CHALLENGES FACING SUGARCANE SUPPLY TO MTIBWA FACTORY: EMPIRICAL EVIDENCE FROM MTIBWA SUGARCANE OUTGROWERS SCHEME, MOROGORO, TANZANIA

HASSAN BAKARI

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

2018

ABSTRACT

This study intended to assess challenges facing supply of outgrowers sugarcane to Mtibwa factory in Morogoro, Tanzania using a sample of 210 respondents. The main objective was to investigate problems leading to low supply of cane from outgrowers. Specifically the study aimed to (i) Investigate factors affecting farm level productivity,(ii) Analyze sugarcane outgrowers technical efficiency, (iii) Determine profitability of sugarcane production among outgrowers and (iv) Examine constraints facing sugarcane outgrowers. Cobb-Douglas stochastic frontier with technical efficiency effect was used to estimate factors affecting sugarcane productivity, technical efficiency and factors affecting efficiency. Outgrowers profitability was estimated by Net Present Value (NPV) analysis. Stochastic production function estimates showed that; factor affecting sugarcane productivity were 0.02, 1.2e-3, and 0.78 for capital, labour and land respectively. Findings also showed that the mean technical efficiency was 53.75%. Furthermore; the results showed that the factors affecting efficiency levels positively were age, farming experience, non-farm activities, marital status and household size. Profitability analysis from calculated values of NPV was positive thus it can be concluded that the business was profitable. Major problems faced by outgrowers included late payments, low price, high service charges and lack of transparency in calculating rendement and sugarcane weight.

DECLARATION

I, Hassan Bakari, do hereby declare to the Senate of Sokoine University of Agriculture, that this dissertation is my original work done within the registration period and that it has never been or being currently submitted for a high degree award in any other university.

_____ _____

Hassan Bakari **Date**

(Msc. Candidate)

The above declaration is confirmed

_____ _____

Prof E.M.Senkondo **Date**

(Supervisor)

COPYRIGHT

ACKNOWLEDGEMENTS

This study is a result of the effort and support from several individuals.

My appreciation is due to my supervisor, Professor E.M.Senkondo for his patience, guidance, moral support and understanding, from the initial stage of the proposal development to the final stage of thesis production.

I would like to thank all staffs of the Mtibwa Outgrowers Association for assisting me through all stage from familiarization of the study area to data collection. I would also like to thank all Mtibwa sugarcane outgrower members since without their participation this study would not be possible.

There are no words to express my deep gratitude to my family for the strong encouragement understanding and support throughout the period of this study. Thank you very much.

Lastly but no least, to the Almighty God, for enabling me withstanding all challenges. I am also thanking God for the blessings he has upon all my parents.

I remain solely responsible for any error in content or in design inherent in this dissertation.

DEDICATION

This dissertation is dedicated to my beloved wife Matinde Mwita Range and my sons PrayGod and Peter for support all the way.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AE	Allocative Efficiency
AIDS	Acquired Immuno Deficiency Syndrome
BACAS	Bureau for Agricultural Consultancy and Advisory Services
CBA	Cost Benefit Analysis
DEA	Data Envelopment Analysis
EAC	East African Community
EE	Economic Efficiency
EU	European Union
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
Ha	Hectare
HIV	Human Immunodeficiency Virus
ISCL	Illovo Sugar Company Limited
KSC	Kilombero Sugar Company
KSL	Kagera Sugar Company
LR	Likelihood Ratio
MALF	Ministry of Agriculture Livestock and Fisheries
MLE	Maximum Likelihood Estimation
MOA	Mtibwa sugar Outgrowers Association
MSE	Mtibwa Sugar Estates
MVP	Marginal Value of the Physical Product
NBS	National Bureau of Statistics
NPV	Net Present Value
OLS	Ordinary Least Squares

REPOA	Research on Poverty Alleviation
SBT	Sugar Board of Tanzania
SFA	Stochastic Frontier Approach
SIA	Sugar Industry Act
SPSS	Statistical Package for the Social Sciences
SUDECO	Sugar Development Cooperation
SUGECO	Sokoine University Graduates Entrepreneurs Cooperative
TE	Technical Efficiency
TPC	Tanganyika Plantation Company
UNCTAD	United Nation Conference on Trade and Development
URT	United Republic Of Tanzania
USA	United States America
USD	United State Dollar
USDA	United State Development Agency

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Sugarcane *(Sacharum officinarum)* is an important food and commercial crop in Tanzania (Tarimo and Takamura, 2001). It is the main source of sugar produced for both export and domestic consumption (Tarimo and Takamura, 2001). The importance of sugar cane is not only because it produces sugar which is a source of energy, but also the commodity complements other key foodstuffs such as tea and coffee. In Tanzania its production is concentrated mainly in three regions of Morogoro, Kagera and Kilimanjaro.

The sugar industry in Tanzania started early 1924 when Tanganyika Planting Company (TPC) factory was built. Later on two other sugar factories were constructed in Kilombero and Mtibwa in 1961 and 1962 respectively (SBT, 2014). The sugar sector accounts for approximately 1% of the national GDP and 7.7% of agricultural GDP in the country (SBT, 2014). Furthermore, the industry provides on average direct employment to 80 000 workers, one third of which are unskilled rural labourers (FAO, 2013). It also provides indirect employment through provision of services and goods e.g. purchases, sales and distribution of imported sugar, supplies of raw materials, transport and social services in townships.

The sub-sector also contributes significantly to the government revenue estimated at 2% of the total annual Government revenue (SBT, 2010). On the other hand direct exchange earnings from sugar export amounts to USD 9.7 million per annum on average (SBT, 2010).

1.2 Tanzania Sugar Production Trend

Sugarcane production in Tanzania accounts for less than 1% of the total crops harvested (NBS, 2015). In 2010/11, sugar production reached 315 000 tons, a near 9% annual growth since 1998/99. The significant increase in sugar output is mainly attributed to large investments flowing into the sugar sub-sector in anticipation of improved access to the EU markets (FAO, 2013). Despite large investments to upgrade sugar mills, the annual production of raw sugar varies substantially largely because of weather conditions, which effect cane yield as well as transport logistics (RaboBank, 2013).

The country is currently having four sugar factories namely Illovo Sugar Company Limited (ISCL), Mtibwa Sugar Estate (MSE), Kagera Sugar Limited (KSL) and Tanganyika Planting Company (TPC). In terms of the total sugar production in Tanzania, Illovo accounts for 40% of total sugar produced through its subsidiary called Kilombero Holding, Mtibwa Sugar Estate (MSE) which accounts for 9%, and Kagera Sugar Limited (KSL) which account for 17% respectively. Sugar supply is still inadequate in the country due to the fact that on average, annual sugar production is 300 000 tons against local demand of 500 000 tons (SBT, 2015). However, the deficit is made up through sugar importation of about 200 000 tons per annum to offset the shortfall (URT, 2015). This costs approximately USD 132 million in foreign Exchange (RaboBank, 2013).

There was a clear need to get supplementary sugarcane from outgrowers to meet the production capacities in the mills (SBT, 2005). Thus the improvement of sugarcane supply from outgrowers will assist to bridge the gap between local sugar production and consumption demand. Outgrowers schemes are systems that intend to enable ordinary peasants to join the production of cash crops (USDA, 2004). They also represent a diverse

group of cane growers with area sizes ranging from less than 1.0 hectare to over 100 hectares (BACAS, 2004).

Mtibwa sugarcane outgrowers Scheme is a well-developed scheme since early 1960s in Tanzania (Matango, 2006). The interaction between sugarcane growers and Mtibwa sugar factory is based on the Sugar Industry Act of 2001 that gives the power to the Sugar Board of Tanzania (SBT) to regulate the sugar industry. Before the opening of the harvesting season, the two parties are required to agree upon the terms of the contracts, among others, the contract specifies prices, credit, and organization of the harvesting, payment and transport of cane from outgrower farms to the factory for processing. However over the years farmers have been complaining of late payments of sugarcane proceeds from the factory. Similarly, poor price, incomplete payments and declining of cane supplied to the factory (SBT, 2015).

1.3 Arguments in favour sugarcane outgrower schemes

According to Mlambiti (1991), the existence of outgrowers schemes provides employment, despite the fact that it involves only a small section of the peasant society. Sserunkuma and Kimera (2005) argued that sugarcane outgrowers scheme in respective areas have played a crucial role and impacted positively on communities and the national economy especially in providing employment, social development, and infrastructure roll out plus diversification in activities of respective areas.

Reginald (2006), showed that there was a significant relationship between engagement in sugarcane outgrower schemes and household poverty whereby the households engaged in sugarcane production comprised 84% of less poor households. Hence it is reasonable to

suggest that sugarcane outgrowers should be given priority as far as the sugar industry in Tanzania is concerned (Msuya, 2003)

1.4 Problem Statement and Justification

The main challenge facing the sugar industry in Tanzania is that local demand for sugar is higher than local supply of sugar. For example the 2014/15 season statistics show that sugar production was about 300 000 tons against the local demand of 500 000 tons (the production was 60% of the local demand). The country's net imports of sugar is about 200 000 tons (about 40% of local demand) per annum to bridge the supply gap (SBT 2015; Chongela, 2015).

As far as outgrowers are concerned, the government of Tanzania has encouraged the small-scale producers to undertake sugarcane production through outgrowers scheme model that allows households to produce the crop to feed the estate processing plants (Chongela, 2015). Looking at sugarcane production trends in Mtibwa as shown in Appendix 2, the contribution of outgrowers to the factory has been fluctuating year after year with a general declining trend. In 1996/97 season the share of outgrowers sugarcane supply to the factory was 62% which declined to 21% in 2013/2014 and 2015/2016 which was a significant decline.

The data show that the estate sugarcane production has remained relatively stable with an increasing trend. This shows that there are challenges facing outgrowers which need to be unveiled.

On sugarcane productivity the national average yield of sugarcane was noted to be 32.2 tons per hectare (Mbilinyi and Semakafu, 1995). Whereas yields on individual farms tend to vary enormously among outgrowers. For example, in Mtibwa scheme the yield varied from 12 to 70 tons per hectare (Msuya and Ashimogo, 2005). Also, Bombo (2013) reported that the minimum production per hectare for Mtibwa outgrowers was 7 tons. Thus, the performance of the outgrowers has remained below the national potential yield.

There is a progressive decrease in the number of sugarcane outgrowers from 6 000 after privatization to 500 in 2016 (Matango, 2006; NBS, 2016). In 2011 Mtibwa had 4 527 active sugarcane out-growers (SBT, 2010). This implied that there were no economic incentives that derived farmers to continue with outgrowers business. The relatively high growth rate of production in both outgrowers farms and the estates witnessed after privatization was mainly achieved through expansion of the cultivated area rather than through increase in productivity of factors of production (Msuya and Ashimogo, 2005).

For example Matango (2006) documented that in 2001, the recorded sugarcane growth when compared to the previous years was attributed to the privatization policy early in 2000. This was further evident in the study conducted by the same author who reported growth of sugar production in MSE from 342 389 tons in 1996/97 to 508 506 tons in 2005/06.

It is also noted that the unit cost of producing local sugar is high. The reaction from government has been protecting the industry against imported sugar from the efficient-low-cost sugar producing countries. However, under trade liberalization, this protection could not be sustained (SRI, 2010). Clearly, the sugar industry in Tanzania needs to develop and embrace modern and efficient production technologies, if its

production costs are to come down so as to attain high profit and its productivity increase to the levels where its sugarcane competes favorably with those from abroad.

Based on the above mentioned facts it is important to investigate problems related to outgrowers sugarcane supply to Mtibwa factory with the view of improving sugar supply to the country and maintain the existence of sugarcane outgrowers. Thus the objectives are as follow;

1.5 Objectives of the Study

1.5.1 Overall objective

The overall objective of the study was to investigate problems leading to low supply of sugarcane from outgrowers in order to provide useful information for improving their performance.

1.5.2 Specific objectives

The specific objectives of the study were:

i. To investigate factors affecting farm level productivity of sugarcane by outgrowers.
ii. To analyze sugarcane outgrowers technical efficiency.
iii. To determine profitability of sugarcane production among outgrowers.
iv. To examine constrains facing sugarcane outgrowers.

1.6 Research Hypothesis and Research question

This study was guided by research hypotheses for specific objectives i, ii, iii and research question for specific objective iv as follows;

(i) Factors of production are not significant in outgrowers sugarcane productivity.

(ii) Outgrowers are technically efficient in production

(iii) Sugarcane production among outgrowers is not a profitable business.

(iv) What are the constraints facing Mtibwa sugarcane outgrowers?

1.7 Organization of the Dissertation

This dissertation is organized into five chapters. The second chapter review literature relevant to this study. The methodology used is described in the third chapter and the findings of the research are presented and discussed in chapter four. The last chapter gives the major conclusions and recommendations of the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter reviews theoretical and empirical aspects of productivity and profitability of Sugarcane farming worldwide. This will prepare grounds for discussing specific issues relevant to the productivity of sugarcane outgrowers scheme in Mtibwa. Similarly this section gives the highlights on methodology and analysis of gap i.e. value addition.

2.2 Tanzania Sugar Policy

Soon after independence the sugar industry became state controlled with policy formulation, implementation, sugar production and marketing being executed by the state, primarily the policy aimed at protecting the consumer from too high prices. Under sugar sector reform of 1998-2001, private sector took the lead of operating the sugar industry with the state remaining the sole sector regulator through 2001 Sugar Act under Sugar Board of Tanzania (SBT) established by Sugar Industry Act 2001 (URT, 2001).

Its roles and functions range from being a government regulatory agency for facilitation of harmony and growth in the industry through regulation, promotion, importation of sugar, seed varieties, development and funding research activities related to the industry. Reports indicate that for some years, the sugar millers have been characterized by lack of trust. The outgrowers feel that their canes are not graded as appropriate and it is likely that the weighbridges are tampered with the millers, and often payments are delayed. The implementation of the sugar acts has created a mechanism for resolving these issues and building trust among the various players.

In other words, the associations together with the millers and the sugar board have managed to put in place series of mechanisms-contracts, forums, consultations and stakeholder meetings to discuss thorny issues and they have come up with settlements (MAFC *et al*., 2006).

The current regulatory framework has supported several positive changes and growth that have taken place in the sugar sector over the past 15 years of privatization, but regulatory inadequacies still exist in the sugar sector with substantial impacts to sugar industry stakeholders (SUGECO, 2013).

2.3 Theoretical concept of efficiency

Efficiency in production is one of the widely used concepts in economic analysis. For example, Kumbhakar and Lovell (2000) defined efficiency as the degree of success which producers achieve in allocating the available inputs and the outputs they produce, in order to achieve their goals. Economic Efficiency is defined as the product of technical and allocative efficiency (price efficiency). It can be interpreted as the potential reduction in production costs (cost efficiency) or the potential increase in revenue (revenue efficiency) that a farm could apply in order to operate at the point of technical and allocative efficiency. Earlier, Farrell (1957) earliest work on production efficiency analysis comes up with two concepts which are technical and allocative efficiency.

2.4 Approaches for Analyzing Farm Efficiency

The relationship between performance of the farm and efficiency has been analysed under different points of view using different techniques in investigating the main determinants of efficiency or inefficiency of a production units. There are two main approaches used to analyse efficiency of the farm which are non-parametric and parametric methods**.**

2.4.1 The non-parametric method

The widely used non-parametric method is Data Envelopment Analysis (DEA). DEA is based on a finite sample of observed production units; it uses a linear programming method and does not need to estimate a pre-established functional form. It follows the Farrell approach (1957) and was originally proposed by Charnes *et al.* (1978). DEA constructs an efficient frontier using the best performing farm business of the sample. The major drawbacks of DEA are high sensitivity of results to outliers and sampling variation, non-specification of functional form and inability to distinguish between technical inefficiency and Statistical noise effects (Cesaro *et al.,* 2009). DEA does not provide a room for a researcher to test hypotheses about the significance of the coefficients estimated**.**

2.4.2 Parametric methods

The stochastic production frontier estimation is a parametric approach that considers the deviation from the frontier as due to the random component reflecting measurement error and statistical noise (Ogundele and Okoruwa, 2006). Stochastic frontier analysis of efficiency technique was first proposed independently by Aigner *et al*. (1977) and Meeusen and Vanden Broeck (1977).

When DEA and stochastic frontier models are compared in terms of their appropriateness in studies related to agricultural sector, Stochastic frontier seems to be more appropriate because of its ability to deal with stochastic noise, accommodate traditional hypothesis testing, and allows single step estimation of inefficiency effects (Kumbhakar and Lovell, 2000).

The major weakness of stochastic frontier is lack of apriori justification for the selection of a particular distributional form for the one-sided inefficiency term. Despite the weakness pointed out, still stochastic frontier approach remains to be the most appropriate model for agricultural related studies (Kumbhakar and Lovell, 2000).

This study used stochastic frontier analysis (SFA) in analyzing efficiency of sugarcane outgrower farmers. This technique was adopted due to its flexibility, ability to decompose error term into two parts one being symmetric which captures stochastic effects outside the control of the outgrowers farmer and another being technical inefficiency of the outgrower farmers.

2.4.3 Outgrowers productivity and technical efficiency in Tanzania

A number of studies aimed at exploring economics and welfare of sugarcane outgrowers in Tanzania were conducted. There is a study by Chongela (2008) on economic analysis of outgrowers sugarcane production scheme at Ruembe sugarcane basin in Kilosa district, Morogoro, Tanzania. This study used Cobb-Douglas production function to analyse the technical relationship between productivity and resource constraints. The Ordinary Least Square (OLS) was used to estimate the model.

The gross margins were also used to measure economic returns per unit of input used in sugarcane. The result revealed that explanatory variables included in the model (land, Labour, credit, fertilizer, herbicide, and extension services) were statistically significant in sugarcane production. However the result showed that there was resources use inefficiency because farmers were operating in the first region of production function. The profitability analysis showed that sugarcane production was a profitable enterprise,

because it earned an average gross margin of 565 USD/hectare in both ratoon and plant cane.

In another study by Msuya and Ashimogo (2005) estimated Technical Efficiency in Mtibwa sugar outgrowers scheme. The study also used Cobb-Douglas stochastic production function to estimate technical efficiency. The results of the estimation showed that there were significant positive relationships between age, education, and experience with technical efficiency. The mean technical efficiency of outgrower farmers was found to be 76.43 %. This indicates that the output could be increased (using existing resources and technology) by 23.57 % if outgrowers achieved the efficiency level of the best outgrowers. The results of the estimation showed that there were significant positive relationships between age, education, and experience with technical efficiency.

Earlier, Senkondo (1988) did a study on economic analysis of the sugar industry in Tanzania, using Kilombero Sugar Company (KSC) as a case study. The study was aimed at understanding the major problems facing the industry with respect to production and processing of sugarcane. The production function approach and returns analyses were used to assess the productivity of outgrower farms.

The study revealed that Kilombero outgrowers are faced with many problems which tend to lower their productive capacity. These included poor drainage, low levels of fertilizer and herbicides use, lack of extension services, lack of credits, food shortage, poor services from KSC, poor sugarcane pricing, poor road networks and inadequate farm machinery. Resources in sugarcane processing were found to be inefficiently utilized that cause lower productivity.

2.5 Studies used SFA to Estimates TE worldwide

In the study done by Ogwang (2009) to determine factors affecting sugarcane outgrowers productivity in Kinyara Outgrowers Scheme in Uganda. The study used Cobb-Douglas production function to estimate factors effecting productivity and gross margin analysis was used to determine profitability of outgrower sugarcane production. The results indicated that sugarcane farmers were getting positive gross margins from their sugarcane enterprises. The Cobb-Douglas results revealed that acreage (farm size), amount of labour used and the distance from farms to factory were statistically significant effecting productivity.

Another study by Dlamini *et al.* (2010) in technical efficiency of small scale sugarcane farmers in Swaziland. The study used Cobb-Douglas stochastic production function to estimate technical efficiency of sugarcane outgrowers. They found that outgowers technical efficiency ranged from 37.5 to 99.9% with a mean efficiency of 73.6%. The technical inefficiency decreased within increased farm size, education and age of the sugarcane farmer.

Later, Erifo *et al.* (2016) conducted a study to identify the factors affecting sugarcane productivity in Wondo Genet, Ethiopia. The input output relationship was analyzed by Cobb-Douglas production function. The results of Cobb-Douglas production function reveals that land size, costs of inputs for land preparation, DAP and urea were highly significant at 1% level with positive coefficients 0.33, 1.86, 0.65 and 0.18 respectively. In another study, Mandla and Masuku (2012) did research on factors affecting productivity of smallholder sugarcane farming in Swaziland. The Cobb-Douglas production function was used to identify the factors affecting sugarcane productivity.

The results indicated that farm size, labour, and fertilizer were statistically significant ($p<0.05$) in influencing sugarcane productivity.

This study used Stochastic Frontier Analysis (SFA) because it accommodates factors affecting productivity, technical efficiency and technical inefficiency in one basket. Stochastic Frontier Analysis is more robust compare to multiple linear regressions in its ability to decompose error term into two parts one being symmetric which captures stochastic effects outside the control of the outgrower farmers and another being technical inefficiency of the outgrower farmers.

With regard to profitability analysis, this study adopted Net Present Value (NPV) as the profitability measure of sugarcane outgrowers. Net Present Value (NPV) is calculated by discounting the summation of all benefits (income) minus discounting summation of total costs for whole sugarcane production circle. Sugarcane involves ratoon crop, ratoon takes more than one harvesting season before uprooting the crop that is the reason why this study did not adopt gross margin analysis to measure sugarcane profitability as detail explained in section 3.6

2.6 Measuring profitability of outgrowers farmer

Various methods ranging from discounting to non-discounting methods are used to analyze the economic viability of investment projects. Discounting measures include cost-benefit ratio, net present value and internal rate of return, while non-discounting measures include payback period, rate of return, contingent valuation, Hedonic Pricing Method, Travel Cost Method, Production Factor Method and Averting Behavior Method (Hoevenagel, 1994).

Discounting measures of project's worthiness such as cost-benefit ratio, net present value and internal rate of return explicitly take into account the time value of money, based on the economic fact that money today is worth more than a promise of money in the future. Cost-benefit analysis (CBA) is a discounting measure of project worthiness. Discounting measures technics originated in the USA in 1936 and has become a world-wide tool to evaluate choices between alternative projects in decision making (Pearce *et al*., 1993).

Traditionally, it is associated with government interventions and the evaluation of public policies and projects (Zerbe and Dively, 1994). It is an assessment method that quantifies the monetary value of all policy or project consequences for the society in which the program is being run (Boardman *et al.*, 2001).

It is particularly useful when a choice has to be made out of several projects (selection), and when the project involves a stream of benefits and costs over time. NPV of a time series of cash flows, both incoming and outgoing, is defined as the sum of the present values (PVs) of the project cash flows. NPV is a central tool in discounted cash flow analysis, and it is a standard method for using the time value of money to appraise long-term projects. Used for capital budgeting, and widely throughout economics, finance, and accounting, it measures the excess or shortfall of cash flows, in present value terms, once financing charges are met (Lin *et al.*, 2000).

The weaknesses of NPV are that, it is very sensitive to the discount rate: a small change in the discount rate causes a large change in the NPV. As the estimate of the suitable discount rate is doubtful, this makes NPV numbers much undecided. Also NPV often relies on uncertain forecasts of future cash flows. The magnitude of this problem obviously depends on how uncertain the forecasts are.

One solution to both problems is to calculate a range of NPV numbers using different discount rates and forecasts, so that one can generate, for example, best, worst and median NPV numbers, or even a probability distribution for the NPV (Lin *et al.*, 2000). The IRR is a rate of return used in capital budgeting to measure and compare the profitability of investments. In the context of savings and loans, the IRR is also called the effective interest rate.

The term internal refers to the fact that its calculation does not incorporate environmental factors e.g. the interest rate or inflation (Bierman, 1986). In many situations, the IRR procedure will lead to the same decision as the NPV procedure, but there are also times when the IRR may lead to different decisions from those obtained by using the net present value procedure. When the two methods lead to different decisions, the NPV method tends to give better decisions.

It is sometimes possible to use the IRR method in such a way that it gives the same results as the NPV method. For this to occur, it is necessary that the rate of discount at which it is appropriate to discount future cash proceeds be the same for all future years. If the appropriate rate of interest varies from year to year, then the two procedures may not give identical answers. It is easy to use the NPV method correctly, but it is much more difficult to use the IRR method correctly (Bierman, 1986).

Despite the disadvantages, the method has been used in many development projects, especially in developing countries like Tanzania. For instance, Kabbiri *et al.* (2008); Denis (2008); Balkema *et al*. (2010); EAC (2010); Brenters and Henny (2002); Akyoo and Lazaro (2008) and Germana (1993) have used cost-benefit analysis methods to analyse the

economic viability of different projects in Tanzania and Kenya. This shows that, the method is very powerful in appraisal of development projects despite its weakness.

Unlike the discounting measures, non-discounting measures of project worthiness do not explicitly consider the time value of money. In other words, each dollar earned in the future is assumed to have the same value as each dollar that was invested many years earlier. The payback period, accounting rate of return or return on investment are two examples of methods used in capital budgeting that do not involve discounting future cash amounts (Averkamp, 2011).

The choice between discounting and non-discounting measures of project worthiness depends on the nature of investment project to be evaluated. For projects like sugarcane growing, that take a long time period for the benefits to return the investments, discounting measures are used because of the time value of money. Therefore, based on this theory, the study used Net Present Value (NPV) to analyse the profitability of outgrowers sugarcane scheme.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Theoretical Framework of the Study

The theoretical framework used in this study in assessing challenges facing sugarcane supply to Mtibwa factory was developed from interplay of the theory of the firm, theory of agricultural production, and efficiency of resource use in sugarcane production. The theory of the firm has three fundamental concepts which are maximization, equilibrium and efficiency (Kaine, 2011). With the concept of maximization, the theory assumes that firms are rational in that they allocate their resources in a way that maximizes their profits.

The concept of efficiency can be said to deal with the relative performance of the process used in the transformation of inputs into outputs (Awerije, 2014). The concept is based on the production frontiers which indicates the minimum inputs required to produce any given level of output for a firm operating with full efficiency (Chukwuji *et al*., 2007). In an earlier inquiry, Farrel (1957) illustrated efficiency measures by involving firms that use two inputs x_1 and x_2 to produce a single output y. Assume the production function (frontier) is $y=f(x_1,x_2)$, under constant returns to scale it may be written as $1=f(x_1,x_2)$, where *1* is a unit isoquant, i.e., the technological frontier can be represented by a unit isoquant UU' as represented in Figure 1 adopted from (Førsund *et al.,* 1980).

We use the figure by Førsund *et al.* (1980) to illustrate Farrell's concept. By assuming constant returns to scale, Farrell (1957) pointed that observed input-per-unit-of-output values (input output ratios) for firms would be above the so-called unit isoquant. This is represented by the space around point A in figure 1. Thus, the ratio OB/OA i.e. the ratio of inputs needed to produce observed output measures technical efficiency.

It takes a value between one and zero and hence provides an indicator of the degree of technical efficiency of the firm. The deviations from UU' were considered by Farrell (1957) to be measures of the technical inefficiency of firms. Despite the fact that the interest of this study was technical efficiency, other types of efficiency (allocative and economic can also be illustrated by the figure as follows:

Introducing the isocost line PP' (represents relative input prices) the ratio OD/OB measures allocative inefficiency, since the cost of point D is the same as that of the allocative efficient point C, and is less than that of the technically efficient but allocative inefficient point B. A measure of total efficiency (or economic efficiency) is provided by the ratio OD/OA (Førsund *et al*., 1980). Economic efficiency is defined as the capacity of a firm to produce a predetermined quantity of output at minimum cost for a given level of technology (Farrell 1957; Kopp and Diewert 1982). An economically efficient firm is the one which is technically as well as allocativelly efficient. It follows therefore that AE=EE/TE.

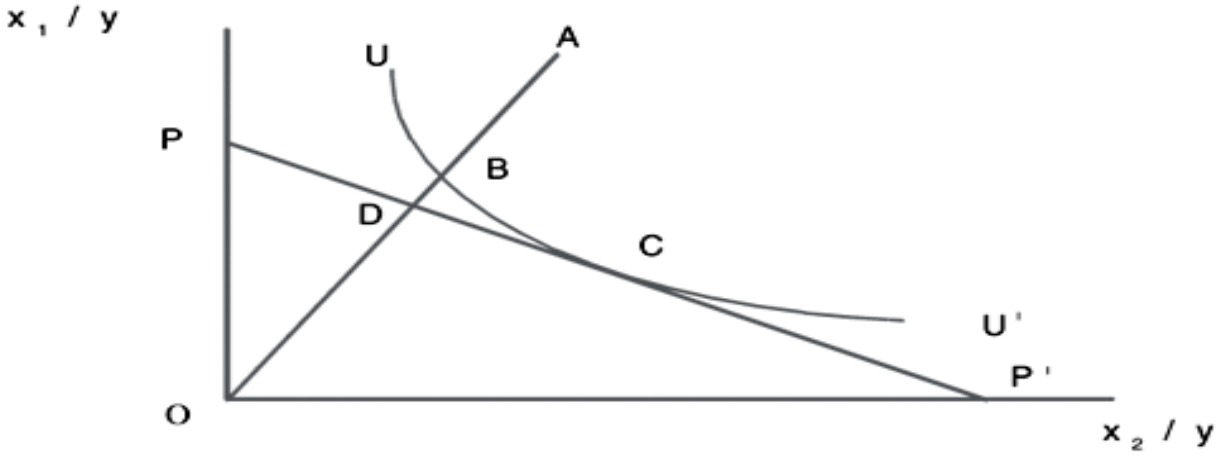

Figure 1: Technical, Allocative and Economic Efficiency

Source: Forsund *et al*. (1980).

3.2 The Conceptual Framework

The conceptual framework adopted by this study is shown in Figure 2. In order to attain goals of the study there is a need of improving sugarcane supply to the factory. However, there are several ways of attaining the goal of improving outgrowers sugarcane supply to Mtibwa factory. In this study it is assumed that to attain the mentioned goal there is a need of improving sugarcane productivity, profitability and business relationship between Mtibwa Sugar Estate and the outgrowers.

Before achieving these there is a need to understand the constraints that affect outgrowers factor productivity, efficiency, profitability and business relationship so as to suggest ways of improving sugarcane supply. Increased productivity and profitability are achieved by improved production efficiency as well as addressing the outgrowers constraints. On the other hand addressing constraints related to business relationship between outgrowers and Mtibwa estate will improve sugarcane supply to the factory (Figure 2)

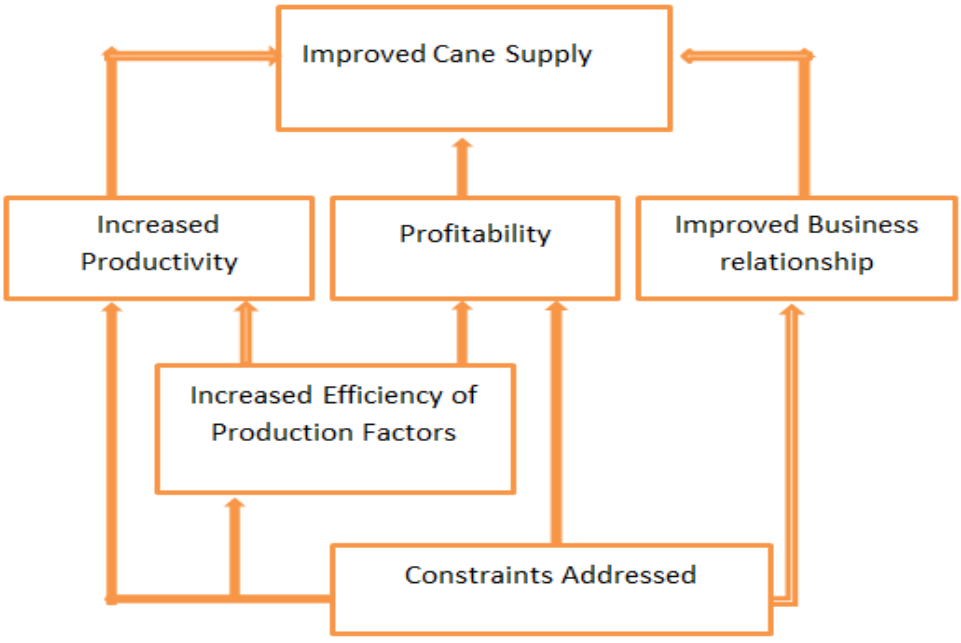

Figure 2: The Conceptual Framework

Source: Own compose

3.3 The description of the Study Area

3.3.1 Location, climate and demographic characteristics

(i) Location

The study was conducted in Turiani division located at Mvomero district in Morogoro region. Turiani division in located in Mvomero district about 130 km from Morogoro Municipality along Kilosa-Handeni road. The district lies between longitudes 37°10’ to 38°31’ East of Greenwish and between latitudes 5°5’ to 7°4’ south of the Equator. Turiani is found at longitude 37°36’ East and Latitude 6°00’ South. The division is comprised of five wards namely, Mtibwa, Sungaji, Mhonda, Diongoya and Kanga. The division headquarter is located in Sungaji ward (Regnard, 2006).

ii) Climate

The division receives a bimodal type of rainfall with peaks in April and December while May to October remains relatively dry. The average rainfall is 1 200 mm per annum with variations from 800 mm to 2 000 mm. Average monthly rainfall is about 106 mm making up a total annual rainfall of about 1 270 mm. The mean annual precipitation is marginal for cane growing under rain-fed conditions, taking account of the annual distribution pattern and year-to-year variation. The prolonged dry season, which is beneficial for harvest operations, unfavorably affects yield level.

iii) Population

According to the population census of 2012 (URT, 2013), Mvomero District had a population of about 312 109 people. Turiani ward had a total population of about 108 279 with an average of 4.3 people per household and an average population density of 31 people per square kilometer.

However, according to NBS (2016), Mvomero district and Turiani ward are expected to have population increase to 343 000 and 120 000 respectively. This is result of an annual population growth rate of 2.4%.

iv) Economic activities

The main crops grown are sugarcane, paddy, maize, cassava and banana. Other crops include beans, millet, cowpeas, potatoes, groundnuts, citrus fruits, mangoes, jackfruits, coconut, tomatoes, and eggplant. With exception of paddy and sugarcane field, cultivation is carried out mainly by use of the hand hoe, using primarily family labour and hired labour when the situation demands. Few individuals own tractors. In the division few individuals keep livestock such as dairy cows, goats, local chicken and ducks.

3.4 Data sources and sampling procedures

Among the sources of data in many researches (for example secondary data, panel data and cross sectional data), this study used cross sectional data sources, the data are collected at a single point in time from a sample to represent a large population. These data (which are also referred to as primary data) are suitable in descriptive study and for determination of relationship between and among variables. It is also economical in terms of time and financial resources (Babbie, 1993).

Primary data was collected through interviews using a structured questionnaire (Appendix 1). Prior to the actual survey, the questionnaire was pre-tested under field conditions. Secondary data was collected from different sources including books, research reports and journals. This study employed a systematic sampling procedure to select sugarcane outgrower in each ward in Turiani division that was involved in sugarcane production. The wards included Mtibwa, Sungaji, Mhonda, Diongoya, and Kanga.

To ease the sampling process, a list of sugarcane growers was developed with the help of agricultural extension agents and leaders of outgrower organizations.

Given that the total number of sugarcane outgrowers farmers in the scheme is known (N = 500), the targeted population is finite and hence the sample size was determined by applying the standard method as proposed by Krejcie and Morgan (1970) as follows:

$$n = \frac{x^2 * N * p * q}{d^2 * (N-1) + x^2 * p * q} = \frac{(3.84)(500)(0.5)(0.5)}{(0.05)^2 * (500-1) + (3.84)(0.5)(0.5)} \approx 210. \ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots (1)$$

Where n = sample size, χ^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (at 95% confidence level, $\chi^2 = 3.8416 \approx 3.84$), N = total number of farmers, p = population proportion considered to be 0.5 to provide maximum sample size, q = (1-p) = 0.5 and, d = degree of accuracy expressed as a proportion (d = 0.05). Applying equation (1), the sample size for the study is n = 210 farmers. From the list of 500 farmers exploiting the scheme (sampling frame), systematic sampling was applied to selected the sample. As such, the sampling interval is 2

$$\left(\frac{500}{210} = 2.5 \approx 2\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Hence each 2nd farmer was selected to be interviewed.

3.5 Data processing and analysis

Data collected were analyzed using different methods to address the specific objectives, these methods were; Descriptive statistics such as means, frequencies and percentages, cross tabulations, and ratios which were generated using SPSS statistical Software version 16. Among others descriptive analysis was used to determine the challenges facing business relationship between sugarcane outgrowers and mtibwa sugar factory.

Percentages were used to express the proportion of the respondents facing a particular constraint.

Farm productivity analysis was carried out using production frontier analysis to generate the technical relationship between inputs and output, technical efficiency and the determinants of household inefficiency factors. This was made operational using a stochastic frontier model (Battese and Coelli, 1992; 1995). The model was specified and estimated using a computer program called FRONTIER 4.1 (See section 3.7)

Farm profitability analysis was carried using discounting measure of project worthiness. Net Present Value (NPV) was used to analyses profitability of sugarcane outgrower farmers. This was prompted by the fact that once sugarcane is planted it generates income for a period of up to four years (through different ratoon crops). Based on the aforesaid, the use of gross margins to assess farm profitability was found to be inappropriate (see section 3.6).

3.6 Farm Household Profitability Analysis

3.6.1 Net present value (NPV)

The NPV was calculated as the present value of the project's cash inflows minus the present value of the project's cash outflows. Net Present Values (NPV) of outgrowers used inorganic inputs (fertilizer + herbicides), outgrowers did not use inorganic inputs (fertilizer + herbicides), and whole sampled outgrowers. Cash inflows are the revenue obtained from selling sugarcane and the cash outflow is the inputs cost for producing sugarcane and initial farm investment cost. This relationship is expressed by the following formula:

$$NPV = \sum_{t=0}^{n} \frac{B_t}{(1+r)^t} \quad - \sum_{t=0}^{n} \frac{C_t}{(1+r)^{t.}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (3)$$

Whereby;

B_t=the benefit of each year

C_t=the cost of each year

n=the useful life of sugarcane. (Number of ratoon)

r=Interest rate.

The farm with higher positive number is the one which is selected.

3.7 Farm productivity analysis

3.7.1 Stochastic production frontier with technical efficiency effect

According to Battese and Coelli (1995) the stochastic frontier production function can be written as

$$Y_i = f(X_i\,; \beta) \exp(-U_i\ ) \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots .. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. \quad (5)$$

Where; Y_i is the production of the i^{th} outgrowers farm,

X_i is a vector of inputs used by i^{th} outgrowers farm.

β is the vector of unknown parameter

V_i is the random variable which is assumed to be independent and is identical distributed (iid) N (0, σv^2) and independent of U_i and U_i is a random variable that is assumed to account for technical efficiency in the production.

Following Battese and Coelli (1995), U_i is assumed to independently distributed as truncation (at zero) of the normal distribution with mean, μ_i and variance $\sigma u^2(\left|N(u_{i}, \sigma u^2)\right|)^1$ $\sigma u^2(\left|N(u_{i}, \sigma u^2)\right|)^1$, $\sigma u^2(\left|N(u_{i}, \sigma u^2)\right|)^1$ Where $\mu_i = Z_i$ σ and Z_i is a 1 x c vector of outgrowers farm specific variables that may cause inefficiency and σ is c x 1 vector parameters to be estimated. The outgrowers farm specific stochastic production frontier representing the maximum possible output (Y^*) can be expressed as

$$Y_i^* = f(X_i; \beta)\exp(V_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (6)$$

Equation (1) may be rewritten using equation (3) as

$$Y_i = Y_i^* \exp(-U_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (7)$$

Thus, technical efficiency of the I^{th} farm, denoted by TE, is given by

$$TE_i = \frac{Y_i}{Y_i^*} = \exp(-U_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (8)$$

This means that the difference between Y and Y^* is embedded in the U_i. If $U_i = 0$, then Y^* This means production lies on the stochastic frontier and hence technically efficient and the farm obtains its maximum possible output given the level of inputs.

If $U_i > 0$, production lies below the frontier and the farm/firm is technically inefficient (Dey, 2000)

3.7.2 Estimation of Inefficiency

The inefficiency model as proposed by Battese and Coelli (1995) consists of regressing estimated mean inefficiency upon a vector of farm-specific factors associated with inefficiency as follows:

$$u_i = zi\delta \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (9)$$

This specification assumes U_i to be a function of a number of household specific factors, which implies that this component is not identically distributed, unless all the coefficients of the factors are simultaneously equal to zero. (condition under null hypothesis for hypothesis one)

i) Model specifications for farm productivity estimates

Two models are specified namely (i) Cobb Douglas stochastic frontier production model to investigate relationship between output and inputs, and to determine technical efficiency, (ii) Inefficiency model to examine the determinants of inefficiency.

ii) Cobb Douglas stochastic production frontier model

Since stochastic frontier production models were proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977), there has been a vast range of their applications in literature. Battese and Coelli (1995) proposed a Cobb Douglas stochastic frontier production function, which has farm effects assumed to be distributed as a truncated normal random variable, The model coefficient estimation follow three steps estimation method which including;

(i) Ordinary Least Square (OLS) estimates of the model are obtained. All β estimators with the exception of the intercept will be unbiased.

(ii) A two-phase grid search of γ is conducted with the β parameters (excepting β_0) set to the OLS values β_0 and σ^2parameters adjusted according to the corrected ordinary least squares formula presented in Coeli (1995). Any other parameters (μ, η or δ's) are set to zero in this grid search.

(iii) The values selected in the grid search are used as starting values in an iterative procedure to obtain the final maximum likelihood estimates.

The Cobb Douglas generalized stochastic frontier model can be expressed as,

$$Q = \beta_0 A_1^{\beta 1} L_2^{\beta 2} K_3^{\beta 3} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

Equation (10) can be linearize by expressing it in a logarithm form as:

$$lnQ_i = \beta_0 + \beta_1 lnA_i + \beta_2\, lnL_i + \beta_3\, lnK_i + \varepsilon_{i.} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

ln= denote logarithms to base e

Q=the maximum attainable output for given level of all inputs, measured in tons

A=land area cultivated, measured in hectares.

L=Labour utilized, measured in man-days.

K=the Total variable inputs (fertilizer, pesticides,) and the value of total capital Equipment (hand hoe, bicycles, axle, and forked hoe)

$\beta_i's$ = Unknown parameters that need to be estimated

According to Aigner, Chu and Lovell (1977), the error term is really a composite of two terms:

$$\varepsilon_i = V_i - U_i \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots;\ i = 1, \ldots\ldots, \ldots..1 \ldots..N$$

Where

V_i= represents independently and identically distributed random errors N $(0,\delta_v^2)$; these are factors outside the control of the firm.

U_i= represents non negative random variables which are independently and identically distributed as N $(0,\delta_u^2)$, i, e. the distribution of U_i is half normal. $|U_i|$ is half normal.

$|U_i|>0$ reflects the technical efficient relative to frontier production function $|U_i|=0$ for firm whose production lies below the frontier.

Explanation of variables estimates prior expectations

a) Land (β_1)

This is natural physical resources which support crops and was measured in hectare (ha). In the case of smallholder sugarcane outgrower farmers, it is expected that they do not have the managerial capacity of operating large farms. However, these smallholder outgrowers in support by outgrowers associations have skilled personnel to manage the farms so it may depend on the individual farm capability, moreover the relationship between farm size and sugarcane output is expected to be positive.

b) Labour (β_2)

This is human input into productions, this include hired and family labour measured in man-days/hectare, since sugarcane production is a labour intensive activity that requires substantial amount of labour for the various farm operations that take place during the production season. Hence it is obvious that in order to produce a good crop, a considerable amount of labour is needed to carry out most of the work. A positive relation between labour and sugarcane yield per hectare is expected.

c) Capital (β_3)

All other inputs used in sugarcane production are categorized as capital which including fertilizer, herbicides and farm implements. All agricultural inputs and farm implements used in sugarcane production process were first converted in monetary values that measured in Tanzanian shillings (TZS). Hence the relationship between capital and sugarcane yield output is expected to be positive.

3.7.3 Inefficiency model

Some studies such that done by Pitt and Lee (1981) estimated stochastic Frontier production function, obtained predicted efficiency measures then regressing them with firm specific characteristics to obtained determinants of inefficiency (also called 2-stage estimation). This 2-stage estimation has been recognized as a useful exercise. However, it has been criticized in its assumptions on independence of inefficiency effects (Coelli, 1996).

Later, Kumbhakar *et al*. (1991); Reifschneider and Stevenson (1991); Battese and Coelli (1996) proposed a stochastic frontier model which expressed inefficiency Ui as a function of firm specific characteristics and a random error to allow independence of inefficiency effects. This study adopted these arguments by including a random error term in 2-stage estimation.

The model specification was;

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 W \ldots\ldots\ldots\ldots (13).$$

Where

Z_1=age of the farmers in years

Z_2=Level of Education of farmers in years

Z_3= Number of years the farmers has been outgrowers

Z_4=Household size

Z_5=Marital status dummy (1 for Married and 0 for Not married)

Z_6=Sex

Z_7= off farm activities

W_i=An error term that follows a truncated normal distribution

δ_1=Inefficiency parameters to be estimated

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents results and discussion of the study. The results are divided into five main sections. The first section explains the socio-economic characteristics of the sampled sugarcane outgrowers. The second, third and fourth section discuss the empirical results as per specific objectives starting with the Cobb-Douglas stochastic frontier production, efficiency and inefficiency results respectively, The fifth section presents the results of profitability analysis i.e. Net Present Value (NPV) Analysis of sugarcane outgrower farmers.

4.2 Socio-economic characteristics of sampled households

4.2.1 Sex of Household head

Table 1 shows that 18% of household heads of sugarcane outgrowers were female whereas 82% were males. This implies that most of sugarcane outgrower households are under the control of males. Therefore the majority of sugarcane production activities are governed by men. This is a common phenomenon to African traditions where most societies are patrilineal, in which husbands are in most cases the head of households. Studies have argued that male and female household head are equally efficient as farm manager and both of them lack access to agricultural resources but women are often claimed to have less access to resources in comparison to men (Quisumbing, 1995).

Table 1: Sex of the household head

Gender	Frequency	%
Female	37	18
Male	173	82
Total	**210**	**100**

4.2.2 Age of the household head

The majority of the household head were above 59 years of age (Table 2). This leads to conclusion that most of the outgrower farmers are above the active age and they probably do not have enough capacity to manage their farms or maybe they delegate responsibilities to other members of the family.

Table 2: Age of household head

Age group	Frequency	%
19-35	43	20
36-59	51	25
>59	116	55
Total	**210**	**100**

4.2.3 Marital status of the household head

As shown in Table 3, about 91.0% of the heads of households were married. The high proportion of married individuals may indicate that more family labour is available for sugarcane production activities since sugarcane production is a labour intensive activity. According to Haruna (2002) this high proportion of marriage indicates greater responsibilities for catering to their family needs, therefore working hard due to the responsibilities.

Table 3: Marital status of the household head

Marital status	Frequency	%
Single	11	5
Married	192	91
Widow	7	4
Total	**210**	**100**

4.2.4 Education level of the household head

The result in Table 4 shows that the majority of sugarcane outgrowers household heads were primary education holders 72%. From the study results it could be deduced that most of the sugarcane farmers in the study area were literate. The level of education of any given farmers has direct effect on the perception and understanding of an activity and hence the willingness to adopt any technologies or changes. This is because of their level of association and ability to decide with minimum guidance provided that the new idea or technologies are going to impact positively on faming activities and livelihood.

Table 4 : Education level of the household head

Education level	Frequency	%
Primary education	152	72
Secondary education	32	15
Postsecondary	16	8
No education	10	5
Total	**210**	**100**

4.2.5 Experience in sugarcane farming

Table 5 shows about a half of the respondents had farming experience of between16-21 years, it shows that a substantial number of sugarcane outgowers are experienced in performing various sugarcane farm management practices and may be in a position to adoption new technologies and can enhance productivity. On other side Table 5 shows only 10% of outgrowers had ≤ 5 years of farming experiences. This may imply that there are limited economic incentives that motivate new entrance to the sugarcane outgrowing venture.

These percentages might increases over time as more mobilization, sensitization and incentives are provided. These incentives include things like appropriate pricing of their sugarcane and good physical infrastructure.

4.2.6 House hold size

The findings showed that the average household size in the study area is 6 persons with the majority of families 50% having a size ranging between 4 and 7 persons. This implies that outgrower farmers in the study area have to produce more in order to be able to feed the family since they have relatively large number of labour force.

Table 5: Experience in sugarcane farming and household size

Experience (years)	**Frequency**	**%**
≤ 5	22	10
06-Oct	18	9
Nov-15	19	9
16-21	106	50
< 21	45	21
Total	**210**	**100**
Household size		
01-Mar	45	22
04-Jul	106	50
08-Nov	49	23
>12	10	5
Total	**210**	**100**

4.3 Input variables

4.3.1 Land availability

i) Area under sugarcane cultivation

Area under sugarcane cultivation by outgrowers ranged from 0.1 hectare to 12 hectares (Table 6). About 97% cultivate less than 3 hectares; this indicates that sugarcane outgrowers in the study area are predominantly smallholders. Since farm size is not a major impediment to adoption of new technologies such as use of fertilizer increased productivity may still be possible.

Table 6: Descriptive statistics of area under sugarcane production

Mean	Standard deviation	Maximum	Minimum
1.12	1.01	12	0.1

Table 7: Land under sugarcane

Estimated variable	Frequency	%
Farm size categories (ha)		
0.5-0.9	131	62.00
1.0-3.0	73	35.00
>3.0	6	3.00
Problem in acquiring land		
No problem	26	12.00
Bureaucracy	9	9.00
High cost	165	79.00
Means of acquiring land		
Bought	171	81.00
Hired	7	3.00
Inherited	24	12.00
N = 120		

ii) Land acquisition methods and Problem in acquiring land

The result in Table 7 shows that the majority of farmers 81% acquired their land through buying from other people. However the major challenge is high costs as reported by 79% of respondents in the study area.

4.3.2 Labour availability

i) Type of labour used in sugarcane production

Table 8 presents the type of labour used in the study area during the 2015/2016 sugarcane production season. The most important feature of labour used in sugarcane production is that 45% used only family labour. Most of the respondents may not have labour problems as much of it could be supplied within the family. However not all the family members are available for farm work e.g. school children and those who are residing outside the family

etc. However as pointed by Wegener (1997), a farmer incurs less production cost if family labour is being fully utilized for farm production.

ii) Problem in acquiring labour

Table 8 shows that high cost of labour was the main problem in acquiring labour (81%) The majority of outgrowers stated that labour is difficult to acquire/afford due to presence of competition among cane growers and the Mtibwa estates in study areas. As outgrowers are close to the sugarcane estate, the price of labour is set by a comparison of the wage offered by the sugar estate, and quite often is higher than that the outgrowers can afford. Failure of outgrowers to afford required labour for managing their farm field operations may affect sugarcane productivity.

Table 8: Labour used in sugarcane production

Estimated variable	Frequency	%
Type of labour		
Hired labour	80	38
Family labour	93	45
Both	37	17
Problem in acquiring labour		
No problem	25	12
Bureaucracy	14	7
High cost	171	81

4.3.3 Fertilizer usage

The results show that majority of the outgrowers in Mtibwa (90%) do not use fertilizer in sugarcane production. Only 10% of respondents apply inorganic fertilizer. The respondents were asked to give reasons or factors hindering fertilizer use in sugarcane production. The main reason given by those who did not use fertilizers was high price of fertilizer. However some outgrowers had the myth that application of fertilizer will be

uneconomical because their fields are still fertile while other were worried of early drying-up of their cane as harvesting is not guaranteed. However to the knowledge of the researcher these arguments have not been justified scientifically.

4.3.4 Herbicides usage

The result in Table 9, shows that, majority of outgrowers in Mtibwa 90% do not use herbicide in their sugarcane farms for 2015/2016 production seasons. The reason for not using herbicides is the same as that given for fertilizer use (section 4.3.3).

Table 9: Fertilizer and herbicides usage in sugarcane production

Estimated variable	Frequency	%
Fertilizer usage		
Yes	17	8.00
No	193	92.00
Problem hindering usage		
High cost	17	8.00
N/A	193	92.00
Herbicides usage		
Yes	22	10.00
No	188	90.00
Problem hindering usage		
High costs	22	10.00
N/A	188	90.00

4.3.5 Financial credit usage

The findings revealed that, despite the obvious need for financial services for agricultural producers, financial facilities for farmers are lacking. The lack of funds is a main limiting factor that slows down inputs use. Credit availability is potential in augmenting the flow of return to farm enterprises (Kashuliza, 1994). According to Mukwenda (2005) the shortage of credit is one of the limiting factors in operations and businesses.

Mukwenda (2005) mentioned further that, the reason for not acquiring credit to be high interest rates, lack of awareness and lack of capital. The result in Table 10 shows that only 29% had an access to credit for sugarcane production in Mtibwa.

The financial institutions providing loans to the sugarcane outgrowers in Mtibwa are CRDB bank and TUR SACCOS were the only providers of credit to sugarcane Outgrowers in 2015/2016 production season (Table 10).

As per Table 11 the total amount of TZS 65 100 000 was disbursed during 2015/2016 sugarcane production season, where by the minimum and maximum amount of loan were TZS 500 000 and TZS 7 500 000 respectively.

Table 10: Access to credit financial service

Estimated variable	Frequency	%
Ever accessed credit?		
Yes	29	14
No	181	86
Source of finance		
N/A	181	86
Bank	10	5
Saccos	19	9

Table 11: Descriptive statistics of credit usage (TZS)

Mean	Total	Maximum	Minimum
2 245 000	65 100 000.	7 500 000	500 000

4.4 Output per hectare

Output per individual outgrower varied depending on various reasons including area under sugarcane cultivation, management aspects, and ratoon stages. Of interest is production per unit area (hectare). Table 12 shows that the mean sugarcane production under

outgrowers per hectare per ratoon was 20 tons. According to Bombo (2013) the mean sugarcane production under outgrowers per hectare was 31 tons per ratoon. The production is below expected potential of 75-100 tons per hectare (SRI, 2010). Table 12 shows that the minimum production was found to be 3.1 tons, while the maximum production per hectare was 67 tons.

Table 12: **Descriptive statistic production (tons/ha)**

mean	Standard deviation	Minimum	Maximum
20	6.5	3.1	67

4.5 Distribution of respondents by different ratoon stages

Results in Table 13 shows that the majority of respondents 58% said that their fields are in 3rd ratoon stage. This is an indication that sugarcane production is no longer attracting new entrants in Mtibwa. This implying that there are fewer new farmers entering in Mtibwa outgrowers scheme.

Table 13: Percentage of respondents by different ratoon stages

Field ratoon stage	Frequency	%
Plant cane	8	4
First ratoon	28	13
Second ratoon	52	25
Third ratoon	122	58
Total	210	100

4.6 Production frontier estimates

According to Agner, Lovell and Schmidt (1977) restricting t=1 (cross-sectional data) half normal formulation of the authors above, to decide whether we interpret OLS or MLE we need to test the following hypothesis.

Ho; $\gamma = 0$

Hi; not the null

Based on the results of this study t =1.4 and not significant implying the null hypothesis is rejected. Since γ is not 0, δ^2 and U_i remains in the model implying that the model cannot be consistently estimated by OLS (Coelli, 1996).

Based on this the study followed the results of MLE. Since γ was not significant at a level of 5% there was no need of discussing the OLS results.

The estimated coefficient (Table 14) of the extent of land under cultivation showed positive values of 0.78 for outgrower farmers which was significant at 5% level. Therefore, an increment of land (farm area) under cultivation by 1% will increase output by 0.78 % ceteris paribus. The estimated coefficient of capital input was significant with a positive value of 0.02 at significance level of 5%. Thus, an increment on capital by 1% will increase output by 0.02 % ceteris paribus.

However labour input is statistically insignificant probably because of farmers were not optimal to utilize available labour due to high cost to acquire. From above results the researcher fails to reject null hypothesis that factors of production are significantly affecting outgrowers cane production at 5% level significance.

Table 14: Stochastic production function estimates

Variable	Parameter	Coefficient	S.E	t ratio
Constant	β_0	1.58	0.08	20.59
Capital	β_1	0.02	0.01	2.11
Labour	β_2	1.20e-3	0.80e-3	1.59
Land	β_3	0.78	0.05	15.07
δ^2		54.55	44.41	1.23
Γ		0.99	0.70e-3	1 477.20
Log Likelihood		-226.00		
LR test		60.06		

4.7 Technical efficiency of outgrower farmers

The mean technical efficiency of sugarcane outgrowers farmers was found to be 53.75 % this indicates that the output could be increased (using existing resources and technology) than hitherto achieved the efficiency level of the best outgrowers. Table 15 shows the distribution of technical efficiencies of sugarcane outgrowers in Mtibwa scheme. It can be observed that only about 60% of sampled outgrowers farmers are efficient.

Table 15: Distribution of TE levels among outgrowers

T.E%	Outgrowers	%
0-50	84	40
51-100	126	60
Total	210	100

4.8 Assessment of factors affecting efficiency levels

It has to be noted that if the explanatory variable in the inefficiency model has a positive sign on a parameter estimated indicates that the associated variable has a negative effect on efficiency and a negative sign indicates a positive effect on efficiency (Table 16). The value of coefficient of age is negative, hence age of farmer is positively affecting technical efficiency, this indicate that older outgrowers were more efficient that younger ones. This could be due to experience and managerial skills, which have learnt over time.

The influence of household size and marital status came with a negative sign on the level of inefficiency. This implies that a big number of family members would lead to a high technical efficiency. Furthermore, experience of farming correlated negatively, negative sign means that the higher the farming experiences of a farmer, the higher the level of technical efficiency. Therefore farmers with little experience should be encouraged to work with the experienced ones.

Table 16: Determinants of technical inefficiency

Variable	Parameter	Coefficient	S.E	t-ratio
Constant	δ_0	0.98	0.47	2.06
Age	δ_1	-0.04	0.01	-3.47
Education	δ_2	0.06	0.01	8.74
Farming experience	δ_3	-4.70e-3	2.90e-3	-1.80e-3
HH-Size	δ_4	-0.02	0.01	-2.61
Marital Status	δ_5	-0.06	0.20	0.28
Sex	δ_6	0.01	0.05	0.09
Off farm	δ_7	-0.04	0.72	-0.05.
Sigma-squared	δ^2	0.11	0.02	4.70
Gamma	γ	0.78	3.50e-3	228.39

Being involved in off farm activities correlate positively to sugarcane production efficiency. This may be because of incomes received from non-farm activities support some of outgrowers field management. Therefore farmer should be encouraged been involved in off farming activities. The positive estimate for level of education implies that farmers with greater years of schooling tend to be high inefficient. This happened probably because outgrowers with greater years of schooling spend most of their time in the employment activities that in the cane fields hence result into low efficiency.

4.9 Profitability analysis of sugarcane outgrower farmers

As mentioned in section 3.6, analysis of profitability for outgrowers was done by estimating Net Present Values (NPV) of outgrowers used inorganic inputs (fertilizer + herbicides), outgrowers did not use inorganic inputs (fertilizer + herbicides), and whole sampled outgrowers. The study result showed that Net Present Values (NPV) were 4 445 080.72; 3 781 880.11; 4 005 644.10 respectively for outgrowers who used inorganic inputs (fertilizer + herbicides), outgrowers did not use inorganic inputs, and whole sampled outgrowers respectively. (Table 17; Appendix 3, 4 and 5).

Result from t-test for independent sample between those used inorganic inputs (Table 17) and those who did not use inorganic input showed that their means were not statistically different at 5% level of significance. From study results the researcher reject null hypothesis of the objective iii that sugarcane production by outgrowers is not a profitable business at 5% level of significance**.** The insignificant results were probably caused by the fewer number of outgrowers that used inorganic inputs compared to outgrowers that did not use inorganic inputs as showed in section (4.3.3 and 4.3.4). Therefore farmers should be encouraged to optimal use of inorganic inputs.

Table 17: NPV for outgrower categories and t test

Variables	**NPVs (TZS)**	**n**
Used inorganic (fertilizer + herbicides)	4 445 080.72	21
Did not use (fertilizer + herbicides)	3 781 880.11	189
Whole Sample(N)	4 005 644.10	N =210
Independent t test: outgrowers used / Did not use inorganic inputs		
t-test		1.72

4.10 Constraints facing outgrowers sugarcane producer

The specific objectives iv of this study was to investigate the constraint facing sugarcane outgrower farmers. The respondents were asked to mention the major constraints they encountered in sugarcane production. The respondent mentioned constraints in the following order as shown in Table 18 ; 90 % of the respondent said late payments of their proceed from the factory, 62 % followed by problem in weighing system and rendement determination, 59 % reported low price and 58% said Higher service charges. Others were 51% cane not harvested on time, 50 % drought and unreliable rainfall, 25% Emergency fire, 21 % corruption in harvesting, 15% poor infrastructure, and 15 % insufficient capital.

Table 18: Constraint facing sugarcane outgrowers

Constraints	**Frequency**	**%**
Late payments	189	90
Problem in weighing system and Rendement determination	130	62
Low price	124	59
High service charges	122	58
Cane not harvested on time	107	51
Drought and unreliable rainfall	61	50
Emergency fire	53	25
Corruption in harvesting	44	21
Poor infrastructure	32	15
Insufficient capital	32	15
Total	**>210**	**>100**

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

5.1.1 Factors affecting sugarcane productivity

The results showed that land and capital inputs were significantly influencing outgrowers sugarcane production. Therefore, sugarcane outgrower farmers were advised to optimally utilize labour and capital inputs so that they can maximize their yield as well as profit. However labour input was statistically insignificant probably because of farmers were not optimally utilizing available labour due to high cost to acquire labour.

5.1.2 Outgrowers technical efficiency

The mean technical efficiency of sugarcane outgrower farmers was found to be 53.75 %. This result implies that on average outgrowers are producing efficiently. However the output could be increased (using existing resources and technology) by 46.25%. Several outgrower specific characteristics affect technical efficiency of outgrower farmers. The result showed that age, education level, farming experience household size, and off-farming activities as sources of inefficiency in cane farming. In order to improve efficiency younger farmer with low experiences are encouraged to work closer with older farmers with high farming experience. Through this, older farmer can induce experience and managerial skills, which they have learnt over time.

5.1.3 Profitability of sugarcane outgrowers farmer

Since results from the study shows that calculated values of NPV of sugarcane outgrowers in Mtibwa scheme were positive, it can be concluded that Mtibwa sugarcane outgrowers scheme is a profitable business. The only challenge is to address the problems faced by outgrowers to produce efficiently.

5.1.4 Constraints facing sugarcane outgrowers

The sugarcane outgrowers farmers in the study area faced a number of problems in their production activities. The main problems faced by the farmers were late payments of their proceed from the factory, problems in the weighing system and rendement determination, low price, higher service charges, sugarcane not harvested on time, drought and unreliable rainfall. Other problems included emergency fire, corruption in harvesting, poor infrastructure, and insufficient capital.

5.2 RECOMMENDATIONS

5.2.1 Factors affecting sugarcane productivity

The outgrowers sugarcane production was affected by resource constraints namely: land, labour, and capital. Therefore, sugarcane outgrower farmers should be encouraged to utilize resources at optimal level so that they would maximize their yield as well as profit.

5.2.2 Outgrowers technical efficiency

The finding of this study indicates that the average efficiency of sugarcane outgrowers in the study area is 53.75%. From this finding this study recommends that there is a room of improving outgrowers level of efficiency by 46.25% through better use of the available productive resources.

5.2.3 Profitability of sugarcane outgrowers farmer

Profit of sugarcane outgrower farmers can be improved through reduction of production cost and increasing production through being more efficient in production. This can be achieved by encouraging farmers to adopt block farming in order to reduce the cost of production.

5.2.4 Constraints facing cane growers

Regarding the problem of delayed payment, it is suggested that MSE should pay sugarcane growers at least 50% of the total value upon delivering sugarcane to mill. This will help sugarcane growers to continue with other farm activities which require immediate attention. The remaining 50% payment can be paid at any time not exceeding 90 days as the contract stipulate. In addition to farmer's contribution from their pay check, a community fund to help road rehabilitation should be established. This will allow accessibility of roads throughout the harvesting season including the rainy season and ultimately reduce operational costs

With regard to problems in determining the weight and rendement of sugarcane these can be addressed by having a representative of outgrower at the weighing bridge. However, a thorough analysis should be made before employing the representatives so as to ascertain how much per acre a grower can gain or lose by having a representative at the weighing bridge.

In order to break even, price setting should be based on the cost production per ton however, in order to increase the price of cane, the value of other byproducts including molasses, bagasse and mud mills must be shared between out-growers and the miller and the price should be uniform across all sugar growing sites where the costs of producing one ton of sugarcane are almost equal.

REFERENCES

Admassie, A. and Matambalya, F. A. (2002). Technical efficiency of small- and medium-scale enterprises: evidence from a survey of enterprises in Tanzania. *Eastern Africa Social Science Research Review* 27 (2): 1 - 29.

Aigner, D. J., Lovell, C. A. K. and Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics* 6(1):120-142

Akyoo, A. and Lazaro, L. A. (2008). An Accounting Method-Based Cost-Benefit Analysis of Conformity to Certified Organic Standards for Species in Tanzania. DIIS Working Paper No. 30. Copenhagen, Denmark, 2008. 76pp.

Alfonso, J.P. (2010). Farm size and Resource Efficiency in small-scale agricultural production: A case study of rice farm in Kwara State of Nigeria. Niger. Agric. J. 23(2):43–50

Averkamp, H. (2011). Evaluating Business Investments. [http://blog.Accounting coach.com/payback-non discounted-capital-budgeting/] site visited on 11/09/2017.

Awerije, B.O. (2014). Exploring the potentials of cassava for Agricultural growth and economic development in Nigeria. A thesis submitted to the University of Plymouth in partial fulfillment for the degree of Doctor of philosophy school of Geography, Earth & Environmental Sciences.

Babbie, E.R. (1993). *Survey Research Methods*. Wasworth Publishing Company. Belmount, California. 395pp.

BACAS (2004).*Institutional Mapping of Sugar, Draft report on phase tw*o. Sokoine University of Agriculture. Morogoro, Tanzania. 72 pp.

Baiyegunhi and Arnold (2011) Economics of sugarcane production on large scale farms in the Eshowe/Entumeni areas of KwaZulu-Natal, South Africa

Balkema, A., Karoli, N. N., Henny, R. and Ralph, R. (2010).Socio-economic analysis of constructed wetlands systems for hygienic sanitation in Tanzania. *The Water Practice and Technology* 5(1): 6 – 8.

Bartlett, J.E., Kotrlik, J.W. and Higgins, C.C. (2001). "Organizational Research: Determining Appropriate sample Size in Survey Research". *Information Technology, Learning, and Performance Journal* 19(1):43-50.

Basnayake, B. M. J. K., and Gunaratne, L. H. P. (2002).Estimation of Technical Efficiency and Its Determinants in the Tea Small Holding Sector in the Mid Country Wet Zone of Sri Lanka. *Sri Lanka Journal of Agricultural Economics* 4(1): 137-150.

Battese, G. E. and Coelli, T. J. (1992). Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India. *Journal of Productivity Analysis* 3(4): 387-399.

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

Beringer, C. (2003). Estimating enterprise production functions from input-output data on multiple enterprise farms. *Journal of Farm Economics* 6(18): 923-93.

Bierman, H. J. (1986). Implementation of Capital Budgeting Techniques. *Financial Management Survey and Synthesis Series* 22 (3): 1- 24.

Bierman, H. J. (1986). Implementation of Capital Budgeting Techniques. *Financial Management Survey and Synthesis Series* 22 (3): 1- 24.

Boardman, D. H., Greenberg, A.R. and Vining, D.L. (2001). *Cost–Benefit Analysis:* Collins College Publishers, New York. 526pp.

Bombo, F. (2013).*Transaction costs in production and marketing under Outgrowers scheme in Morogoro*. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 100 pp.

Boyd, H.W., Westfall, R. and S.F. Stasch (1981) Marketing Research. Text and Cases. Homewood, Illinois, Richard D. Irwin

Brenters, J. and Henny, R. (2002). A Sub-Sector Approach to Cost Benefit Analysis: Small-Scale Sisal Processing In Tanzania. Working Paper No. 4.Eindhoven Centre for Innovation Studies, Netherlands. 22pp.

Brenters, J. and Henny, R. (2002). A Sub-Sector Approach to Cost Benefit Analysis: Small-Scale Sisal Processing In Tanzania. Working Paper No. 4. Eindhoven Centre for Innovation Studies, Netherlands. 22pp.

Cesaro, L., Marongiu, S., Arfini, F., Donati, M. and Capelli, M. (2009). Methodology for analysing competitiveness, efficiency and economy of scale. Use and applications of DEA: FACEPA Deliverable No. D5.1.3.

Charnes, A., Cooper, W. and Rhodes, E. (1978). Measuring the inefficiency of Decision Making Units. *European Journal of Operational Research* 2(6): 429-444pp.

Chongela, J. (2008). *Economic Analysis of Outgrower's Sugarcane Production Scheme at Ruembe Sugarcane Basin in Kilosa District, Morogoro*. Dissertation for Award of Msc degree at Sokoine university of Agriculture, Morogoro, Tanzania. 28 pp.

Chukwuji, C.O., Inoni, O.E. and Ike, P.C. (2007). Determinants of technical efficiency of garri processing in Delta state, Nigeria. *Journal of Central European Agriculture* 8(3): 327-336.

Coelli, T. J. (1996).A guide to FRONTIER Version 4.1. A computer programme for Stochastic Frontier Production and Cost Function Estimation. Centre for

Efficiency and Productivity Analysis (CEPA) Working Papers. Department of Econometrics University of New England, Armidale, NSW 2351, Australia. [http://www.une.edu.au/econometrics/cepawp.htm] site visited on 20/05/2017.

Damas, P. (2001). *Economic analysis of medium scale agricultural enterprises in predominantly smallholder agriculture sector.* Dissertation for Award of Msc degree at Sokoine University of Agriculture, Morogoro, Tanzania, 139pp

Debreu, G. (1951). The coefficient of resource utilization. *Econometrica* 19: 275 – 292pp.

Denis, G. M. (2008). *Adaptive Adoption of Rainwater Storage Systems by Farmers: A Case of Makunga Ward in Same District*. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania.

Denis, G. M. (2008). Adaptive Adoption of Rainwater Storage Systems by Farmers: A Case of Makunga Ward in Same District. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania.

Dey, M. M. (2000). Technical efficiency of tilapia growout pond operations in the Philippines. *Aquaculture Economics and Management* 4 (1/2). 73 – 112pp.

Dixie, G. (1989). Horticultural marketing In: *A resource and training manual for extension officers:* FAO Agriculture services bulletin Rome. 1-5pp.

Dlamini, S., Rugambisa J.I., Masuku, M.B, and Belete, A. (2010).Technical efficiency of small scale sugarcane farmers in Swaziland: A case study of Vuvulane and Big bend farmers. *African Journal of Agricultural Research* 9(1):935-940.

EAC (2010). Feasibility Study for a Natural Gas Pipeline from Dar es Salaam to Tanga (Tanzania) and Mombasa (Kenya). Methodology for Financial and Economic Analysis report. 28pp.

Erifo, S., Tesfaye, P., and Ayenew, B. (2016).The determinant factors of sugarcane productivity: the case of wondo genet, Ethiopia. *Journal of Resources Development and Management* 2(25): 316-221.

FAO (2013). Structural change in sugar market and implications for sugarcane smallholder in developing countries. 12pp

FAO (2013).Commodity and Trade Policy: structural changes in the sugar market and implications for sugarcane smallholders in developing countries. [*www.fao.org/docrep/019/ar714e/ar714e.pdf*] site visited on 20/10/2017.

FAO (2012). Sugar Annual Report. [http://www.fao.org] site visited on 12/05/2017

Farrell, M. (1957). Measurement of Productive Efficiency. *Journal of the Royal Statistical Society* 120 (3): 253-290.

Fernandez, M.D, and Fernandez, P.L (2009). Technical efficiency in the production of sugar cane in central Negros area, Philippines. *Asian Journal of Agricultural Extension, economics & Sociology* 8(1): 61-70.

Forsund, F.C., Lovell, A. K.andSchmidt, P. (1980). A survey of frontier production functions and their relationship to efficiency measurement, *Journal of Econometrics* 13(2): 5-26.

Germana, C. L. (1993). A Socio- Economic Analysis of Modern Irrigation Projects under Small Scale Farming: A Case of the Lower Moshi Irrigation Project in Kilimanjaro Region. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 117pp.

Greene, W. H. (2008). *Econometric Analysis*, New Jersey, Prentice Hall Press, 2008.

Haruna, U. (2002). Economics of Sustainable Fadama Farming among Fadam Users association in Bauchi State, Nigeria. Unpublished PhD Dissertation, ATBU, Bauchi.; 153pp.

Hoevenagel, R. (1994). An assessment of the contingent valuation method. In *Valuing the Environment: Methodological and Measurement Issues*, Pethig, R. (Ed.). Kluwer Publisher, Dordrecht. 372pp.

Kabbiri R., Senkondo, E.M.M., Aboud, A.A., Israel, S.H., Mbaga, S., Msaky, J.J.T. and Mkomwa, S.A. (2008). Profitability of Draught Power in Semi-Arid Tanzania:

A case study of Hai, Kongwa and Siha districts. *Food and energy crises* 8 (271): 107-114pp.

Kabbiri, R., Senkondo, E.M.M., Aboud, A.A., Israel, S.H., Mbaga, S., Msaky, J.J.T. and Mkomwa, S.A. (2008). Profitability of Draught Power in Semi-Arid Tanzania: A case study of Hai, Kongwa and Siha districts. *Food and energy crises* 8 (271): 107-114pp.

Kaine, A. I. N. (2011) Investigation of Factors Affecting Technical Infancy of Akpu Processing in Delta State, Nigeria'. *Journal of human ecology 33(2): 133-137.*

Kamaga, B.C.G. (2000). Sugarcane production cropping system in Malawi. *African Crop Science Journal* 8(4):429-440.

Kashuliza, A. K. (1994). Smallholders Credit in Mbeya Region (Tanzania): Role Performance and Policy Implications. Mimeo. Department of Rural Economy Sokoine University of Agriculture. 78pp.

Katanila, R.S, (1989).Social factors associated with female household headship in Tanzania. *Tanzania Journal of population studies and development* 19(1): 65-80.

Kohls, R. L. and Uhls, J.N. (1990). Marketing of agricultural products. Macmillan Publishing Company, New York. 173 pp.

Koopmans, T. C. (1951). An analysis of production as an efficient combination of activities. In: *Activity Analysis of Production and Allocation. Cowls Commission for Research in Economics.* (Edited by Koopmans, T. C.), John Wiley Sons Publishers, New York. 77pp

Kopp, R.J. and Diewert, W. E. (1982) The Decomposition of frontier cost function deviations into measures of Technical and allocative efficiency *Journal of Econometrics* 19(213) : 319-320.

Krejcie, R. V. and Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement* 30: 1 – 4.

Krugman, P. (1994). Defining and Measuring productivity

Kumbhakar, S. and Lovell, K. (2000). *Stochastic Frontier Analysis*. Cambridge University Press, Cambridge, United Kingdom. 332pp.

Kumbhakar, S.C, and Ghosh, S. and McGuckin, J.T. (1991) A generalized production frontier approach for estimating determinants of inefficiency in US dairy farms. *Journal of Business and Economic Statistics* 9(1):279-286.

Lin, C. I., Nagalingam, and Sev, V. (2000). CIM justification and optimization. London: Taylor & Francis. 36pp.

MAFC, PADEP and MMA (2006). Contract farming; Status and prospect of Tanzania. [www.mma-ltd.com/cons.htm] site visited on 23/01/2017

Maganya, N.E., Chambua, S. and Hyuha, T. (1989).Eastern Africa Economics review: Outgrower schemes in Tanzania Institute of Development studies, University of Dar es Salaam. 72-86pp.

Makeham, J.P. and Malcolm, L.R. (1986*). The Economics of Tropical Farm Management*. Cambridge University Press. 968pp.

Mandla, B. D. and Masuku, M. B. (2012). Productivity of Smallholder Sugarcane Farmers in Swaziland: The Case of Komati Downstream Development Programme (KDDP) Farmers Associations, 2005-2011. Canadian Centre of Science and Education. *Environment and Natural Resources Research*, 2 (4):1-7.

Masuku, M. B., Kirsten, J.F., Van Rooyen, C.J. and Perret, S. (2009). Contractual relationships between small holder sugarcane growers and millers in the sugar industry supply chain in Swailand. *Jounal of Agriculture Economics* 42 (3): 183-198.

Matango, R. (2006) *Outgrowers Scheme: A model for Small Holder Mtibwa Cane growers Production in Tanzania'*. A paper presented in UNCTDA Expert Meeting Enabling Small Producers in Developing Countries to Reach Global Markets, Geneva (11-13 December).

Matungul, P.M, Lyne, M.C. and Ortmann, G.F. (2001). Transaction costs and crop marketing in the communal areas of Impedle and Swayimana, KwaZulu-Natal. *Development Southern Africa*. 18 (3): 347-363

Mbilinyi, M. and Semakafu, A.M. (1995). Gender and Employment on sugarcane plantation in Tanzania, Working papers SAP 2.44/WP.85.

Meeusen, W. and Vaden Broeck, J. (1977). Efficiency estimation from Cobb Douglas production function with composed error. *International Economics Review* 18**:** 435-444

Mlambiti, M.E. (1991). *Introduction to Rural Economy. For east Africa students.*Mzumbe Book Project, Morogoro.36 pp.

Mmari, D. (2014). Incomplete Intermediary Coordination and its Effects on Productivity of Sugarcane in Tanzania 75pp.

Msuya, E. (2003). "*Estimation of Technical Efficiency in Tanzanian Production in Tanzania". A Case Study of Mtibwa Sugar Estate Outgrowers Scheme.* Dissertation for Award of Msc degree at Sokoine university of Agriculture, Morogoro, Tanzania, 67 pp.

Msuya, E. and Ashimogo, G. (2005) "*Estimation of Technical Efficiency in Tanzanian Production in Tanzania". A Case Study of Mtibwa Sugar Estate Outgrowers Scheme* Munich Personal RePEc Archive Paper No. 3747

Mukwenda, E.B.J. (2005). Potential for Using the Warehouse Receipt System in Financing Maize Marketing in Tanzania under Market Liberalization: Case study of Mbozi and Babati District. Unpublished Dissertation for award of Msc. degree at Sokoine University of agriculture, Morogoro, Tanzania 150 pp.

NBS (2016).*Household Budget Survey 2016/01*: *Key findings*. National Bureau of Statistics, Dar es Salaam. 355pp.

NBS (2016).Tanzania in Figures: Key Statistics. [http://www.nbs.go.tz/] site visited on 12/5/2017.

Ndayitwayeko, W. M. and Korir, M. (2012). Determinants of technical efficiency in rice production in Gihanga (Burundi) Irrigation Scheme: A stochastic production frontier approach. *Egerton Journal of Science and Technology* 12: 1 – 12.

Obwona, M. (2006). Determinants of technical efficiency differentials amongst small- and medium-scale farmers in Uganda: A case of tobacco growers. AERC Research Paper 152. Economic Policy Research Centre (EPRC), Nairobi, Kenya. 27pp.

Ofejekwu, P.O. (1992). *Economic analysis of tomato production under a small scale irrigation scheme*: A Case study of Gelma irrigation scheme, Zaria. Unpublished MSc. Thesis, Ahmadu Bello University, Zaria, Nigeria.

Ogundele, O. and Okoruwa, V. (2006). Technical efficiency differentials in rice production technologies in Nigeria. Africa Research Consortium. Research paper 154. [core.ac.uk/download/pdf/6562544.pdf] site visited on 28 /8/ 2017.

Ogwang, H. J. (2009). Production and profitability of sugar cane among Kinyara cane out growers, Masindi District. Pearce D., Marglin, S. and Sen, A.K. (1993). Guidelines for project evaluation. UNIDO, New York, 1972. 383pp.

Pearce, D., Marglin, S. and Sen, A.K. (1993). Guidelines for project evaluation. UNIDO, New York, 1972. 383pp.

Pitt, M. and Lee, L.F. (1981). The measurement and sources of technical inefficiency in the Indonesian weaving industry. Jounal of Development Econ9:43–64

Quisumbing, A. R. (1995). Gender Differences in Agricultural Productivity: A Survey of Empirical Evidence. *Food Consumption and Nutrition Division. International Food Policy Research Institute*.

Rabo Bank, (2013). Foreign investor needs enabling environment report.72pp.

Rangarajan, C. (1996).*Banking with poor people. National banking news review* 12(5): 20-25

Rawlins, G. (1989). A Model to Measure Achieved Levels of Technical Efficiency of Africa Farmers. CERAF, Montclair State University, New Jersey. 336pp.

Reginald, I. (2006). *Contribution of Outgrowers scheme in Household poverty reduction: A case study of Mtibwa sugar Estates, Tanzania*. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 101pp.

Rehmand, A. and Ullah, E. (2008). Increasing yield of ratoon sugarcane. [http://archives.dawn.com] site visited on 18/2/2017.

Reifschneider, D. and Stevenson, R. (1991). Systematic departures from the frontier A framework for the analysis of firm inefficiency. *International Economic Review* 32(2):715-723

Samboko, P.C. (2011). An Assessment of factors influencing the profitability of bean production in Zambia A Research Report In Partial Fulfillment of the Requirements for the Degree of Bachelor of Agricultural Sciences, University of Zambia.

Senkondo, E. M. M. (1988). *Economic analysis of Tanzania sugar industry: The case of Kilombero Sugar Company*. Unpublished Dissertation for award of MSc Degree at University of Nairobi, Nairobi, Kenya. 194 pp.

Senkondo, E.M.M. and Ashimogo, G.C. (1991). Factor substitution and wage employment in Agriculture: The case of Kilombero Sugar Estates, Tanzania. *Beitr.trop. Landwirtsch. vet. med. 29(3): 259-266pp.*

Seyoum, E.T., Battese, G.E., and Fleming, E.M. (2004).Technical efficiency and productivity of maize producers in eastern Ethiopia: A study of farmers within and outside Sasakawa-Global 2000 project. Journal Agricultural Economics vol 19, pp. 341-348.

Sserunkuma, S.R. and Kimera, H.R. (2005). Impact of European Union Sugar Trade on Developing Countries (Kenya, Tanzania and Uganda) *[https://germanwatch.org/tw/zu-afr06.pdf] site visited on 10/05/2017*

SBT (2005). Programme for Stakeholder Workshop report. SBT, Dar es Salaam. 18pp.

SBT (2010).*Development on Government Structures, Instruments, Financing models and negotiation forums*. Mkuki na Nyota Publisher. Da r es Salaam. 46pp.

SBT (2014).Challenges and Opportunities for Diversification of Sugar Industry in Tanzania. Mkuki na Nyota Publishers. Dar es Salaam. 68pp.

SBT (2015). Programme for Stakeholder Workshop report. 18pp.

SRI (2010). A brief presentation on research activities. Sugarcane Research Institute. Kibaha. 13pp.

SUGECO (2013). Policy based evidence for enhancing sugar industry regulatory framework for Tanzania. 20pp.

Supaporn, P. (2015).Determinants of Technical efficiency of Sugarcane production among smallholder farmers in Lao PDR-in Thailand. American Jounal of Applied Science vol 9, pp. 935-940

Tanzania National bureau of Statistics (2015). Crops census (2015) pp 34

Tarimo, J.P. and Takamura, Y.T. (1998). Sugarcane Production and Marketing in Tanzania: Joint paper prepared for the department of Crop Science and Production, Sokoine University of Agriculture and Center for African Area Studies.

Thomas, C. R. and Maurice, S.C. (2008). Managerial Economics (9thed) McGraw-Hil/Irwin

UNCTAD (2006).Expert Meeting on Enabling Small commodity producers in developing countries to reach global markets. [http://www.unctad.org/commodities/htm/] site visited on 20/6/2017

URT (2013). *Population and housing Census–General Report*. United Republic of Tanzania. President's Office, Planning and Privatisation, National Bureau of Statistics, Central Census Office. Dar es Salaam. 203pp.

URT (2015).*National Agricultural and Livestock Policy*. Ministry of Agriculture and Co-operatives, Dar es Salaam, Tanzania. 70pp.

URT (2001). United Republic of Tanzania Sugar Industry acts [http://www.agriculture.go.tz/Regulations/The%20Sugar%20Industry%20Ac%202001.pdf] site visited on 11/9/2017

URT (2001)."United Republic of Tanzania Sugar Industry Act" [http://www.agriculture.go.tz/Regulations/The%20Sugar%20Industry%20Act, %202001.pdf] site visited on 11/9/2017

URT (2003). *Household Budget Survey 2003/01*: *Key findings*. National Bureau of Statistics. 65pp.

USAD (2004). World Sugarcane Production Annual Report. USDA, New York, USA. 25pp.

Varian, H. (2003). Micro economic Analysis Third edition.

Wegener, M.K. (1997). Opportunity to Improve Economic Performance on Sugarcane Farms: Paper presented at the Department of Agriculture and CRC for sustainable sugar production. The University of Queensland, Old 4072, Australia.

Wegener, M.K. (1997). Opportunity to Improve Economic Performance on Sugarcane Farms: Paper presented at the Department of Agriculture and CRC for sustainable sugar production. The University of Queensland, Old 4072, Australia

Wooldridge, J. M. (2015). *Introductory Econometrics: Economic Analysis.*

Yeboah, (2009). Factor affecting productivity in the Agriculture sector of Iran. *African journal of Agricultural Research* 6(18):4340-4381.

Zerbe, R. and Dively, D. (1994). Calculations of Costs and Benefits in Partial Equilibrium

APPENDICES

Appendix 1: A household survey questionnaire

SECTION A: BASIC INFROMATION

Questionnaire Number	
Date of interview	
Ward	
Village	

SECTION B: HOUSE HOLD INFORMATION

1. Name of Household head ……

2. Age of Household head ……

3. Sex of respondent: male (1) Female (2)

4. What is your marital status? Married (1) Single (2) Widowed (3) Others. Please specify?

5. What is the education level of household head? Primary (1) Secondary (2) College (3) None (4)

6. Experience in sugarcane farming; ……

7. Are a member of any Outgrowers Association? 1=yes, 2=No

8. Size of the household…….

SECTION C: FACTORS AFFECTING CANE PRODUCTIVITY.

I. Labour availability

8. Mention types of Labour you used in 2016/2017 sugarcane production season, 1=family Labour, 2=hired, 3=both

9. Indicate area cultivated, Output obtained and number of Labour (man hour/day) used in sugarcane production which includes land preparation, manual planting, seed cane preparation & Transport, weeding, fertilizer application and harvesting.

Area(ha)	Family Labour (Man hrs/days)	Hired Labour (Man hrs/days)

10. Indicate the problems you experience from acquiring Labour.1=no problem, 2=bureaucracy 3=high cost 4=others (specify)……

II. Herbicide Availability

11. Do you use herbicides? [Circle] 1=Yes 2=No

12 If yes indicate amount of area cultivated, herbicides used, cost and output obtained in sugarcane production in the 2015/2016season.

Area	Herbicides(L/acre)	TZS/L	Output(tons)/acre	Production (tons)

13. If the answer of the question above is no state why……

14. Indicate the problems you experience from acquiring herbicides.1=no problem, 2=bureaucracy 3=high cost, 4=other (specify)

15. Do you think that herbicide is helpful 1=Yes 2=No

16. If no, Why…….

III. Land Availability

17. Please provide information on the land cultivated and total output obtained from sugarcane in (2015/2016) season.

Land(acre)	**Output(tons)/ha**	**Production(tons)**

18. What is the total land owned by the family?

19. How did you acquire the land? 1= brought, 2=hired, 3=inherited, 4=given by the village government, 5=accessed a free land, 6=others (specify)

20. Indicate the problem you experienced from acquiring land.1=no problem, 2=bureaucracy, 3=high cost, 4=other (specify)

IV. Extension services availability.

21. Did you ever demand Extension services? [Circle] 1=Yes 2=No

22. If the answer in question **above** is YES, how many times? .....

23. If the answer in question **above** is NO, Why? 1=so remote, 2 no research center in the area, 3=No Transport, 4=others specify……

V. Credit Availability

25. Did you take credit for sugarcane production in 2016/2017 season? [circle] 1=YES 2=NO

26. If yes indicate the Amount and sources of Credit.

S/N	Amount of Credit(Cash)	Source(Bank,Saccos) or Other Specify

27. Do you think Credit is helpful? 1=Yes 2=No

28. If no Why?.....

VI. Fertilizer availability

29. Do you use fertilizer? 1=YES 2=NO

30. If yes indicate amount of area cultivated, fertilizer used, cost and output obtained in sugarcane production in the 2015/2016 season.

Area	Fertilizer(Kg/acre)	TZS/50kgs	Output(tons)/acre	Production (tons)

31. If the answer of the question above is no state why……

Indicate the problems you experience from acquiring fertilizer.1=no problem, 2=bureaucracy 3=high cost, 4=other (specify)

32. Do you think that fertilizer is helpful 1=Yes 2=No

33. If no, Why…….

VII. Capital availability

34. Indicate farm implements used in sugarcane production.

Farm implement	Number	Initial cost	Useful life
Hoes			
Panga			
Tractors			
Harrows			
Others(specify)			

SECTION D.INFORMATION FOR PROFITABILITY

35. What is the current stage of your sugarcane farm? 1= Field crops ( ) 2=first ratoon ( ) 3=second

Ratoon ( ) 4=third ratoon ( )

Please indicate the Gross revenue, Area cultivated and costs from sugarcane production in the 2015/2016 season as Guided By the table below

36. Gross revenue from factory in TZS …….

37. Total area Cultivated in hactare ……..

38. Costs

Costs	TZS /hactare	Total(TZSs)
Ploughing		
Harrowing		
Furrowing		
planting		
Fertilizer application		
Herbicide application		
Fire break		
Cutting		
loading		
leavy		
Tasga		
INFR		
OG-services		
Fire accident		
Transportation		
Others(specify)		

SECTION E. SUGARCANE PROCUCTION CHALLENGES

37. Comment on price of sugarcane prevailing in the market.1=high price.2=low price, 3=satisfactory.4 =others (specify)

38. Have you been incorporated in arranging the price of your sugarcane?1=yes 2=no

39. Mention payment time taken between sellers and buyers. 1=early payment, 2=late payment 3=other (specify).

40. Give the challenges facing you on cane production business.

41. What are the causes of these problems?

42. In order to solve the problems what do you think should be done?

43. What is your attitude toward Mtibwa sugar factory…….

Appendix 2: Sugarcane contribution by outgrowers

Year	Estate	OG's	Total	%
1996/97	131 064.53	211 325.10	342 389.63	62.00
1997/98	178 168.10	80 013.70	258 181.80	31.00
1998/99	126 143.68	209 170.12	335 313.80	62.00
1999/00	173 564.50	172 485.42	346 049.92	50.00
2000/01	220 777.08	120 144.45	340 921.53	35.00
2001/02	202 000.40	246 143.63	448 144.03	55.00
2002/03	251 218.44	176 000.88	427 219.32	41.00
2003/04	197 556.55	240 201.92	437 758.47	55.00
2004/05	186 525.25	241 063.90	427 589.15	56.00
2005/06	248 554.48	259 952.28	508 506.76	51.00
2006/07	232 122.36	129 623.52	361 745.88	36.00
2007/08	281 160.60	230 873.52	512 034.12	45.00
2008/09	228 885.92	213 664.08	442 550.00	48.00
2009/10	259 954.58	179 884.10	439 838.68	41.00
2010/11	313 044.59	195 112.42	508 157.01	38.00
2011/12	237 972.34	108 030.72	346 003.06	31.00
2012/13	285 567.88	138 523.64	424 091.52	33.00
2013/14	284 861.42	70 229.54	355 090.96	20.00
2014/15	217 657.44	58 661.80	276 319.24	21.00
2015/16	161 137.74	42 893.72	204 031.46	21.00

Appendix 3: Net Present Value for outgrowers using inorganic inputs

	Plant Cane	Ratoon 1	Ratoon 2	Ratoon 3	Total
A:Maintenance costs					
Farm Equipments	52 855.00			13 405.93	66 260.93
Land preparation	244 350.93				244 350.93
Seed cane costs	291 101.85				291 101.85
Fertilizer & Herbicides costs	81 176.55	56 476.55	56 476.55	51 536.55	245666.20
Labour costs	129 181.00	86 450.00	79 040.00	74 100.00	368 771.00
Sub-Total 1	798 665.33	142 926.55	139 042.48	139 042.48	1 216 150.90
B. Other Costs					
Transport		530 626.22	525 566.95	522 977.69	1 579 170.86
Fire Accident		174 200.43	171 563.63	168 394.62	514 158.68
Infrastructure		67 682.25	67 005.42	66 328.59	201 016.26
Og-Services		14 665.87	14 157.87	13 888.59	42 712.33
Fire Breaking		41 296.79	41 296.79	41 296.79	123 890.38
Tasga		12 338.39	11 857.70	11 849.51	36 045.61
Levy		34 578.39	34 232.64	33 886.87	102 697.91
Loading		285 071.59	282 295.11	279 518.51	846 885.22
Cutting		667 936.91	662 739.53	660 006.67	1 990 683.11
Sub-Total 2		**1 828 396.80**	**1 810 715.65**	**1 798 147.86**	**5 437 260.36**
Grand Total		**1 971 323.40**	**1 946 232.20**	**1 937 190.33**	**6 653 411.26**
Discounted costs	(798 665.33)	1 744 533.98	1 524 185.29	1 342 570.07	5 409 954.27
Gross revenue		4 579 654.84	3 943 557.59	3 915 819.66	12 439 032.09
Net Benefit	(798 665.33)	2 608 331.44	1 997 325.39	1 978 629.33	5 785 620.83
NPV	(798 665.33)	2 308 257.91	1 564 198.75	1 371 289.38	4 445 080.72

Appendix 4: Net Present Value for outgrowers did not use inorganic inputs

	Plant Cane	Ratoon 1	Ratoon 2	Ratoon 3	Total
A:MaintenanceCosts					
Farm Equipments	52 855.00			13 405.93	66 260.93
Land preparation	244 350.93				244 350.93
Seed cane costs	291 101.85				291 101.85
Labour costs	129 181.00	86 450.00	79 040.00	74 100.00	368 771.00
Sub-Total 1	717 488.78	86 450.00	79 040.00	87 505.93	970 484.71
B. Other Costs					
Transport		493 848.59	468 861.33	436 041.04	1 398 750.96
Fire Accident		161 278.40	152 286.02	140 103.13	453 667.56
Infrastructure		63 621.31	59 167.82	55 026.07	177 815.21
Og-Services		13 785.92	12 820.91	11 923.44	38 530.27
Fire Breaking		38 818.99	36 101.66	33 574.54	108 495.19
Tasga		11 598.09	10 786.22	10 031.19	32 415.49
Levy		32 503.69	30 228.43	29 926.15	92 658.27
Loading		267 967.30	249 209.59	229 272.82	746 449.70
Cutting		627 860.69	583 910.48	543 036.71	1 754 807.85
Sub-Total 2		1 711 282.98	1 810 715.65	1 798 147.86	4 803 590.49
Grand Total		1 797 732.98	1 946 232.20	1 937 190.33	5 774 075.19
Discounted costs	(717 488.78)	1 590 914.14	1 524 185.29	1 342 570.07	4 718 531.33
Gross revenue		3 992 706.61	3 525 581.82	3 183 023.64	10 701 312.07
Net Benefit	(717 488.78)	2 194 973.63	1 843 169.41	1 606 582.62	4 927 236.88
NPV	(717 488.78)	1 942 454.54	1 443 472.01	1 113 442.34	3 781 880.11

Appendix 5: Net Present Value for whole Sample

	Plant Cane	Ratoon 1	Ratoon 2	Ratoon 3	Total
A:MaintenanceCosts					
Farm Equipment	52 855.00			16702.97	69 557.97
Land preparation	244 350.93				244 350.93
Seed cane costs	291 101.85				291 101.85
Fertilizer & Herbicides costs	81 176.55	56 476.55	56 476.55	51 536.55	245 666.20
Labour costs	129 181.00	86 450.00	79 040.00	74 100.00	368 771.00
Sub-Total 1	798 665.33	142 926.55	135 516.55	142 339.52	1 219 447.94
B. Other Costs					
Transport		512 237.40	497 214.14	479 509.36	1 488 960.91
Fire Accident		167 739.42	161 924.82	154 248.88	483 913.12
Infrastructure		65 651.78	63 086.62	60 677.33	189 415.73
Og-Services		14 225.89	38 699.22	12 906.02	40 621.30
Fire Breaking		40 057.89	41 296.79	37 435.67	116 890.38
Tasga		11 968.24	11 321.96	10 940.35	34 192.78
Levy		33 541.04	32 230.54	31 906.51	97 678.09
Loading		276 519.44	265 752.35	254 395.66	796 667.22
Cutting		647 898.80	623 324.99	601 521.69	1 872 745.48
Sub-Total 2		1 769 839.91	1 707 044.03	1 643 541.47	5 120 425.40
Grand Total		1 912 766.46	1 842 560.58	1 785 880.98	5 541 208.02
Discounted costs	(798 665.33)	1 692 713.68	1 442 995.20	1 237 705.10	4 373 413.99
Gross revenue		4 286 180.73	3 734 569.71	3 549 421.65	11 570 172.08
Net Benefit	(798 665.33)	2 373 414.27	1 892 009.13	1 763 540.67	5 230 298.74
NPV	(798 665.33)	2 100 366.61	1 481 720.67	1 222 222.15	4 005 644.10