PERFORMANCE OF COTTON SMALLHOLDER FARMERS UNDER CONTRACT FARMING IN BARIADI DISTRICT

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ABSTRACT

Agriculture sustains the livelihoods of about 80% of Tanzanian households. Cotton is amongst the two most important export cash crops in Tanzania and the first for the Western cotton producing zone. Although Tanzania's cotton output has increased, average cotton yields in the country reported to be only 760 kg /ha though yields of about 1200 kg/ha can be realized. The objective of this study was to measure the performance of cotton small holder farmers. Technical factors that affect efficiency and the level of profit attained by smallholder cotton farmers were used as the measure of farmers' performance. A multistage sampling procedure was employed to select 120 respondents from Bariadi district. Descriptive statistics, a stochastic frontier model and GM analysis were employed. The study established that contract farming enhanced performance of cotton farmers. The means TE were 73% and 57% for contract and non-contract smallholder cotton farmers respectively. The inefficiency model revealed that TE among farmers was positively influenced by education, distance to the market, extension services, information and credit access while negatively influenced by age, sex and years of farming. The mean GM for contract farmers was higher than that of non-contract farmers. On average contract farmers achieved a GM of 220099 TZS while non-contract farmers achieved a GM of 113796 TZS Per acre. The study recommended the need for increased provision of quality extension services, training, developing roads, market infrastructure, and provision of affordable credit to improve production efficiency and hence profit of smallholder cotton farmers.

DECLARATION

I, Masingi, Geoffrey, 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 in any other institution..

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The above declaration is confirmed by:

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(Supervisor)

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DEDICATION

I dedicate this work to my family for their sacrifice and encouragement during my academic study.

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LIST OF ABBREVIATIONS AND SYMBOLS

AAEEN	African Agricultural Economics Education Network
AE	Allocative Efficiency
AERC	African Economic Research Consortium
CSDP	Cotton Sector Development Program
CEP	Centre for Economic Performance
CSDP	Cotton Sector Development Program
DALDO	District Agricultural and Livestock District Officer
DEA	Data Envelop Analysis
ECGA	Eastern Cotton Growing Area
EE	Economic Efficiency
EPP	Extension Package Program
FAO	Food and Agriculture Organization
FAO STAT	Food and Agriculture Organization Statistics
GDP	Gross Domestic Product
GM	Gross Margin
IAD	Institutional Analysis and Development
ICTSD	International Centre for Trade and Sustainable Development
IFPRI	
IRDP II	Integrated Rural Development Project Phase II
LR	Likelihood Ratio
MAFAP	Monitoring African Food and Agricultural Policies
MLE	Maximum Likelihood Estimator
NEPAD-	New Partnership for African Development

NIE	New Institutional Economics
OLS	Ordinary Least Square
SFA	Stochastic Frontier Analysis
SSA	Sub Saharan Africa (SSA)
TCB	Tanzania Cotton Board
TCMB	Tanzania Cotton Marketing Board
TE	Technical Efficiency
TVC	Total Variable Cost
TR	Total Revenue
USA	United State of America
USD	United state Dollars
WCGA	Western Cotton Growing Area

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Most of the people living in rural areas especially in developing countries are poor and depend mostly on agriculture. Cotton is the most important cash crop for many countries in the world, the crop seems to play a big role in alleviating poverty among rural household. Cotton also has a significant contribution to the GDP of countries. China is a leading producer and consumer of cotton in the world followed by India and the United State of America (USA). Almost all the cotton produced in china is consumed domestically. China is also a leading importer of cotton (Cotton Incorporated, 2014). Over the last 5 years USA is said to be the leading exporter of cotton accounting about third of all cotton export in the world market followed by India with a share of about 19% of the total export market, Central Asia 16%, Brazil and the C-4 countries (Benin, Burkina Faso, Chad and Mali) 6% and 3% respectively (ICTSD, 2013). The remaining part is contributed by other cotton producing countries in the world. This proportion places developed countries in a powerful position on influencing world price while developing countries remain price takers.

The economy of many African countries is still dependent on agriculture as most of the populations are living in the rural areas where agriculture is the dominant economic activity. Four countries are leading in cotton production commonly referred to as C-4. African cotton producers contribute only a small share accounting for only 5% of global production, 11% of exports, 5% of mill use and 10% of imports (ICTSD, 2013). Though the cotton subsector is said to be uncertain, the performance of the sector in developing countries in terms of cotton production, export and processing of cotton into finished product has been improving overtime. This improvement is due to efforts made by some African countries in supporting cotton farmers. For example the C-4 countries are amongst the top ten highly cotton supporting countries.

In Tanzaniacotton is the second largest export cash crop after coffee, contributing about US$90 million to export earnings. During 2011 the cotton sector employed about 500 000 rural households (TCB, 2011). Prior to 1994, the sector was dominated by regional cooperative unions and primary societies (Baffes, 2004). Cotton Export was done only by the government through the Tanzania cotton Marketing Board (TCMB). During the early nineties many of the cooperatives failed to operate due to corruption and financial mismanagement (Poulton and Maro, 2009). As a result, the government liberalized cotton marketing. Subsequently the remaining cooperatives failed to compete with private firms. This new institutional setup enabled cotton farmers to earn a higher share of the export price than before market liberalization. Cotton farmers reacted to the rise in price by increasing cotton production during 1995-96 (Poulton and Maro, 2009).

However it has been discussed by Poulton and Maro (2009), as well as Baffes (2004), that the collapse of cooperatives disrupted the input distribution system pushing up prices of inputs to levels that smallholder farmers could not afford. Lack of credit led to a decline in yields as farmers were not able to acquire inputs due to cash flow problems.

Following to failure of market liberalization in the cotton subsector, during the year 2006/07 the government introduced a Contract farming scheme in the cotton sub sector. Currently, farmers are allowed to grow cotton either under contract or independently.

Private ginning companies were allowed to enter into contract with cotton farmers who are organized into groups (George, 2012). With contract farming in place input use is said to have risen and the average yield has increased from 161kg/ha of seed cotton in 2001 to 760 kg/ha of seed cotton in 2009 (TCB, 2010).

The increase in average yield of seed cotton per hectare has been encouraging, implying that contract farming is playing the intended role toward improving cotton production. The decision by the government to introduce contract farming in the cotton subsector is consistent with the argument made by Askon (1997) that; contract farming is an institutional setup that responds to market failure. Askon suggested that when a farmer is unable to acquire necessary inputs in the right quantity and at the right time through the open market, the best alternative is to enter into contract farming arrangement, which ensures regular supply of desired raw materials. Conditions that require contract farming as suggested by Ask on also prevailing among cotton farmers in Tanzania.

1.2 Statement of the Problem and Justification

1.2.1 Statement of the problem

Different literature sources have explained the performance of the cotton subsector in Tanzania. Itika and Makauki (2007) found cotton farming to be an expensive activity, and farmers in the sub sector are characterized by limited access to inputs due to widespread poverty among them. Coles *et al*. (2011) observed that majority of cotton farmers are still practicing conventional agriculture and are still facing poor working conditions. Similarly, Bitzer and Glasbergen (2010) argued that poor working conditions for farmers had led to low productivity and reduction in agriculture earnings. Meanwhile, the government has implemented different initiatives to facilitate growth of the cotton subsector. In 2007 for example the Cotton sector development program (CSDP) was introduced, aiming at increasing cotton production by more than half, mainly focusing at improving contract farming and research programs. Recently, the Tanzania Cotton Board (TCB) embarked on promoting contract farming in the Western Cotton Growing Zone (WCGZ) to solve the problem of inefficiency in the cotton subsector, which includes low productivity and low quality of cotton (Naluyaga, 2011).

Although there is evidence that Tanzania has observed an increase in cotton production and productivity during the last few years, this increase in production could be due to increase in use of inputs, increase in area under cotton production or both. The increase in area is more likely because it has been noted that the productivity of cotton remains low and the potential productivity is yet to be achieved. The average yield of seed cotton in Tanzania has been reported to be 760 kg/ha (TCB, 2010), although yields of up to 1200 kg/ha can be realized (Tschirley *et al.,* 2008). Different stakeholders including the government and Tanzania Gatsby trust have taken measures to increase cotton productivity since 2006 through a contract farming scheme.

Evaluating the effectiveness of this intervention was important so as to provide feedback with the aim of improving the programme to attain higher cotton productivity and efficiency, hence improved farmers' welfare. Past studies on cotton farming in Tanzania have not focused on assessing production efficiency. Valerian (2012) addressed the impact of cotton contract farming on farmers' income. Mwangulumba and Buluma (2012) assessed cotton production and productivity based on the mean yield while Itika and Makauki (2007) addressed emerging issues on the part of the government and other institutions that provide services to the cotton subsector. This study investigated whether there are inefficiencies in cotton production under contract and/or non-contract farming resulting from poor utilization of available resources among cotton farmers in Bariadi district, Tanzania, where cotton production is an important economic activity for majority of smallholder farmers. The study also assessed whether contract farming had resulted in higher profit among cotton farmers compared to non-contract farmers.

1.2.2 Justification of the study

The presence of inefficiency means output can be increased without using more input (Bravo-ureta *et al.*, 1997). Reducing inefficient could lead to shortrun increase in output and thus income without necessarily using more inputs or introducing new technology. Evaluating the effectiveness of the contract farming programme as it is implemented in Bariadi district was important in order to determine whether it is improving the performance of cotton production in the district such that it could be replicated in other parts of the country. Conversely, through the evaluation, avenues for reducing the inefficiency could be identified thereby improving productivity and production without applying any additional inputs. In this study factors that affect efficiency of contract and non-contract cotton farmers were determined. Results from this study are useful to the government and other stakeholders in the cotton sub-sector in Tanzania, especially in creating awareness regarding areas for intervention toward improving cotton productivity and production among small holder cotton farmers through contract farming.

1.3 Research Objectives

1.3.1 Overall objective

This study sought to compare the profitability and measure the production efficiency of cotton farmers under contract and non-contract cotton farmers in Bariadi district, Simiyu region of Tanzania.

1.3.2 Specific objectives

The study pursued four specific objectives as follows;

(i) To assess the trend of cotton production overtime and the share of cotton from contract farming in the study area.

(ii) To assess and compare the Technical efficiency (TE) of contract and non-contract cotton farmers.

(iii) To determine the effect of factors that influences the TE of cotton farmers under contract and non-contract farming.

(iv) To determine and compare profit levels of cotton farmers under contract and non-contract farming in the study area.

1.4 Research Hypothesis

Based on the specific objectives, three hypotheses were tested as follows:

In relation to specific objective number two, the null hypothesis was; Contract and non-contract cotton farmers are equally technically efficient.

Mathematically;

$H_O: \bar{TE}_{CF} = \bar{TE}_{NCF}$ .... (1.1)

The alternative hypothesis was; Contract cotton farmers are more technically efficient than non-contract cotton farmers.

Mathematically;

$$H_A: \bar{TE}_{CF} > \bar{TE}_{NCF} \text{ ……………………………………..……………… (1.2)}$$

Where; $\bar{TE}_{CF}$ is the mean technical efficient of contract farmers and $\bar{TE}_{NCF}$ is the mean technical efficiency of non-contract cotton farmers. In relation to specific objective number three, the null hypothesis was; Coefficients of selected farmers' characteristics affecting TE for contract and non-contract cotton farmers are equal.

Mathematically;

$$H_O: \rho_{iCF} = \rho_{iNCF} \text{ ……………………………......………………………….. (1.3)}$$

The alternative hypothesis was; the coefficients of selected cotton farmers' characteristics affecting TE between contract and non-contract cotton farmers are not equal.

Mathematically;

$$H_A: \rho_{jCF} \neq \rho_{jiNCF} \text{ …………………………...…………………………………….. (1.4)}$$

Where; ρ_{jCF} is the j^{th} coefficient of the i^{th} contract respondents characteristics and ρ_{jNCF} is the j^{th} coefficients of i^{th} noncontract respondents characteristics.

In relation to specific objective number four, the null hypothesis was; Average profits per acre between contract and non-contract cotton farmers are equal.

Mathematically;

$$H_O: \bar{\pi}_{CF}/acre = \bar{\pi}_{NCF}/acre \text{ …………………………..…………………… (1.5)}$$

The alternative hypothesis was; average profits per acre between contract and non-contract cotton farmers are not equal.

Mathematically;

H$_A$: $\bar{\pi}_{CF}/acre \neq \bar{\pi}_{NCF}/acre$ …………………………………….……………… (1.6)

Where; $\bar{\pi}_{CF}$ is the average profit for contract cotton farmers and $\bar{\pi}_{NCF}$ is the average profit for non-contract cotton farmers.

1.5 Organization of the Study

This thesis is organized in five chapters. The first chapter presents the background information for the study covering the; problem statement; justification of the study, objectives of the study and the study's hypotheses. In the second chapter, different literature on cotton and farmers efficiency under contract farming, factors affecting efficiency and profitability of farmers under contract farming are reviewed. The third chapter presents the methodology while the fourth chapter presents results and discussions. The Conclusion and recommendations of the study are given in the fifth chapter.

1.6 Shortcomings of the Study

The study encountered some shortcoming as failure of farmers to keep past records, especially for non-contract farmers while it was important for commercial farming farmers. On the other hand, limited fund and time were also a challenge.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Contract Farming

The term contract farming has been defined in different ways; this study adopts the definition by Little and Watts (1994) who defined contract farming to be a situation where farmers raise or grow agricultural commodities for a vertically integrated corporation under a forward contract. In a forward contract, farmers are assured about the market for inputs and output. For example, in the cotton subsector, cotton farmers are provided with inputs based on an agreement to sell the cotton output to the contractor. There are numerous ways of classifying contract schemes. In this study, three common ways are reviewed.

First, Dansson *et al.* (2005) classified contract schemes according to the formality of contract itself. Two types of contracts are described. An oral agreement between a farmer and a buyer; this type of agreement is said to be more common when a buyer is a trader purchasing a crop to resell in the wholesale market. Unlike oral agreement, a formal written contract involves a document that specifies input use, production methods, minimum quality standards and the price at which the product will be purchased. This type of contract is more commonly offered by large processing firms. Dansson *et al.,* further states that, formal contracts are more common in Kenya and South Africa while informal contracts are the norm in Ghana, Nigeria and Uganda and many other African countries.

Second, contract farming schemes can also be classified according to the type of commitments made in the contract between the buyer and seller. Mighell and Jones (1963) classified contract farming schemes into three categories. Market specifying contract; in this category, terms of sales transaction with regard to price, quantity, timing and product attributes are specified. This type of contract makes sense when market coordination is needed but the farmer does not need assistance in obtaining inputs and the buyer is not concerned about production methods since product quality can be measured at harvest. Another category is resource-providing contract where the buyer also provides agricultural inputs and technical assistance on credit. This type of contract is appropriate when the buyer has better access to credit and specialized inputs that are needed for production. Due to the need to specify the terms for input credit, resource providing contracts are more likely to be formal.

The last category is production-management contract, which specify the manner under which a commodity is to be grown, such as the planting density, use of pesticides and timing of harvest. This type of contract is useful when the buyer has more information about production methods or wants to ensure a level of quality or food safety. For example, a buyer may specify the types of pesticides to be used and the timing of their application to ensure that pesticides residue standards are met.

Martinez (2002) however argued that, in practice many contracts combine elements of all three categories. For example, the contract may specify the production methods and the terms of sale as well as providing inputs to farmers on credit. Third, the last dimension of classifying contract farming schemes in this study is the way price is determined and paid. Minot (2011) categorized three types of contract farming under the price dimension.

This includes fixed-price contracts where the price is fixed at planting time by the buyer. This kind of contract seems to have the risk reducing advantage to farmers, but it also leads to side selling problems where farmers violate the terms of the contract by selling some or all of their harvest to the market in case the market price diverges too much from the fixed price at the time of harvest. Conversely, if the price is lower, the buyer may be tempted to purchase their supplies from the market rather than the contracted farmers. Another contract type under this dimension is formula-price contract, to avoid the problem of side selling, contract farming schemes sometimes rely on formula pricing in which the buyer agrees to pay a price which is based on a market price and or the market price plus a percentage premium. Farmers are assured that they will be at least as well off as if they had produced for the market. Minot pointed out the last type of contract farming schemes under the price dimension to be split-payment contracts, in which the buyer makes two or more payments to the farmers. The first payment is usually a fixed price determined before planting, while subsequent payments vary depending on the sales price realized by the buyer. This system is often said to be used by processor and exporters in the case of cotton.

Contract farming has been the focus of many studies since the late 1980s. For example, Minot (1986) discussed the role of smallholders in the course of economic growth and the influence of contract farming. By considering potentials and constraints of contract farming, Minot concluded that in almost all cases contract farming succeeded in improving income. Agro-processing firms, with whom farmers enter into contract agreement to produce a particular crop, provide new techniques of production for accessing the recommended quality and quantity for meeting the consumer's demand (MacBride, 2003). Such firms have direct interest towards improving the quality of product and therefore are willing to offer improved and better technical assistance more effectively than government's agricultural extension services (Minot, 1986). In addition, they also have an incentive to learn from farmers experience and modify their advice accordingly.

Contract farming is expected to increase the productivity and efficiency of a farm (Ramswami *et al.,* 2005). The argument is that when growing crops under contract, the contractor facilitates the production and therefore reduces risks in relation to credit, input, technology and price. The technical assistance provided under contract involves farm visits and advising the growers to apply seeds, pesticide, and fertilizer at the right time and in correct proportions. Contracting is therefore said to relieve farmers from credit constraints and market constraints, and thus enabling them to apply inputs at an optimum levels. Meanwhile, farmers have to cover the entire cost of production for growing non-contract crop; and hence farmers may not be able to apply inputs at optimum levels because of market imperfection. The decline in rate of inputs used reduces the efficiency of land and labor, resulting in reduced farm efficiency. From that point of view, a farmer is likely to be more productive and efficient when growing under a contract scheme compared to growing under non-contract arrangement.

2.2 Contract and Cotton Contract Farming in Sub-Saharan Africa (SSA)

Small farmers in sub-Saharan Africa, like those in other developing regions, face a number of constraints that limit their productivity (Minot, 2011). They lack information about production methods and market opportunities. Farmers in this region are said to be more familiar with subsistence crops and perhaps a few widely grown cash crops. Even with sufficient information about profitable investments, small holder farmers often lack access to credit due to lack of collateral. Minot suggested that contract farming has attracted the interest of researchers and policy makers because it has the potential to solve several of these constraints simultaneously.

Cotton is the main source of income to farmers in a large part of sub-Saharan Africa (SSA) (Tschirley *et al.,* 2009). Most of the cotton farmers in SSA are small, engaging in low intensity production. They often lack access to market information. Contract farming is envisaged to play an important role in overcoming the information gap problem (Sautier *et al.*, 2006). According to NEPAD (2006) all of the cotton and tobacco in Mozambique, 90% of the cotton in Malawi, and 70% of the cotton in Zimbabwe were produced through contract farming. In Zambia 100% of paprika, tobacco and cotton are produced through contract farming. In a comparative study for cotton across nine SSA countries, Tschirley *et al*. (2008) argued that for contract farming to perform better, suitable institutional environmental conditions should be in place. Tschirley *et al*. (2008), further pointed out that the absence of suitable conditions affects the performance of contract farming as evident from low yield level of 575 kg/ha of seed cotton in Tanzania and Uganda, compared to the potential yield of 1200kg/ha. The two countries were said to introduce contract farming while free trade was still allowed, this encourages the moral hazard problem among contracted farmers where farmers cheated their contractor by selling part of the cotton to other buyers. As a result contractors withdrew or provided less input.

2.3 Cotton and Cotton Contract Farming in Tanzania

2.3.1 Cotton production

During the last 20 years Tanzania had an average close to 400 000 ha under cotton production. Production trends have steadily increased as area, yields has improved from a five year average of 0.46 tons/ha in 1990-94 to 0.64 tons/ha in 2005-09 (Mwinuka and Maro, 2013).

2.3.2 Regional Share of seed cotton production in tones (2004/05-2010/11)

Cotton is currently grown in several regions of Tanzania but most of the production is in the western zone where farmers are able to earn an average income of USD 226 per acre (TCB, 2010). Based on TCB data, 13 out of 23 regions produce cotton in the country. This data did not take into account the current number of 25 regions in Tanzania. Most of the production (over 99%) is concentrated in the western cotton growing area (WCGA). For the period between production seasons of 2004/05-2010/11, Shinyanga produced 62% of total seed cotton in the country, followed by Mwanza (23%), Mara (8%), (4%) and Kagera, Kigoma and Singida (2%). Unlike production in WCGA the Eastern cotton growing area (ECGA) comprising of Manyara, Morogoro, Kilimanjaro, Coast, Tanga and Iringa accounts for a maximum of 1% of total production. All the production and ginning takes place in the producing areas after which cotton is sent to Dar es Salaam for further processing and or export.

2.3.3 Cotton consumption and utilization

The literature shows that Seed cotton in Tanzania is mostly used by local ginners that separate the fiber from the seed to produce cotton lint. The lint then goes to local textile industries mainly to spinners that transform the fiber into yarn, while the seed is typically used for planting and/or for producing oil and animal feed. According to Mwinuka (2013) cotton products follows the following composition or proportion; first from 100% of the raw cotton 32%forms cotton lint, 62% of cotton seed and 4% comes as waste at the ginning stage. Thereafter, from the cotton seed 8.5% come out as the fresh seed while 91.5% is processed cotton, of which 14%, 46% and 40% constitute oil, cake and hulls respectively.

2.3.4 Cotton marketing and trade

According to Mwinuka and Maro (2013), during the period 2000-09 out of the four products that can be derived from seed cotton (lint, seed, cake and oil) Tanzania was the net exporter of lint, seed and seed cake while importing cotton seed oil. Statistics show that an export of cotton lint from Tanzania is increasing. The same applies to cotton seed cake, with the share of exports to production increased from an average of 40% during 2000-04 to 64% during 2005-10. Most of these exports go to Kenya, Uganda and South Africa. This trend suggests that if the Government of Tanzania increases efforts including improving cotton quality, the country's competitiveness will increase in the world market and improving cotton exports will increase even further.

2.4 Analytical Issues

2.4.1 Assessing production efficiency

When considering contract farming as a tool for rural development, it is necessary to assess its production efficiency comparing it to other production schemes. The stochastic frontier model has been widely used to estimate TE of different production systems in agriculture including cotton. The study by Jaenicke *et al.,* (2003) titled Estimating production risk and inefficiency simultaneously, compared the inefficiency between four cotton cropping systems. The mean TE were estimated to be 0.765 for wheat system, 0.727 for cover system, 0.701 for no cover production system and 0.687 for vetch system. The results indicate that the TE of wheat system is highest, hence more technically efficient than the other systems. Swain (2013) compared production of the rice crop under contract and non-contract. The results indicated that farmers under contract were able to attain a higher level of technical efficiency of 89% compared to 82% for non-contract farmers.

Alena and Hassan (2008) undertook a comparative study titled Efficiency of Food production under old and new technology. They used a stochastic production function approach to measure technical, allocative and economic efficiency of farmers within and outside the extension package program (EPP), in two different agro ecological zones high (Meta district) and low (Babile district) in Eastern Ethiopia. Two groups of farmers were selected, those in EPP and those outside the program. The results indicated efficiency variation not only among farmers outside EPP who used traditional technologies, but also among farmers within EPP who used improved technological packages. In the case of the high potential region (Meta district) the mean TE was 79% and 72% for farmers within and outside EPP respectively. In the low potential region (Babile district) the gap in mean TE declined, being 68% and 66% for farmers within and outside the program respectively. The results indicated that farmers within EPP are more technically efficient than farmers outside the EPP.

Rawlins (1985) evaluated the effects of the Jamaica second integrated Rural Development Project (IRDPII) on the level of technical efficiency for peasant farmers by using cross sectional frontier model. Although the results showed that non-contract farmers have higher average technical efficiency, they concluded that contract farming drives up the frontier of participating farmers. Ramswani *et al.* (2006) focused on the efficiency factor of contract farming in India among poultry farmers. They found that farmers who were involved in contract farming achieved a higher level of efficiency than their counterparts' non-contract farmers mainly due to a higher feed-conversion ratio. Saigenji and Zeller (2009) examined the effect of contract farming on the productivity and income of smallholder tea farmers in north-western Vietnam. It was found that the mean technical efficiency of 69% for contract farmers was higher than the mean technical efficiency of 47% for non-contract farmers. They suggested that the difference in TE might be caused by factors such as the timing of certain management measures.

A study by Swain (2013) on productivity and farmers efficiency under contract farming for rice seed cultivation in Southern India found a wide variation in efficiency across crops. The mean TE of 89% was observed for contract crop and 82% for non-contract crop. These results implied that farmers are more technically efficient for growing crop under contract compared to non-contract farmers. The result indicated further that around 56% of farmers could achieve 91 to 100% of the output obtained by the most technically efficient farmer in case of contract crop, whereas it was only possible to increase efficiency by 22% for non-contract crop. The variation was observed to be larger for noncontract crop. All these studies support the argument that growing crops under contract is more technically efficient than non-contract crop because of the, provision of inputs, supervision and technical assistance under contract farming.

2.4.2 Assessing Factors influencing production efficiency

Bravo-Ureta and Evenson (1994) examined technical, allocative and economic efficiency by estimating separate Cobb-Douglas production frontiers of peasant farmers in eastern Paraguay. They found that there is no strong relation between socio-economic characteristics and productivity of farmers. In another study Bachewe *et al.* (2010) focused on factors that explain variation in efficiency among subsistence farmers in Ethiopia. They found age of head household to have a positive sign implying that farmers become less efficient as they get older. The study also established that literate farmers were more efficient than illiterate farmers; the coefficient on gender was negative indicating those female headed households were less efficient than male headed households.

This may be the case because in most cases females became head of household only when males are deceased or not around, therefore when females are head of the household they only take farming activity in addition to their traditional homemaker roles. It was established also that female headed household lack resources, labour, credit and hence unable to attain optimum production. The study by Kumar (2006) on tomato and potato contract farming in India noted no difference in farm productivity between contract and non-contract farmers but in factors that induce production across contract and non-contract farmers. Kumar noted that chemical inputs have higher elasticity on production in case of the contract farmers, whereas, the opposite was observed among non-contract farmers. Another study by Aswoga *et al.* (2011) examined economic efficiency of small scale rice farmers in Nigeria. They focused also in factors influencing inefficiency. The coefficient of age, education, farming experience, household size, dependency ratio, access to extension and household distance to the nearest city were found to be negative and significant at 5% level. The negative coefficients implied that an increase in any of or all of the variables would lead to decline in the level of technical inefficiency. While the coefficient for household distance to the nearest market was positive implying that an increase in this variable would lead to increase in the level of technical inefficiency.

2.4.3 Approaches for Assessing Technical efficiency

Farmer's technical efficiency is characterized by the relationship between observed and some potential production (Green, 1993). The measurement of firm specific technical efficiency is based on deviations of observed output from the best production or the efficient production frontier. When actual production lies along the frontier, a farmer is said to be perfectly efficient. Basing on the definition of technical efficient by Farrell (1957) methods for estimating relative technical efficiency of farmers was developed. The common feature of these estimation techniques is that, information on the highest efficiency is obtained based on extreme observations from a body of data to determine the best practice located on the production frontier. Then the relative measure of technical efficiency for the remaining farmer can be derived.

Approaches for estimating technical efficient can be parametric or non-parametric methods (Seiford and Thrall, 1990). While parametric approaches meet the assumptions of normality, equal variance and independence, non-parametric approach do not rely on all the three assumptions and they do not need specification of functional forms. Normally; the parametric approach uses linear programming methods for estimating efficiency. However, this approach is subjected to many limitations such as being extremely sensitive to outliers, it does not take into account non-constant return to scale and it does not lend itself to standard statistical tests of significances (Admassie and

Matambalya, 2002). Two analytical tools are widely used for measuring efficiency of a decision making unit. They include; the non-parametric Data Envelop Analysis (DEA) and the parametric Stochastic Frontier Analysis (SFA).

Based on the stochastic frontier production function, different approaches can be adopted to analyze the determinants of technical efficiency. One can use the two-step procedure where the frontier production function is first estimated to determine technical efficiency indicators, thereafter the technical efficiency scores obtained are regressed against a set of explanatory variables, usually are the firms specific characteristics (Ogundele and Okoruwa, 2006). The advantages of the stochastic frontier approach over other approaches are that; it allows stochastic noise because it assumes that firms may deviate from the frontier not only because of technical inefficiency but also because of measurement errors.

The approach also permits statistical tests of hypotheses pertaining to the structure and degree of inefficiency. In the first step of the stochastic production frontier the error term (inefficiency effects) is assumed to be identically independently distributed and the technical efficiency scores obtained are said to depend on a number of firm's specific characteristics, implying that the inefficiency effects are not identically distributed (Battes and Coelli, 1992). The main drawback is the assumption of an explicit functional form for the distribution of the inefficiency terms (Kumbhakar*,* 1994). Thus the stochastic frontier approach violates assumption about the error term, that the mean of the error terms given the independent variables is zero ($E[u_i] = 0$).

Due to the drawback mentioned above a more consistent approach was developed, which models inefficiency effects as an explicit function of certain firm's specific characteristics, using maximum likelihood estimation. In this approach, all the parameters are estimated in one step (Ajibefun and Daramola, 2003). According to green 1993 the maximum likelihood procedure (MLE) is a more consistent and asymptotically efficient estimator which allows for random error estimation as opposed to ordinary least Square (OLS).

2.5 Assessing the Profit Level

While TE is an important factor in production, rational economic agents are driven by the profit motive to engage in various economic activities. Joining a contract farming program has the promise of higher net returns but also the uncertain of loss in case the contract fails or is not honored. Profit is the return made in a business activity for the benefit of the owner of the business or shareholder. The word comes from the Latin meaning "to make progress." Profit is defined in two different ways, one for economics and another one for accounting purposes.

Pure economic profit refers to an increase in wealth from a certain investment, taking into consideration all cost associated with a given investment including the opportunity cost of capital Makeham and Malcom (1986). Meanwhile Kumbhakar (1994) defined accounting profit as the difference between price and costs of bringing output or services to the market (both operational cost and delivery cost). A firm is said to be making profit if revenue exceed the cost of production.

Kunene (2010) in a study on profitability and allocative efficiency of broiler production in Swaziland, compared profitability and allocative efficiency between contract and non-contract broiler farmers. It was found that Net profit was higher for non-contract than contract farmers. The result revealed that feed cost, feed conversion and veterinary cost was much higher for contract farmers than non-contract farmers. In another study Ramswami *et al.* (2005) estimated the average returns of contract and non-contract farmers, they concluded that contract farming enables farmers with poorer prospects to generate a comparable income to non-contract farmers with better prospects.

Similarly Birthal *et al.* (2008) examined the net revenue of contracted and non-contracted smallholder dairy farmers in India. They found that net revenue per unit of output while excluding family labor cost was higher for contract farmers compared to independent farmers, but the difference was not significant. It was noted also that, contract farmers did not have any significant difference in milk yield and cost of production relative to independent farmer. However, the independent farmers who sold milk in the open market received a higher price than contract farmers who were selling to a specific buyer. Although the study found there was no significant difference in revenue, authors concluded that contract farming helped to improve farm profitability by reducing transaction costs. The scenario by Ramswami *et al.* (2005) suggest that if contract farmers were to be assured a higher price as non-contract farmers did they could achieve a significance difference in profit from non-contract farmers.

2.6 Gross Margin Approaches

Various methods have been used to determine the level of firms' profit. Some of the most used procedure is Profit margin that takes into account variable cost and fixed cost.

Another method is Gross margin analysis, which unlike profit margin takes into account only the variable costs. Those two approaches are discussed further in the following part.

Profit margins as stated earlier measures the profit of a firm by summing the fixed and variable cost items and then subtract it from gross returns obtained from the sale of the crop, livestock or enterprise. In most cases farmers do not deduct an opportunity cost for their own money invested in farming. Moreover, they often ignore the cost of family labor in their budget as an expense. Debertin (1992) argued that the profit figure that often appears on farming enterprises is more of return against operational expenses excluding family labour cost.

Unlike profit margin, Gross margin analysis does not take into account the fixed cost pertaining to a given firm. Makeham and Malcom (1986) said Gross margin is determined by deducting variable costs from the gross income of a given crop and/ or livestock within a given period of time. Output and cost vary with the scale of enterprises. It is therefore expected that if an enterprise grows the Gross margin per hectare does not remain the same. This study used Gross margin analysis to determine the relative profit earned by contract and non-contract cotton farmers in Bariadi district.

Using the knowledge obtained from the reviewed studies and other sources, this study seeks to fill the knowledge gap regarding the TE of small holder cotton farmers in Tanzania. In chapter three, the analytical framework of production economic theory using the case of cotton production, econometric approaches for measuring technical efficiency and data collection procedures are outlined.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Theoretical Framework for Measuring Efficiency

The study was guided by the theory of the firm as modified by Hyuha *et al.* (2007). According to economic theory, a rational producer seeks to maximize profit or minimize cost as they allocate productive resources across enterprises. The theory identifies three important efficiency measures that are technical, allocative and economic efficiency. Technical efficiency (TE) refers to the ability of a firm to produce the maximum output from a given level of inputs. Allocative efficiency (AE) refers to the ability of using the inputs in an optimum way given their respective prices and the production technology. Economic efficiency (EE) refers to the capacity of a producer to produce a predetermined quantity at the minimum cost given a certain level of technology. Hence, EE is the combination of TE and AE. The study examined the TE for contract and non-contract cotton farmers in Bariadi district, Simiyu region of Tanzania. The study went on to examine the profitability level attained by farmers within and outside the contract scheme.

3.2 Conceptual Framework

The conceptual framework of this study was based on the institutional analysis and development (IAD) approach based on new institutional economics (NIE) developed by Dorward and Were (2005). The approach assumes that a set of exogenous variables are responsible for influencing the behavior of economic agents in a given institution. The concept is presented in Fig.1, where policy factors have an important influence on cotton productivity since they affect all of the other factors. Institutional factor affect production factors while some institutional and socio-economic factors tend to reinforce each other. For example female gender influences ones access to credit which inturn influences off-farm income. Production factors are used directly as inputs into the production process but availability and distribution of these inputs is affected by policy which in turn affects cotton productivity. Institutional and socio-economic factors influence cotton productivity directly through factors like distance to the market, belonging to farmer group, credit access and presence of effective extension services. All these were expected to have a positive effect on productivity. Meanwhile, a factor like age is expected to have a negative effect implying that as people grow older their ability to achieve higher productivity declines.

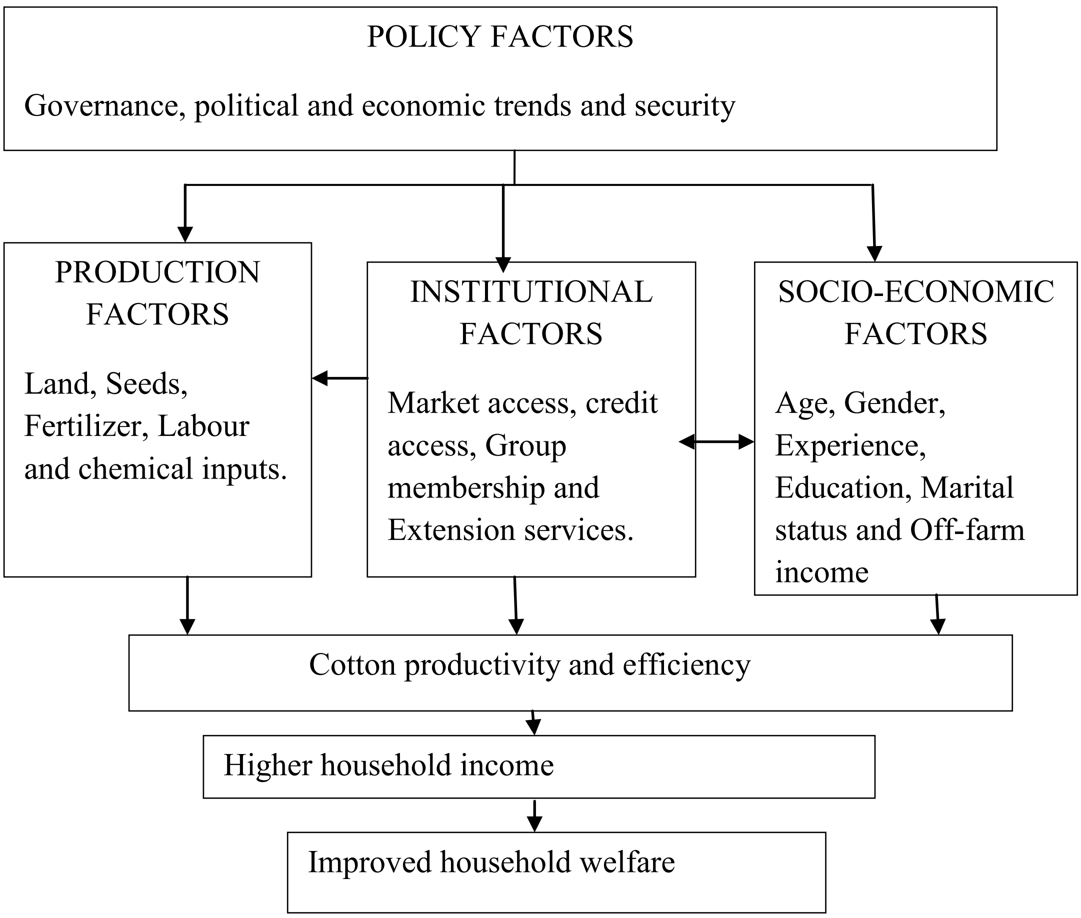

Figure 1: The conceptual framework of factors influencing production efficiency

Source: Dorward and Were (2005)

3.4 Analytical Framework

From Fig. 2 the analytical framework of this study is based on producer theory where farmers are said to allocate a combination of inputs to produce a given level of output at the minimum possible at the lowest isoquant curve. From another perspective, farmers may choose to allocate a given amount of input in order to maximize output on the production possibility frontier. Cotton farmers are said to be technically efficient if they are producing along the lowest isoquant curve or the highest production possibility frontier, (TE is equal to one), given the price ratio and the resource endowments.

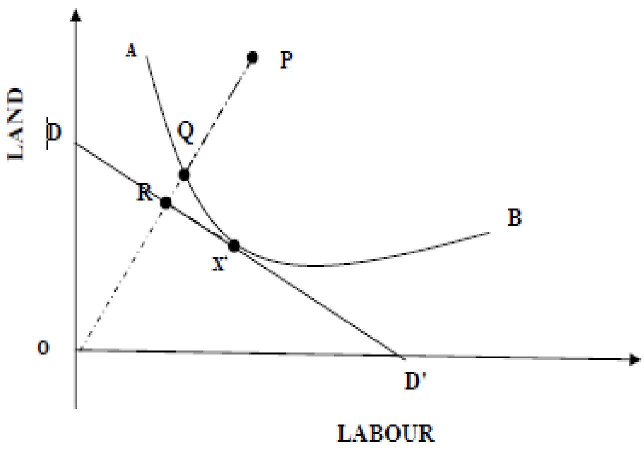

Figure 2: Input oriented efficiency measure

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

Using a simple example of two input (Land, Labour) efficiency can be considered in terms of the optimum combination of inputs to achieve a given level of output (an input oriented approach). If production is at point P, while the lowest Isoquant is AB, then $TE = {}^{OQ}\!/_{OP}$; $AE = {}^{OR}\!/_{OP}$ and $EE = {}^{OR}\!/_{OQ}$. Technical efficient (TE) considers the combination of input required to produce a given amount of output, allocative efficiency (AE) consider input cost for producing a given amount of output while Economic efficient (EE) represent the minimum cost to produce given amount of output (TE, AE, EE, ≤ 1). From another perspective (output oriented); efficiency can be considered as the optimal output that could be produced given a set of inputs.

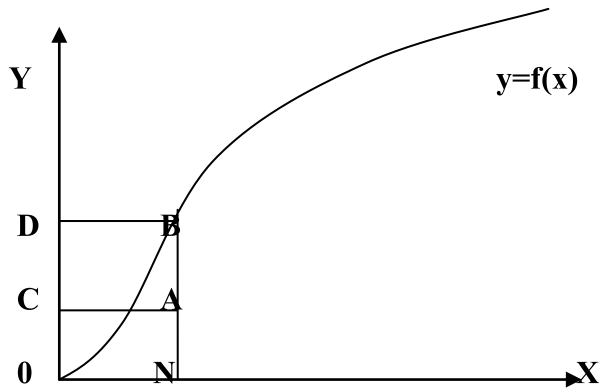

Figure 3: Output oriented efficiency measures

Source: Swain (2013).

In general, when the household is producing on the production frontier and is said to be technically efficient (TE=1), while TE<1 implies that the farm household is not technically efficient in cotton production. This is illustrated in fig. 3 where it is assumed that production employs two factors, land (L) and labour (N) to produce a single output Y. "A" is a point below the production frontier $f(x)$, and B is a point on the production frontier. Being at point A implies a technical inefficiency, $TE = {NA}/{NB}$ which is less than one while being at point B implies technical efficiency.

3.5 Model Specification

3.5.1 Descriptive statistics

To address the first specific objective of this study descriptive statistics using graphs was used to discern cotton production trends from conventional and contract farming overtime in the study area.

3.5.2 Stochastic production frontier

To address the second and third specific objectives, a stochastic production frontier model was used. A stochastic production frontier was estimated to compute the TE of each cotton farmer. Subsequently, the computed TE of each cotton farmer was regressed against a set of socio-economic and institutional factors to identify factors affecting cotton production. Farell (1957) defines TE as the ratio of the observed output to the highest potential output along the frontier, as estimated from the composed error term. The model in this study is based on improvement made by Bravo-ureta and Laszlo in 1990. A production function was used to define the stochastic production frontier from which an isoquant curve was derived is given in a general form as in Equation 2.1.

$$Y_i = f(X_i) \quad \text{...} (2.1)$$

Where;

Y_i represents cotton output of the i^{th} respondent

X_i represents farm specific production factors (size of land, amount of fertilizer, amount of seed, amount of chemical inputs and labour used in cotton production).

Different functional forms can be used to estimate the general production function specified in equation 2.1. Amongst, the most commonly used are; the Cobb-Douglas and the Trans log production functions. The Cobb-Douglas production function is used because of its simplicity and ease of estimation from agricultural data has been widely used (Derbetin, 1992). In this study, to establish the production frontier from which isoquant curve were derived, a Cobb-Douglas functional form was used to estimate parameter estimates of equation 2.2.According to Zaibet and Dharmapala (1999). The multiplicative form of the production function is given as in Equation 2.2:

$$Y_i = b_o \Pi X_{ij}^{b_{ij}} e^{\varepsilon_{ij}} \quad \text{……………………………………………………………} (2.2)$$

Where;

Y_i = Cotton output of the i^{th} respondent, for i=1, 2,…… n

X_{ij} = The j^{th} variable input for the i^{th} respondent; for i=1, 2,………, n; and j=1, 2,……k

Π = A steady multiplicative symbol

e = Natural logarithm

ε = Error term for the i^{th} respondent and the j^{th} input

b_o = A vector of a constant parameter and

b_{ij} = A vector of parameter estimates for the i^{th} respondent and the j^{th} input.

Linear transformation of equation (2.2) gives equation (2.3) that was used for parameter estimation, using frontier regression analysis.

$$\ln Y_i = \ln A + \sum_{i=1}^{n} \beta_i \ln X_i + \varepsilon_i \quad \text{……………..………………..…………………} (2.3)$$

Where;

ln =natural logarithm and all other variables are as previously defined.

In estimating the stochastic frontier function, the effects of socio-economic and institutional characteristics of the cotton farmers on the variation of the cotton output (Y_i)

were often lumped together in the error term, which accounts for the component of variation due to random, unsystematic and unexplained noise.

Equation (2.3) was estimated through the maximum likelihood estimation (MLE). According to Green (1993), MLE is a consistent and asymptotically efficient estimator that allows for random error estimation as opposed to ordinary least square (OLS) which is an inefficient estimator. From equation (2.3) the TE among cotton farmers was obtained from the conditional expectation of the error term u_i given ε_i $\left(E[-u_i/\varepsilon_i]\right)$. This measures the expected value of the random component of the error term as shown by Zaibet and Dharmapala (1999) and indicated in Equation 2.4:

$$E[-u_i/\varepsilon_i] = \frac{\sigma_u \sigma_v}{\sigma}\left[\frac{f^*\left(\lambda\varepsilon_i/\sigma\right)}{1-F^*\left(\lambda\varepsilon_i/\sigma\right)} - \frac{\varepsilon_i \lambda}{\sigma}\right] \quad \text{………………..……..… (2.4)}$$

Where;

σ_v = Standard error of v, the random component of the error term

σ_u = Standard error of u, the inefficiency component of the error term

$\lambda = \frac{\sigma_u}{\sigma_v}$ Ratio of the standard error of the error terms $(u \,\&\, v)$

f* = Value of a standard normal density function

F* = Value of the distribution function

$\sigma^2 = \sigma_u^2 + \sigma_v^2$ = Components of variance of the error terms

$E[-u_i/\varepsilon_i]$ = Conditional mean of u_i given ε, which measures expected value of the random component of the error term.

The error term (ε_i) in equation (2.4) have two components u_i and v_i such that:

$$\varepsilon_i = v_i - u_i \quad \text{……………………………………………………….…………… (2.5)}$$

Where;

$v_i =$ Random error associated with random factors, farmers have no control on it. It follows a normal distribution having zero mean and constant variance given as $v \sim N(0, \sigma_V^2)$. The second component of the error term u_i captures the technical inefficiency of the individual cotton farmer. It can take either a half normal, exponential or gamma distribution. This study assumes this component (u) is a non-negative half normal random variable truncated at zero, has a variance σ^2, with a distribution given as $u \sim (0, \sigma_u^2)$.

Technical efficiency is measured as the mean of the negative value of the inefficiency component of the error term (-u) or $\frac{\sum_{i=1}^{n}(-u_i)}{n}$, also as given in equation (2.6) such that $0 \leq TE \leq 1$

$$TE_i = \exp(E[-u_i / \varepsilon_i]) \quad \text{……………………….……………………….………… (2.6)}$$

The inefficient component (u_i) is associated with farmers' socio-economic and institutional factors. The mean values of u_i can be determined by equation (2.7):

$$u_i = \rho_i z_i \quad \text{…………………………………...……………………………… (2.7)}$$

Where;

z_i represents inefficiency variable for the i^{th} respondent; i=1, 2,….. n;

ρ_i = Parameter estimates for the i^{th} respondent.

It is socio-economic and institutional factors that cause performance difference among farmers, some being more efficient than others.

3.5.3 Empirical models

To estimate the stochastic frontier, a two-step process was followed. First, using a transformed linear Cobb-Douglas type production function as derived in Equation (2.3), where cotton output(Y_i) was regressed against the size of the land (X_1), amount of; seeds (X_2), fertilizer (X_3), chemical input (X_4), labour used (X_5) as given in equation (2.8):

$$\ln Y_i = \beta_o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + v_i - u_i \quad \text{................ (2.8)}$$

Where v_i and u_i are the random error and technical inefficiency effects of the error term respectively. The TE of each respondent was computed as the deviation between Y_i and Y_P where Y_P is the potential output obtained by the best performing farmer while Y_i is the output of the ith farmer. Thereafter, the second step was followed based on equation (2.7), where the effect of socio-economic and institutional factors on the variation of TE was estimated through the maximum likelihood model. The inefficiency component of the error term u_i was regressed against respondents gender (z_1); age (z_2); education level (z_3); occupation (z_4); experience (z_5); access to extension services (z_6); access to credit(z_7); off-farm income (z_8); distance to the market (z_9); and belonging to farmer group (z_{10}). These variables were thought to influence respondent's observed output deviating from the potential output level. The model for empirical estimation is as presented in equation (2.9):

$$u_i = \rho_o + \rho_1 z_1 + \rho_2 z_2 + \rho_3 z_3 + \rho_4 z_4 + \rho_5 z_5 + \rho_6 z_6 + \rho_7 z_7 + \rho_8 z_8 + \rho_9 z_9 + \rho_{10} z_{10} \quad \text{..............................2.9}$$

In practice the frontier tool version 4.1 gives result of the two processes at once (Equation 2.8 and 2.9). For the purpose of this study the result of the two specific objectives as described in this section were discussed separately for better clarity in deriving the analytical process.

The final model which was used in the analysis is as follows;

$$\ln Y_i = \beta_o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \rho_0 + \rho_1 Z_1 + \rho_2 Z_2 + \rho_3 Z_3 + \rho_4 Z_4 + \rho_5 Z_5 + \rho_6 Z_6 + \rho_7 Z_7 + \rho_8 Z_8 + \rho_9 Z_9 + \nu - \mu \quad (2.10)$$

Table 2: List of variables for estimating stochastic production frontier

Variable	Description	Measurement unit	Expected sign
Yield (Y)	Quantity of cotton yield	Number of bags	
Area (X_1)	Size of the land under cotton cultivation	Hectares	+
Seeds (X_2)	Amount of cotton seeds used	Kilograms	+
Chemical input (X_3)	Quantity of pesticides, herbicides and fungicides used	Liters	+/-
Fertilizer (X_4)	Quantity of fertilizer used	Kilograms	+/-
Labour (X_5)	Hired and family used in cotton	Man days	+/-

Table 3: List of variables for estimating inefficient model

Variable	Description	Measurement unit	Expected sign
μ_i (Dependent)	TE of the i[th] farm	%	
Gender (z_1)	Sex of the household head	1=female 0=male	+
Age (z_2)	Number of years of cotton farmer	Years	+
Education (z_3)	Level of education of cotton farmer	Years of schooling	-
Experience (z_5)	Experience of the bean farmer	Years of farming	-
Extension (z_6)	Access to extension services	1=Yes, 0= No	-
Credit (z_7)	Amount of credit borrowed for farming	Tsh.	-
Distance (z_9)	Proxity for distance to the nearest input market	Km	-
GRPMSHP (z_{10})	Membership in farmers association	1=Yes. 0=No	-

3.6 Gross Margin (GM) Analysis

To address the fourth objective of determining levels of profit of cotton farmers under contract and non-contract farmers. Gross Margin Analysis was used. Gross Margin is expressed as

$$GM = TR - TVC$$

Where;

GM Represents Gross Margin

TR Represents Total Revenue

TVC Represents Total Variable Cost

The Gross Margin (GM) of each farmer was computed, and comparison of the mean GM of contract and non-contract farmers as well as their percentile distribution from the highest to the lowest profit levels was made.

3.7 Research Design

A cross-sectional research design was used where the survey was done at a single point in time. This design was used because the data were collected once in the study area.

3.8 Sampling Procedure

A multistage sampling technique was used, whereby Dutwa division was selected out of 4 divisions in Bariadi district. Ikungulyabashashi ward was chosen randomly and from it two villages of Mkuyuni and Ikungulyabashashi were randomly selected using the table of random numbers among 4villages already having contract farming scheme. A list of cotton farmers that are under contract and those not under contract farming constituted the sampling framework. A total of 120 cotton farmers were randomly selected of whom 70 belong to contract farming and 50 non-contract farming. According to Bailey (1998), a sub-sample of 30 respondents is the bare minimum for studies in which statistical analysis can be done for inference from the sample of the population. The aim of using this sampling technique is to avoid selection bias.

3.9 Data and Data Collection Procedure

Primary data collection took place between March and February 2014 using a structured personal questionnaire (Appendices 1). The information on cotton output, farm specific factors, institution and socio-economic factors as shown on the empirical models were collected. These include among others cotton output, amount of seeds, gender, age and experience. Data on values of output were obtained as the product of total output sold and the price while data on cost was collected as the price of inputs and other operational cost incurred by a farmer.

Secondary data on various aspects; including cotton production, cotton sales, number of cotton farmers' over time was obtained from Bariadi District Agricultural and Livestock Officer (DALDO) and the Tanzania Cotton Board (TCB).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic and Institutional Characteristics of Respondents

4.1.1 Sex of respondents

From a sample of 120 contract farmers; 70 and 50 farmers constitute contract and non-contract cotton farmers respectively. Table 3 shows the composition of respondents by gender. Majority of the respondents were male with only 8.6% and 20%being females under contract and non-contract farming respectively. Culture seems to be the reason why in the study area most of household are headed by men. The findings show further that in Bariadi there were few females participating in contract farming than those who participated in non-contract farming.

Table 4: Sex of respondents

Gender	Contract farmers		Non-contract farmers	
	Number	**Percentage**	**Number**	**Percentage**
Male	64	91.4	40	80.0
Female	6	8.6	10	20.0
Total	70	100.0	50	100.0

4.1.2 Age of respondents

Results in Table 4 show that the mean age for contract farmers was higher (38.8 years) than the mean age for non-contract farmers (35.7 years). The difference between the lowest and highest age from18 to 82 was 54 years and from 20 to 54 years for contract and non-contract farmer respectively. The results further show that majority of farmers were between 40 and 50 years old for contract and non-contract farming respectively. The result indicate that the mean age of females (39) in contract farming is higher than that of males (37) while in non-contract farming mean age of males (40) was found to be higher than that of females (35). Generally, in the study area most farmers were in the productive age.

Table 5: Age of respondents

Standard measure of the sample	Contract farmers			Non-contract farmers		
	M	**F**	**T**	**M**	**F**	**T**
Number of respondents	64	6	70	41	9	50
Mean	37	39	38.8	40	31	35.70
Mode	40	40	40	50	40	50
Standard deviation			12.3			10.91
Minimum			18			20
Maximum			82			54

4.1.3 Marital status of respondents

Results from Table 5 shows that among the contract farmers 90% were married and 7% of farmers were not married, for non-contract respondents about 84% were married and 16%were single. The percentage of married respondents was higher for males in both groups than that of females. It was found that 92% of males in contract farming were married contrary to 89% for females. Result found that 87% of males in non-contract were married contrary to 75% of females. Furthermore, using the t-test the difference in marital status between contract and non-contract farming was not significant.

Table 6: Marital status of respondents

Marital status	Contract farmers				Non-contract farmers			
	Number	**Percent**	**M (%)**	**F (%)**	**Number**	**percent**	**M (%)**	**F (%)**
Married	63	90.0	92	89	42	84.0	87	75
Single	7	10.0	8	11	8	16.0	13	25
Total	70	100.0	**100**	**100**	50	100.0	**100**	**100**

4.1.4 Education level of respondents

According to the results from Table 6, majority of the sampled farmers had only 7 years of formal education. Contract farmers had a higher mean for schoolingat7.49 years compared to non-contract framers who had a mean of 6.88 years, implying that contract framers were more educated than the non-contract framers. The result further found that secondary education was the highest level attained in all of the groups while it was also observed that some of the sampled farmers didn't have any formal education.

Table 7 Education level of respondents

	Contract farmers				Non-contract farmers			
Category	Number		%		Number		%	
	M	F	M	F	M	F	M	F
None	3	1	7.3	11.1	2	1	2.6	25
1 – 7	36	6	87.8	66.7	64	3	84.2	75
Secondary	2	2	4.8	22.2	10	0	13.2	0

4.1.5 Respondents experience in running cotton farming (years)

Results from Table 7 show that there is little difference in the mean years of farming experience, with the mean farming experience for contract farmers being 16 years while the mean farming experience for non-contract farmers being 15 years. The minimum years of farming experience was 2 years for both categories but the maximum was higher for farmers under contract (67) compared to 36 years for non-contract farmers. The mean years of farming for males under contract farming (18) was higher than that of their counterpart under non-contract farming (11). Meanwhile, females under contract farming had less mean years of experience (8) compared to 13.5 of non-contract farming.

Table 8: Respondents experience in running cotton farming

Standard measure of the sample	Contract farmers			Non-contract farmers		
	M	F	T	M	F	T
Number of farmers	64	6	70	41	9	50
Mean	18.1	7.7	15.99	10.7	13.5	14.7
Mode	30	2	2	25	3	3
Std. Deviation			14.0			10.24
Minimum	2	2	2	3	2	2
Maximum	67	25	67	25	36	36

4.1.6 Respondent distance to inputs and output market

From Table 8 the results show that on average contract farmers are near to input and output market than non-contract farmers. The mean distance from the nearest input market was 5.7 km for contract farmers and 6.2 km for non-contract farmers. In the case of output market the mean distance was 2.8 and 3.4 km for contract and non-contract farmers respectively. Using the t-test statistics the mean difference in distance to the market was found to be statistically significant at $\alpha = 5\%$ level of significant. It was also found that majority of contract farmers were located 1km from input and output market while non-contract farmers were about 2 km from the input and output market. These findings imply that, farmers were travelling a longer distance to collect inputs than for selling their product. The reason for the difference is the tendency of buyers to locate their collection points within villages during harvest. The findings show that male household travels a longer distance for input and output market than female household. Table 8 shows that males under contract farming travel 2.9 and 2.3 km to input and output market respectively compared to 1.5 and 2.1 km for females.

Table 9: Distance from the input and output market (km).

Standard measure of the sample	Contract farmers						Non-contract farmers					
	Input market distance			Output market distance			Input market distance			Output market distance		
	M	F	T	M	F	T	M	F	T	M	F	T
Number of farmers	64	6	70	64	6	70	41	9	50	41	9	50
Mean	2.9	1.5	5.7	2.3	2.1	2.80	2.2	2.2	6.2	3.7	3.0	3.4
Mode	1	1	1.0	1	1	1.0	2	2	2.0	2	1.5	2.0
Std. Deviation			9.4			5.3			11.3			4.5
Minimum	1	1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	1	0.1
Maximum	30	2	30.0	30	4.4	30.0	68	5	68	20	6	20.0

4.1.7 Respondents belongings to farmers group

It was found from table 9 that all of the respondents in contract farming belong to a farmer group while only 70% of non-contract farmers belonged to a farmers group. Being in a group is one of the conditions that must be fulfilled for a farmer to enter into a contract while in the case of non-contract farmers joining a farmer group was optional. Table 9 shows that the number of males belongs to a farmer group among non-contract farmers was higher to number of females. 68.3% of males were observed to belong to a farmer group compared to 22.2% of females.

Table 10: Belonging to a farmer group

Farm group	Contract farmer						Non-contract farmer					
	Number			Percentage			Number			Percentage		
	M	F	T	M	F	T	M	F	T	M	F	T
Yes	64	6	70	100	100	100	28	2	35	68.3	22.2	70.0
No	0	0	0	0	0	0	13	7	15	31.6	77.8	30.0
Total	64	6	70	100	100	100	41	9	50	100	100	100.0

4.1.8 Respondents cotton farming information access

Table 10 shows that, at least 97 and 76% of contract and non-contract sampled farmers respectively were able to access information. The main source of information was extension officers. Other sources were Tanzania Cotton Board (TCB) and other farmers;

the higher percentage for contract farmers reflects the role of contract to cotton farmers. Males household were observed to access information widely compared to females.

Table 11: Respondents access to information on cotton farming

Information access	Contract farmers						Non-contract farmers					
	Number			Percentage			Number			Percentage		
	M	F	T	M	F	T	M	F	T	M	F	T
No	2	1	2	3.1	16.7	2.9	29	7	12	70.7	77.7	24.0
Yes	62	5	68	96.9	83.3	97.1	12	2	38	29.3	22.3	76.0
Total	64	6	70	100	100	100.0	41	9	50	100	100	100.0

4.2 Area under Cotton and Cotton Production Trends in Bariadi District

Total area under cotton and cotton production trends in Bariadi districts have been fluctuating overtime. It is during the first three season from 1991/92-1993/94 as indicated in fig.4that both area allocated to cotton and cotton production were observed to be stable and were at the same level about 20 115 ha and 20 115 tons for area and production respectively. Thereafter, the area under cotton and cotton production started to fluctuate. Production in tons has been higher than area under cotton throughout the interval 1991/92-2011/12 except for the season 2008/09.The area allocated to cotton production was highest during 2008/09 season when a total of 63 975 ha were cultivated and the lowest occurred during 1992/93where only 19903 ha were cultivated. Within the same interval cotton production was highest during 2005/06 season when 72 101 tons of seed cotton were harvested and was lowest during the 1992/93 season when only 19 903 tons of seed cotton were harvested.

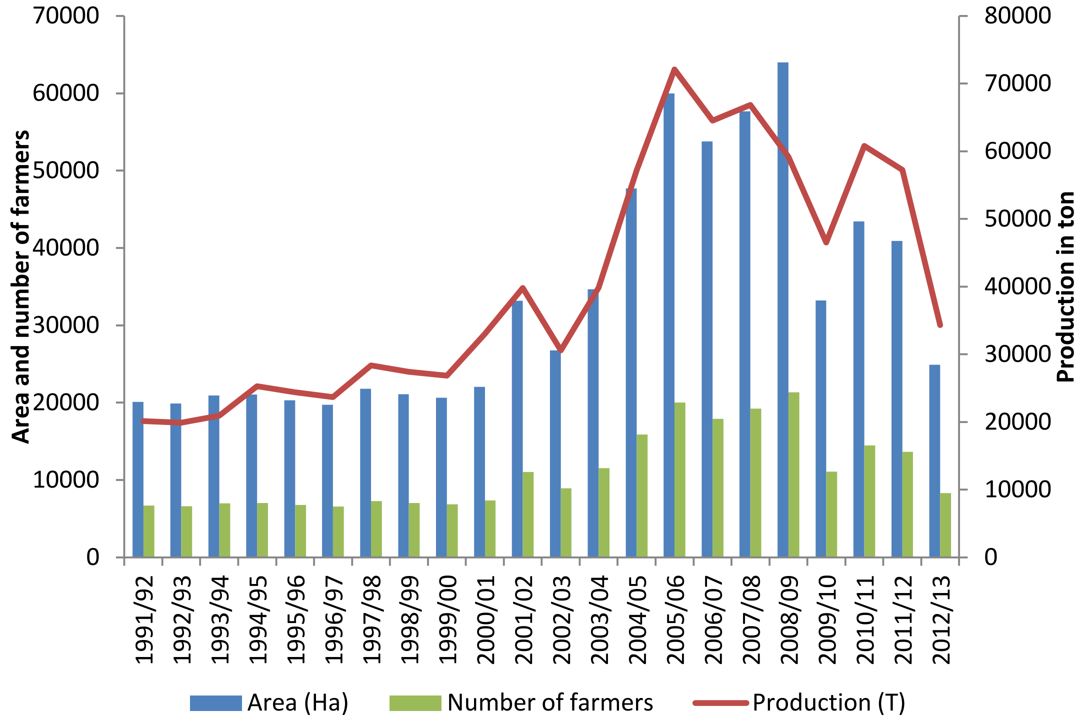

Figure 4: Area under cotton, Number of cotton farmers and Cotton Production Trends in Bariadi District

Source: DALDO Bariadi District

Mwinuka and Maro (2013) observed that cotton production increased with an increase in area allocated to cotton production. Reasons that affect allocation of land to cotton production was the reaction of farmers to policies and incentives set by the government and market change in number of farmers undertaking cotton production, emergence of alternative low cost and high return cash crops. For example, following the introduction of sunflower production in Bariadi district farmers have shifted resources towards sunflower or reducing the portion of land for cotton (DALDO, 2014).

While that explains reasons for land allocation in the case of production fluctuation the main reasons were said to be area allocated to cotton production, use of inputs and fluctuations in weather conditions. Fig.4 shows that production is proportional to area allocated to cotton production, increasing and decreasing according to changes in area allocated to cotton production. The decline in cotton production since 2009/10 is attributed to the division of Bariadi district to form other two district of Bariadi rural and Itilima districts (DALDO, 2014).

4.3 Cotton Farmers in Bariadi District: 1991/92 to 2012/2013

It was also important to compare the trend of cotton farmers with that of area allocated to cotton production. This comparison is helpful in making conclusion on the reasons for fluctuation of production as previously hypothesized. As reported in Fig.4, the trend of cotton farmers in Bariadi district follows the same trend of production, the number of farmers fluctuate overtime. During the 24 years interval, the numbers of farmers were highest during the 2008/09 production season when 23 072 farmers were involved in cotton production, while the lowest number was observed during the 1996/97 season when only 7889 farmers were involved in cotton production. This fluctuation is mainly attributed to policies in place and population growth (DALDO, 2014). For example, in the production season of 2008/09 the number of cotton farmers increased mainly due to effort done by the government to strengthen the performance of contract farming. In the following years the number of cotton farmers declined due to the division of Bariadi district as explained in the previous section.

It is evident from the result that, farmers are willing to engage in cotton production only when the condition and or policy at place assures them of getting promising returns in terms of both production and profit. It's therefore the role of the government and other cotton stakeholders to introduce as well as implement such a policy to sustain cotton farming.

4.4 Determinants of Cotton Productivity

Analysis to identify the determinants of cotton productivity was done based on equation 2.8 and 2.9 derived earlier in chapter 3. The models derived in chapter two were run and results of the analysis are presented in this section. The model was tested for heteroscedasticity, multicollinearity and autocorrelation. The breusch-Pagan test also known as the Cook-Weiberg test for heteroscedasticity with a null hypothesis that error terms have equal variance was found to be 0.62. Since the Breusch-pagan test was less than one then heteroscedasticity is not a serious problem. Multicollinearity was tested through auxiliary regression where one independent variable was regressed against a number of other independent variables thereafter; the R^2 for each auxiliary regression was compared with that of the original regression.

Using Klein's Rule of thumb, if the R^2 for the auxiliary regression is higher than that of the original regression, the problem of multicollinearity is suspected. The tests were done and the R^2 for all the auxiliary regression were found to be lower with the highest being 0.37 compared to the original model R^2 (0.79) therefore rullingout the problem of multicolliniarity. Though Autocorrelation problem is not common in crossectional data, the problem was tested using the Durbin Watson *d* test that assumes no time lag in dependent variable. The test was done and the model was found to be free from the problem of autocorrelation at 5% level of significance since the estimated DW statistic d =1.71 was found to lie above d_l=1.57.

Table 12: Stochastic production frontier and inefficient effect for cotton farmers

	Contract farming			Non-contract farming		
	Coefficient	**Standard error**	**t test**	**Coefficient**	**Standard error**	**t test**
Stochastic production frontier						
Constant	6.13	0.38	15.73	5.24	0.61	8.5
Farm size	1.09***	0.07	15.92	0.83***	0.19	4.17
Seeds	0.02	0.18	0.09	0.30*	0.17	1.78
Pesticides	0.14**	0.07	1.97	0.40**	0.19	2.02
Animal manure	0.002	0.006	0.03	0.0005	0.005	0.08
Labour	-0.048	0.077	-0.62	-0.006	0.0006	-0.88
Sigma squared	0.24	0.067	3.55	0.029	0.003	8.91
Gamma	0.79	0.13	5.99	0.91	0.43	2.12
Log likelihood function	-22.73			13.54		
LR test of the one sided error	3.34			29.8		

*=Significant at 10%, **=Significant at 5% and ***=Significant at 1%.

In estimating the TE of individual farmer, a stochastic frontier production function was estimated based on which factors that influence variation in cotton productivity among farmers were obtained. The results are presented in Table 11 for both contract and non-contract farming.

4.4.1 Determinants of contract farmers cotton productivity

In the case of contract farming two variables (farm size and Pesticides) were found to significantly affect cotton productivity. From table 11the log likelihood function for the fitted model was found to be -22.73. Meanwhile the log likelihood ratio (LR) of the one sided error was found to be 3.34 and was significant at 5% level. Thus the overall model was statistically significant and the explanatory variables used in the model were collectively able to explain the variations in cotton productivity. Results further show that the variance of the technical inefficiency parameter γ is 0.79 and it is significantly different from zero at 1% level of significance. This implies that 79% of the variations in cotton output among contract farmers were due to technical inefficiency.

The following partial elasticity's were generated from the stochastic production frontier estimation and presented in table 11: Labour (-0.05), farm size (1.09), pesticides (0.14), animal manure (0.002) and seeds (0.02). The results showed a negative coefficient for labour indicating that a 1% increase in the number of labour *ceteris paribus* significantly decreased cotton yields by 5%. This suggests that contract cotton farmers in Bariadi over utilize labour by employing more labour for the work that can be done by only few labours.

The results also indicated a positive sign for farm size that is significant at 1% level indicating that a 1% increase in farm size *ceteris paribus* increased cotton yields almost by 100%. Due to its high elasticity it can be said that contract farmers can improve cotton production by employing more land. The findings are consistent with that of Goni *et al.* (2007) whom reported that, most smallholder farmers fail to maximize yields due to underutilization of farm land. They further argued that lack of enough tools to cultivate large area and limited availability of other production factors seems to be the reason for the underutilization of land available for production.

The positive sign for the coefficient on pesticides suggests that a 1% increase in the use of pesticides *ceteris paribus* increased cotton yield by 14%, the variable was also significant at 5% level. A positive sign for animal manure suggests that a 1% increase in use of animal manure increase cotton yield by 0.02%. The result also showed a positive coefficient for seeds indicating that a 1% increase in the quantity of seeds *ceteris paribus* increased cotton yield by 2%. This suggests that increased number of seeds per hole helped reduce the risk of plant failing.

Summation of all the partial elasticity of production with respect to every input is 1.8, which represents the function coefficient of the production. If all factors are varied by the same proportion, output would increase by 1.8% representing increasing return to scale.

4.4.2 Determinants of non-contract cotton productivity

Three variables (farm size, pesticides and seeds) were found to significantly affect cotton productivity among non-contract farmers. The results are presented in Table 11. The log likelihood function for the fitted model was found to be 13.54 and log likelihood ratio (LR) of the one sided error 29.8 being significant at 1% level. Thus the overall model was statistically significant and the explanatory variables used in the model were collectively able to explain the variations in cotton productivity. The model results further show that the variance in technical inefficiency parameter γ is 0.91 and is significantly different from zero. This implies that 91% of the variations in cotton output were due to technical inefficiency among non-contract farmers.

Partial elasticity's were generated from the stochastic production frontier estimation and presented in Table 11 as follows: Labour (-0.006), farm size (0.83), pesticides (0.40), animal manure (0.0005) and seeds (0.30).The results showed a negative coefficient for labour indicating that a 1%increases in the number of labour decreased cotton yield significantly by 0.6%. The results indicated a positive sign for farm size implying that a 1% increase in farm size increased cotton yield by 83%.

The positive sign for pesticide indicates that a 1% increase in unit of pesticides holding other variables constant will increase cotton productivity by 40%.The result also showed a positive coefficient for seeds indicating that a 1% increase in the quantity of seeds used significantly increased cotton yield by 30%. This is due to the fact that the increased number of seeds per hole reduces the risk of plants failing.

Summation of all the partial elasticity of production with respect to every input is 1.2, which represents the function coefficient of the production function. If all factors are varied by the same proportion, output would increase by 1.2% representing increasing return to scale. In fact, the high land elasticity for both contract and non-contract suggests that expansion in production among the cotton farmers was mainly due to increase in farm size rather than increase in technical efficiency. Its therefore encouraging that there is a room of increasing cotton production by considering factors such as education, information access and the use of appropriate technology.

4.5 Farm Specific Efficiency Scores

Estimated farm specific scores for technical efficiency among sampled contract and non-contract cotton farmers in Bariadi district are summarized in Table 12. The technical efficiency of all sampled farmers was found to be less than 1 (or 100%) indicating that all the sampled farmers were producing below the maximum efficiency frontier. The mean technical efficiency score for contract cotton farmers (73%) was found to be higher than that of non-contract cotton farmers (57%). The tendency of crop intercropping, low use of critical inputs such as pesticides and seeds may have undermined the yield and hence technical efficiency of non-contract cotton farmers.

Table 13: Distribution of Technical efficient scores

Score (percentage)	Contract farmers						Non-contract farmers					
	Frequency			Percentage			Frequency			Percentage		
	M	F	T	M	F	T	M	F	T	M	F	T
25-49	1	1	4	1.5	16	5.7	1	3	31	2.5	33.4	62
50-74	38	3	45	59.4	50	64.3	32	5	14	78	55.6	28
75-100	25	2	21	39.1	34	30	8	1	5	19.5	11.0	10
Total	64	6	70	100	100	100	41	9	50	100	100	100
Mean				72	61	73				67	51	57
Maximum				89	78	93				90	76	92
Minimum				30	27	30				29	27	37

The most efficient farmer among contract farmers had a score of 93% compared to the corresponding highest score of 92% among non-contract farmers. Meanwhile the least technically efficient contract farm recorded a score of 30%. While the least technical efficiency score for noncontract farm was 37%. These scores provide evidence that there is a gap between the two extreme farms in terms of technically efficiency in both farming systems. However, if an average contract cotton farm were to achieve the level of technical efficiency obtained by the most efficient farm, then they could realize an increase of 22% while an average non-contract farmer could realize an increase of 38%. The percentage increase in efficiency is obtained by using the formula $\left[(1-\left(averageefficiency / \max imumumefficiency\right))*100\right]$. The results also indicate that even farmers within contract farming have yet to exploit the yield and profitability potentials of the improved technologies through improved technical efficiency. In the short run, there is scope for increasing cotton production by 27 and 43%among contract and non-contract cotton farmers respectively if farmers opt to use the best practices. The result indicate further the presence of substantial efficiency variation not only among the non-contract farmers, who are using widely differing management practices and input mixes but also among the contract farmers, who were expected to be using almost the same improved management practices and input mix recommended by contract scheme and hence should have little or no efficiency variation.

It was also evident in Table 12 that 5.7% of the contract farms had TE levels less than 50%, which was small compared to 62% among non-contract farms. The proportion of farmers in the highest TE class was 30% and 10% for contract and non-contract farms respectively. These results provide evidence that contract farming helps farmers to improve TE.

The result also indicated that the percentage of females in lower TE level was higher than that of males. It was shown that 16% of females in contract farming achieve TE between 24%- 45% while only 1.5% of males were found to be in that class. Meanwhile 33.4% of females under contract farming were in the class of 24%- 45% compared to 2.5% of males. On the other hand, 39% and 19.5% of males in contract and non-contract farming respectively were found to be in the highest level of TE compared to only 30% and 10% of females under contract and non-contract farming respectively. This suggests that male farmers are more efficient than females.

The mean difference in TE between contract and non-contract farmers was 30%, using the independent t-test the comparison between two means was done and the mean difference was found to be statistically significant at 1% level (Appendices 2). The study therefore was able to reject the first null hypothesis that; the means technical efficiency between contract and non-contract farmers are equal.

Indeed, the study findings are consistent with results by (Seyoum *et al.,* 1998; and Alene and Hasan, 2008) that low efficiency would be expected among farmers within an extension program that promotes new technologies but have weak extension, credit and input supply services. Alene and Hassan further argued that new technologies are known to require intensive management and information for farmers to realize the potential gains and when support services are weak to cater the needs of poor and illiterate farmers in developing countries, it would be difficult for potential gains to be realized by these farmers. Furthermore; Xu and Jeffrey (1998) obtained significantly lower technical and allocative efficiency for hybrid rice production in China compared with conventional rice production while Singh *et al.* (2000) obtained lower technical and allocative efficiency for newly established Indian dairy compared to the old processing plants after liberalization of the dairy industry. In fact farmers need time to reach full operation potential and choice of the managerial skills required for higher performance.

4.6 Determinants of Technical Efficiency

This section reports on sources of inefficiency where the error term (u_i) was regressed against a set of socio-economic and institutional factors. The stochastic frontier model was run using frontier version 4.1 as it has been discussed in chapter three was able to give the results for Technical efficiency and the determinants for inefficiencies simultaneously. The parameter estimates of the inefficiency model using Maximum likelihood estimation (MLE) to identify factors influencing technical efficiency among contract and non-contract farmers are presented in Table 13. A negative sign on an efficiency parameter means that the variable increases technical efficiency or reduces inefficiency, while a positive sign implies that a variable reduces technical efficiency or increases technical inefficient.

Table 13: Factors affecting level of technical efficiency

	Contract farmers			**Non-contract farmers**		
Inefficient model	Coefficient	Standard error	T test	Coefficient	Standard error	T test
Constant	-10.96	7.22	-1.52	-1.47	0.24	-6.19
Sex	1.16**	0.57	2.02	0.20***	0.06	3.12
Age	0.32*	0.22	1.45	0.12***	0.02	7.70
Education	-0.003*	0.002	-1.47	-0.0002***	0.0002	-6.98
Years of farming	2.15**	1.26	1.7	0.03***	0.008	4.18
Information	-0.06	0.008	-0.72	-0.24***	0.05	-5.14
Credit	-0.3**	0.17	-1.74	0.00002	0.00006	0.38
Distance	-0.07*	0.05	-1.37	-0.0009	0.003	-0.27
Farm size	0.02	0.02	1.22	0.004	0.008	0.54
Farm group				0.22***	0.05	4.38
Sigma squared	0.24	0.067	3.55	0.029	0.003	8.91
Gamma	0.79	0.13	5.99	0.91	0.43	2.12
Log likelihood function	-22.73			13.54		
LR test of the one sided error	3.34			29.8		

*=Significant at 10%, **=Significant at 5% and ***=Significant at 1%.

Among the selected variables, six were found to have a significant contribution on technical efficiency variation among contract and non-contract cotton farmers. In the case of contract farming, distance from the market, education, credit and access to extension services were found to have a negative sign while sex, age and years of experience were found to have a positive sign. Meanwhile, for non-contract farming access to extension services, credit and education were found to have a negative sign while sex, age, years of farming and farm group were found to have a positive sign.

The negative sign and significant coefficient of distance to the nearest market among contract farmers, suggests that farmers who were closer to the market tend to exhibit higher levels of technical efficiency. These farmers would access input on time and at a lower price. In the study area contract farming scheme delivered input at a Centre closer to farmers, this increases efficiency and effectiveness of using inputs among contract farmers and hence increase in production efficiency. Tchale (2009) noted that access to market is an important institutional variable that positively influence efficiency. On one hand market access provides the incentive and means for farmers to access improved crop technology, on the other hand they improve farmers' liquidity and the affordability of the inputs required for production.

The coefficient for education had a negative sign, indicating that literate farmers tend to be more technically efficient compared to illiterate farmers. This finding is consistent with findings reported in previous studies. For example, Pinherio and Bravo-ureta (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. Pinherio and Bravo-ureta further suggested that, educated farmers are very likely to be less risk averse and therefore more willing to try out morden technologies. Furthermore, Bachewe *et al.* (2010) suggested that education is believed to increase human capital and contributes positively to change farmers' attitudes towards morden practices. The coefficient for use of credit was found to have a negative sign, implying that farmers who had access to credit tend to achieve more technical efficiency than those who don't. Awudu and Huffman (2001) found the same result for the case of rice farmers in Northern Ghana. Wambui (2005) had similar results for maize farmers in Kenya.

Access to extension services was included in the analysis to examine if extension services have any effect on technical efficiency. The result on coefficient for access to extension services was negative as expected implying that access to extension services tends to increase the level of efficiency among contract farmers. Farmers under contract farming are more subjected to a number of farm visits from extension services officer, also extension agents referred to as "*paraprofes*" that were selected among farmers themselves might have supplemented the role played by extension services. The study findings are consistent to findings by Amaza *et al.* (2006) who reported access to extension services to have a negative sign and therefore positively influencing technical efficiency among farmers.

The variable sex (1 if female) was included to examine if gender has any effect on technical efficiency. The parameter estimate for this variable was positive, implying that female headed household tends to exhibit lower level of technical efficient than male headed households. This is due to the fact that in the study area, most of females are poorer and less educated therefore failing to access adequate input hence low performance. The same result was observed by Bachewe *et al.* (2010) in Ethiopia where females were taking on farming activity in addition to their traditional homemaker role.

The age of the household head was included in the inefficiency equation to examine the effect of physical strength on efficiency. The study found age to have a positive sign; this variable supports the argument that farmers become less efficient as they get older. Bachewe *et al.* (2010) suggested this could be a result not only from efficiency loss as farmers get older but also because younger farmers tend to be more open and likely to be exposed to methods and new technology.

In the case of non-contract farmers; education, distance to the market and access to extension service coefficients were found to have a negative sign, indicating that these variable helps in reducing inefficiency. As it has been explained in the case of contract farmers, literate farmers tend to achieve higher technical efficiency than illiterate farmers. As expected coefficient for extension service was negative implying that farmers with access to extension services tend to achieve higher technical efficient than farmers with little or no access to extension services. Aswoga *et al.* (2011) similarly found that availability of extension services and information about technical aspects of crop technologies plays an important role in increasing the level of farm efficiency. They further argued that, the availability of extension worker in the community and the usefulness of the extension messages as it was perceived by the respondents were significant determinants of technical efficiency. The variable distance had a negative sign as it is the case for contract farmers implying that farmers who are close to the market tend to exhibit higher TE than farmers who are distant from the market.

The coefficients for sex, age, years of farming and belongings to farm group had a positive signs, indicating that these variables tend to reduce the level of technical efficiency among non-contract cotton farmers. Most female headed household are poor and less educated therefore failing to access input hence low performance. The coefficient for age supports the argument that was given in the case of contract farming that, farmers tend to be less efficient as they become older. The study results are consistent with findings by Kibaara (2005) in Kenya who found older farmers to be less technically efficient than their younger counterparts. However; Illukpitiya (2005) found contradicting results in Sri-lanka, where it was observed that elderly farmers had a wealth of experience and therefore were technically more efficient in production than their younger counterparts. The positive sign for years of farming and belonging to farm group is unexpected. These variables were likely to be influencing technical efficient positively. However, older farmers who were expected to be more experienced in the non-contract farming were observed to be rigid to accept changes this might be the reason why they didn't opt for contract farming. Meanwhile; groups for non-contract farmer were observed to be informal unlike, contract farmers groups. Non-contract farmers indicated that they joined temporally groups just for the purpose of labour sharing especially during cultivation and harvesting time. These groups were not providing any addition services among farmers.

4.7 Profitability analysis of contract and non-contract cotton farmers in Bariadi District

The aim of any business firm is to earn profit. The analysis on profitability was important in order to make conclusion to whether contract farming helps farmers to get higher profit level than their counterpart non-contract farmers. In the analysis returns and cost were computed to assess the profitability of each individual cotton farmers under contract and non-contract farming. Thereafter Gross margin per acre were computed for both contract and noncontract farmers and comparison was made.

Table 14: Profitability of cotton farmers

Returns without family labour cost			Returns with family labour cost	
Revenue/Cost	**Contract Farmers**	**Non-contract farmers**	**Contract Farmers**	**Non-contract Farmers**
Revenue per acre	**302704.77**	**219121.90**	**3027004.77**	**219121.90**
Variable cost per acre:				
Land preparation	30000	27500	30000	27500
Seed	9600	6400	9600	6400
Pesticides	16000	10666.67	16000	10666.67
Animal manure	5000	7000	5000	7000
Labour	15050.40	10900	58376.33	50692.60
Other cost	6955.44	3067.33	6955.44	3067.33
Total variable cost	82605.40	65534.20	125931.77	105326.60
Gross margin	**220098.93**	**153587.70**	**176773**	**113795.50**
Family labour units	356	222	356	222
Return to family labour	**618.25**	**691.84**	**496.55**	**512.60**
Minimum Gross Margin	**(55200)**	**31700**	**(126075)**	**31700**
Maximum Gross Margin	**2797614**	**454200**	**2797614**	**356162.50**

Revenue was obtained as a product of cotton price and quantity of cotton sold per acre. The price of cotton varied across farmers from the minimum of 650 TZS to a maximum of 800 TZS Per kg depending with the time of selling being low at harvesting time and higher later on. The cost includes the cost of production per acre as indicated in Table 14. Gross Margin was obtained as revenue per acre in average minus variable cost per acre on average. Table 14 shows the Gross Margin without and with family labour cost for contract and noncontract farmers.

When family labour cost were excluded only cash expenses that a farmer incurred in farming activity were considered. As expected the study found that on average farmers under contract farming get higher gross margins than their counterparts under non-contract farming. The averages Gross Margin were 220 098.98 TZS and 153 587.70 TZS for contract and non-contract farmers respectively. The mean differences of 66 340.05

TZS was significantly different from zero at 5% level of significant using t-test assuming unequal variances (Appendices 3). Findings of this study are contrary to those of Kunene (2010) who found because of high operational cost contract farmers had low net return compared to non-contract farmers. However, these findings are consistent with many other previous studies. For example a Study by Ramswami *et al.* (2005) found that contract farming helps farmers to achieve higher average net returns than non-contract farming.

The study further investigated variation of Gross Margin in each group. The variation seems to be high among contract farmers compared to non-contract farmers. Under contract farming 2 797 614 TZS and (55 200) TZS were the highest and Lowest GM respectively, in contrast 454 200 TZS and 31 700 TZS were found to be the highest and the lowest GM for non-contract farmers respectively. The loss that accrue to a farmer under contract farming was observed to be due to the high interest rate charged from informal borrowing, a farmer reported a total of 150% interest rate which was charged for a loan from savings and credit group. It was observed also that, larger farmers under contract farming are more likely to get higher profit, probably due to; economies of scale that large farmers were able to obtain some services at a discount and contract assure farmers for input market access, where farmers under contract farming were in a better position to get sufficient inputs than farmer under non-contract farming.

The Gross Margin discussed earlier does not include the cost of family labour, it was therefore important to value family labour in monetary term and include it in the farming operational costs. The value of family labour was obtained by adding the market cost of every activity undertaken by family labour per respondent. After getting the cost of farming per acre including the cost of family labour the same procedures that were used in determining the GM without including the cost of family labour were followed. The Gross Margins for each group were obtained as indicated in Table 14. Though on average the Gross Margin declined in both groups, farmers in contract farming were still observed to have high GM than their counterpart non-contract farmers. On average contract farmers had a Gross Margin of 176 773 TZS per acre while non-contract farmers had a GM of about 113 795.30 TZS per acre on average.

The GM mean difference among the two groups was found to be 62 049.22 TZS and was statistically different from zero at 5% level of significant. Unlike the case where family labour cost was not included in the analysis the loss of the lowest farmer in contract farming increases to 126 075 TZS while the profit of the highest farmer remained the same. In a case of non-contract farmers the profit of the lowest farmer remained the same while that of a highest farmer declined to 356 162.50 TZS. This provides evidence that the highest profit in both cases was obtained by a farmer under contract farming and that this farmer was incurring almost all the necessary cost for cotton production. It can therefore be concluded with no doubt this is a large farmer and enjoying economies of scale as previously discussed. It can also be said; where a farmer has access to all the necessary input for production, this farmer is likely to achieve higher production and hence higher profit.

The return for labour was computed to assess if it was profitable for farmers to engage in cotton farming. The return for labour was computed by dividing the Gross margin by units of labour. Since in all cases the return to labour was found to be less than the average local wage rate (10 000 TZS) therefore it was better for cotton farmers to work than to engage in cotton production.

Furthermore; the study tested if the difference in GM with and without family labour costs for both contract and non-contract farmers was statistically significant. The two groups were treated separately; using the paired t test. For each group the study found that the means difference in GM with and without family labour for all of the two groups was statistically different at 5% level of significance (Appendices 4 & 5). On the basis of these results the study rejected the third null hypothesis that; there is no significant difference in average gross margin between contract and noncontract cotton farmers. It was therefore concluded that on average contract cotton farmers were able to achieve higher gross margin than their counterpart under non-contract farming and the difference was statistically significant at 5% level of significant.

4.8 Implication of the Findings

The existence of substantial performance variation among farmers within and outside contract farming indicates that knowledge of producing cotton is not uniformly distributed among farmers. Identifying and promoting innovative practices thus offers an opportunity to help farmers raise production through adoption of these practices is important. However, this requires reorientation of extension services towards promoting new technology and innovative practices. In this way, the effectiveness of the contract farming in raising cotton production could be enhanced. On the other hand, the inefficiency among farmers within contract farming is due to the observed differential adoption of recommended technology. While some of the adopters used the full technological package, for instance, right spacing, monoculture farming system and applying the required input use timely, some of them were partial adopters who used only parts of the technological package and did not adopt the recommended crop management practices to fully exploit the yield potentials. Extension services should thus promote recommended crop management practices to help adopters exploit the yield potentials of improved varieties and hence to enhance cotton production. Increased production will lead into lower per unit costs of production and increased profitability of improved technology. Moreover, in view of unfavorable output-input price ratios, farmers own cash savings do not allow them to buy enough inputs such as pesticides, seeds and fertilizer with the result that yields and incomes would be low. This is due to the fact that farmer's access to input credit is limited by their poor access to financial resources as input credits still require a high interest rate to be paid. With little input use, cotton production would be too low to enable farmers to reduce per unit costs of production to a level that makes technology adoption profitable to cotton farmers.

The results thus point to the need for an integrated credit, extension services and input supply system to enhance cotton production through improved access to and better use of modern inputs and crop management practices. Such a system with appropriate technologies would help reducing yield and efficiency variations hence improved cotton production. For extension services, this may require staff re-training to effectively address the new challenges of identifying and promoting best practices concerning crop production and promoting the adoption and proper application of crop management practices recommended for improved crop production. For credit and input supply, there is a need for increased access to modern inputs through reduced interest rate payments and timely and adequate supply of improved seeds, fertilizer and chemicals.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECCOMENDATIONS

5.1 Conclusions

The main objective of this study was to compare the profitability and technical efficiency among contract and non-contract smallholder cotton farmers in Bariadi District of Tanzania. It was established that the mean technical efficiency for contract farmers was higher than that of non-contract cotton farmers. The mean technical efficiency was 73% and 57% for contract and non-contract cotton farmers respectively. However, there were large variation between the most efficient and the least efficient farmers in both groups. It was also found that 30% of farmers under contract farming had technical efficiency scores of 75% and above and could easily improve to the level of the most efficient farmer. In contrast was discouraging to observe most of famers in non-contract farming (62%) had a score of less than 50%

From the inefficiency model, factors that accounted for the variation of technical efficiency were examined. Technical efficiency among contract farmers was positively influenced by education, distance, credit and access to extension services while negatively influenced by age, sex and years of experience. Meanwhile; efficiency among non-contract farmers was positively influenced by education, distance and access to extension services while negatively influenced by age, sex, years of farming and farm group

Finally, it was found that the mean Gross Margin for contract farmer was higher than that of non-contract farmers. On average contract farmers achieved a Gross margin of 220 098.93 TZS while non-contract farmers achieved a Gross margin of 153 587.70 TZS

Per acre where family labour cost was not included in the analysis. When family labour cost was included it was observed that on average contract farmers achieved GM of 176 773 TZS while non-contract farmers achieved the GM of 113 795.50 TZS. It was also found that a highest GM was attained by a contract farmer, who was also incurring all the necessary cost of production, suggesting that when a farmer is in a position to acquire all the input necessary for production they are more likely to increase production and profit.

5.2 Recommendations

The findings indicated that cotton production was highly influenced by size of the farm, pesticides and seeds. This suggested that availability of production factors could enhance cotton production among smallholder cotton farmers in Bariadi district. Factors like education, distance to the market, access to extension services and credit were observed to increase efficiency Government and other cotton subsector stakeholders are therefore advised to provide more and quality extension service and training to farmers about correct input application. They are also advised to conduct research and introduce new seed varieties that have disease resistant and high productivity. It is further necessary for farmers to be encouraged to enter into contract farming and also allocate more of the available farm land to cotton production. Also farmers are advised to learn and practice proper application of inputs.

The findings show that contract farmer had a higher profit level than their counterpart non-contract farmers. It is important to encourage farmers to join contract in order to improve their performance.

Furthermore, interest rate charged by the informal financial institution was observed to reduce the level of profit attained by cotton farmers. The government of Tanzania and other cotton subsector stakeholders are advised to establish a good financial institutional basis from which farmers will access credit at a lower interest rate compared to informal financial institutions. This will enable farmers to invest more in cotton farming and achieving not only high technical efficiency but also improved profit.

The government should also develop better roads and market infrastructure to attract private investors, as a way to reduce the distance farmers have to travel searching for the market. In so doing, cotton farmers in Bariadi District will become more efficient and able to achieve higher profit from cotton production.

Areas of further study; While this study only covered profitability and technical efficiency among contract and non-contract cotton farmers. It may also be important for future research to evaluate not only technical efficiency but also allocative and economic efficiency in order to give accurate policy recommendations. The inequality in technical efficiency and profit level between the two groups also requires further investigation into factors influencing contract farming adoption among cotton farmers in Bariadi district. This kind of study will require different methodology and analytical approach. It will, however, provide more insight and useful explanations as regards the issue of technology diffusion and why some farmers prefer to steak into tradition farming system in spite of lower yield.

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APPENDICES

Appendix 2: Structured Household Survey Questionnaire Analysis of Profitability and Efficiency of Contract Smallholder Cotton Farmers: Case of Smallholder Farmers In Bariadi District

Department of Agricultural Economics & Agribusiness

Sokoine University, Box 3057, Morogoro, Tanzania.

Section A: General Information

Questionnaire number…………………………………………

Respondents name……………………………………………………….., Sex: 1=Female, 0=Male ………………..

District………………………………………………………

Village……………………………………………………..

Farming scheme 1=Contract, 0=Non-contract ……………………………

Section B: Farmers Household Characteristics

Questions	Codes
1. Sex of household head	1=female, 0=male
2. Age in years	Actual number of years
3. Marital status	1=Married, 2=Single, 3=Divorced, 4=widowed, 5=others (specify)
4. Number of years of schooling	
5. How many people are living with you currently	Adult (F+M) aged 60+
	Adult females (18-59)
	Adult males (18-59)
	Children (7-17)
	Young children below 6 years
6. What is your main occupation?	1=farming, 2=off farming activity
7. How many years have you been farming cotton?	Number of years

Section C: Cotton Productivity In The Last Croping Season

Area planted (Acres)	Yield or production in Kg.	Price per kg in Tsh.

Section D: Input And Input Access

Types of inputs	[1]Common source	Distance from house to source (km)	Time to source (Minutes)	Quantity used	Price per unit kg and or little	[2]Main constraints for use of this inputs
Planting fertilizer						
Top dressing fertilizer						
Herbicides						
Fungicides						
Pesticides						
Animal manure						
Certified seeds						
Seed dressing						

[1]Code for common source of inputs: 1=Purchased from the market, 2=Purchased from stockiest, 3=Purchased from other farmers, 4= Received from government, 5=Received from NGO'S, 99=others (specify)………………………………………………
[2]Code for main constraints to access: 1=Too far from household, 2=unsuitable packaging (too large), 3=Lack of enough knowledge on how to use, 4=absence of transport, 99=others (specify).

Section E: Average Annual Household Income Sources (2013).

Type of earning or income	Amount in Tsh.
Employment	
Cotton produce sales	
Livestock sales	
Others (Specify)	

Section F: Cotton Productivity Issues

G1a: Labour and labour distribution.

Sloughing	Planting	Weeding	Fertilizing	Spraying	Harvesting	Post harvesting handling	Marketing produce

Codes for labour distribution: 1=Family labour, 2=Hired labour, 3=others (specify)

b. What is the cost of labor per ha. In TSH

…………………………………………………..

Section G1: Access To Market

Type of market	Distance in km	Time in minutes
Input market		
Output market		

G2: Please provide information about cotton sales in the last season

Quantity sold (kg)	[1]Where do you sell mostly	[2]Who do you usually sell to	Mode of selling 1=cash, 2=credit, 3=both	[3]Means of transport to market

[1] Codes for buyers: 1=specific buyer (contractor), 2=local trader, 3=others (specify)
[2]Codes for place of sale: 1=on farm, 2=Home, 3=local market, 4=others (specify).
[3]Codes for transport means: 1=Private car, 2=public vehicle, 3=motorbike, 4=bicycle, 5=others (specify).

G3: Do you have information to cotton farming? 1= Yes, 0= No ……………

G4: Do you have access to extension services? 1=Yes, 0=No …………….

G5: If yes how do you access information on cotton farming?

Source	Rank the usefulness of sources for 1 least useful to 8 very usefully
1=radio	
2=extension office	
3=fellow farmers	
4=group members	
5=news papers	
6=phone (sums)	
7=market boards	
8=others (specify)	

Section H: Collective Action

H1a: Do you belong to any farmer group? 1=yes, 0=no …………..

b. If yes

Name of the group	How long is your membership (number of years)	Rank the primary objective of your group 1=Saving, 2=production , 3=Marketing 4=others (specify)

Section I: Savings And Credit

I1a Do you have individual saving? (1=if yes, 0= no …………..)

b. If yes where are your individual savings kept?

1=Home, 2= bank, 3=group account 4=others (specify)……………………………….

I2: Have you ever borrowed money from any of the following sources in the last two years?

Source of borrowing	Ever borrowed 1=Yes, 0=No	Amount borrowed in Tsh.	Interest rate charged per month or year (specify)	[1]Purpose of borrowing
Informal saving and credit group				
Government				
NGO				
Bank or micro finance institution				
Others (specify)				

[1]Codes for purpose of borrowing: 1=Cotton farming, 2=other agriculture crop farming, 3=Family use, 4=others (specify)……………………………………….

Would you like to make any Comments and or ask question, what are the comments and or question?

……………………………………………

THANK YOU VERY MUCH!!

Appendix 3: Mean difference Technical Efficient test: Independent Samples Test

	Lavene's Test for Equally varience			t-test for Equality of means			95% Confidence Interval	
TE	Sig	T	df	Sig(2-tailed)	Mean difference	Standard Error Differ	Lower	Upper
Equal variances assumed						0.2538	0.257	0.358
Equal variances not assumed		11.83	94.93	2.2E-20	0.308	0.026	0.256	0.359

Appendix 4: Mean Gross Margin different test: Independent Samples Test

	Lavene's Test for Equally Variences		t-test for Equality of means					95% Confidence Interval	
GM	F	Sig.	T	df	Sig(2-tailed)	Mean difference	Standard Error Difference	lower	Upper
Equal variances assumed	3.89	0.0507	1.053	125	0.294	66340.06	63024.63	-58393.5	191073.62
Equal variances not assumed			1.307	85.94	0.194	50752.42	50752.42	-34553.5	167233.58

Appendix 5: Mean GM difference test with and without family lab our cost among contract farmers: Paired sample Test

GM for contract farming	Paired Differences			Paired Sample Test		t	Df
				Lower	Upper		
	43325.93	26567.59	3008.187	37335.87	49316	14.4026	77

Appendix 6: Mean GM difference test with and without family labour cost among non-contract farmers: Paired Sample Test

GM for non-contract Farming	Paired Differences			Paired Sample test		t	Df
				Lower	Upper		
	38293.46	111213.8	16052.33	6000.33366	70586.58	2.385539	47