow students in the Department of Agricultural Economics and Agribusiness (DAEA) of the Sokoine University of Agriculture (SUA) where I registered and pursued my studies. I am also thankful to my employer Agricultural Seed Agency (ASA) who gave me special assistance in making sure that my study is done without any obstruction. And more thanks to all ASA staffs in head office, Mbozi seed farm and Dabaga seed farm for their corporation during study. Special thanks to Levi Charles who during his time as acting Chief Executive Officer (CEO) of our organization granted me the permission to undertake my studies.

My heart thanks are extended to my beloved wife, Mariam John Kibinza who typed this work and my children, Novatus, Beatrice, Careen and Mercy for their patience and perseverance during my stay away from home.

I find myself in short of words to express my warmest thanks to all the people who helped me in conducting field works. Mr. Eliud Musumi, acting farm manager Mbozi Seed farm, Amon Kanyenye, and Adil Laison all deserves my sincere and profound gratitude for helping me in data collection.

Special appreciation is to my co-workers at Dabaga seed farm. The everlasting love, cheerful associations and encouragement received from them is beyond my capacity to express in words.

Appreciation go to my Mother, Father (may God rests him in peace), brothers, and sisters and all other members of my family who prayed for me and also for their constant patience and emotional support. Special thanks are to my sister Violeth A. Mbugi, and my brother-in-law Brown Mwakalinga for encouragement and kind support in pursuing my studies.

DEDICATION

This work is dedicated to my Father, the late Angolile Balilege Malambugi and my mother Tughanigwe Mwakapugi Malambugi who together laid the foundation of my Education. I also dedicate this work to my beloved wife Mariam John Kibinza, my children Novatus, Beatrice, Careen and Mercy who encouraged me and supported me through their prayers during the entire study time.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LISTS OF ABBREVIATIONS

AE	Allocative Efficiency
ASA	Agricultural Seed Agency
CEO	Chief Executive Officer
CIAT	*Centro Internacional de Agricultura Tropical*
CRS	Constant Return to Scale
DAEA	Department of Agricultural Economics and Agribusiness
DAICO	District Agricultural, Irrigation and Cooperative Officer
DEA	Data Envelopment Analysis
EE	Economic Efficiency
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistics
GDP	Gross Domestic Product
MAFC	Ministry of Agriculture, Food security and Cooperative
MLE	Maximum Likelihood Estimation
MOA	Ministry of Agriculture
MT	Metric Tonne
SFA	Stochastic Frontier Analysis
SNAL	Sokoine National Agricultural Library
SUA	Sokoine University of Agriculture
TE	Technical Efficiency
TI	Technical Inefficiency
URT	United Republic of Tanzania
USD	United State Dollar
VRS	Variable Return to Scale

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Common beans (*Phaseolus vulgaris L*) form an important food and cash crop in Africa, particularly in the Eastern, Southern, and Great Lakes regions of the continent. It plays a principal role in the livelihoods of smallholder farmers as food security crop and source of income. It is an important source of dietary protein, calories, dietary fibres and minerals particularly iron and zinc (Binagwa *et al.,* 2016). The crop is included in the daily diets of more than 300 million people worldwide and is a source of proteins and micro-nutrients to over 500 million people in Africa, Latin America and Caribbean (Mwaipopo *et al.,* 2017). It has been estimated to meet 50% of dietary protein requirements of households in Sub-Saharan Africa and constitutes about 50% of the grain legumes consumed worldwide and has been recognized as a crop that can ensure food security, mostly in Sub-Saharan Africa (Namugwanya *et al.,* 2014).

Worldwide common beans production exceeds 23 million Metric tonnes (MT) of which 7 million MT are produced in Africa, and the highest producer globally is India at more than 4 million metric tonnes per year (Reddy *et al.,* 2015). Tanzania rank seventh worldwide in common bean production and is the leading producer in East Africa and largest producer in Africa with more than 950 000 MT. (FAOSTAT, 2017). In Tanzania, it is the leading leguminous crop, accounting for 78% of land under legumes (FAO, 2013). It is estimated that over 75% of rural households in Tanzania depend on common beans for daily subsistence (Binagwa *et al.,* 2018). Common beans in Tanzania are mainly grown in Southern Highland Zone (Mbeya, Ruvuma, Iringa and Rukwa regions), in the Lake Zone (Kagera region) and the Northern Zone (Arusha, Kilimanjaro, Manyara and Tanga regions)

(Larochelle *et al.,* 2017). Common 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 (Karani *et al.,* 2015); (Mpina *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 (Sibiko *et al.,* 2013).

However, the common bean production in Tanzania is low and does not meet the increasing demand of the product outside the country as the country is the major exporter of the common beans in the Eastern African regions (URT, 2016; Kilimo Trust, 2013). The average yield is less than1000 kgha^{-1} which is lower than that found in the developed countries where it reached up to 2904.2 kgha^{-1}. In East African countries, Tanzania is the leading producer of common beans with 1 140 444 tonnes followed by Uganda with 1 024 742 tonnes, Kenya with 846 000 tonnes, Rwanda with 455 822 tonnes, and Burundi with 379 861 tonnes. But in case of productivity in common beans, Uganda is doing better by reaching up to 1618.3 kgha^{-1} followed by Burundi with 1497.1 kgha^{-1} then Tanzania 991 kgha$^{-1,}$ Rwanda with 829.6 kgha^{-1} and Kenya with 716.5 kgha^{-1} (FAOSTAT, 2017).

The government has made much effort in improving beans productivity by using different intervention through their research stations in collaborations with international organizations like CIAT, and others. This collaboration has resulted in the release of more than 20 improved common bean varieties in the country which are being used by farmers (Hillocks *et al.,* 2006). Despite farmers using improved seed in common beans production, productivity level of Tanzania which is 991 kgha^{-1} of the crop showed to fall far below the potential yield which is between 1500-3000 kgha^{-1} as recommended by agricultural researchers (Bucheyeki and Mmbaga, 2013; FAOSTAT, 2017).

1.2 Problem Statement and Justification

In Tanzania among of all pulses produced, common beans are the most exported pulses and contributes 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). This crop has significant importance in the growth of the national economy. Therefore, it is not surprising that, the government of Tanzania has made different interventions on the crop increasing yields.

Despite the great efforts invested by the government through national programmes in collaboration with international organizations, notably the International Center for Tropical Agricultural (CIAT) in boosting efficiency for common bean production in Tanzania, the productivity level of the crop is still far below the potential yield (Letaa *et al.*, 2015). The average common bean yield in the Country has been recorded as 991 kgha^{-1}, (FAOSTAT 2017) while yield of 1500-3000 Kgha^{-1} can be realized by using improved varieties and good crop husbandry practices (Bucheyeki and Mmbaga, 2013; Binagwa *et al.*, 2018). Abdulai *et al.* (2017) argued that, agricultural crop production is largely dependent on farmer's efficiency which is also a function of the socio-economic indicators and farm characteristics.

Many Previous efficiency studies in Tanzania have looked mainly at technical efficiency (Msuya and Ashimogo, 2005; Baha *et al*., 2013; Rajendran *et al*., 2013; Kidane and Ngeh, 2015; Mlote *et al*., 2013; Sesabo and Tol, 2007). Technical efficiency derives from agronomic view and it is possible that the farmer could achieve this kind of efficiency, though at a much higher cost. An economic view, on the other hand, considers the use of inputs in optimal quantities while keeping their cost in proportion to the price the farmer receives for the outputs. For that case examination of the factors that affect overall economic efficiency become very important. This study was built on the previous studies by examining the levels and determinants of overall economic efficiency among smallholder common beans farmers in Igamba and Itaka Divisions in Mbozi District.

1.3 Overall Objective

The broad objective of this study is to establish the determinants of technical, allocative and economic efficiency among smallholder common beans farmers and the challenges they encounter in their daily activities in Igamba and Itaka Divisions in Mbozi District.

1.3.1 The specific objectives

The specific objectives of this study include:

1. To estimate the levels of technical, allocative and economic efficiency among smallholder common beans farmers in the study area.
2. To analyse the socio-economic factors influencing technical, allocative and economic efficiency among common bean farmers in the study area.
3. To determine the challenges facing smallholder common beans farmers in the study area.

1.3.2 Hypothesis

1. Socio-economic factors have no significant influence on technical, allocative and economic efficiency among common beans farmers in the study area.

1.3.3 Research questions

1. What are the levels of TE, AE and EE of smallholder common bean farmers in the study area?
2. What are the challenges facing smallholder common beans farmers in the study area?

1.4 Organisation of the Study

This dissertation is organised into five chapters. Chapter one presents background information, an overview of the research problem and justification, objectives of the study and hypotheses; Chapter two presents literature review, whereas chapter three describes the methodology adopted. The findings and discussion are presented in chapter four. Chapter five concludes the study and gives recommendations according to the findings.

CHAPTER TWO

2.0 LITERATURE RIVIEW

2.1 Theoretical Literature

2.1.1 The concept of efficiency

In microeconomic theory, a production function is viewed as a technical relationship which describes conversion of inputs into output (Battese and Coelli, 1992). It is also defined in terms of maximum output that is attainable from a given set of inputs. Maximum output achievable in a production process is what gives rise to certain concerns in economic theory which includes efficiency with which economic agents produce such outputs. To measure this efficiency, a production frontier function is derived which depicts the maximum output as a function of input set. In the same line of economic view, a cost frontier function describes the minimum cost as a function of input prices and output (Coelli, *et al*., 2005). The term efficiency therefore becomes a relative measure of a firm's ability to utilise inputs in a production process in comparison with other firms in the same industry. It is relative in the logic that comparisons of efficiency scores are made relative to the best performing firm in the same industry. Similar assertions can be made with regard to cost efficiency. In economic theory, production efficiency comprises technical and allocative efficiencies, with technical efficiency reflecting the ability of a firm to maximize output for a given set of resource inputs while allocative (factor price) efficiency reflects the ability of the firm to use the inputs in optimal proportions given their respective prices and production technology (Farrell, 1957). Efficiency is achieved either by maximizing output from given resources or by minimizing the resources required for producing a given output (Varian *et al.*, 1992).

2.1.2 Theoretical framework for measuring efficiency

One of the assumptions of the neoclassical economics is that firms are fully efficient in the production process (Kabwe, 2012). The neoclassical economists assume that all firms are fully efficient in resource use in any production process and regardless of the sector they operate in. However, efficiency studies have shown that contrary to the neoclassical view which assumes every firm to be fully efficient two or more indistinguishable firms cannot possibly produce the equivalent output since their quantity produced, expenses and revenue are different (Kumbhakar *et al.*, 2006). A rational producer, producing a single output from a number of inputs, $x = x_1 \ldots\ldots x_n$, that are purchased at given input prices, $p = p_1 \ldots.. p_n$ is thought to be efficient if operating on a production frontier. But if the producer is using a combination of inputs in such a way that it fails to maximize output or can use less inputs to attain the same output, then the producer is not economically efficient. A given combination of input and output is therefore economically efficient if it is both technically and allocativelly efficient.

Figure 1 is a diagrammatic exposition with a simple example of firms using two inputs land and labour to produce common beans. Firms producing along AB are said to be technically efficient because they are operating on the “efficiency frontier” or the isoquant, although they represent different combinations of land and labour inputs, used in producing output Q. This is the least cost combination of inputs. In addition, DD' is an iso-cost line, which represents all combinations of inputs land and labour, such that input costs sum to the same total cost of production, given the firm’s budget. However, any firm intending to maximize profits has to produce at X', which is a point of tangency and representing the least cost combination of land and labour in production of Q metric tonnes of beans. Therefore, at point X' the producer is economically efficient.

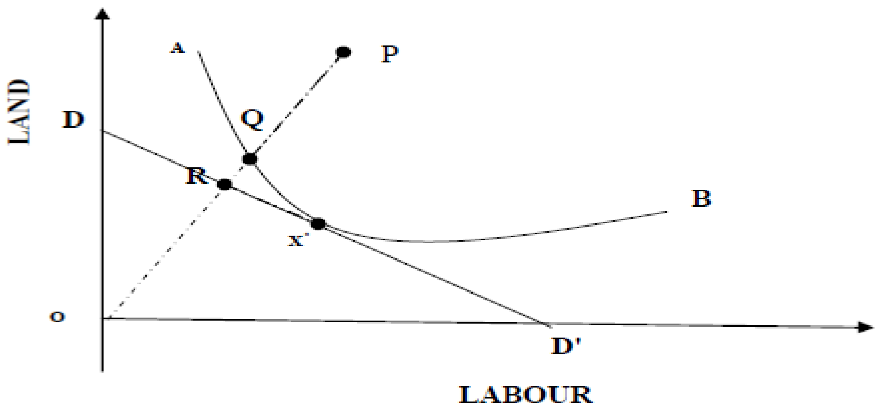


Figure 1: Technical, allocative and economic efficiency diagram

Source: Hyuha et al. **(2007)**

To illustrate the measurement of technical, allocative and economic efficiency, we suppose a bean producing farmer whose output is depicted by isoquant AB, with input (land and labour) combination levels as in Figure 1. At point (P) of input combination, the production is not technically efficient because the farmer can instead produce at Q (or any point on AB) with fewer inputs. The degree of technical efficiency of such a firm is given as TE= OQ/OP. For a fully efficient firm, TE = 1 but for all inefficient firms, a degree of TE < 1 is achieved. The difference between the estimated TE and 1 (or TEi-1) depicts the proportion by which the firm should reduce the ratios of both inputs used to efficiently produce a metric ton of beans (Gelan and Muriithi, 2010). The distance QP measured the technical inefficiency of P which is the amount by which the firm's inputs can be proportionally reduced without reducing output.

However, TE does not take into account relative costs of inputs. In Figure 1, DD' represent input price ratio or the iso-cost line, which gives the minimum expenditure for which a firm intending to maximize profit should adopt. The same firm using land and labour to produce beans at P would be allocatively inefficient compared to that producing at R. And its level of allocative efficiency is given by OR/OQ. The distance RQ represent the reduction in production cost that would occur at allocative and technically efficient point X' instead of at technically efficient but allocative inefficient point Q. The product of technical and allocative efficiency provide the overall economic efficiency $TE_i x AE_i = OQ/OP x OR/OQ = OR/OP = EE_i$. Therefore at point X' which is the point of tangency of iso-cost and isoquant represent the least cost combination of inputs (land and Labour) in the production of common beans, in other words, is where the marginal rate of substitution is equal to the price ratio P_2/P_1.

2.2 Empirical Literature

2.2.1 Empirical studies on efficiency and productivity

Efficiency is the act of achieving good result with little waste of effort. Efficiency measurement is very important because it is a factor for productivity growth (Abdulai and Huffman, 2000).Technical efficiency is defined as the ability of producers to maximize output for a given set of resources (Onubuogu *et al.,* 2014). According to Mwajombe and Mlozi (2015) efficiency in farm production can be defined as a way to ensure that products are produced in the best and most profitable way using a minimum quantity of inputs under a given technology. Adeoye *et al.* (2014) explained efficiency with which producers use resources and technologies is important because low productivity is the major problem impeding farmers' success. Zamanian (2013) conducted a study on same and concluded that an increase in agricultural productivity and also the technical efficiency of agriculture is a very important political goal in most countries. This phenomenon results from the fact that these are some of the major sources of the overall economic growth.

Etwire *et al*. (2013) analyzes the level and determinants of technical efficiency of soybean farms in the Saboba and Chereponi districts of northern Ghana. Using stochastic Frontier Approach the results showed a mean technical efficiency estimate of 53% and return to scale is 0.75. Also the study revealed that farm size and other input are the significant determinants of soybean production in the Saboba and Chereponi districts of northern Ghana.

The study conducted by Mailena *et al*. (2014) on efficiency and determinants of efficiency using the SF analysis on rice farms in Malaysia, revealed that out of five inputs (land, seed, fertilizer, pesticides and labour) only land, seed and chemicals significantly influence the rice farm efficiency, also the study revealed that the farmer access to credit and their education level were important determinants upon the rice farm technical efficiency.

Chiona *et al*. (2014) estimated the technical efficiency of maize producers in Zambia using Stochastic Frontier Analysis (SFA). His findings showed the average technical efficiency was at 50%, with a minimum of 2% and a maximum of 84%. The distribution of the technical efficiency was such that 14% of the farmers have efficiency scores that are less than 30% while 46% of the farmers have technical scores above 50% and 14% have technical efficiency scores above 70%. Further, the research results showed that the age of a farmer, use of certified hybrid seed, access to loans, and extension advice and off-farm income influence technical efficiency of maize producers in Zambia.

Aneani *et al*. (2011) conducted a study on analysis of economic efficiency in cocoa production in Ghana using SF analysis. From this study, the results indicated that household size, farm size insecticides and fertilizer were found to have statistically significant impact on Cocoa output. The findings also showed that, the sum of elasticities of the factors included in the Cobb-Douglas production function was 1.463, which was more than one, implying that the cocoa farmers were operating in the increasing returns to scale.

Abdulai *et al.* (2017) did a study using stochastic frontier model to examine the technical, allocative and economic efficiency of maize production in northern Ghana using cross-sectional. His study revealed that inputs such as farm size, seed, fertilizer, labour and weedicides were statistically significant and had positive effects on maize output using the Cobb-Douglas functional form. The results from this study further showed that, the determinants of technical inefficiency were experience, agricultural extension service and gender. The study more showed that, the farmers with many years of experience and who had access to agricultural extension services were more technically efficient in maize production.

In addition a study conducted in Ghana on maize productivity and technical efficiency (Kuwornu *et al.* (2013) showed that there were over-utilization in some factors of production like family labour, seed and fertilizer while other inputs like agro-chemicals and credits access were under-utilized. Results revealed a mean efficiency of 0.71 implying that output from maize production could be increased by 29 percent using available technology. Results further revealed land, labour, inorganic fertilizer and planting materials were found to have positive and significant influence on technical efficiency. Mahjoor (2013), conducted a study TE, AE and EE of boiler farms in far province, Iran using a Data Envelopment Analysis approach (DEA) method and found that, under Constant Return to Scale (CRS) and Variable Returns to Scale (VRS) specification, on average, the farms technical, allocative and economic efficiencies were 82, 70, 57 percent and 82, 73, 64% respectively. The findings also showed that, education, age of farmer, training and being member of broiler producers cooperatives were statistically significant factors associated with technical, allocative and economic inefficiency.

2.2.2 Empirical studies on influence of socio–economic factors in productivity

Socio economic characteristics play a key role in decision making in many aspects of life. In farming activities as well farmers’ decision on resource use are influenced by the socio economic characteristics such as age, gender, level of education, farming experience and occupation (Kintché, 2017; Obayelu, 2016). According to a study by Lwayo *et al.* (2003) on how the socio economic factors affect farmer' decision to adopt farm forestry, his study result showed a positive relationship between age and decision to adopt farm forestry. It indicated that age influences the farmer's decision to adopt. The study further showed a positive relationship between adoption of farmer and education. The results showed that formal education is a vital aspect in farmer's decision to adoption.

Mburu *et al.* (2014) estimated the levels of technical, allocative, and economic efficiencies among the large and small scale wheat producers in Nakuru District using SF analysis. The results from his study indicate that the mean technical, allocative, and economic efficiency indices of small scale wheat farmers are 85%, 96%, and 84%, respectively. The corresponding figures for the large scale farmers are 91%, 94%, and 88%, respectively. The number of years of school a farmer has had in formal education, distance to extension advice, and farmer groups have strong influence on the efficiency levels.

Asongwa *et al.* (2011), analysed the economic efficiency of Nigerian small scale farmers using the parametric frontier approach. The study revealed that, the average level of technical, allocative and economic efficiency was estimated at 30%, 12% and 36% respectively. The study showed that technical inefficiency was higher than allocative inefficiency. The study also showed high level of technical inefficiency was highly attributable to the low availability of extension services and information about technical aspects of crop technologies. On the other hand, high level of cost inefficiency was highly attributable to the low profitability that results from inadequate organization of farmers into collective farmers' institutions that can provide opportunities for risk sharing and improved bargaining power.

Sibiko *et al.* (2013) assessed the factors influencing economic efficiency among beans farmers in eastern Uganda by applying a stochastic frontier cost function and a two-limit Tobit regression mode. Findings showed that bean efficiency was significantly influenced by plot-size, seeds and planting fertilizer; mean technical efficiency for sampled farms found to be 48.2%. The Tobit model estimation revealed that technical efficiency was positively influenced by value of assets (at 1% level), extension service and group membership (at 5% level); while age and distance to the factor market negatively influenced technical efficiency at 10 and 5% levels respectively.

2.2.3 Challenges facing smallholder farmers in beans production

Beans farmers in Tanzania faces a number of challenges on their activities of farming including poor quality of seeds, bad weather, poor capital, poor yields, pests and diseases, poor agricultural equipment, lack of knowledge on climate change, , 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). Despite all these there is a need in my study to examine to what extent each of these challenges had affected the smallholder common beans farmers in the study area.

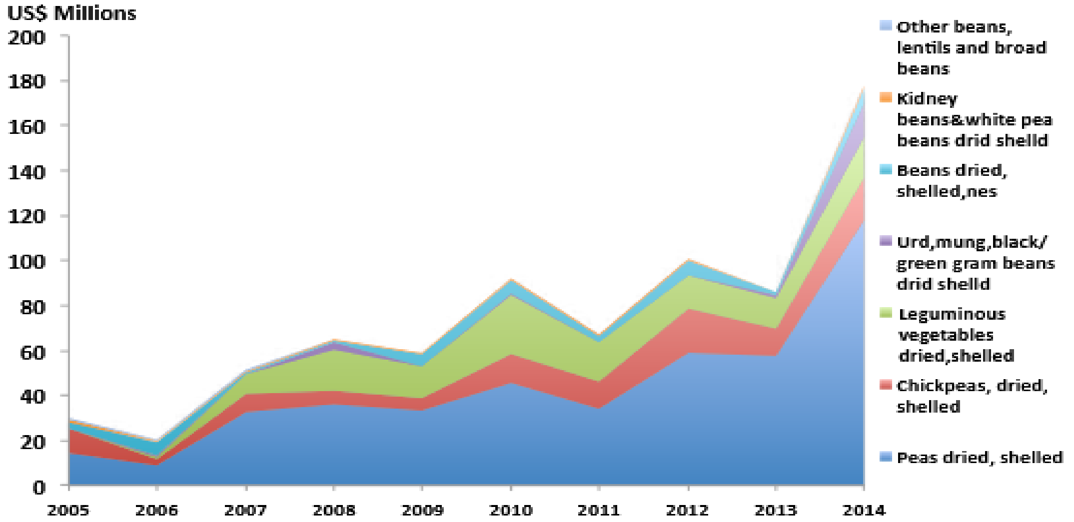
However, Rodriguez and Creamer (2014) indicated that diseases were the principal constraint of common bean production, pests are the second principal constraint; followed by market constraints, such as: access to and the high cost of inputs; the low prices received by farmers, the appropriation of a 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 on production trends of food crops, opportunities, challenges and prospects to improved Tanzania rural livelihoods 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.

2.4 Situation of common Bean Production in Tanzania

In Tanzania Agriculture is an important economic sector of the Tanzanian Economy and contribute about 29.1 percent of Gross Domestic Product (GDP) (URT, 2016). It is the major source of food, employment, raw materials for industries and foreign exchange earnings. Since Tanzania is endowed with a diversity of climatic and geographical zones, farmers grow a wide variety of annual and permanent crops, common beans being one of them.

Common beans account for 71% of leguminous protein in diet and 75% of areas under legumes (Binagwa *et al*., 2016). Approximately 95% of the farmers are smallholders with less than 5 ha dedicated to common beans production (URT, 2016). Over 75% of rural household in Tanzania depend on beans for daily subsistence (Xavery *et al.,* 2006). Per capital common bean consumption is 19.3kg contributing 16.9% protein and 7.3% calorie in human nutrition. In addition to internal common beans consumption, Tanzania supplies/ export to more than 10 countries. On average, Tanzania exports about 11 105 MT annually of common beans fetching the nation about USD 5 706 000 (Kilimo Trust, 2013). Figure 2 shows pulses exports trends from 2005 to 2014.



Year

Figure 2: Tanzanian exports of pulses, 2005–2014

Source: URT (2016)

In season 2016/17 common beans was amongst pulse crops produced in the country with a total of 1 945 607 operators of which 1 945 229 (99.9 percent) was in Mainland and 378 (0.1 percent) was in Zanzibar. The total planted area with beans was 732 531 ha of which 732 495 ha (99.9 percent) in Mainland and 37 ha (0.1 percent) in Zanzibar (URT, 2016).

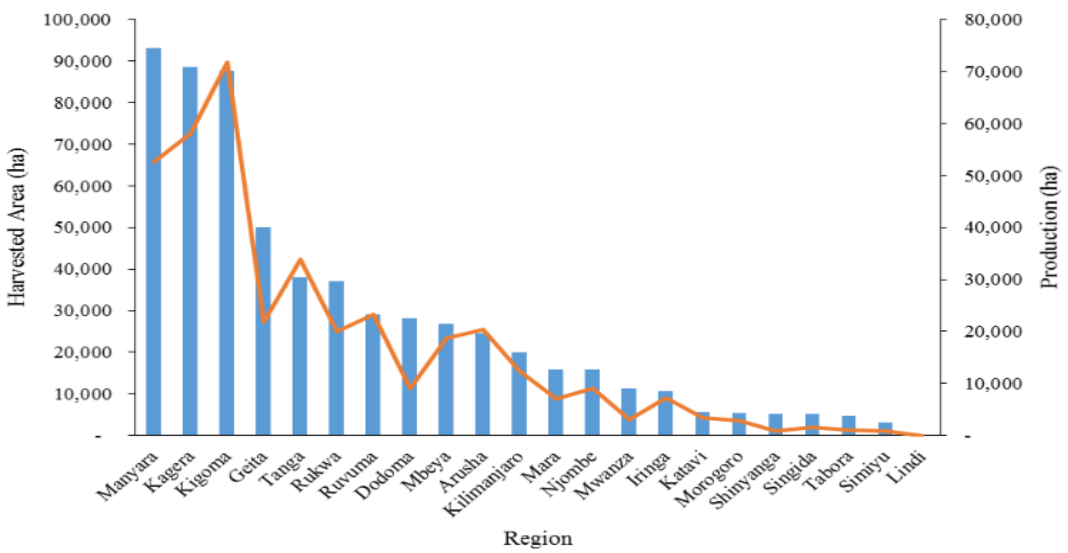


Figure 3: Harvested Area (ha) and Production (tons) of common beans by Region in Tanzania 2016/17

Source: URT (2016)

Tanzania ranks 7th worldwide in bean production and is the leading producer of beans in Africa. Common beans in Tanzania are produced almost entirely under intercropped systems with maize and other crops (FAOSTAT, 2014). In addition to internal bean consumption, Tanzania supplies/export to more than 10 countries in the Eastern countries regional. From 2011 the production and demand of common beans in Tanzania have shown to grow steadily (Figure 4). This is the evidence that, this crop play vital role in the livelihood of the majority of the household in Tanzania.

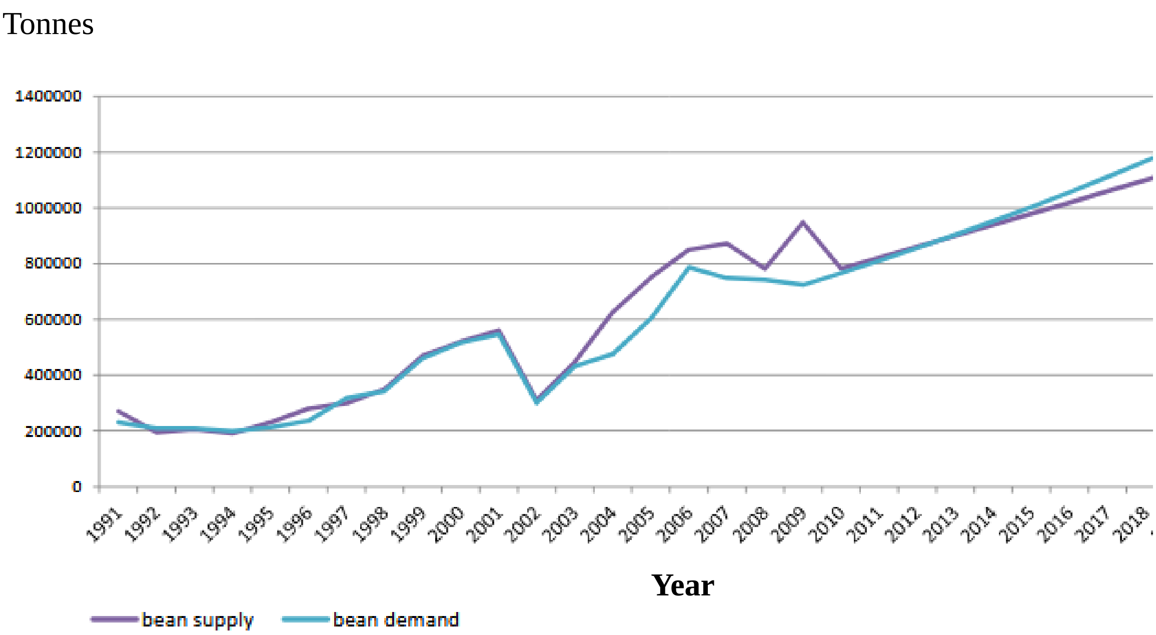


Figure 4: Trend in common beans production and demand (MT) in Tanzania

Source: Computed from FAOSTAT (2018)

Table 1: Some of Improved common bean varieties grown in Tanzania

Bean varieties	Grain Yield	Reasons for growing the variety
Uyole njano	2.0- 3.0 t/ha.	Early maturity, high yield, marketable, liked for consumption
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 and 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
BilfaUyole	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	Resistant to disease, good market, pleasant colour, medium Maturity
Selian 14	> 2t/ha	Resistant to Anthracnose and common beans virus, fast to Cook, high iron minerals, high yields
Selian 15	> 2 t/ha	Resistant to Anthracnose and bacterial blight, fast to cook, High yields
Selian 13	>1.2 t/ha	High yields, drought resistant, mature fast, good colour, liked for consumption.
Selian 12	> 1.2 t/ha	Mature fast, high yield, liked for market and consumption, Resistant to diseases, fast to cook.
Selian 09	> 1.5 t/ha	High yields, tolerant to diseases, fast to cook, drought tolerant
Selian 10	> 1.5 t/ha	High yields, liked for consumption and market, resistance for pest and diseases
Selian 11	> 1.5 t/ha	High yields, good market, fast to cook, early 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: MoA (2018)

2.5 Conceptual Framework

A production process involves the transformation of inputs into outputs. In crop production, technical inputs such as seeds, land, labour, manure and fertilizer are combined to produce the crop. The transformation process depends not only on the levels of inputs used, but also on the management practices that influence the way farmers use to combine these inputs. Management practices used in production represent an amalgam of knowledge and skills that the farmer has or acquires overtime and characteristics of the farm. The technical inputs and the management practices jointly determine the quantity and quality of output produced. Also there are other factors which determine the level output like education of the producer, age, experience, which are collectively termed as socio-economic factors (characteristics of the farmer). In addition to that also we have external factors which also contribute in large in farmers' efficiency in production of common beans; these factors are like, weather condition, government policies and infrastructure. The common beans production process is summarized in Figure 5.

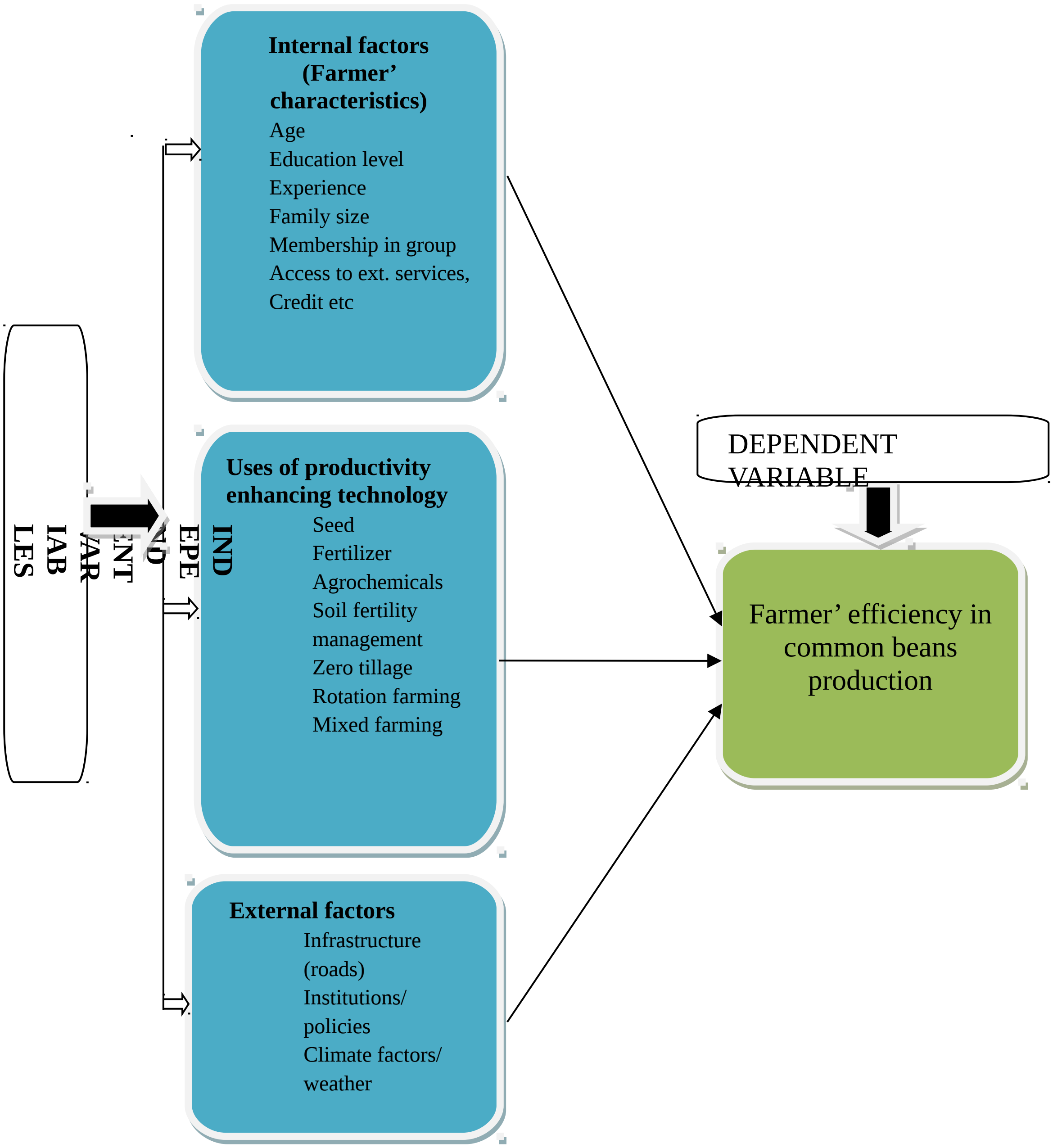


Figure 5: Conceptual frame work

Source: Adapted from Abawiera and Dadson (2016)

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

This study was conducted in Mbozi District-Songwe region. The District lies between latitude 8º and 9'South of Equator and longitudes 32º 7' and 33º 2' East of Greenwich Meridian. It is bordered to the north by Songwe District, to the east by Mbeya Urban, to the south by Ileje District and to the west by Momba District. Its total area is 3404 km^2. The district is selected due to its high potential for producing common beans.

3.1.1 Demographic data

According to URT (2012) the district has 446 339 people, with 213 217 males and 233 122 females.; population growth is 4.1%; population density is 34 persons per square Km; Average family size 4.3 and Sex Ratio of 91:100.

3.1.2 Main economic activities

The main economic activities in Mbozi District is agriculture, practicing crop production and livestock keeping. Over 80% of people in Mbozi District depend on agriculture. A variety of crops grown in the district including common beans, maize, rice, millet, sorghum, yams, bananas, sunflower, cashew nuts, avocado, mangoes etcetera. Besides food crops, the main cash crops are Coffee and sesame. Some of the food crops are also used as cash crops like maize and beans. The district has 766 640 Ha suitable for agriculture in cultivation of cash and food crops.

Figure 6: A Map of Mbozi District showing the study areas

Source: District Executive Director's Office-Mbozi District (2017)

3.2 Data Required and their Sources

Both quantitative and qualitative primary data were collected from sampled bean producers' households in Mbozi District. Data were collected from two divisions of Igamba, Itaka in which three wards and six villages were involved. These villages and their respective wards were Iwalanje and Iganya from Magamba ward, Hangomba and Iporoto from Bara ward, and Isenzanya and Hampangala from Halungu ward. The key variables for which primary and secondary data were collected are; yield of beans, socio-economic variables, labour, fertilizer, agro chemicals, quantity of seeds, access to credit and access to extension services. Secondary data were collected from various sources like Mbozi District Council reports, division office reports, ward office reports, village government reports and through other publications and office reports.

3.3 Research Design

A cross sectional research design was used where data were collected at a single point in time. This method is flexible, economical and easy to handle data and information. The design allows a clear definition of the situation and estimations of survey statistics such as means, measures of variability, proportions and determinations of the relationship existing between productivity and economic efficiency through regression model (Bryman, 2016).

3.4 Sampling

The study was undertaken in Mbozi District and two stage sampling design was employed for the identification of the subject to be included in the sample. From the two divisions which were purposively chosen out of 4 divisions as a study area; at first stage, three wards were selected purposively due to their importance as the major beans growing areas as per District Agriculture, Irrigation and Cooperatives Officer (DAICO). Secondly, simple random sampling design was employed to select six villages, of which two villages were drawn from each ward. Furthermore, the sample size of smallholder common beans producers was calculated using Cochran equation which is $n = Z^2pq/e^2$, where by n = sample size; Z^2 = Abscissa of the normal curve that cuts off an area α at the tail (s); P = is the estimated proportion of an attribute that is present in the population; 1-α = the desired confidence level; e = is the desired level of precision and q = 1-p. For social science research, 5% level of precision is recommended. However, if there is resource limitation more than 5% level of precision can be used (Naing *et al*., 2006). Therefore the current study suggested Z =1.96, p = 0.5, e = 8.3% and q = 0.5 with an assumption of homogeneous population. The study came up with the sample size of 131 smallholder common beans farmers in Igamba and Itaka divisions.

Table 2: Sampling of divisions, wards, villages and farmers

Divisions	Wards	Villages	Households
Igamba	Magamba	Iwalanje	23
		Iganya	23
	Bara	Iporoto	24
		Hangomba	21
Itaka	Halungu	Isenzanya	20
		Hampangala	20
Total			**131**

3.5 Data collection methods and implementation

3.5.1 Primary data

A structured questionnaire was developed based on data required for assessing the determinants of economic efficiency among smallholder common beans farmers in the study area. The questionnaire was designed to capture data from sampled beans farmers in the study area. The questionnaire contained both close-ended and open-ended questions on farm household characteristics, beans production data, labour, fertilizer and other input data, micro credit and extension services. The Researcher administered questionnaire to farmers by means of interviews with the help of three enumerators. On administration of questionnaire, the researcher together with enumerators managed to visit the farmer's household home.

3.5.2 Secondary data

Secondary data were collected from various reports on beans growing records and references (documentary sources) from Mbozi District, Sokoine National Agricultural

Library (SNAL), Ministry of Agriculture (MoA), research reports, journals and other sources were also used. Most of the data used were that of beans production, and uses of agrochemicals, fertilizers, improved seeds and agronomic practice on beans crop.

3.6 Variable Description

This part describes the main variables which were used in the analysis. The means and standard deviations of output and input variables used in the analysis are given. Land, labour, fertilizer, agrochemicals and seed are the inputs which smallholder mainly use in crop production.

In the SF model, OUTPUT refers to the quantity of common beans produced by each household for the last agriculture season measured in kilograms. The LAND input refers to the area which was cultivated for common beans production by each smallholder household for the last agricultural season measured in hectares. LABOUR was estimated as a summation of both household and hired labour measured in man-days. FERTILISER was the amount of inorganic fertilizer which was applied per hectare of land cultivated by each household for common beans during the period under study. Amount of fertilizer applied was measured in kilograms. Fertilizer applied by each farm household was assumed to be the quantity that each farmer purchased during the season under study. SEED refers to the quantity, in kilograms, of improved common bean seed which each household planted per hectare of land during the last agriculture season. AGROCHEMICALS refer to the amount of pesticides and herbicides applied per hectare by each household for common beans production during the period under study. The amount of agrochemicals was measured in litres. Normally common beans farmers apply Glyphosate (commonly known as Round up) before and after ploughing to kill all types of glasses and Beans clean or SATECA as post emergence herbicides. Also common beans farmers use Duduba or Karate as pesticides. All these Agrochemicals were measured in litres.

In addition to these, other variables which were used in the regression as the determinants of efficiency were also described. These include respondents‟ EDUCATION LEVEL (1= no formal education, 2= Adult education, 3= Primary education, 4= secondary education 5= university), YEARS IN FARM, ACCESS TO EXTENSION (an indication of whether households received any visits from agriculture extension officers during the period under study), ACCESS TO CREDIT SERVICES (indicating whether households access credit for farming or not) and FARMER GROUPS (indicating whether the farmer belongs in farmer groups)

3.7 Analytical Framework for Measuring of Economic Efficiency (EE)

The economic theory of production provides the analytical frame work for most empirical research on efficiency (Debertin, 1986). The fundamental idea underlying the measurement of economic efficiency (EE) is that attaining maximum possible output from a set of inputs at a minimum cost. Both technical and allocative efficiencies were determined to obtain the Economic efficiency (EE).

Thus, EE = TE * AE

To obtain the parametric measure of efficiency, a functional form for the stochastic production frontier was chosen. Preferably, the functional form should be computationally straightforward and provide a fairly good approximation of production process. To satisfy these properties, most empirical studies use the Cobb-Douglas production function. Stochastic function that used in this study attributes part of inefficiencies to external factors. They are suitable in analyzing the role of measurable socio-economic factors in observed differences in efficiency score (Coelli, 1996). This was important in this study because efficiency gains were estimated taking into consideration all possible relationships. This was done using Maximum Likelihood Estimation (MLE) procedure available in FRONTIER 4.1 statistical package (Coelli, 1996).

3.8 Empirical Model Specification

3.8.1 Estimation of TE, AE and EE

The parametric frontier approach is chosen because of the many variations that underlie small scale production in developing countries. The stochastic frontier attributes part of the deviation to random errors (reflecting measurement errors and statistical noise) and farm specific inefficiency (Forsund *et al.,* 1980; Battese and Coelli, 1995; Coelli *et al.,* 1998). Thus, the stochastic frontier decomposes the error term into a two-sided random error that captures the inefficiency component and the effects of factors beyond the control of the farmer. The stochastic frontier production function is given as;

$Q_f = g\ (X_{tf}\beta)$, ... (1)

where Q_f is the total output of the f^{th} farm (household) obtained by $farmer_{i;}$ using input from a set of different but complementary inputs denoted X_{tf}, such as land, labour, fertilizer, seeds, agrochemicals. β denotes the vector of parameters to be estimated. From equation (1), it is possible to derive technically efficient output level Q for any given level of inputs by solving equation (1) substituting the X_{tf} with the technically efficient input quantities.

Next, if we assume that the production frontier given in equation (1) is self-dual the corresponding cost frontier can be given as:

$K = h(P,Q;\ \gamma)$ .... (2)

where K is the minimum cost to produce output level Q, with P denoting the vector of input prices, h is the function form, and to this case it is a Cob Douglas function form and γ a vector of the parameters to be estimated (unknowns). From this, the system of minimum cost input demand equations can be recovered by differentiating the equation in (2), which is referred to as the cost frontier, with respect to each by applying Shephard's lemma. This may be given as:

$\partial K/\partial P_t = X_{tf} = l\ (P, Q, \theta)$, ... (3)

whereθ denotes the vector of unknown parameters. If we substitute the input prices and the technically efficient output level Q into equation (3), we can obtain economically efficient input quantities X_e . Given these technically and economically efficient input bundles, it is now possible to calculate the actual cost of these observed input levels by their respective prices as $X_t.P_t$ in the case of technical efficiency(TE) and $X_e.P_e$ in the case of economic efficiency(EE). From these, we can easily deduce that:

$TE = X_t.P_t / \Sigma(X_t.P_t)$ .... (4)

$EE = X_t.P_t / \Sigma(X_e.P_e)$ .... (5)

As given by Farrell (1957) and Bravo-Ureta and Pinheiro (1997), economic efficiency is the product of technical efficiency (TE) and allocative efficiency (AE). Hence, by definition, it is possible to compute AE using equations (4) and (5) as:

$AE = EE/TE = X_t.P_t / \Sigma(X_e.P_e) / X_t.P_t / \Sigma(X_t.P_t)$ .... (6)

3.8.2 Empirical stochastic frontier model

To obtain a parametric measure of efficiency, a function form for stochastic production function were chosen and for this study Cobb-Douglas production function was used due to its advantage of being computationally straightforward and provide a fairly good approximation of production process. Following Seyoum *et al*. (1998), the Cobb-Douglas function form can be estimated as a linear relationship using the following expression:

ln Yi = βo + βijlnXij + Vi – Ui………………………...(7)

Where Yi is the total crop output obtained by the farm household, Xij are inputs, βo….βij are parameters to be estimated, Vi is a two-sided random error and assumed to be identically and independently distributed and Ui are non-negative random variables assumed to account for technical inefficiency in production.

Estimates for cost frontier was done by estimating a stochastic cost frontier where natural log of total cost K is regressed against the natural log of output and natural log of specific prices (land, seed, hired labour, fertilizer, chemicals). Mathematically expressed as:

lnK=βo+lnYi+βijlnHij + Vi+Ui…………………….…………...……..………………(8)

Where K is the total cost of crop production, Y_i is the output of common beans, $H_i \ldots H_j$ is the inputs unit prices (land, seed, labour, fertilizer and chemicals). We then specify the one-sided technical efficiency effect as being related to the exogenous factors, z that influences common beans production:

U_i = f (z) + ε .... (9)

Where *z* is a vector of determinants of economic efficiency and ε is the error assumed to be iid (independent and identically distributed). The determinants are specified as household socioeconomic characteristics and some selected institutional variables that are known to influence farm-level efficiency.

Therefore objective two is completed by specification of inefficiency model which involves regressing the inefficiency component (U_i) to the farm social-economic characteristics. Equation (9) is empirically specified as follows:

$U_i = \delta_0 + \delta_1 Farm\ Grp_i + \delta_2 HHsz_i + \delta_3 Exp_i + \delta_4 Educ_i + \delta_5 CredAcc_i + \delta_6 ExtAcc_i$………(10)

Where u_i = as defined before; δ_b, b = 0,1,2,…6 are parameters to be estimated; $FarmGrp_i$= Membership of the i[th] Farmer in farmer association(1= if a farmer is a member, 2= if a farmer is not a member); $HHsz_i$ = size of the family of the i[th] farmer (number of persons); Exp_i = experience of thei[th] farmer in years; $Educ_i$ = education level of the i[th] farmer (1= no formal education, 2 = adult education, 3 = Primary, 4= secondary, 5= university); $CredAcc_i$ = Access to credit by the i[th]farmer (1 = if farmer accessed to credit, 0 = no access to credit); $ExtAcc_i$ = Access to Extension for the i[th] farmer (1= if the farmer accessed extension, 1 = no Access to extension).From equation (10), parameters for the inefficiency model were derived.

It is important to note that equations (7), and (10) for the case of frontier production or (8), and (10) for the case of frontier cost are usually estimated simultaneously using MLE procedures with FRONTIER 4.1 software.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Descriptive Results

4.1.1 Gender of the household head

As tabulated in Table 3, the results show that about 56.5% of sampled common beans farmers' households were female headed with male headed household comprising about 43.5%. This is not surprising as due to traditions, norms and customs in most of the ethnics in Tanzania, females are more engaged with production of common beans compared to men. This has an implication on efficiency and production of common beans in the study areas. So in the study area large proportion of female headed households was engaged in common beans production. The results are consistent with those reported by Nakazi *et al.* (2017), whose study was about participation of men and women in common beans production in Uganda. Their study results showed that common beans crop was mainly owned by women.

Table 3: Distribution of respondents by sex of the household head

Sex	Number of farmers	Percent
Female	74	56.5
Male	57	43.5
Total	**131**	**100.0**

4.1.2 Marital status of the household head

The results on the marital status of the household head as indicated in Table 4 show that most (62.6%) of the household head in Igamba and Itaka divisions were married which is above the national average of 57% (URT, 2012). The results further show that, widowed household heads in the study area accounts for about 9.9% of the common beans farmers which is also above the national average of 2% according to the National Census (URT,

2012) and separated household heads in Igamba and Itaka division accounts for about 10.7 of the common beans farmers. This is twice as much to that of National average of 4.3% (URT, 2012). The high percentage of the married household head implies that, community in Itaka and Igamba division is stable which is good for the production activities.

Table 4: Marital status of the household head

Marital status	Number of farmers	Percent
Single	22	16.8
Married	82	62.6
Separated	14	10.7
Widow	13	9.9
Total	**131**	**100.0**

4.1.3 Education of the head of the household

The current study also assessed education of the farmers of common beans. Education develops knowledge and skills that help the farmer make good decision making pertaining management in production process. Therefore, it is believed that household head with many years of formal education will lead to better management of agronomic practices hence high efficiency in production. The results of this assessment as presented in Table 5 show that about 20.6% of the households' head reported to have no formal education. 6.9% of the households' reported to have adult education, 36.6% have primary education, 28.2% have secondary education and 10% have university education. From Table 5 it shows that 72.4% have formal education and this is little above the national literacy level which is 71.53% (URT, 2012). Furthermore, the Table 5 shows that those who reported to have attained formal education completed more than seven years of schooling. The results therefore, imply that Igamba and Itaka division community in Mbozi District have farmers who can be trained easily since most of them attained the basic education.

Table 5: Distribution of respondents by level of education

Level of education	Number of farmers'	Percent	
No formal education	27	20.6	
Adult education	9	6.9	
Primary	48	36.6	
Secondary	37	28.2	72.4
University	10	7.6	
Total	**131**	**100.0**	

4.1.4 Household size

The results on household size as indicated in Table 6 show that, 13.7% of the interviewed household comprises members less than 2, 38.1% comprises members between 2 and 4, 32.8%with members between 5 and 7, 10.7% of households comprise members between 8 and 10, 3.2% constitute house members between 11 and 13 and 1.5% of the total household interviewed comprises more than 13 household members. The largest household size in the sampled households was 15 members while smallest household size contained only a single member. The average household size among the sampled common beans farmers is 4.7 members. This is similar to the national average household size of 4.7 members (URT, 2012).

Table 6: Distribution of respondents by household size

Family size	Number of farmers	Percent
below 2	18	13.7
2-4	50	38.1
5-7	43	32.8
8-10	14	10.7
11-13	4	3.2
above 13	2	1.5
Total	**131**	**100.0**

4.1.5 Experience in common beans production

The number of years of common beans cultivation achieved by household head is used as proxy for managerial input. Older farmers are more experienced, therefore are likely to be more efficient than younger farmers who are less experienced in managing and allocating productive resources. The present study assessed experience of common beans farmers in the study area and the results in Table 7 show that, the respondents with the highest experience in the common beans growing has been growing the crop for 38 years and minimum number of experience in years of growing common beans was 1 year. The average years in growing common beans were 11.4 and standard deviation of 9.5. Furthermore, results show that 38.9% of the respondents had an experience of growing common beans between 0-5 years, while 61.9% of the respondents had grown common beans for more than 5 years. This implies that most of the farmers in Igamba and itaka divisions in Mbozi District are experienced farmers who can make right decision in managing and allocating productive resources.

Table 7: Distribution of respondents by number of years in common beans cultivation

Years in Growing common beans	Number of respondents	Percent
0-5	51	38.9
6-11	29	22.1
12-17	18	13.7
18-23	16	12.3
24-29	4	3.1
30 above	13	9.9
Total	**131**	**100.0**
Mean		11.4
Std. Deviation		9.5
Minimum		1
Maximum		38

4.1.6 Availability of credit services in the study area

The present study also explored whether sampled common beans farmers had any access to credit. Results on Table 8 show that, majority of the respondents (71%) reported to have no any access to credit and only 21% of the respondents reported to secure credit. Credit access has an impact to efficiency in common beans production. It is expected that, if a farmer is able to secure credit, will be able to purchase inputs, hire labour, hire and /or purchase equipments and initiate off farm activities. This concur with study done by Shamsudin *et al.* (2014) on efficiency of rice farms and its determinants and found that farmer's access to credit was important determinant upon the rice farm technical efficiency

Table 8: Distribution of respondents by credit access

Response	Number of farmers	Percent
Yes	38	29
No	93	71
Total	**131**	**100**

4.1.7 Availability of extension services in the study area

On the assessment of the extension services in Igamba and Itaka division in Mbozi District, respondents were asked whether they had access to extension services for the issues related to common beans production activities. Also the interviewees were asked whether they had attended any farmers' training and/or received any extension materials such as leaf-lets. Moreover, they were asked if they had any farmers group where they normally act together and also if they have ever attended any agriculture exhibition such as Nanenane. The results of analysis of these questions are presented in Table 9. Results show that about 57.3% of the respondents reported to have an access to extension services. This implies that Igamba and Itaka divisions have enough networks of extension services. The results further show that, 56.5% of the respondents are engaged in farmer groups where they take time to exchange experiences and knowledge and only 57 (43.5) are not attached to any farmer group in the study area. Also the results of the study show that 64.9% have received various extension materials. In addition to that the study come out with a result that only 19.1% had attended farmers' training on various issues related to common beans production activities. Again the same Table 9 shows that 51.1% of the respondents have attended in agriculture exhibition (Nanenane show). This shows that farmers in the study area are participating in different activities to improve their efficiency in common beans production. The relatively low proportion of farmers who had attended farmers' training could be attributed to the fact that, some of the farmers (about 43.5%) do not belong to any farmers groups. These results are the same as those reported by Geta *et al*. (2013) who conducted a study on Productivity and efficiency analysis of smallholder maize producers in Southern Ethiopia and found that, most of farmers who had an access to extension service with positive impact on maize productivity.

Table 9: Various type of extension services

Services/event	Number of farmers	Percent
Extension services		
Yes	75	57.3
No	56	42.7
Total	**131**	**100.0**
Farmer groups		
Yes	74	56.5
NO	57	43.5
Total	**131**	**100.0**
Attendance in agriculture show		
Yes	67	51.1
No	64	48.9
Total	**131100.0**	
Access to extension materials		
Yes	85	64.9
No	46	35.1
Total	**131**	**100.0**
Farmer training		
Yes	25	19.1
No	106	80.9
Total	**131**	**100.0**

4.1.8 Use of fertilizer and agrochemicals in the study area

As shown in Table 10, Igamba and Itaka division farmers apply fertilizer and agrochemicals in their crops. The results show that 74% and 71.8% of the respondents used fertilizers and agrochemicals respectively. Only 26% of the respondents were found not to be using fertilizers and this was due different reasons, 58% claimed lack of capital to purchase fertilizer, 22% high cost of fertilizer, and 18% unreliable output prices and 2% .claimed unstable supply of fertilizer. Also the results show that 28.2% did not use agrochemicals.

Table 10: Use of fertilizer and agrochemical

Responses	Number of farmers	Percent
Yes	97	74
No	34	26
Total	**131**	**100.0**
Reason for not using fertilizer		
Lack of capital	20	58.9
High cost	7	20.6
Unreliable output prices	6	17.6
Unstable supply of fertilizer	1	2.9
Total	**34**	**100.0**

4.2 Results from Econometric Estimations

4.2.1 Maximum likelihood estimates

To establish the factors affecting common bean efficiency in production, a stochastic frontier production function was estimated and the results are presented in Table 11. Three variables (plot size, quantity of seeds, and planting fertilizer) were found to significantly affect common bean production efficiency. The log likelihood for the fitted model was -39.3865 and the chi-square was 679.06 and it was strongly significant at 1% level. Thus the overall model was significant and the explanatory variables used in the model were collectively able to explain the variations in common bean efficiency production. Using the maximum-likelihood estimates for the parameters of the production frontier (Table 11), the elasticities of frontier output with respect to land, fertilizer, seed, labour and agrochemical were estimated at the means of the input variables to be 0.32, 0.24, 0.38, 0.14 and -0.001 respectively. Given the specification of the Cobb- Douglas frontier models the results show that the elasticity of mean value of farm output is estimated to be an increasing function of land, an increasing function of seed and an increasing function of labour. Also an increasing function of fertilizer and a decreasing function of herbicide. This imply that, the outputs values decreases as the input values (herbicides) increase and this might occur due to excess supply of herbicides which ultimately harm crops and reduce output. The high seed elasticity suggests that expansion in production among the farmers was mainly due to increase in quantity of seed used rather than increase in technical efficiency. The returns to-scale parameter was found to be 1.08, implying increasing return-to-scale for production among the smallholder beans farmers in the study area. This suggests that a proportionate increase in all the inputs would result to more proportionate increase in the output of the farmers. The increasing return-to-scale in this study implies increasing production per unit of input, suggesting that the farmers are not using their resources efficiently. This means that the farmers can still increase their level of output at the current level of resources. Contrary to the expectation, agrochemical had negative and significant coefficient. High cost of herbicides or high burden of pesticides accounts for the negative relationship between output and agrochemical use among the respondents.

The results show a positive coefficient for seeds as was hypothesized. Seeds had a strongly significant effect on common bean production at 1% level. The results showed that a 1% increase in the quantity of seeds used significantly increased common bean yields by 37.7%. This is fact because increasing quantity of seeds means increasing plant population in the field, hence increasing yields. The importance of seeds in determining common beans production has also been emphasized by Reardon *et al.* (1997). However, the seed variety used is also important in determining the contribution of seeds to common bean production.

The findings also showed a positive coefficient for plot size as was postulated. Plot size has a strongly significant influence on common bean production at 1% level. According to the results, an increase in the plot size by 1% significantly increased the farmer's bean yields by 31.8%. This suggests that the more farm land a farmer allocated to bean farming, the higher the yields obtained, which presents similar findings as those reported by Goni *et al.* (2007). The authors argued that most smallholder farmers usually fail to maximize bean yields due to underutilization of farm land.

Table 11: Maximum likelihood estimates for parameters of the stochastic frontier production model for common beans smallholder farmers in Mbozi District

Variable	Parameter	Coefficient	Std error	P>|z|
Frontier				
constant	β_o	-0.208392	0.5443687	0.709
Ln (Farm size)	β_1	0.3182796	0.1223038	0.004***
Ln (Fertilize)	β_2	0.2422572	0.0124356	0.000***
Ln (Seed)	β_3	0.3776051	0.1030905	0.000***
Ln (Labour)	β_4	0.1409385	0.0864994	0.636
Ln (Herbicides)	β_5	-0.0006953	0.330483	0.983
Inefficiency model				
constant	δ_o	-2.09843	18.703408	0.931
Farmer group	δ_1	-0.4778154	0.7078369	0.092*
Household size	δ_2	-0.1008184	0.1497952	0.093*
experience	δ_3	-0.0519421	0.0701958	0.069*
education	δ_4	-0.143797	0.2591809	0.051*
credit	δ_5	0.484266	2.41687	0.763
extension	δ_6	-0.751492	0.261234	0.528
Variance parameter				
Sigma square	σ^2=0.417348			
gamma	γ=0.986381			
Loglikelihood= -39.3865	Prob > chi^2=0.0000***			

Source: field survey 2019
*, **, *** is significant at 10%, 5% and 1% respectively *

It was further found that planting fertilizer showed a positive coefficient as hypothesized, with a significant relationship with bean yields at 1% level. The results revealed that a 1% increase in the quantity of planting fertilizer applied; significantly improved common beans mean production by 24.2%. The results are consistent as hypothesized and they reflect the findings presented by Tchale (2009) in Malawi where fertilizer was a key factor in production of major crops grown by smallholder farmers. Reardon *et al.* (1997) also found a positive effect of fertilizer on productivity in case studies from Bukina Faso, Senegal, Rwanda and Zimbabwe. However herbicide was found to have an insignificant influence on common bean production as hypothesized.

The estimated coefficients of farmer groups, education, farming experience, household size, are negative and significant at 10 percent level of significance. This implies that farmer groups, education, farming experience and household size, are determinants of technical inefficiency at 10 percent level of significance among the respondents. The negative coefficients of farmer group, education, farming experience and household size, imply that an increase in any of or all of these variables would lead to decline in the level of technical inefficiency. Thus from the results, farmer group has a negative effect to the technical inefficiency this imply that the respondents who involved in many farmer groups tend to be more technically efficiency than those involved in few farmers groups. The negative sign of education in inefficiency model imply that farmers who have many years in attending school are more technically efficiency than those with few years. Likewise experience has negative sign implying that, farmers who had been in common beans cultivation for many years were more technically efficiency. This could be interpreted as farmers with many years of experience were more technically efficiency than those with few years. Also from the findings, negative sign of the household size imply that household with many family members were more technically efficiency than those with few family members. The other socio economic variables such as credit and extension were not statistically significant.

The elasticity of mean values of cost with respect to the output and input prices was estimated at the values of the means of the costs of resources. Using the maximum-likelihood estimates for the parameters of the cost frontier (Table 12), the elasticities of frontier cost with respect to output, seed price, fertilizer price, herbicide price, labour price and land price, were estimated at the means of the input price variables to be 0.133, 0.455, 0.017, 0.0015, 0.794 and 0.014 respectively.

Table 12: Maximum likelihood estimates for parameters of the stochastic frontier cost model for common beans smallholder farmers in Mbozi District

Variable	Parameter	Coefficient	Std error	P>|z|
Frontier				
constant	μ_o	-0.5546493	0.5736804	0.034***
Ln (output)	μ_1	0.1330592	0.0290359	0.000***
Ln (land cost)	μ_2	0.0149081	0.0022954	0.000***
Ln (Fert cost)	μ_3	0.0179228	0.0035715	0.000***
Ln (seed cost)	μ_4	0.4559128	0.0432967	0.000***
Ln (labour cost)	μ_5	0.7948487	0.0315804	0. 000***
Ln (herbicide cost)	μ_6	0.0015712	0.0026531	0.554
Inefficiency model				
constant	δ_o	0.1949782	0.7429073	0.673
Farmer group	δ_1	-0.092947	0.604138	0.079*
Household size	δ_2	0.134515	0.127391	0.057*
experience	δ_3	-0.0839829	0.0894127	0.061*
education	δ_4	-0.0286813	0.103008	0.0684*
credit	δ_5	0.4783652	0.7492652	0.445
extension	δ_6	-0.6939734	0.8009351	0.0502*
Variance parameter				
Sigma square	σ^2=0.78493			
gamma	γ=0.89002			
Loglikelihood= 85.8196	Prob > chi^2=0.0000***			

Source: field survey 2019

*, **, *** is significant at 10%, 5% and 1% respectively

Given the specification of the Cobb-Douglas frontier models the results show that the elasticity of mean value of farm production cost is estimated to be an increasing function of output, an increasing function of seed price, an increasing function of fertilizer price and an increasing function of labour price and also an increasing function of land price and herbicides price. The low land price elasticity suggests that low production cost among the farmers was mainly due to land acquisition by inheritance rather than increase in allocative efficiency. The returns-to-scale parameter was found to be 1.4, implying increasing return-to-scale for production cost among the small scale common beans farmers in the study area. This suggests that a proportionate increase in all the inputs given their respective prices would result in more proportionate increase in the production cost of the farmers. This means that the farmers can still minimize their production cost at the current level of technology by using their inputs in optimal proportions given the input prices. This also implies that if the farmer is allocative efficiency would result to higher common beans profit in the study area. The implication is that policy that will help to increase allocative efficiency in production among the farmers would bring about an increase in farm profit of the small scale farmers in Mbozi District. The implication of the foregoing finding is that any policy that would provide affordable land, planting materials, fertilizer, agrochemical and labour would improve the production efficiency, as farmers through the expansion of input use would be able to move from the production phase of increasing returns to scale to the phase of decreasing returns to scale where profit would be maximized.

From the inefficiency model, education level, farming experience, household size, access to extension, household membership of farmer association, are significant determinants of allocative inefficiency at the 10% percent level of significance among the respondents (Table 12). The negative coefficients of education level, farming experience, and access to extension, imply that an increase in any of or all of these variables would lead to decline in the level of allocative inefficiency. The positive coefficients of household size and access to credit imply that an increase in any of or in all of these variables would lead to increase in the level of allocative inefficiency.

From Table 11, the estimated value of gamma is (γ =0.987, the variance of the parameter) for production frontier function at 10% level of significance which indicated that the technical inefficiency effect had influence on the variation in common beans produced in the study area. In other words, the variation in common beans produced in Igamba and Itaka divisions was 99% explained by failure of farmers use inputs technically. Also for cost frontier function (Table 12) the estimated value of gamma is γ=0.89 which also indicated that allocative inefficiency effect had influence on common beans production at the same level of significance. Since economic efficiency combines technical and allocative efficiencies it is evident that the smallholder common beans producer in the study area were not economically efficient.

Thus determinants of economic efficiency among the respondents were then identified to be education level, farming experience, household size, access to extension and household membership of farmer association were significant at10% level of significance. This is consistent with findings reported in previous studies. For example, Bravo-Ureta and Pinheiro (1997), among others, have reported that formal education is likely to increase farm level efficiency. Educated farmers are able to gather, understand and use information from research and extension more easily than illiterate farmers can. Moreover, educated farmers are very likely to be less risk-averse and therefore more willing to try out modern technologies. Tchale (2009) had noted that extension is important policy and institutional variables that positively influence efficiency, because they provide the incentive and means for farmers to access improved crop technology required for production. Following to the above conclusion, TE, AE and EE indices for each individual farm level were computed.

4.2.2 Estimation of TE, AE and EE

Given the specification of the Cobb-Douglas stochastic frontier in equation 7, the predicted technical efficiency varied widely among the sample farmers, with minimum and maximum values of 32.8 percent and 97.2 percent respectively and a mean technical efficiency value of 64.8 percent (Table 13).

Table 13: Summary of distribution of TE, AE and EE indices for beans production in Igamba and Itaka divisions

	TE		AE		EE	
Efficiency level	**Frequency**	**percent**	**Frequency**	**Percent**	**Number**	**Percent**
< 30	2	1.52	20	15.26	55	41.98
31-40	3	2.29	24	18.32	22	16.79
41-50	4	3.05	41	31.29	20	15.26
51-60	9	6.87	13	9.92	19	14.50
61-70	30	22.9	18	13.74	9	6.87
71-80	20	15.26	15	11.45	6	4.58
81-90	50	38.16	0	0	0	0
91-100	13	9.92	0	0	0	0
Total	**131**	**100.0**	**131**	**100.0**	**131**	**100.0**
Mean	64.8		52.7		43.62	
SD	0.12		0.14		0.06	
Minimum	32.8		27.6		26.3	
Maximum	97.2		78.3		75.6	

This means that, common beans smallholder farmer, could raise their production level by 35.2 percent if they use input efficiently. The wide variation in technical efficiency estimates is an indication that most of the farmers are still using their resources inefficiently in the production process and there still exists opportunities for improving on their current level of technical efficiency. This result suggests that the farmers were not utilizing their production resources efficiently, indicating that they were not obtaining maximum output from their given quantum of inputs.

On the other hand, the predicted allocative efficiency varied widely among the sample farmers, with minimum and maximum values of 27.6 percent and 78.2 percent respectively and a mean allocative efficiency estimate of 52.7 percent (Table 13) implying that common beans farmers are not producing with minimal cost and indeed farmers still have to reduce their cost about 47.3 percent in order to be efficient allocatively. The wide variation in allocative efficiency estimates is an indication that most of the farmers are still allocating their resources inefficiently in the production process and there still exists opportunities for improving on their current level of allocative efficiency. This result suggests that the farmers were not minimizing production costs, indicating that they were utilizing the inputs in the wrong proportions, given the input prices.

Similarly, the economic efficiency varied widely among the sample farmers, with minimum and maximum values of 26.26 percent and 75.58 percent respectively and a mean economic efficiency value of 43.6 percent (Table 13). Given the mean economic efficiency of 43.6 percent, it means that households will have to improve their cost efficiency by 56.4 percent if they are to operate on the Cobb Douglas stochastic production frontier. The wide variation in economic efficiency estimates is an indication that most of the farmers are still economically inefficient in the use of resources for production and there still exists opportunities for improving on their current level of economic efficiency. This result suggests that the farmers in the study area were not maximizing profit. These findings concur with the assertion of Desli *et al*. (2002) that in reality, small scale producers are not always efficient.

The results further indicate that allocative inefficiency is worse than technical inefficiency, which implies that the low level of overall economic efficiency is the result of higher cost inefficiency. This suggests that solving the allocation problems may be more critical for improving small scale farmers' efficiency than solving technical problems. These results are consistent with those reported by Battese and Coelli (1996), Ogundari and Ojo (2006), LeQuang Long *et al.* (2013) and Magreta *et al.* (2013) where findings revealed that smallholder farmers are more likely to be technically efficient than they are allocatively or economically.

4.3 Challenges Facing Smallholder Common Bean farmers

Agricultural activity in Tanzania faces many barriers towards achieving high yields in all crops. For the sake of this study, Table 14 presents a summary of challenges faced by smallholder common bean farmers in Igamba and Itaka division in Mbozi District in line to their opinion expressed during answering an open ended question included in the questionnaire.

4.3.1 Bad weather

Bad weather, basically poor pattern of rainfall sound as the most amongst the challenges faced by bean farmers in the study area and constituted of 85.4% as shown in Table 14. In a study area 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 Mkonda and Xinhua (2016) who reported that unpredictable and unreliable rainfall is a serious problem in Tanzania that decreases crop yields of smallholder farmers.

Table 14: Challenges facing smallholder common beans farmers

		Response	
S/no	**Challenges**	**Respondents**	**Percent**
1	Bad weather	112	85.4
2	Poor quality seed and agrochemicals	79	60.3
3	Crop diseases	58	44.2
4	Pest	56	42.7
5	Unstable price of outputs	42	32.1
6	High cost of inputs	32	24.4
7	Unreliable market of beans	30	22.9
8	Shortage of land	20	15.2
9	Inadequate capital	18	13.7

4.3.2 Poor quality seed and of agro-chemicals

About 60.3% respondents responded that poor quality seeds and chemicals are among of the constraints in the study area. This is due to the fact that the performance of agricultural seeds and chemicals like insecticides, herbicides and fungicides is too low. Due to inability seed to perform well and 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.

4.3.3 Crop diseases

About 44.2% of the respondents sampled in the study area highlighted diseases as a serious constraint affecting beans production 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 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*). 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.

4.3.4 Pests

Table 14 indicate pests as one of the challenges in the study area and as accounted for 42.7%.This implies that pests lower the yield and quality of the crop. 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.

4.3.5 Unstable price of output

About 32.1% of the respondents identified price fluctuation of beans as one of the challenges facing common bean farmers in the study area. 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 line with Venance *et al*. (2016) who reported that small scale farmer's production of all grain legumes is still low and far below potential and this has impacted on productivity and profitability which makes farmers end up getting the losses as they are exploited by the buyers thus do not maximize profits.

4.3.6 High cost of agricultural inputs

High cost of inputs was among the constraints identified by the respondents in the study area as shown in Table 14. The findings show that about 24.4% of sampled farmers incur high cost for purchasing 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. This constraint is supported by report of MALF (2016) that farmers in Tanzania are still forced to pay higher prices for farm inputs even if 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 among common bean farmers through reduced area of cultivation.

4.3.7 Unreliable market of beans

There is a poor and unreliable market of beans in the study area in which most of the farmers sell their produces after harvesting by low price. Only 22.9% urged on unreliable market of common beans as seen in Table 14. 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.

4.3.8 Shortage of land

The results in Table 14 show that about 15.2% respondents identified land shortage as one of the constraints of common beans production. 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 that don’t have a title hold to the land and this discourages them from continuing the agricultural or rural work.

4.3.9 Inadequate capital

About 13.7% 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.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The present study examined the determinant of economic efficiency of smallholder's common beans farmers in Igamba and Itaka divisions in Mbozi District. The conclusions made basing on results of the study to tackle the objectives are as follows.

It was established that the efficiency of smallholder common bean farmers was strongly significantly influenced by plot size, quantity seeds, and fertilizer. The log likelihood for the fitted model was -39.3865 and it was strongly significant at 1% level. Thus the overall model was significant and the explanatory variables used in the model were collectively able to explain the variations in common bean production. The results further showed that the variance of the technical parameter γ is 0.9863 and is significantly different from zero. From objective one, the aim was to estimate the levels of TE, AE and EE of smallholder common beans farmers and this went along in the same direction of answering the first research question which was asking about levels of TE, AE and EE of smallholder common beans farmers in the study area. The average level of technical, allocative and economic efficiency is estimated at 64.8%, 52.7% and 43.62% respectively and it implies that smallholder common beans farmers in the study area were more likely to be technically efficient than allocatively or economically efficient. Hence smallholder common beans farmers in Igamba and Itaka Divisions in Mbozi District could raise their production of common beans by 56.38% by efficiently adjusting inputs with the existing technology at time of the study.

Objective two aimed at analysing socio-economic characteristics affecting efficiency levels in Igamba and Itaka Divisions and it was hypothesized that farm specific characteristics and socio-economic factors have no significant influence on TE, AE and EE among small holder common beans farmers in the study area. Findings revealed that attainment of more education would improve the efficiency levels of smallholder common beans farmers in Igamba and Itaka divisions at significance level of 10%. This implies that farmers who are educated are more likely to have ability to use new techniques. Access to credit for smallholder common beans farmers in the study area was found to negatively influence efficiency levels among common beans farmers.

From the findings the results showed, the experience of the farmer to have positive influence in TE of smallholder common beans farmers in the study area at significance level of 10%. This implies that more experienced farmers are in a better position of understanding and integrating agricultural instructions and apply more rapidly new techniques. The influence of household size was significant at 10% level of significance; this implies that having a big number of family labour would reduce cost of hiring labour.

Also findings showed that the membership of farmers in farmers group have positive influence in TE at significance level of 10%, this implies that when farmer meet they have the chance to exchange knowledge, skills and also get new information about technology which help them to improve efficiency in common beans production.

In addition to that, membership of a farmer to farmers association, household size, experience of the farmer, education of the farmer and access to extension have positive influence in AE at significance level of 10%. Since EE combine both TE and AE the results revealed that, membership of a farmer to farmers association, household size, experience of the farmer, education of the farmer and access to extension with no doubt have positive influence in EE of the smallholder common beans farmers in the study area.

Objective three was to identify some challenges that smallholder common beans farmers are facing in the study area. The main challenges to beans production in the study area were identified and mentioned as bad weather (unreliable rainfall), poor quality seeds and agrochemicals, pest and diseases, unstable price of output, high cost of farm inputs, unreliable market, shortage of land and luck of capital, were the main challenges encountered by farmers. These challenges as reported by farmers make reasons to the smallholder farmers to have lower yield, poor quality and hence low production efficiency in common bean production.

5.2 Recommendations

Based on the key findings, the present study recommends the following;

Government, and private sectors have to invest in giving knowledge on appropriate usage of different inputs that will assist increase in crops productivity like fertilizers, agrochemicals, seeds and other equipment used in common beans production. In line to that, government through its organs specific for inspection of agrochemicals and seeds should be giving stern measures to those found distributing fake agricultural inputs as this has discouraged many of the farmers when they don't realize the effectiveness of those inputs after using them. In the study area, issue of poor quality seed and agrochemicals was serious mentioned.

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 smallholder bean farmers through the provision of seminars and workshops where farmers would acquire more training on improved bean varieties production.

Moreover farmers should organize themselves in groups for seeking market price information and this can provide opportunities for risk sharing and improved bargaining power when time to sell their produce comes.

Apart from poor quality seed and agrochemicals the study 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.

Finally the government and policy makers should address the key factors that affect the efficiency of smallholder common beans farmers. Findings showed that AE is worse than TE and that the low the EE is largely explained by low level of AE. Government should look on how to reduce prices of inputs to enable farmer to improve cost efficiency.

5.3 Areas for Furthers Studies

The present study focused on determinants of economic efficiency among smallholder common beans farmers in Igamba and Itaka divisions in Mbozi District. However, the current study would like to recommend further studies to be done on economic efficiency on other crops in Tanzania instead of common beans only. Also this study has only employed the parametric approach which only told one side of the story. Therefore it suggested that further study should also use non-parametric approach in order to compare the results.

REFERENCES

Abawiera, W. C. and Dadson, A. V. (2016). Technical efficiency of maize farmers in Ghana. *Discourse Journal of Agriculture and Food Services* 4(3): 17-20.

Abdulai, A. and Huffman, W. (2000). Structural adjustment and economic efficiency of rice farmers in northern Ghana. *Economic Development and Cultural Change* 48(3): 503-520.

Abdulai, S., Nkegbe, P. K. and Donkor, S. A. (2017). Assessing the Economic Efficiency of Maize Production in Northern Ghana. *Ghana Journal of Development Studies*14(1): 123-145.

Adeoye, I. B., Fashogbon, A. E. and Idris, B. A. (2014). Analysis of Technical Efficiency of Pepper Production among Farmers under Tropical Conditions. *International Journal of Vegetable Science* 20(2): 124-130.

Andrew, R. and Philip, D. (2014). Coffee Production in Kigoma Region, Tanzania: Profitability and constraints. *Tanzania Journal of Agricultural Sciences* 13(2): 75-85.

Aneani, F., Anchirinah, V. M., Asamoah, M. and Owusu-Ansah, F. (2011). Analysis of economic efficiency in cocoa production in Ghana. *African Journal of Food, Agriculture, Nutrition and Development* 11(1).

Asogwa, B. C., Umeh, J. C. and Penda, S. T. (2011). Analysis of economic efficiency of Nigerian small scale farmers: A parametric frontier approach. *Journal of Economics* 2(2): 89-98.

Baha, M., Temu, A. and Philip, D. (2013). Sources of Technical Efficiency Among Smallholders Maize Farmers in Babati District, Tanzania. *African Journal of Economic Review* 1(2): 1-14.

Battese, G. and Coelli, T. (1992). Frontier Production Function. *Technical Efficiency*.

Battese, G. E. and Coelli, T. J. (1995). A model of technical inefficiency effects in a stochastic production function for panel data. *Empirical Economics* 20: 325–332.

Battese, G. E. and Coelli, T. J. (1996). A model of technical inefficiency effects in a stochastic production function for panel data. *Empirical Economics* 20: 325–332.

Binagwa, P. H., Bonsi, C. K., Msolla, S. N. and Ritte, I. I. (2016). Morphological and molecular identification of *Pythium* spp. isolated from common beans (Phaseolus vulgaris) infected with root rot disease. *African Journal of Plant Science* 10(1): 1-9.

Binagwa, P. H., Magdalena, W., Michael, K., Zakayo, E., Mbiu, J., Msaky, J. and Rubyogo, J. C. (2018). Selian Agricultural Research Institute (SARI) Released Seven (7) Improved Common Bean Varieties January 2018.

Birachi, E. A., Ochieng, J., Wozemba, D., Ruraduma, C., Niyuhire, M. C. and Ochieng, D. (2011). Factors influencing smallholder farmers' bean production and supply to market in Burundi. *African Crop Science Journal* 19(4): 335-342.

Bravo-Ureta, B. E. and Pinheiro, A. E. (1997). Technical, economic and allocative efficiency in peasant farming: Evidence from the Dominican Republic. *The Developing Economies* 35(1): 48–67.

Bryman, A. (2016). *Social Research Methods*. Oxford university press. 784pp.

Bucheyeki, T. L. and Mmbaga, T. E. (2013). On-farm evaluation of beans varieties for adaptation and adoption in Kigoma region in Tanzania. *ISRN Agronomy*, *2013*.

Chiona, S., Kalinda, T. and Tembo, G. (2014).Stochastic frontier analysis of the technical efficiency of smallholder maize farmers in Central Province, Zambia. *Journal of Agricultural Science* 6(10): 108.

Coelli, T. J. (1996). A guide to FRONTIER version 4.1: a computer program for stochastic frontier production and cost function estimation. *CEPA Working papers* No. 7/96. University of New England, Armidale, NSW 2351, Australia. 33pp.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J. and Battese, G. E. (2005). *An Introduction to Efficiency and Productivity Analysis*. Springer Science and Business Media. 349pp.

Coelli, T. R., Prasada, R. D. S. and Battese, N. (1998). *An Introduction to Efficiency and Productivity Analysis*. Boston: Kluwer Academic.

Debertin, D. L. (1986). *Agricultural Production Economics*. Macmillan Publishing Company. New York. 427pp.

Desli, E., Ray, S. C. and Kumbhakar, S. C. (2002). A Dynamic Stochastic Frontier Production Model with Time-Varying Efficiency. *Working Paper Series-*

Working Paper 2003-15, Department of Economics, University of Connecticut.

Etwire, P. M., Martey, E. and Dogbe, W. (2013). Technical efficiency of soybean farms and its determinants in Saboba and Chereponi Districts of Northern Ghana: a stochastic frontier approach. *Sustainable Agriculture Research* 2(4): 106-112.

FAO, Food and Agriculture Organization of the United Nations (2013). *Food and Agriculture Organization of the United Nations Statistics*. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO, Food and Agriculture Organization of the United Nations (2014). *Food and Agriculture Organization Statistics*. Food and Agriculture Organization, Rome, Italy.

FAO, Food and Agriculture Organization of the United Nations (2017). Food and Agriculture Organization for United Nations. Food and Agriculture Organization for United Nations Statistics Division Data. [www.fao.org/statistics/faostat agriculture 2017] site visited on 05/07/2017.

FAO, Food and Agriculture Organization of the United Nations (2018). *Food and Agriculture Organization Statistics*. Food and Agriculture Organization, Rome, Italy.

FAOSTAT (2018). Trend in common beans production and demand in Tanzania. [www.fao.org › faostat] site visited on 15/08/2018.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, *Series A* 120(3): 253 – 290.

Førsund, F. R., Lovell, C. K. and Schmidt, P. (1980). A survey of frontier production function and of their relationship to efficiency measurement. *Journal of Econometrics* 13(1): 5-25.

Gelan, A. and Muriithi, B. (2010). Measuring and explaining economic efficiency of dairy farms: A case study of smallholder farms in East Africa. In: *3rd Conference of African Association of Agricultural Economists: Africa and the Global Food and Financial Crises, Cape Town*.

Geta, E., Bogale, A., Kassa, B. and Elias, E. (2013). *Productivity and Efficiency Analysis of Smallholder Maize Producers in Southern Ethiopia*. Journal of Economics 41(1): 67–75.

Goni, M., Mohammed, S. and Baba, B. A. (2007). Analysis of resource-use efficiency in rice production in the Lake Chad area of Borno State, Nigeria. *Journal of Sustainable Development in Agriculture and Environment* 3(2): 31-37.

Hillocks, R. J., Madata, C. S., Chirwa, R., Minja, E. M. and Msolla, S. (2006). *Phaseolus* bean *in* Tanzania, 1959 – 2005. *Euphytica* 150(1-2).

Hyuha, T. S., Bashaasha, B., Nkonya, E. and Kraybill, D. (2007).Analysis of profit inefficiency in rice production in Eastern and Northern Uganda. *African Crop Science Journal* 15(4).

Kabwe, M. (2012). Assessing of TE, AE and EE of smallholder maize producers using the stochastic frontier approaches in Chongwe District, Zambia, Dissertation for Award Degree of M.Sc. Degree at University of Pretoria- South Africa. 107pp.

Kanyama, A. and Damian, L. (2015). The Challenges of Adaptation of Maize and Beans Farming due to Rainfall Variability in Mwanga. District, Tanzania. *International Journal of Modern Social Science 2015* 4(2): 105-117.

Karani, A. O., Ndakidemi, P. A. and Mbega, E. R. (2017). Botanical pesticides in management of Common bean pests: Importance and possibilities for adoption by small-scale farmers in Africa. *Journal of Applied Life Sciences International* 2017: 1-10.

Karanja, D. (2016). *Pulses Crops Grown in Ethiopia, Kenya and United Republic of* Tanzania *for Local and Export Market.* International Trade Centre, Eastern Africa Grain Council. 42pp.

Kidane, A. and Ngeh, E. T. (2015). A comparative analysis of technical efficiency of smallholder tobacco and maize farmers in Tabora, Tanzania. *Journal of Development and Agricultural Economics* 7(2): 72-81.

KILIMO Trust (2013). *Analysis and Design of a Regional Agricultural Markets Development Programme* in the East African Region-EAC Regional Beans Sub- sector.138pp.

Kintché, K., Hauser, S., Mahungu, N. M., Ndonda, A., Lukombo, S., Nhamo, N. and Mbala, M. (2017). Cassava yield loss in farmer fields was mainly caused by low soil fertility and suboptimal management practices in two provinces of the Democratic Republic of Congo. *European Journal of Agronomy* 89: 107-123.

Kumbhakar, S. C. and Tsionas, E. G. (2006). Estimation of stochastic frontier production functions with input-oriented technical efficiency. *Journal of Econometrics* 133(1): 71-96.

Kuwornu, K. M. J., Demi, S. M. and Amegashie, D. P. K. (2013). Analysis of food security status of farming households in the forest belt of the Central Region of Ghana. *Russian Journal of Agricultural and Socio-Economic Sciences* 13(1): 26-42.

Larochelle, C., Katungi, E. and Cheng, Z. (2017). *Pulse Consumption and Demand by Different Population Subgroups in Uganda and Tanzania.* International Center for Tropical Agriculture (CIAT); Pan-Africa Bean Research Alliance (PABRA). Uganda. 66pp.

Le Quang, L., Phan, V. T., Nghi, K. O. and Doan, M. T. (2013). *S*tudy on economic efficiency in rice production of Cuu Long Delta. *Omonrice* 19: 250 – 260.

Letaa, E., Kabungo, C., Katungi, E., Ojara, M. and Ndunguru, A. (2015). Farm level adoption and spatial diffusion of improved common bean varieties in southern highlands of Tanzania. *African Crop Science Journal* 23(3): 261-277.

Lwayo, M. K. and Maritim, H. K. (2003). Socio-economic factors affecting farmers' decision to adopt farm forestry: An application of multivariate Logistic analysis in Busia District In: *XII world forestry congress, Quebec City, Canada*. [www.fao.org ›] site visited on 12/08/2018.

Magreta, R., Edriss, A. K., Mapemba, L. and Zingore, S. (2013). Economic Efficiency of Rice Production in Smallholder Irrigation Schemes: A Case of Nkhate Irrigation Scheme in Southern Malawi. *Invited Paper Presented at the 4th International Conference of the African Association of Agricultural Economists,* 22 – 25 September 2013, Hammamet, Tunisia. 15pp.

Mahjoor, A. A. (2013). Technical, allocative and economic efficiencies of broiler farms in Fars Province, Iran: A data envelopment analysis (DEA) approach. *World Applied Sciences Journal* 21(10): 1427-1435.

Mailena, L., Shamsudin, M. N., Radam, A. and Mohamed, Z. (2014). Efficiency of rice farms and its determinants: Application of stochastic frontier analysis. *Trends and Applied Sciences Research* 9(1): 360-371.

MALF, Ministry of Agriculture Livestock and Fisheries (2016). *High Prices of Inputs Limit Agricultural Production*: Tanzania. Tanzania Daily news (newspaper) reported on 6 July 2016.

Mburu, S., Ackello-Ogutu, C. and Mulwa, R. (2014). Analysis of economic efficiency and farm size: A case study of wheat farmers in Nakuru District, Kenya. *Economics Research International* 2014: 1-10.

Mkonda, M. Y. and Xinhua, He. (2016). Production Trends of Food Crops: Opportunities, Challenges and Prospects to Improve Tanzanian Rural Livelihoods. *Natural Resources and Conservation* 4(4): 51-59.

Mlote, S. N., Mdoe, N. S. Y., Isinika, A. C. and Mtenga, L. A. (2013). Estimating technical efficiency of small scale beef cattle fattening in the lake zone in Tanzania. *Journal of Development and Agricultural Economics* 5(5): 197-207.

MoA, Ministry of Agriculture (2018). Characteristics of improved bean varieties in Tanzania. [www.researchgate. net › figure › Characteristics-of-improv] site visited on 17/01/2019.

Mpina, M. H. and Mkalanga, H. S. (2016). Fluopyram 250G/L+ Trifloxystrobin 250 G/L, Increases Fungicides Options for the Control of Angular Leaf Spot and Rust of Beans in Tanzania. *International Journal* 2016: 1-13.

Msuya, E. and Ashimogo, G. (2005). Estimation of technical efficiency in Tanzanian sugarcane production: A case study of Mtibwa sugar Estate outgrowers scheme.

Mwaipopo, B., Nchimbi-Msolla, S., Njau, P., Tairo, F., William, M., Binagwa, P., andMbanzibwa, D. (2017). Viruses infecting common bean (*Phaseolus vulgaris* L.) in Tanzania: A review on molecular characterization, detection and disease management options. *African Journal of Agricultural Research* 12(18): 1486-1500.

Mwajombe, K. K. and Mlozi, M. R. (2015). Measuring farm-level technical efficiency of urban agriculture in Tanzanian towns: the policy implications. *World Journal of Social Science* 2(1): 30-62.

Naing, L., Winn, T. andRusli, B. N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of orofacial Sciences* 1: 9-14.

Nakazi, F., Njuki, J., Ugen, M. A., Aseete, P., Katungi, E., Birachi, E. and Nanyonjo, G. (2017). Is bean really a women's crop? Men and women's participation in bean production in Uganda. *Agriculture and Food Security* 6(1): 22-32.

Namugwanya, M., Tenywa, J. S., Otabbong, E., Mubiru, D. N. and Masamba, T. A. (2014). Development of common bean (*Phaseolus vulgaris* L.) production under low soil phosphorus and drought in Sub-Saharan Africa: a review. *Journal of Sustainable Development* 7(5): 128-136.

Obayelu, A. E., Arowolo, A. O., Ibrahim, S. B. and Oderinde, C. O. (2016). Socioeconomic determinants of profitability of fresh fish marketing in Ogun State, Nigeria. *International Journal of Social Economics* 43(8): 871-883.

Ogundari, K. and Ojo, S. O. (2006). An Examination of Technical, Economic and Allocative Efficiency of Small Farms: The Case Study of Cassava Farmers in Osun State of Nigeria. *Journal of Central European Agriculture* 7(3): 423 – 432.

Onubuogu, G. C., Esiobu, N. S., Nwosu, C. S. and Okereke, C. N. (2014). Resource use efficiency of smallholder cassava farmers in Owerri Agricultural zone, Imo State, Nigeria. *Scholarly Journal of Agricultural Science* 7(8): 142-152.

Rahman, S. and Salim, R. (2013). Six decades of total factor productivity change and sources of growth in Bangladesh agriculture (1948–2008). *Journal of Agricultural Economics* 64(2): 275-294.

Rajendran, S., Afari-Sefa, V., Karanja, D. K., Musebe, R., Romney, D., Makaranga, M. A., and Kessy, R. F. (2015). Technical efficiency of traditional African vegetable production: A case study of smallholders in Tanzania. *Journal of Development and Agricultural Economics* 7(3): 92-99.

Reardon, T., Kelly, V., Crawford, E., Jayne, T., Savadogo, K. and Clay, D. (1997). *Determinants of farm productivity in Africa*: A synthesis of four case studies. Sustainable development bureau of Africa: SD Publication series.

Reddy, S. B., Naidu, G. V. and Reddy, M. N. (2015). Trends in food crops and non-food crops in India. *International Journal of Current Innovation Research* 1(9): 207-212.

Rodríguez De Luque, J. J. and Creamer, B. (2014). *Principal constraints and trends for common bean production and commercialization*; establishing priorities for future research. *Agronomía Colombiana* 32(3): 423-431.

Ronner, E. and Giller, K E. (2012). Background information on agronomy, farming systems and ongoing projects on grain legumes in Tanzania. *N2Africa Milestones. Accessed* 17: 09-13.

Seidu, A. (2008). Technical efficiency of rice farmers in Northern Ghana. Tamale, Ghana: AERC Research Paper.

Sesabo, J. K. and Tol, R. S. (2007). Technical efficiency of small-scale fishing households in Tanzanian coastal villages: an empirical analysis. *African Journal of Aquatic Science* 32(1): 51-61.

Seyoum, M. J. Battese, G. E. and Fleming, E. M. (1998). *Technical efficiency and productivity of maize producers in eastern Ethiopia*: a study of farmers within and outside the Sasakawa- Global 2000 project. *Agricultural Economics* 19(3): 341–348.

Shamsudin, M. N. (2014). Rice Farms Efficiency and Factors Affecting the Efficiency in MADA Malaysia. *Journal of Applied Sciences* 14(18): 2177-2182.

Sibiko, K. W., Owuor, G., Birachi, E., Gido, E. O., Ayuya, O. I. and Mwangi, J. K. (2013). Analysis of determinants of productivity and technical efficiency among smallholder common bean farmers in eastern Uganda. *Current Research Journal of Economic Theory* 5(3): 44-55.

Tchale, H. (2009). The efficiency of smallholder agriculture in Malawi. *African Journal of Agriculture and Resource Economics (AFJARE)* 3(2): 101-121.

URT, United Republic of Tanzania (2012). Population and housing census. Government printing office, Dar es Salaam, Tanzania. 44pp.

URT, United Republic of Tanzania (2016).Value Chain Roadmap for Pulses 2016-2020. 83pp.

Varian, H. R. and Varian, H. R. (1992). *Microeconomic Analysis* (Vol. 3). New York: Norton.

Venance, S. K., Mshenga, P. and Birachi, E. A. (2016). Factors influencing on-Farm Common Bean Profitability: The Case of Smallholder Bean Farmers in Babati District, Tanzania. *Journal of Economics and Sustainable Development Vol.7, No.22, 2016.*

Xavery, P., Kalyebara, R., Kasambala, S. and Ngulu, F. (2006). The impact of improved bean production technologies in Northern and North Western Tanzania. *Occasional Publication Series* 2006(43).

Zamanian, G. R., Shahabinejad, V. and Yaghoubi, M. (2013). Application of DEA and SFA on the Measurement of Agricultural Technical Efficiency in MENA Countries.

APPENDICES

Appendix 1: Respondent's questionnaire

Dear respondent,

Introductory statement (to be read to the respondent)

I am Mr. Mbugi,Edward a Masters's student at Sokoine University of Agriculture (SUA). I am undertaking research titled "*Determinants of economic efficiency among common Beans smallholder producers in Mbozi District*" as a partial fulfillment for award of M.Sc in Agricultural Economics and this interview is part of this research. 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.

General Information

Questionnaire No:……………………….. Date of interview:……………………………

Interviewer's name:……………………………..Name of Respondent:…..………………..

Division:………………………Ward:…………………………Village:………………….

Farmer's household characteristics

1. Age of the household head (years): ……………………

2. Gender of the household head: 1 = Male [ ] 2 = Female [ ]

4. Marital status: 1 = Single [ ] 2 = Married [ ] 3 = Separated [ ] 4 = Widow [ ]

5. Level of education: 1 = No formal education [ ] 2 = Adult education [ ]

3 = Primary [ ] 4 = Secondary [ ] 5 = University [ ]

6. Household size and composition

Age group (years)	**Male**		**Female**		**Total**
	Attend School	**Not attending School**	**Attend School**	**Not attending School**	
0-5					
6-9					
10-15					
15-55					
Total					

7. Years in common beans farming: …..Years

Plot #	1	2	3	Total
Area (hectare)				
Belongs to HH				
Rent from a person				
Total				

C. Farmer's land information for the last season

8. What size of land have you cultivated during last the season?......................(hectare)
9. For the piece of land owned, how was it obtained? 1 = Inherited [ ] 2 = Bought [ ]

   3 = Accessed free land [ ]

10. If bought land, what was the price? …………………………Tsh/hectare
11. If rented from a person, how much paid per hectare (in cash)?.................Tsh/hectare
12. If payment of rent was done in kind after harvesting, how many Kg (or bags) per hactare? ……………….Kg (bags)
13. For the land rented from a person, if you decide to buy, how much would it cost?

    ………………….Tsh/hectare

D. Inputs use information for the last season

(a) Labour

14. What is the average amount of labour used and cost for the full season for

    various activities in common beans farming (man-days) for last season?

Activity	Family labour				Hired labour			
	No of person	Days spent	Cost per	Total costs	No of person	Days spent	Cost per	Total costs

			day				day	
Land Clearance								
Ploughing								
Planting/sowing								
First Weeding								
First fertilizer application								
Second Weeding								
Second fertilizer application								
Pesticide/herbicide application								
Harvesting								
Transportation								
Drying andThreshing								
Sorting and packaging								
Packing in Store Others Specify:								
Total								

15. Which factors do you think they greatly affect the use of labour in beans growing?

1 = High labour cost [   ] 2 = Labour unavailability during intense activities [   ]

3 = Unstable labour supply [   ] 4 = Other factors (specify) ………………………

(b) Fertilizer

16. Did you use fertilizers during the last season? 1 = Yes [ ] 2 = No [ ]

17. If yes, what is the amount per hectare and cost?

Types of Fertilizer	**Unit**	**Quantity**	**Unitary price (in Tsh)**	**Total cost (in Tsh)**
NPK/DAP	bag			
Urea	bag			
Total	**bag**			

18. If no, which factors do you think they greatly affect the use of fertilizer in beans growing?

1 = High cost [ ] 2 = Fertilizer unavailability [ ] 3 = Lack of capital to purchase fertilizer [   ] 4 = Unreliable output price [ ] 5 = Unreliable fertilizer supply [   ] 6 = Other reasons (specify) [ ]………………………..........…..

(c) Seeds

19. What quantity of seeds and variety per hectare did you use and what is the cost?

Variety of seed	**Unit** kg	**Quantity**	**Unitary price (in Tsh)**	**Total cost (in Tsh)**
	Kg			
	Kg			
	Kg			
	Kg			

(d) Pesticides/ Herbicides

20. What quantity of pesticides per hectare did you use and what is the cost?

Types of Pesticides	**Unit**	**Quantity**	**Unitary price (in Tsh)**	**Total cost (in Tsh)**

21 Other expenses per hectare related to production process (other than investment)

S/N	**Nature of expense**	**Amount (in Tsh)**
1		
2		
3		
4		
Total		

(e). Production and off farm income

22. What quantity of common beans have you harvested during the last season?

Plot #	**Quantity**	**Unit (Kg or Bags)**	**Unitary price (in Tsh)**	**Revenue(in Tsh)**
1				
2				
3				
4				
5				
6				
7				
Total				

23. Given the size of land owned and input availability, do you set any target on yield to be achieved? 1 = Yes [ ] 2 = No [ ]

24. If yes, do you think that the targeted yield was achieved? 1 = Yes [ ] 2 = No [ ]

25. If no, what were the reasons to do not achieve the optimal yield?

1 = Bad weather [ ] 2 = Pests and diseases [ ] 3 = Low soil fertility [ ]
4=Lack of fertilizers (low input use) [ ] 5= Shortage of labour supply
6= Other reasons (specify)……………………………………………

6 Apart from crop farming activities, do you have other activities that bring income to your household? 1 = Yes [ ] 2 = No [ ]

27. What is your main activity? 1 = Bean farming [ ] 2 = Other activity [ ]

28. If yes, (in 26) which activities and how much did you get from these activities during the last season?

S/N	Income generating activities	Daily Income (in Tsh)	Average monthly income (in Tsh)	Off-farm income for the last season (in Tsh)
1				
2				
3				
4				
5				
Total				

(f).Institutions and social inclusion

(a) Access to credit

29. Do you have access to credit facilities? 1=Yes [ ], 2= No[ ]

30. If the answer is yes in question (29) above, please fill the information in below table.

31. Indicate credit amount, interest rate and repayment period in the table below.

Source of credit	Type of credit		Amount	Rate	Repayment period
	Formal	informal			
1.					
2.					

32. Do you think, credit is important in common beans production? 1= Yes[ ], 2=No[ ]

29.

33. If the answer is yes in question (34) above, how? 1. Use fewer amounts of inputs if no credit,[ ] 2. Fail to expand farms in less or no credit,[ ] 3. Others [ ] (Specify)………………………………………………………………………

(b) Extension service

34. Do you access the extension services? 1= Yes[ ], 2= No [ ]

35.If yes, specify which type of service do you get, Frequency and if any payments do you make for it. 1= very often, 2= Often, 3= rarely 4. No access

Type of Extension Services	YES or NO	Frequency	Cost if any
DES			
NGO			

36. Have you ever participated in any farmers training workshop in the last two years 1= Yes[ ], 2= No [ ]

37. Are there any farmer groups, where you can exchange farming experience? 1= Yes[ ], 1= No[ ]

38. Do you receive any extension materials such as Farming calendar, leaflets, Journal and Others? 1= Yes[ ], 2=No[ ]

39. Do you think Extension Service is important in improving common beans productivity? 1=Yes[ ], 2= No[ ]

40. If yes In Question (38) above, how? 1. I meet light expertise, 2. I meet research information, 3. Others (Specify) _____________

41. Have you ever to NaneNane exhibition? 1=Yes[ ], 1=No[ ]

42. If yes, do you think the NaneNane Exhibit helps in Improving Crop productivity?
1=certainly[ ], 2= Never[ ]

(g). Challenges and possible solutions

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

Challenges	Possible solutions

THANK YOU VERY MUCH FOR YOUR COOPERATION

Appendix 2: Expected signs of variables included in the model

Variables used in the Frontier production model

Variables	Description	Measurement	Expected sign
DEPENDENT	Total beans output for the HH	90 kg bag	
PLOT SIZE	Area of land under beans	Hactares	+
SEED	Quantity of seed applied per plot	Kilograms	+
FERTILIZER	Quantity of organic fertilizer used	Kilograms	+/-
LABOUR	Hired and family labour used in beans	man- days	+
CHEMICALS	Quantity of Pesticides, Fungicides	Kilograms	+

Variables used in the stochastic Frontier cost function

DEPENDENT C)	Total input cost of the ith farmer	TSH	
LABOUR WAGE	Wage per man-dayHactares	TSH	+
FERT PRICE	Price per unit of chemical fertilizer	TSH	+
SEED PRICE	Price per unit of bean seeds	TSH	+
CHEMICALS	Price per unit of pesticides	TSH	+

Variables used in the efficiency regression model

DEPENDENT	TE , EE and AE of the ith farm	%-	
HOUSEHLD SIZE	Number of people in household	number	+/-
EXPERIENCE	Experience of the bean farmer	Years	+
EDUCATION	Education level of the bean farmer	Schooling years	+/-
CREDIT	Access to credit	1=Yes; 2= No	+
EXTENSION	Access to extension service	1=Yes; 2= No	+
FARMER GROUP	engagement in farmer groups	1= yes, 2= No	+