ECONOMIC PERFORMANCE OF SMALLHOLDER TOBACCO FARMERS IN TABORA AND RUVUMA REGIONS, TANZANIA

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ABSTRACT

Low crop productivity in Tanzania leads to developing ways of improving efficiency in production. Just like other crops, tobacco production efficiency in the country leaves a lot to be desired. Conversely, there is dearth of information on how limited resources in crops production are being used to optimize outputs. Thus, this study was conducted to assess resource use efficiency and subsequently to determine the underlying factors which affect inefficiencies in the production of tobacco, maize, paddy and beans by tobacco smallholder farmers focused on comparing profitability and efficiency across districts. Data were collected from twelve Cooperative Societies involving 395 farmers. Profitability was quantified using enterprise budgeting technique and the GM differences were analysed using Analysis of Variance (ANOVA). The DEA approach was used to estimate efficiency scores while a two-limit Tobit model was used to identify factors which explain inefficiency variation. Finally, a five point Likert scale was used to identify challenges facing smallholder farmers. Results show that tobacco production is profitable with an average gross margin of TZS 1 610 582.72 per hectare. Further, the results show that there were significant differences ($p<0.05$) in gross margin across districts. The overall mean levels of technical, allocative and economic efficiency have been estimated at 68%, 42% and 28% respectively. Accordingly, there are statistically significant differences across districts ($p<0.05$). Technical inefficiency in crop production was negatively and significantly ($p<0.05$) influenced by age of household and farm size and positively and significantly ($p<0.05$) influenced by distance to the field and access to extension services. Further, economic inefficiency was negatively and significantly influenced by farm size, access to credit and frequently visits by extension officers positively and significantly ($p<0.05$) influenced by access to extension services. Besides, low price of outputs, complicated grading system, side selling, access to credit and high costs of inputs were found to be critical challenges faced by tobacco smallholder farmers.

As such improvement in production efficiency would amongst others, require improved access to credit, reduction of tax on imported inputs, investment in extension services and programmes focusing on increased access to markets and credit sources are suggested as policy options.

DECLARATION

I, ALOYCE MARTIN MBUJILO, do hereby declare to the Senate of Sokoine University of Agriculture, that this thesis is my original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

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(PhD Candidate)

The above declaration is confirmed by:

Dr. Damas Philip **Date**

(Supervisor – DEAN SAEBS)

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DEDICATION

This work is specifically dedicated to my Lord Jesus Christ,

My son, Tony and daughters; Julie, Clara and Eva

To my wife

Joyce Damian Kimaro

and

Commemorations of my parents

Martin M. Mbujilo and Magdalena M. Mpili

My Grandfather

Salehe Chidabo Mbujilo

"*May God Rest their souls in Eternal Peace*",

Amen.

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LIST OF ABBREVIATIONS AND ACRONYMS

AE	Allocative Efficiency
ANOVA	Analysis of Variance
APCS	Agriculture Primary Cooperative Societies
ATFA	Thick Frontier Approach
BCC	Banker, Charnes and Cooper (1984) DEA model
BoT	Bank of Tanzania
^{0}C	Degrees Centigrade
CAN	Calcium Ammonium Nitrate
CCR	Charnes, Cooper and Rhodes (1978) DEA model
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
DEAP	Data Envelopment Analysis Program

DED	District Executive Director
DFA	Distribution Free Approach
DFC	Dark Fire Cured Tobacco
DMUs	Decision Making Units
DRS	Decreasing Returns to Scale
EE	Economic Efficiency
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agricultural Organization Statistics
FDH	Free Disposal Hull
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GM	Gross Margin
ha	Hectare
IRS	Increasing Returns to Scale
Kg	Kilogram
Km^2	Kilometre Square
LP	Linear Programming
MLE	Maximum Likelihood Estimator
mm	Millimetres
NE	Neo-Classical Economics
NIE	New Institutional Economics
NBS	National Bureau of Statistics
NPK	Nitrogen, Phosphorus and Potassium
NSGRP	National Strategic for Growth and Reduction of Poverty
OLS	Ordinary Least Square
PTE	Pure Technical Efficiency

ROA	Return on Assets
ROE	Return on Equity
ROI	Return on Investment
RTS	Return to Scale
SAEBS	School of Agricultural Economics and Business Studies
SE	Scale Efficiency
SFA	Stochastic Frontier Analysis
SNAL	Sokoine National Agriculture Library
SONAMCU	Songea Namtumbo Agriculture Marketing Cooperative Union
SPF	Stochastic Production Frontier
SPSS	Statistical Package for Social Sciences
TC	Total Cost
TE	Technical Efficiency
TE_{crs}	Technical Efficiency under the assumption of CRS
TE_{vrs}	Technical Efficiency under the assumption of VRS
TFC	Total Fixed Cost
TR	Total Revenue
TTB	Tanzania Tobacco Board
TVC	Total Variable Costs
TZS	Tanzania Shillings
UN	United Nations
URT	United Republic of Tanzania
VFC	Virginia Flue Cured Tobacco
VRS	Variable Return to Scale
WB	World Bank
WETCU	Western Tanganyika Cooperative Union

WHO	World Health Organisation
π	Profit

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The overall economic performance in Tanzania is closely linked to the performance of the agricultural sector (WB, 2019). The sector is a major source of income and employment for about 65% of the work force; contributing about 51% of foreign exchange and about 28.2% in the country's growth of the total Gross Domestic Product (GDP) (BOT, 2019). Moreover, the sector is the main source of food, industrial raw materials and foreign exchange earnings. Thus, an increase in productivity in the agricultural sector is one of the country's primary policy objectives (URT, 2019). Tobacco is one of the main export crops in Tanzania alongside tea, coffee, cashew nuts, and cotton. During the 2018 cropping season, total tobacco production was estimated to be 60 000 metric tons valued at an estimated USD 310.2 million (Louw, 2018).

In addition, tobacco plays an important role in Tanzania's economy as it accounts for more than 35 % of the export cash crops, 6.8% of the total exports and nearly 0.5% of the country's GDP (BOT, 2019). Furthermore, tobacco generates employment to about 60 000 farmers and about 921 775 households in the value chain (Louw, 2018). Likewise, the crop contributes a significant amount of foreign exchange to Tanzania's economy. For instance, tobacco export recorded a rise in revenue from USD 127 million in 2009 to USD 288 million in 2015 (BOT, 2015). Despite these fairly impressive milestones, the crop's productivity is below its potential; furthermore, its impact on improving household income and reducing poverty among smallholder farmers is limited (Kagaruki, 2010).

Furthermore, irrespective of its enormous contribution to the economy in Tanzania, tobacco cultivation faces several challenges such as drought as well as untimely and inadequate inputs supply which are attributable to monopolistic[1] tendencies among inputs' suppliers. This leads to low productivity which is also attributed to many other reasons, including market distortions or imperfect market, unpredictable weather, poor technology, poor credit arrangements, contradictory grading systems[2], inadequate capital as well as weak primary cooperative societies (Henningsen *et al.,* 2015; Kuboja *et al.,* 2012).

Consistently, tobacco farming has been facing stiff opposition from many fronts worldwide. For instance, the World Health Organisation-Framework Convention on Tobacco Control (WHO-FCTC) restricted the promotion of tobacco products, with the aim of reducing consumption and concomitant morbidity and mortality associated with tobacco use (WHO, 2003 *cited by* Kuboja and Temu, 2013). In addition to that , changes in the regulations such as exercise duty and selling tax, customer rules and environmental conservation as well as anti-tobacco campaigns have had a negative influence on tobacco production and marketing (Hadi *et al.,* 2008; Ntibiyoboka, 2014). As a result, these challenges have transformed the costs and revenues in the input/output markets and restricted realization of productivity gain and potential profit by tobacco growers.

In order to address some of these challenges, contract farming arrangements (CFA), which started in Tanzania since the 1990s was considered as one of the strategies for increasing agricultural productivity, and guaranteeing secure a market for agricultural produce, thereby leading to increased farmers' incomes (Mwimo *et al.,* 2016). Tobacco contract farming in Tanzania was established in 1997/98, prior to that, tobacco farmers sold their

1 Monopolistic is a market structure characterized by a single seller of a unique product with no close substitutes.

2 Tobacco has seventy-two grades which are classified according to the quality, quality evaluation or grading of the flue-cured tobacco leaves are manually operated, which relies on the judgmental experience of experts, and inevitably limited by personal, physical and environmental factors. The classification and the quality evaluation are therefore subjective and experientially based (*Tobacco Leo,* 2014; Ntibiyoboka, 2014)

produce to primary cooperative unions that received inputs, market assistance and regulations from Tanzania Tobacco Processing and Marketing Board. During this period, tobacco production was undertaken through contracts between tobacco buyers and farmers, either on an individual basis or through cooperative societies or farmers' associations (TTB, 2015). Unfortunately, these efforts have not been translated into improved wellbeing for tobacco smallholder farmers as the crop productivity has been low and its effect on improving householder income and poverty reduction to smallholder farmers remain limited (Kagaruki, 2010).

Realizing these challenges, during 2009/10, the government of Tanzania revamped the tobacco CFA for the purpose of linking smallholder farmers with larger processing companies. The aim was amongst others, to enable private sector actors and service providers such as commercial banks to assist in containing production risks, improving technology transfers and providing input credits to smallholder farmers. In this new system, cooperatives through their primary societies purchase agricultural inputs for farmers using bank credit (Mwimo *et al.*, 2016). Moreover, the government and development partners increased efforts to improve the crop (*i.e.* establishment of tobacco research institute, provision of free seeds and extension services and guarantee for input credit). Further, leaf dealers provide farmers with inputs credit for production of other main food crops such as maize, paddy and beans (TTB, 2015).

Despite the Government of Tanzania and other stakeholders' efforts to initiate different agricultural strategies to increase tobacco productivity through interventions like CFA, farmers have failed to take advantage of these efforts as indicated by the low yields mainly due to low capital, limited access to credit, risk aversion, and a poor connection to the market. Even though CFA has been addressed as a means to alleviate constraints facing tobacco producers through the productive capacity of farmers via the provision of inputs credit, cash credit, technical advice, and market services from tobacco dealers, still farmers have been complaining about the services they acquire from tobacco companies. The complaints ranges from unfair grading systems, perceived measures that companies take in the event of farmers' failure to pay back the loans and the pricing of inputs received under contract farming arrangements, as well as the price of the tobacco at the market.

Prevalence of the high price of inputs resulting from monopolistic tendencies of tobacco companies with inflating prices on credit to farmers is one among the reasons for low crop productivity. Since the smallholders are poor, plough small land size with low level of productivity. In such a situation most of household food requirements are not fully met (Kagaruki, 2010). Thus, an increase in production efficiency assumes greater significance in attaining potential farm output. High input costs with basic expenses associated with crop production and immense dependence on rain-fed agriculture and low level of inputs use such as chemicals and fertilizers, smallholder farmers is menace to towards their success. In such a situation, there should the use of production systems that use inputs more efficiently and in the least cost combinations to achieve profitability gain. Thus, improving smallholder farmers’ access to these resources would likely increase farm productivity, improve efficiency and profitability. Thus, raising productivity levels is essential aspects to improve smallholder farmers’ income.

Tobacco production in Tanzania is dominated by smallholder farmers and is practised in more than 21 regions including Tabora, Shinyanga, Iringa and Ruvuma (Sutton, 2012). There are three types of tobacco varieties grown in the country, these are Virginia Flue Cured tobacco (VFC), Dark Fire Cured tobacco (DFC) and Barley Tobacco (BT). Accordingly, about 80% of tobacco produced in Tanzania is VFC (Ndomba, 2018). Depending on their localities, tobacco farmers also grow other cash and subsistence crops such as maize, paddy, simsim, sunflower, groundnuts and beans to fulfil household needs.

In this study tobacco, maize, paddy and beans are the main crops used to estimate farmers' efficiency. Meanwhile, other smallholder farmers do make both crops cultivation as well as livestock keeping (URT, 2019).

Recently, the estimated tobacco production costs per hectare increased while the crop's farm gate prices remained considerably low (Kidane *et al.,* 2015). An increase in farming cost and the stagnant low output prices which are obtained at the auction affect farmer's cash income, resulting to low use of productivity enhancing inputs such as improved seeds and fertilizer and henceforth leading to low yield, low profit and widespread poverty among smallholder farmers. Thus, the reduction in production costs and better farm gate prices are likely to improve profitability and reduce income poverty, which is widespread among farmers.

Agricultural production in Tanzania, as compared to other developing countries, is mainly dominated by smallholder farmers cultivating an average of 0.9 to 3.0 hectares (URT, 2016), these farmers are highly dependent on rain-fed agriculture using family labour, hand tools, natural resources base, and animal drawn farming implements in undertaking various farming operations. The use of productivity enhancing inputs such as improved seeds and fertilizer is low which inevitably leads to low yields and profits. Consequently, farmers can only expand their production by clearing more land irrespective of the financial cost (Mangora, 2012). Conversely, further expansion of cultivated land is unsustainable and thus farmers have to change the practice by efficiently use of land resources (WB, 2007).

Productivity can be improved through the introduction of new technologies and efficient use of the existing resources. However, new technologies are meaningless if the existing technologies are not used to their full potential. Available literature indicates that farmers in developing countries fail to exploit technologies to their full potential. Farmers also make allocative errors resulting to production inefficiency (Umanath and Rajasekar, 2013). When farmers are not operating efficiently, then they are either employing more units of input to produce the same level of output or they are producing fewer outputs from a given level of inputs. Hence, improving productive efficiency allows farmers to increase their output without additional inputs (Watkins *et al.*, 2014).

Besides, productivity can also be achieved by improving the technical and allocative efficiencies of farming households in crop production. Accordingly, efficiency can be explained in terms of technical efficiency, allocative efficiency and economic efficiency. Technical efficiency refers to the minimum combination of inputs required to produce a given level of output. Allocative efficiency refers to the least cost combination of inputs required to produce a given level of output. Determination of allocative efficiency, in this case, requires knowledge of the market prices of all inputs used in the production process. A technically efficient way of production is not necessarily allocative efficient and an allocative efficient way of production is not necessarily technically efficient. If the production method is both technically and allocative efficient, we call it economically efficient (Farrell, 1957; Siva, *et al.*, 2018).

Thus, it is important to determine whether or not farmers' actual production process in the study area follows the economic rationality criterion; and if this is not the case, then to what extent these farmers are operating off the efficiency frontier. Moreover, since farmers make decisions in relation to producing other crops given available resources, this study deemed it important to measure farmer's efficiency by including other main crops. Such information is considered important in guiding resource allocation, given the prevailing input and output prices. Hence, the present study, amongst other things, aimed at investigating what could be done to improve efficiency among farmers.

1.2 Problem Statement and Justification

Despite the Government and other stakeholders' efforts to initiate different agricultural strategies to increase tobacco productivity through interventions like contract farming and credit guarantee schemes to increase tobacco productivity, the crop average yields have remained low among farmers (URT, 2016). The current tobacco yield is 1.1 tons/ha compared to established potential yield of 1.8 tons/ha (TTB, 2015). Tobacco yield in Tanzania is lower than that in other tobacco producing countries such as 2.6 tons/ha in South Africa, 1.6 tons/ha in Uganda, 1.5 tons/ha in Zimbabwe and 1.2 tons/ha in Kenya (FAOSTAT, 2017).

Further, these efforts have also not translated into improving cereal crop productivity among tobacco farmers. For instance, maize yield has been fluctuating between 1.0 tons/ha and 1.5 tons/ha, which is nowhere near the potential yield level, which has been estimated at 4.0 to 5.0 tons/ha. Again, maize yield in Tanzania is lower than that in other African countries such as South Africa 4.0 tons/ha and even far below from 12.0 tons/ha recorded in the United States of America (Suleiman and Rosentrater, 2015). Similarly, paddy average yield in Tanzania range from 1.6tons/ha to 2.4 tons/ha which is also lower than the potential yield of 4.0 to 6.0 tons/ha depending on rice variety grown and whether the crop is irrigated or rain fed (Ngailo *et al.*, 2016) while common beans also recorded low average yield ranging from 0.7 to 1.1 tons/ha which is low compared to the potential yields recommended by agricultural research (Musimu, 2018).

Declining crops productivity necessitates farmers either to use modern technologies or need to use resources efficiently in order to optimize outputs in the country. However, formulating strategies aimed at enhancing production efficiency at the farm level requires clear farm knowledge on what determines efficiency among smallholders. In this study profitability and efficiency were used as indicators to measure farmers' performance. Several studies on agriculture efficiency have been carried out worldwide (Adeoye and Balogun, 2016; Awerije and Rahman, 2016; Usman, *et al.*, 2016; Lubis *et al.*, 2014; Watkins *et al.*, 2014). Similarly, several studies have been conducted on tobacco profitability (Drope *et al.*, 2016; Mohammad *et al.*, 2015; Chidi *et al.*, 2015; Hassan *et al.*, 2015; Ullah, *et al.*, 2015). However, studies that have looked at tobacco and cereal crop production efficiency jointly and/or combined both performance measures indicators are rare.

Firm's efficiency is usually measured either by parametric approach (such as the stochastic frontier analysis [SFA]) or by non-parametric methods, such as the data envelopment analysis (DEA), In Tanzania, much of the existing studies on efficiency in tobacco has exclusively focused on technical efficiency using Stochastic Frontier Analysis (SFA) approach (Kidane *et al.*, 2015; Ilembo and Kuzilwa, 2014; Kidane *et al.*, 2013). Likewise, most studies on cereal crop production in Tanzania also focused on technical efficiency using SFA approach (Mkanthama *et al.*, 2017; Henningsen*et al.*, 2015; Mwajombe and Mlozi, 2015; Baha, 2013). Unlike most studies, this study uses a Gross Margin (GM) approach to determine tobacco profitability, and the Data Envelopment Analysis (DEA) approach to jointly determine crop production efficiency of all important crops produced by farmers in the study area. The technique is frequently chosen because it does not impose a priori functional form and allows for multiple output technologies (Syp and Osuch, 2018).

This study attempted to fill the existing knowledge gap by focusing on issues related to economic, technical and allocative efficiency of tobacco smallholder farmers by jointly including maize, rice and beans in production efficiency estimation. Further, the study provides empirical evidence on resource use efficiency and identifies factors that explain the inefficiency variation among individual farmers using DEA approach. Examination of the existing gap between the potential and the actual yields on the farm, given the technologies and resource endowments, provide a better understanding of the yields gap and the causative factors. This is provide empirical evidence on resource use efficiency of farmers and identify key findings that could guide the government in formulating appropriate policy interventions in addressing the challenges facing smallholder farmers' crop production in the country.

1.3 Study Objectives

1.3.1 Overall objective

The overall objective of this study is to evaluate the economic performance of smallholder tobacco producers by estimating their profit, level of technical, allocative, and economic efficiency and identify factors that explain the inefficiency variation among individual tobacco farmers.

1.3.2 Specific objectives

i. To compare the profitability of tobacco farming in Urambo, Kaliua and Namtumbo Districts.
ii. To estimate farm level technical, allocative and economic efficiency among smallholder tobacco farmers in the study area.
iii. To analyse socio-economic determinants affecting technical and economic inefficiency among smallholder tobacco farmers in the study area.
iv. To identify the main problems encountered by smallholder tobacco farmers in the study area.

1.3.3 Research hypotheses

First hypothesis

In order to address the first specific objective, the first hypothesis states that; ‘There are no significant differences in tobacco profitability across districts;

i. $H_0: \beta_{ij} > 0$

ii. $H_0: \alpha_{ij} > 0$

iii. $H_0: \mu_{ij} > 0$

Where, β = gross margin, α = return on investment, μ = return on labour, i = tobacco; j = Urambo, Kaliua and Namtumbo districts.

That is tobacco farming profitability across districts is not the same.

Second hypothesis;

In relation to the second specific objective, the hypothesis states that “Smallholder tobacco farmers in the selected districts are technically, allocatively and economically inefficient”,

i. $H_0: \beta_{ij}$ ¿ 0.60

ii. $H_0: \alpha_{ij}$ ¿ 0.60

iii. $H_0: \mu_{ij}$ ¿ 0.60

Where β = coefficient for technical efficiency, α = efficiency of allocative efficiency and μ = coefficient for economic efficiency

i = Crop farms; j = Urambo, Kaliua and Namtumbo Districts.

That is, there is no significant difference on smallholder farmer’s crop production technical, Allocative and Economic efficiency across districts.

Third hypothesis;

In order to address the third specific objective, the hypothesis states that, socio-economic, demographic and institutional factors have no significant influence on the technical, allocative and economic inefficiency of smallholder tobacco farmers’ crop production in the study area.

i. *H0: βij = 0*

ii. *H0: βij ≠ 0*

i = Socio-economic, demographic and institutional factors while *j* = Technical, Allocative and Economic efficiency.

Fourth question;

In order to address the fourth specific objective a research question was raised as stated below.

i. What are the main challenges facing tobacco farmers in Tanzania?

1.4 Organization of the Thesis

This thesis is divided into 5 chapters. Chapter one provides background information on agricultural sector in Tanzania specifically major crop production. This section also presents the problem statement, study objective, research hypothesis, research questions, and organization of the thesis. Chapter two presents literature review on agriculture production in Tanzania, measuring firm's performance, (profitability and efficiency), literatures on the methodologies used by other scholars on production efficiency, determinants of efficiency, factors influencing efficiency, challenges facing tobacco farmers as well as review of theoretical perspectives.

Chapter Four presents research findings and discussion. The first section presents result of the descriptive statistics. The second section presents summary statistics of outputs and inputs variables used. The third section deals with tobacco farming profitability results from budgetary techniques analysis. The fourth section deals with efficiency scores resulting from the Data Envelopment Analysis (DEA). The fifth section presents results from the two-limit Tobit regression model assessing factors affecting resource use efficiency and, the challenges facing smallholder farmers discussed in section six. Finally, Chapter Five presents conclusions and recommendations drawn from the present study findings.

1.5 Scope and Limitation of the Study

The present study attempted to analyse economic performance of contracted tobacco farmers using profitability and efficiency indicators. However, the present study failed to capture data from independent farmers, mainly due to the reason that, in Tanzania tobacco is cultivated under contract arrangement only, thus, it was not possible to have a comparison study of with and without contract farming. Moreover, the theoretical analysis of the present study is largely based on static models, in which production and marketing decision process are treated as static phenomenon and ignored issues of expectations and dynamic adjustments. Likewise, incorporation of dynamics and expectations into controllable models is likely to remain a key issue in agricultural research for the near future; the dynamic model avenue is thus, excluded in the present study.

There were three dimensions related to the study's objectives: firstly, this study focused on the economic performance of smallholder farmers and the forthcoming linkages on smallholder's income in Tanzania. Secondly, the study determined the profitability of tobacco production. It should be noted that, the unit of study is tobacco farmers. Accordingly, in the production process farmers make decision to produce other crops to meet household food requirement. Thus, this study estimated economic, technical and allocative efficiency scores of only major crops produced by tobacco farmers which included tobacco, maize, paddy rice and beans for selected sample farmers due to data availability.

Tobacco is the main cash crop in the study area and it was selected for this study due to its key contributions to the country's employment, foreign exchange and to the GDP. The study generalization was made for smallholder farmers in the Tanzania, based on the information generated from smallholder sample household survey carried out in the 2014/15 cropping season using across-sectional data. Thus, its generalization of the results may not be possible without taking note of these limitations. Finally, the study covered only three districts Urambo, Kaliua mainly due to their leading potential in the production of flue-cured tobacco. It should be noted that, more than 60% of the total tobacco produced in Tanzania comes from Urambo and Kaliua districts (Mayuya, 2013). Meanwhile, Namtumbo district was chosen due to its potential in the production of Dark fire tobacco though currently they have shifted to Virginia flue cured tobacco mainly due to change in market demand, previously the district has been the leading in producing Dark fire Cured. Notwithstanding of all these limitation, the study is still valid for agricultural policy formulation in the country.

1.6 Contributions of the Study

1.6.1 Methodological contribution

The present study, amongst other things aimed at exploring what could be done to improve efficiency among tobacco producers in the country. In this study profitability and efficiency were used as indicators to measure the farmers' performance. This study contributes to the body of research findings on smallholder production efficiency in both the methodological approach and in the findings. The first methodological innovation is the multi-input/output approach to smallholder farm's efficiency. This study deepens the understanding farm household behaviour in resource use efficiency across districts. The second methodological invention is that the study exploits the heterogeneity which is shaped by smallholder livelihood strategies in making its case. This heterogeneity can be observed within the farm due to the diversity in plot characteristics and crops grown, within a season emanating from variability in the labour constraint and within a household due to variable payments to labour (Gebre *et al.*, 2019)

There are many studies on production efficiency elsewhere. A number of studies on tobacco farming in Tanzania have been conducted with a multidimensional focus, Kidane *et al.* (2015), Ilembo and Kuzilwa, (2014) and Kidane *et al.* (2013) focused on technical efficiency, Sambuo, (2014) on contract farming and income, Mayuya (2013) focused on poverty reduction and Kuboja *et al.* (2012) on technology. In contrast to other mentioned studies however, Kuboja and Temu (2013) focused on tobacco profitability using gross margin analysis. However, they all focused on tobacco technical efficiency using Stochastic Frontier Analysis (SFA) methodology and focusing on tobacco alone.

Therefore, this study attempted to contribute to the literature by addressing issues related to technical, allocative and economic efficiencies by including other main crops grown by tobacco smallholder farmers using Data Envelopment Analysis (DEA) methodology and identify factors that explain the inefficiency variation among individual tobacco farmers. This could provide empirical evidence on tobacco smallholder resource use efficiency and to single out key findings that could guide the government in coming up with appropriate policy interventions for the challenges facing smallholder farmers.

1.6.2 Policy implication(s)

This study is linked to the National Strategies for Growth and Reduction of Poverty (NSGRP) and the National Development Vision 2025, which aim at improving agricultural productivity (URT, 2016). The government and development partners have constantly devoted efforts through interventions like contract farming to mitigate the challenges facing smallholder crop production in the country. However, farmer's productivity is still low in most of smallholder farmers. In addition, this study contributes to the theoretical framework by addressing farm household resource use efficiency, which is an important issue in the use of crop production technologies by smallholder farmers. The study's contribution is to provide a genuine understanding of farm household behaviour under resource use efficiency.

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter reviews literature for smallholder farmers in Tanzania and Worldwide tobacco production and utilization, the section reviews the techniques used in measuring farmers' performance and literatures on the methodologies used by other scholars on efficiency. It further reveals tobacco farming profitability and crop production efficiency (technical, allocative and economic) and factors that influencing efficient in agriculture.

Literature on the Data Envelopment Analysis as well as theoretical perspectives is also reviewed.

2.2 Review of tobacco production, marketing and utilization

2.2.1 Worldwide tobacco production and utilization

Agricultural production in Tanzania, as compared to other developing countries, is mainly dominated by smallholder farmers cultivating an average of 0.9 to 3.0 hectares (URT, 2016). The major crops grown by smallholder farmers include maize, rice, coffee, cotton, cashews and tobacco. Other crops which are grown by smallholder farmers include wheat, millet, sorghum, vegetables, bananas, and cassava; the main export crops grown by smallholder farmers include tobacco tea, coffee, cashew nuts, and cotton. Tanzania is one of the largest tobacco producers in Africa (WHO, 2012).

Globally, tobacco is grown in more than 125 countries on over four million hectares of land (WHO, 2012) of which China being the leading producer. Other tobacco major producers include the United States of America, India, Brazil, Turkey, Zimbabwe and Malawi. In Africa, more than 21 countries grow tobacco, with the top three tobacco producing being Malawi, Tanzania and Zimbabwe in that order (WHO, 2012), Cigarette production utilize up 90% of the raw tobacco (UN Comtrade, 2013). While the amount of tobacco cultivated in developed countries is steadily decreasing, cultivation in developing countries particularly in Africa has increased significantly with many smallholder farmers being encouraged by their respective governments to engage in tobacco farming as a way of reducing poverty (UN Comtrade, 2013). Figure 1 shows the increasing trend of tobacco production in some African tobacco producing countries.

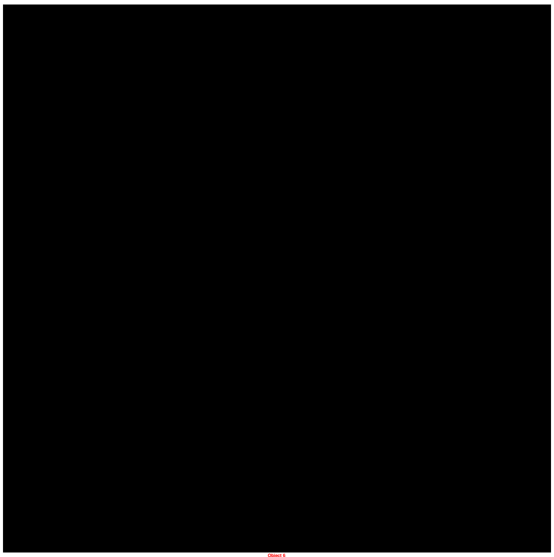

Figure 1: African tobacco production trends from 2000 – 2014

Source: FAOSTAT Data retrieved on 9th September, 2017

In Africa most governments are encourages by tobacco companies to promote tobacco farming for economic reasons, which include employment generation, tax revenue and an increase of cash income among smallholder farmers, which in turn reduces household income poverty. Other reasons are income generation, promotion of local economic development, making use of less fertile land which would otherwise be underutilized and making use of the idle rural labour that would otherwise be unemployed[CITATION Sam14 \l 1033].

Accordingly, tobacco farming has been affected by the World Health Organisation Framework Convention on Tobacco Control (WHO, 2003). The essence was to involve all member countries in a comprehensive and multi-sectorial control and restrict accessibility and promotion of tobacco products so as to reduce consumption and concomitant disease and mortalities associated with tobacco use. Besides, the comparison of the unit price of a country's tobacco leaf export with the average auction price from other African countries' trading floor shows that, significant portion of tobacco income goes to intermediaries and processors leaving smallholder tobacco farmers in perpetual poverty (Drope *et al.*, 2016).

Regardless of all the challenges facing smallholder farmers, tobacco is still widely grown in African countries, making wealthy multinational companies subsist as growers, traders and manufactures at the expense of the wellbeing of farmers. Smallholder farmers continue to produce tobacco due to a number of reasons including that of among others, tobacco is the highly attractive crops to due to fairly stable price compared to prices of other crops produced by farmers. Meanwhile, tobacco industry usually supplies farmers with strong in-kind support, including materials and advice, free tobacco seeds, extension services and cash loans. Furthermore, tobacco is less perishable compared to many other crops (Mayuya, 2013).

2.2.2 Tobacco production in Tanzania and institutional arrangement

Tobacco production was introduced in Tanganyika[3] by the British colonial administration in the 20th century (Kidane *et al.*, 2013). In the 1940th Greek settlers as well as some missionaries introduced Flue Cured Virginia tobacco in Iringa region, where tobacco production remained the business of settler farmers until independence in 1961. In Tabora, smallholder farmers started Flue Cured Virginia tobacco in 1951 and its cultivation spread over time to other regions such as Shinyanga, Rukwa, Mbeya, Singida, Ruvuma, Kigoma, Kagera and Morogoro (Sutton and Olomi, 2012). During that time, tobacco administration was taken over by cooperatives and the Tanzanian Tobacco Board (TTB). Production was very tightly controlled by the cooperatives, but there were no contracts between Cooperatives and growers.

After independence, Tanzania Tobacco Authority (TTA) was established, taking over responsibilities of developing tobacco schemes, infrastructure and extension services as

3 On 29 October 1964, the United Republic of Tanganyika and Zanzibar was renamed the United Republic of Tanzania. Tanganyika became independent on 9 December 1961 from a United Kingdom (UK) ruled United Nations (UN) trusteeship and Zanzibar gained its independence on 19 December 1963.

well as running research institutions. The authority was also responsible for organizing the chain of activities from buying; curing of tobacco leaf from growers; keeping individual and village records of inputs; providing credit; and transporting, storing, grading, bailing, reprocessing and selling of tobacco (TTB, 2015). During the privatization period (1995-2005), the major challenges for smallholder farmers remained to be lack of access to new technologies, government extension services as well as input and output market for farmers' produce. The key problems of markets were associated with high risks such as low price, price fluctuation and market uncertainty (Mwimo, 2016).

In Tanzania, all tobacco farming and trade is under the Tanzania Tobacco Board (TTB). The Board was established by Act No. 4 of 1994 and charged with the responsibilities of licensing tobacco growers and processors. The Board established the Tanzania Tobacco Council (TTC) whose membership includes tobacco growers represented by primary cooperative societies, tobacco buyers and representatives from the Ministry of Agriculture Food Security and Cooperation. The TTC was established by section 42 of the Tobacco Industry Act of 2001.

In Tanzania tobacco farmers are organized into primary cooperative societies which are in turn, affiliated to co-operative unions. In tobacco farming, there are six tobacco unions joined the system of contract farming, these are the Western Zone Tobacco Growers Cooperative Union 1994 Ltd (WETCU) of Tabora and Kigoma regions, Kahama Cooperative Union Ltd (KACU 1995) of Kahama and Bukombe districts in Shinyanga Region, the Central Zone Tobacco Growers Cooperative Union 1995 Ltd (CETCU) of Manyoni district in Singida Region, the Songea and Namtumbo Agricultural Marketing Cooperative Union Ltd (SONAMCU) of Songea and Namtumbo districts in Ruvuma region, the Lake Tanganyika Tobacco and Coffee Cooperative Union 1995 Ltd (LATCU) of Mpanda district in Rukwa Region and the Chunya Tobacco Growers Cooperative Union 2001 Ltd (CHUTCU) of Chunya district in Mbeya Region. In addition, there are few tobacco large scale producers in Iringa region affiliated into an association called Southern Highlands Tobacco Growers Association (SHITGA) (TTB, 2015).

Accordingly, the market is handled by the following tobacco companies, first is the Tanzania Leaf Tobacco Company Ltd (TLTC) a subsidiary of Universal Leaf, Inc. based in the North America. The Alliance One Tobacco Tanzania Ltd (AOTTL) also a subsidiary of Alliance One International Inc. based in the North America. The Premium Active Tanzania (PATL) a subsidiary of Premium Tobacco holdings headquarters in the United Arab Emirates and the JTI Leaf Services Limited, which is a subsidiary of Japan Tobacco International of Japan. Accordingly

In Practice, tobacco is sold to buyers through the Tanzania Tobacco Board (TTB) registered market centres. Classifiers from TTB would then classify the tobacco in the presence of both farmers and buyer representatives. Once all parties agree with the classification, the purchase contract note is signed to effect ownership transfer of the produce, then farmers are paid using the grade price list approved by the Tobacco Council. The Council approves the minimum grade indicative price in the auction market after the buyers and the growers have come to a consensus through negotiations in the forum called Tanzania Tobacco Council. Prior to price negotiations the Council has to reach a consensus on the farmer’s cost of production (Mwimo, 2016).

In Tanzania, almost 90% of all tobacco produced is exported while the rest is for the domestic market, purchased by the Tanzania Cigarette Company and the Mastermind cigarettes company located in Dar es Salaam and Zanzibar respectively. The main foreign market of tobacco produced in Tanzania are Belgium, the Netherlands, Portugal, France, South Africa, Great Britain, Japan, USA, Russia and Germany. Apart from the foreign market, tobacco production provides a reliable source of government revenue, which is raised by taxing both growers and buyers based on some fixed percent on the value of crop sales. These taxes and levy payment to the local government authorities are used for improving social services and other economic development activities in rural and urban areas (Ndomba, 2018).

2.3 Measuring Firm's Performance

Performance measurement is a structured process through which a production firm identifies, measures, and monitors important programmes, systems and processes for improvement purposes (Kokkinou, 2012). While production is an ongoing process to meet the firm's objectives, it is important to understand how efficiently resources are utilised in that process. The objective is to link the firm's performance with efficiency (Hibbert *et al.*, 2013). When performance is measured, the firms understand how well or poorly their performance is with reference to the past or relative to the similar firms. Thus, firms can then take steps to consume resources more efficiently, improve the quality, ensure higher customer satisfaction, and meet the strategic firm's objectives [CITATION Alr15 \l 1033].

The term performance measurement is associated with the manufacturing industry, and it has been branded by financial measures such as liquidity, leverage ratios and net profit Marwa and Aziakpono, (2014). Agricultural production, like any other business, is cost driven, and thus, its performance is a function of its productivity, which is measured as the ratio of the costs of the required inputs to the costs of the product (Hassan *et al.*, 2015). However, this measurement has been criticized for various reasons; one of the main reasons is its failure to accommodate a variety of environmental factors. For instance, when financial measures are the only variables used to measure performance, then this may imply that cost reduction as well as profit margins and decision-making in the short-term are the only focus of organizations, while ignoring a variety of environmental factors that could be essential to be achieved in the long-term[CITATION Alr15 \l 1033].

Theoretically, there are two approaches through which the performance of firms can be measured. The first is the Classical approach which is based on profit-cost analysis and has its roots in accounting. This approach is simple and is represented by performance indicators that concentrate on examining financial ratios such as return on equity (ROE), return on investment (ROI) and return on assets (ROA), others are capital asset ratio, growth rate of total revenue, and cost/income ratio. These indicators are commonly used by independent regulators, managers, and industry consultants to evaluate firm's performance. However, these indicators fail to control the influence of input price, output price and other exogenous market factors which prevent the standard performance ratios from reaching close estimations of the true performance (Marwa and Aziakpono, 2014).

Accordingly, for more than twenty years now scholars have developed an alternative approach to measure firm's performance, this is the frontier approach (Shahzad, 2019). The frontier approach measure has a deviation in performance of the individual from those of the 'best-practice firms' on the efficient frontier. The approach measures how well a firm performs relative to the expected performance of the best firms facing the same market conditions in the industry. This approach represents the ability of the management to control the production cost and efficient utilization of resources at their disposal to produce the required output. The result can be summarized in efficiency scores that can control for differences among firms in a developed multidimensional framework. Thus, frontier efficiency indicators appear to be superior to the performance indicators which are used in the classical approach as it obtains better estimates of the basic performance of the firms (Shahzad, 2019). Thus the objective of this study is to evaluate farmers' crop production performance in terms of their efficiency and profitability.

2.3.1 Evaluating crop performance in agriculture

Improving performance of the agricultural sector remains an important objective in many developing countries. Performance evaluation is important, as it enables the firm to identify underlying problems, and to benchmark with other firms in the industry (Charnes and Cooper, 1984). Performance analysis is also important as it is considered a significant factor in driving the survival of a firm (Xaba *et al.*, 2018). This study employs performance measurement through efficiency and profitability analysis. The present study focuses on measuring the economic performance of farmers, using profitability and technical efficiency as indicators. Further, a summary and evaluation of the accumulated empirical literature regarding efficiency on crop production with the aim of analysing the economic efficiency of farmers, which is consistent with the set objectives of measuring economic performance is presented. Besides, agricultural production models are also presented and evaluated. These provide an important form of measuring efficiency in crop production. This section reviews development theories, and comprehensively evaluates efficiency measurement techniques in agricultural production addressed by various studies that assess economic efficiency relative to the production frontier representing the benchmark.

Different definitions of farms performance measurement are provided and several financial and non-financial measures are presented to identify firms' performance measurement. According to Tasie *et al.* (2011), three performance indicators were identified, namely; efficiency, productivity, and profitability. However, the terms productivity and efficiency are often used interchangeably though they are not precisely the same. Productivity is an absolute concept which is measured by the ratio of outputs to inputs; whereas, efficiency is a relative concept and is measured by comparing the actual ratio of outputs to inputs with the optimal ratio of outputs to inputs; this is a success of producing as much as possible an output from a given set of inputs (Farrell, 1957).

In fact due to the failure of classic definition to distinguish between productivity and efficiency some authors have used the two concepts as synonymous without making any difference between the two (Cooper, *et al.*, 2000). In this study therefore, efficiency scores and profitability were used as indicators to measure the performance of tobacco farmers. In this study, efficiency is defined as the ability of a firm to produce the maximum output possible at a given level of input (Coelli, *et al.*, 2005). According to Kahan (2010), efficiency is a careful use of the resources available to the farmer which can be either technical or economic perspective. This is measured as the ratio of output to input in a simple production setting in which a high ratio implies high efficiency levels (Marwa and Aziakpono, 2014). However, when multiple inputs and multiple outputs are concerned, the efficiency becomes a scalar derived as a ratio of weighted sum of outputs and inputs (Lovell, 1993). Meanwhile, profitability is a measure of performance that shows how well the resources available to the farmer are used to generate income and profit (Khan, 2010). The assessment of farm's efficiency and its determinants provide valuable information for improving farm management and economic performance. In the presence of technical inefficiency, farmers can increase their production levels without increasing the use of inputs that are usually scarce and expensive. As such, production efficiency studies have important implications on firms' economic performance, technological innovation and the overall resource use efficiency in the agricultural sector. The concepts of efficiency and production economics therefore provide the foundation for understanding performance variation between different farms (Besanko and Braeutigam, 2010).

In understanding farm performance in this study are the relative efficiency scores and farm profitability. Subsequently, efficiency and profitability analysis measures firms' performance, and assists management in decision-making through benchmarking with other firms. To increasing efficiency requires tobacco farmers to increase output per unit of output. This can happen if output increases proportionately more than the corresponding increase in input or an increase in the output while inputs remain the same or a decrease in both output and input with input decreasing fast or a decrease in inputs while the outputs remain the same (Oni *et al.,* 2009). In the next subsection empirical reviews of agriculture profitability is discussed.

2.3.2 Empirical review of agriculture profitability

Profitability analysis is one of the most traditional methods used to measure firm's performance, be it in industry, services, or agricultural farms. Profitability shows how well available resources are used by the farmer to generate income and profit (Kahan, 2010). Moreover, profitability is a relative concept whereas profit is an absolute connotation. Despite being closely related to and mutually interdependent, profit and profitability are two different concepts. In other words, in spite of their generic nature, each one of them has a distinct role in business. For instance, a very high profit does not always indicate sound organizational efficiency and low profitability is not always a sign of organizational failure. Therefore, it can be said that profit is not the prime variable on the basis of which the operational efficiency and financial efficiency of an organization can be compared. To measure the productivity of capital employed and to measure operational efficiency, profitability analysis is considered as one of the best techniques (Khan, 2010).

The aim of the first's objective in the current study is to compare tobacco farming profitability levels using Gross margin as a proxy for profit across districts, Generally, tobacco input/output prices in Tanzania are determined through the Tobacco Council prior to beginning of the production season (TTB, 2015). Thus, with respect to the grade a farmer would get, the price is the same for all the farmers across the country. Hence in order to maximize profit, farmers would efficiently allocate their resources endowments at their disposal or improve the quality of the product while keeping other inputs constant.

Traditionally, most smallholder farmers believe that an increase in farm size leads to an increase of farm profit Ogunleye *et al.* (2017). This is mainly because farmers do not include family labour cost in the calculations of farm's profit and hence they assume that the net income they get is the farm profit (Drope *et al.,* 2016). Most studies conducted in Tanzania on tobacco profitability and efficiency confirmed that tobacco farming is a profitable business but if labour costs were involved in the profit calculation, then tobacco farming is an unprofitable business (Kidane *et al.,* 2015; Ntibiyoboka, 2014; Kuboja and Temu, 2013)

Elsewhere, a number of studies on farms profitability (e.g. Drope *et al.,* 2016; Adeoye and Balogun, 2016; Hassan *et al.,* 2015; Ullah, *et al.,* 2015; Kahan, 2010; Gumus, 2008) have been conducted employing different methodological approaches to measure farm profitability. For instance, Ullah, *et al.* (2015) conducted a study on tobacco profitability in Swabi district, Pakistan using farm a budgeting technique. The study revealed that an NPK fertilizer is the most expensive input which accounts for about 36.2% of the total production cost. The study revealed further that the total production cost from a tobacco enterprise was lower than the total gross return from tobacco output which implies that tobacco farming is profitable in Swabi District.

In other study, Hassan *et al.* (2015) conducted an empirical study on farmer's profitability of tobacco cultivation at Rangpur District in the socio-economic context of Bangladesh using tabulation and statistical techniques. The study revealed that large farmers were more profitable compared to other farm categories (small and medium farmers). The author revealed further that lower tobacco price during harvesting period, price fluctuation, shortage of capital, lack of good quality seed, poor storage facilities, higher price of inputs and lack of marketing facilities were the main problems confronted by tobacco farmers in Bangladesh. In Malawi, where tobacco is extensively cultivated, Drope *et al.* (2016) also conducted a study on farm level economics of tobacco production using a mixture of comprehensive budgeting techniques, the findings revealed that tobacco is more profitable than other crops such as maize and paddy rice. However, when the labour variable was included to the profit calculation then tobacco ranked the last.

Profitability analysis has also been widely studied in other cereal crops. For instance, Adeoye and Balogun (2016) conducted a study on profitability and efficiency of cucumber production among smallholder farmers in Oyo state, Nigeria employing descriptive statistics, costs and returns analysis using budgetary technique. Likewise, Chidi *et al.* (2015) investigated socio-economic factors and profitability of rice production among small scale farmers using farm budgetary technique in Ebonyi state, Nigeria while Ogunleye *et al.* (2017) conducted studies on the assessment of profitability and efficiency of cassava production in Osun State, Nigeria.

All these studies point out that, budgeting techniques methodology is the widely used in estimating farm profitability. However, in tobacco profitability cost of firewood, cost of loan and marketing cost is often ignored. This study therefore, adopted the budgeting techniques methodology as used by Ullah, *et al.,* (2015) to examine tobacco profitability in Tanzania. It should be noted that in estimating tobacco profitability, labour is the most critical input variable especially in developing countries where most smallholder farmers use traditional farm implements (Kidane *et al.,* 2015).

2.4 Review of Theoretical Framework

Although a firm's profitability and efficiency rest on several theoretical concepts, this study relies on the synergistic relationship between two paradigms of Economics; New Institution Economics (NIE) and Neo-classical Economics theories (NE). The study is grounded on neo-classical production theory since the farm is the cost minimizing entity and collective action theory due to the fact that, tobacco smallholder farmers in agriculture cooperative societies take actions in an interdependent situation Besanko and Braeutigam (2010).

2.4.1 Neo-classical production theory

One of the most important hypotheses in modern economic theory is based on the assumption of optimizing behaviour, either from a producer or a consumer approach. This study however, based on the neo-classical production theory with the view that the farm is a cost minimising and profit maximising entity. As far as producer behaviour is concerned, economic theory assumes that technically producers' aim is to maximise output by not wasting productive resources, economically producers' am is to minimise inputs by solving allocation problems involving prices (Kokkinou, 2010). In practice however, not all producers succeed in solving both types of this optimization problem under all circumstances. In practice, it is not true that all producers operate at the efficiency frontier. Failure to attain the efficiency frontier implies the existence of technical or allocative inefficiency (Kumbhakar and Lovell, 2003).

This difference may be explained both in terms of efficiency, as well as unforeseen exogenous shocks outside the producers' control. Neo-classical production theory puts forward the farmers' objective, constraints and assumptions in agricultural production system (Besanko and Braeutigam, 2010). The objective of the farmer is to minimize cost of production subject to constraints imposed by the availability of resources. The two constraints are choice of outputs to be produced and amount to be produced, given available land, labour, machinery and allocation of resources among outputs.

Furthermore, smallholder farmers are only semi commercialised in the sense that, even if all markets work, at least some of their production is kept for home consumption and some of their labour resources are used directly for home production. Food produced in excess of household consumption is sold on the product market, and family labour supplied in excess of use on the home plot is sold on the labour market. If production is less than consumption and/or labour supplied less than needs for the plot, the household is a net buyer of food and/or a net employer of labour. Hence, farm profit comprises implicit profits from goods produced and consumed by the same household, and consumption included both purchased and self-produced goods (Saysay, 2016).

Furthermore, the neo-classical theory assumes that agricultural production has two main assumptions, assumption of pure competition and assumption of risk and uncertainty. It is hypothesized that, the farmer knows with certainty the applicable production function governing the agricultural production. The farmer has perfect knowledge of prices both for inputs to be purchased and outputs to be sold. However, these assumptions are normally violated in many agricultural production systems (Debertin, 2012). Thus, it is important to analyse the degree to which producers fail to optimize and the extent of deviation from the technical and economic efficiency frontier. Based on this assumption, Neo-classical production economics theory of profit maximization is therefore frequently used to provide guidance for decisions which are related to optimum allocation of resources (Collie *et al.*, 2005).

2.4.2 Collective action theory

The economic theory of collective action is concerned with the provision of goods and services that are collectively consumed through the collaboration of two or more individuals and involve pooled decisions (Kirsten *et al.,* 2009). Individuals under collective action choose actions in an interdependent situation (Araral, 2009). In tobacco producing areas collective action arises when farmers collaborate to accomplish an outcome that involves their common interests on well-being. These including bargain for the contract output price in case of tobacco farming, to outsource agricultural production inputs on credit and others. This is usually accompanied by enforcing bylaws, rules and norms in the community. Collective actions are widely used in management of common pool resources, such as water, community land, fisheries and forests and their management involve pooled decisions (Vanni, 2014).

Success in managing the common pool resource depends on the size of the group, homogeneity, enforcement of the agreed rules and the purpose of the group (Janssen and Anderies, 2013). Collective action helps to overcome the problem of some members who tend not to contribute to group activities because they benefit from other member's activities, there free riding (Vanni, 2014). Collective action also provides joint solutions for the management of common pool resources thereby avoiding opportunism.

2.5 Production Efficiency

The conceptual framework for this study is based on producer theory with a focus on productivity. Productivity measures how efficiently production inputs are being utilized to produce a given level of output (Watkins *et al.,* 2014). In a competitive market those producers who use inputs efficiently remains in the market while driving out inefficient users of inputs from the market, assuming that all producers are commercial producers and market oriented. In this case even if farmers are producing for subsistence purposes it is assumed that they will be involve in the factor market. That means subsistence producers will use inputs more efficiently which is important for improving income and overcome food insecurity. Mango *et al.* (2015) argued that agricultural productivity is limited by production inefficiency. Therefore, increasing production efficiency of smallholder farmers' increases their output and hence income. In fact, farms that are efficient tend to increase their income and profitability which provides a better opportunity for their survival and prosperity (Marwa and Aziakpono, 2014).

2.5.1 The concept of production efficiency

The firm in production economics is directly related to the concept of efficiency frontier which provides the basis for understanding the variation of efficiency between various firms [CITATION Bes \l 2057]. According to Kumbhakar and Lovell (2003), efficiency is the ability of a farmer to obtain the maximum output from a set of inputs (output orientation) or to produce an output using the lowest possible amount of inputs combination (input orientation). For instance, when farmers are not operating efficiently it means they are either employing more units of input to produce a given level of output, or they are producing less output from the same level of inputs as another, more efficient farmer. In fact, given the same inputs and level of technology, some farmers will produce more efficiently than others. Thus the neoclassical production economics theory of maximizing profits is therefore frequently used to provide guidance for decisions which are related to optimum allocation of resources (Kokkinou, 2010).

Besides, it should be noted that, variations in productivity among farmers is a function of differences in the scale of operation, production technology, operating environment and operating efficiency (Fried *et al.* 2008). Consequently, any alterations on these factors would lead to either increasing or decreasing farm productivity depending on the direction of analysis. An increase in productivity can be achieved by improvement of the technology such as the introduction of new machinery, pesticides, and improved seed varieties among others. Alternatively, productivity can be improved by changing factors that improve the efficiency by which inputs are being transformed into outputs such that higher outputs are produced from the same level of inputs and at a given technology (Bravo-Ureta and Pinheiro, 1997).

Historically, the debate concerning efficiency in economic literature started with contemporaneous seminar papers by Debreu (1951) and Koopmans (1951) who made the first systematic efforts in investigating efficiency and its measurement based on technical efficiency. However, the standard efficiency measurement literature was empirically applied by Farrell (1957). Moreover, the important contribution to the development of efficiency and productivity analysis was made by Shepherd’s models of technology and his distance functions which assumed to be a convenient way to represent a multiple-input multiple-output production technology (Shephard, 1953). Interestingly, among its several useful properties is the fact that the reciprocal of the direct input distance function has been proposed by Debreu (1951) as a coefficient of resource utilization, and by Farrell (1957) as a measure of technical efficiency. Thus, based on Debreu (1951), Koopmans (1951) and later by Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977). However, Farrell (1957) was the first to discover a new method of measuring technical efficiency that eventually led to the development of Data Envelopment Analysis (DEA).

Farrell introduced a method to decompose economic efficiency into its technical and allocative efficiency components and concluded that these are the main factors of the total production efficiency and defined efficiency as the relationship between what a firm produces and what it could optimally produce with a given set of inputs. The optimum is defined in terms of production possibilities and technical efficiency [CITATION Tum11 \l 1033]. Given the level and quality of inputs available, how well farmers are able to utilize these inputs is an important determinant of the quantity of output they are able to produce. In agriculture, Fare *et al.,* (1985) was the first to study and apply frontier efficiency concept to investigate farms performance. However, it was Coelli (1995) who surveyed the literature on the estimation of frontier functions and the measurement of efficiency and proposed their potential applications in agricultural economics followed by Sharma *et al.,* (1997) and Sharma *et al.,* (1999) who used DEA and the stochastic frontier production function to measure the productive efficiency of swine industry in Hawaii.

In general, measurement of productive efficiency has important implications for the neo-classical theory of production economics and economic policy, mainly because it allows the test of competing hypotheses regarding sources of inefficiency or differentials in productivity (Farrell, 1957). Furthermore, such measurements permit quantification of potential increases in output that might be associated with an increase in efficiency (Rios *et al.,* 2005). Thus, the present study apart from profitability used efficiency indicators to assess tobacco farmers' performance in the study area. The theoretical literature of efficiency concepts is provided in the next section.

2.5.2 Theoretical literature on efficiency estimation

Efficiency and productivity assessment for different sectors is very important in practice and a key research field because it allows firms to control production processes (Toma *et al.,* 2017). There are diverse frontier models, including parametric and non-parametric models, however, despite of these diversity, they both share common characteristics in modelling relative efficiency as a quantitative measure of performance (Syp *et al.,* 2015). Figure 2 presents the model used in measuring efficiency. The dominant model under the parametric approach is the Stochastic Frontier Approach (SFA) which usually adopt production, cost or profit functions, this is the most widely used in measuring efficiency particularly when many inputs and only one output is involved (Ambetsa *et al.,* 2020). Other parametric approaches include Thick Frontier Approach (TFA) and Distribution Free Approach (DFA).

Meanwhile, non-parametric approach includes Data Envelopment Analysis (DEA) and Free Disposable Hull (FDH). However, DEA is the mostly widely used approach for measuring a firm's efficiency in agriculture (Watkins *et al.,* 2014). The two approached used to measure technical (technological) efficiency, technical efficiency looks at the level of inputs or outputs. Being technically efficient means to minimise inputs at a given level of outputs, or maximise outputs at a given level of inputs (Mbehoma and Mutasa, 2013). Each approach has its own strength and weakness as briefly explained in section 2.5.2.1 and 2.5.2.2. However, the selection of which method to use depends on theoretical and empirical considerations. Specifically, the choice of the model depends on the objective of the study, the type of data, the underlying behavioural assumptions of firms and the extent of noise in the data (Thanassoulis and Silva, 2018; Erkoc, 2014). This study adopts the DEA approach due to the fact that, in the study area, smallholder farmers use many different inputs to produce many outputs; the major crops produced by farmers include produce tobacco, maize, paddy rice and beans.

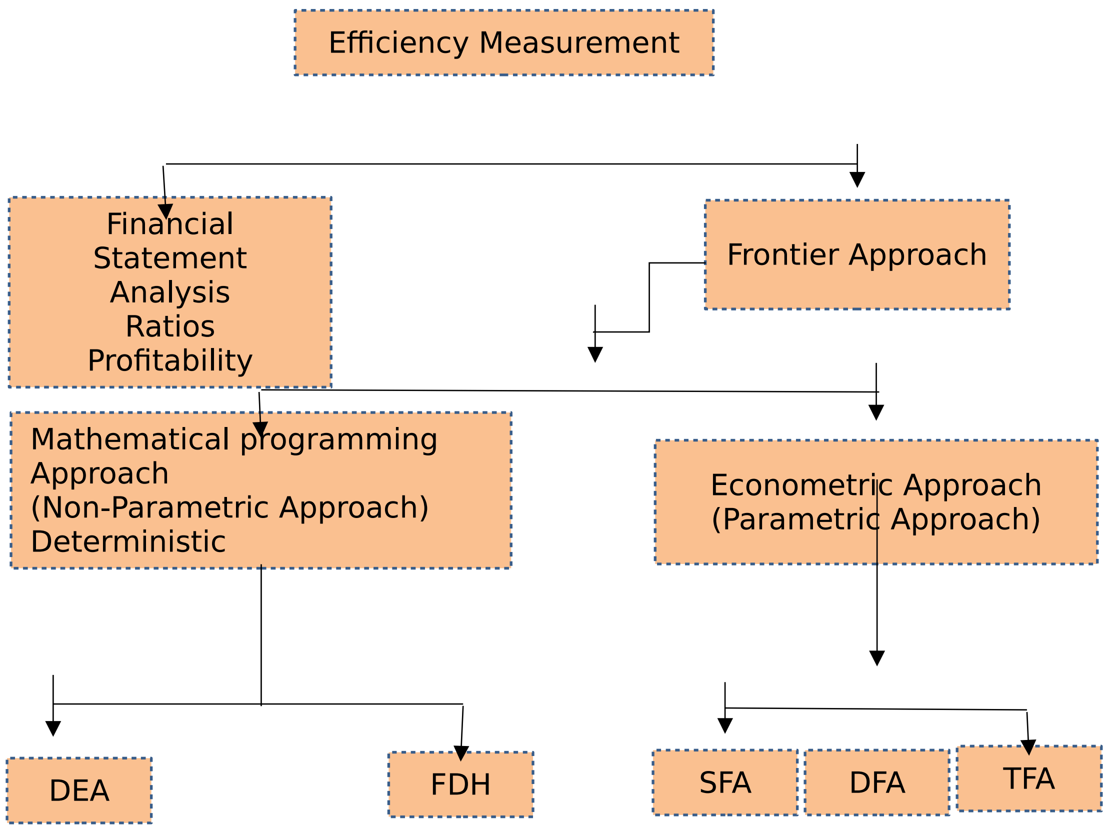

Figure 2: Efficiency measurement approaches

Source: Kokkinou, (2012)

Note: DEA stands for Data Envelopment Analysis, FDH for Free Disposable Huller, SFA for Stochastic Frontier Analysis, DFA for Distribution Free Approach and TFA for Thick Frontier Approach.

2.5.2.1 Stochastic Frontier Approach (SFA)

Following the pioneering work of Farrell (1957) various modifications and improvements have been made. Aigner and Chu (1968) translated Farrell's frontier into a production function and later, Aigner *et al.* (1977), Meeuseen and van den Broeck (1977) and Battese and Corra (1977) suggested the stochastic frontier approach (SFA). The SFA is a parametric method where the error term (ε_{ij}) is decomposed in a regression model into two terms, the inefficiency component u_{ij} and measurement error component v_{ij}; $\varepsilon_{ij} = v_{ij} + u_{ij}$, where ε_{ij} is the error term. The first component of this stochastic term v_{ij} captures the effect of random error, while the second term u_{ij} captures inefficiency effects (Chiona *et al.,* 2014; Chikobola, 2016).

The SFA use parametric model to estimate the upper limit of the production frontier of observed farms, in order to compare the observed output in relation to the optimal output given by the production frontier (Coelli *et al.,* 2005). The stochastic frontier production function comprises of a production function of the usual regression type with a composite disturbance term equal to the sum of two error components (Quattara, 2012). Aigner *et al.,* (1977) suggest using a likelihood function to allow for two variance parameters, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\lambda = \sigma_u/\sigma_v$ in the stochastic frontier production function. The values of γ must lie between zero and one with values of 0 indicating the deviations from the frontier are entirely due to noise, and values of 1 indicating that all deviations are due to technical inefficiencies. The model is recommended when analysing farm level data where measurement error, some missing information and presence of risks factors are likely to have a significant impact (Coelli, 1996).

Furthermore, the SFA approach can be extended to measure inefficiencies in individual production units based on some distributional assumptions for the inefficiency (u_{ij}) on the technical and economic inefficiency scores. These assumptions are based on functional forms used in the analysis; half normal distribution for Cobb-Douglas forms, truncated normal for Translogarithmic forms and exponential distribution for generalized Leontief models. The models for SFA allow for estimation of standard errors and tests of hypotheses using maximum likelihood methods which cannot be possible with deterministic models because they violate certain maximum likelihood assumptions (Ali and Flinn, 1989).

However, the main limitation of the model is that, it requires an explicit imposition of a particular parametric functional form representing the underlying technology and also an explicit distributional assumption for the inefficiency terms (Chiona, 2014). Thus, there is no priori justification for the selection of any particular functional form for the inefficiency component Coelli *et al.* (1998). This implies that, the SFA is appropriate for single-output technologies; unless a cost-minimizing objective is assumed. Considering these weaknesses of SFA, the present study applied the DEA due to an opportunity to handle multiple inputs and outputs to estimate technical, allocative and economic efficiency as well as identify factor accounting for inefficiency (Galluzzo, 2018) as presented in the next section 2.5.2.2.

2.5.2.2 Data envelopment analysis (DEA)

Data Envelopment Analysis (DEA), as originally proposed by Charnes, Cooper and Rhodes (CCR) (1978) as an extension of Farrell's idea, is a linear programing technique for evaluating relative efficiencies and performance of related comparable entities in transforming inputs into outputs using mathematical programming tools (Galluzzo, 2018). The DEA model is a powerful quantitative tool that provides a means to obtain useful information about efficiency and performance of functionally comparable farms working in a similar environment, somewhat autonomous, operating units. DEA's domain can be any group of many entities characterized by the same set of multiple attributes, and therefore making it appropriate to measure efficiency when there are multiple inputs and outputs and there are no general acceptable weights of aggregating inputs and aggregating outputs (Ngangaji, 2018).

The DEA model is applied to observed data that provide a new way of obtaining empirical estimates of relations, such as the production functions or the efficient production possibility surfaces that are a cornerstone of modern economic analysis; the methodology is directed to frontiers rather than central tendencies. Instead of trying to fit a regression plane through the centre of the data as in statistical regression, non-parametric approaches do not require such restrictions, although they assume the absence of measurement or sampling errors and deviations from the production frontier are under the control of the production unit being considered.

The DEA model is determined by a linear optimization procedure that determines some farms as fully efficient in relation to other farms. So the best observed farms are defined as the 'best practice frontier'. Further, the virtues of the DEA models are their straightforward interpretation such that, modelling with a comparatively low number of observations is possible (Lubis *et al.,* 2014). It should be noted that, in the DEA technique, factors such as variation of firms' structure, climate, geographical location, soil type, economic conditions and measurement errors are not considered. Hence, accurate data which is free from measurement errors in variables of homogenous farm households should be employed in the analysis, and thus, the results should be examined in depth through field studies. Furthermore, DEA model has two alternative orientations which are input and output orientation (Charnes *et al.,* 1978). Input orientation has been recommended for cost minimization focused policies, while output orientation has been recommended for impact maximization policies (Cooper *et al.,* 2011). According to Toma *et al.,* (2017), the input-oriented model estimates the proportional reduction of applied inputs while output remains unchanged while output-oriented model is to using the existing technology to produce the highest level of outputs from a given combination of inputs. It is argued that the orientation choice must be made according to the quantities of inputs and outputs that a farmer has able to control (Coelli *et al.,* 2005).

However, some researchers stated that input-orientated model is more appropriate for agriculture because it depends on limited resources and in the production process farmers have more control over input rather than output ((Ul Haq and Boz, 2019; Toma *et al.*, 2015; Syp *et al.,* 2015). Accordingly, others pointed out that it is easier for farmers to adjust their final outputs than the volume of inputs and, therefore, selected output-oriented model (Fogarasi and Latruffe, 2009). Conversely, Coelli *et al.* (2005) noticed that the outcomes from both models are comparable; therefore, the choice of orientation is not essential. In the present study however, farmers are more capable to control the inputs than the outputs which are subject to external market forces. Therefore, in this study we adopted the input orientation approach. In this study, tobacco farmers have control over the inputs compared to the output. Thus, an input-oriented efficiency model was constructed to estimate the efficiency score of smallholder farmers. Additionally, DEA enables to estimate under which returns to scale each farm operates: constant (CRS), decreasing (DRS) or increasing (IRS) ones (Spy. 2018). However, despite of all these advantages the main criticism of DEA is that it assumes all deviations from the frontier are due to inefficiency. Due to this, non-parametric frontier approach may overstate inefficiencies and hence outliers may have profound effect on the magnitude of inefficiency. Another limitation is that it is not possible to estimate parameters for the model and hence impossible to test hypothesis concerning the performance of the model (Coelli and Rao, 2003; Coelli *et al.*, 2005). Moreover, the first problem of DEA models assumes that all farmers are homogenous and identical in their operations.

2.5.3 Treatment of zero data in the DEA model

The basic DEA models were initially developed taking into account the fact that all the data points in the analyses are positive. However, there are situations where this assumption may not hold due to variation in technology and managerial qualification between farmers as well as due to missing data, researchers can find that some data may be zero or even negative. Thus, in DEA analysis, one of the most critical steps is a careful examination of the output and input variables and establishment of an appropriate level of combination. It is necessary to combine the data to form a smaller number of inputs and output variables. Regarding the reconciliation of zero value data in the DEA analysis different, approaches for outputs and inputs were used.

Consequently, a farmer producing any of the outputs (single or multiple positive outputs) regardless of the type and quantity they produced zero level output was taken as zero for analysis. This is because the outputs can be zero in the DEA analysis. However, unlike zero outputs, zero inputs were treated differently. For farmers having zeros values in the inputs an arbitrary very small positive value greater than zero but less than the smallest positive observation was assigned during analysis. However, descriptive statistics for DEA variables were presented before replacement is made, the literature on zero data treatment in DEA include (Andreu, 2008; Fried *et al.,* 2008 *cited by* Mussa, 2014)

2.5.4 Econometric model

Generally, regression models that could be used in the second stage procedure are the Tobit, Ordinary Least Squares (OLS) and Maximum Likelihood Estimator (MLE). However, McDonald (2008) and Banker *et al.,* (2008) independently, reviewed these models using efficiency scores generated by either censoring or as fractions and they made suggestions on the appropriate technique to be used. These separate studies, concluded that the Tobit model is more suitable in the second stage of regression when efficiency scores are generated by data censoring process otherwise it is an inconsistent estimator (Green 2003). But, when efficiency scores are generated by using DEA where efficiency scores are not censored or corner solution data, but are fractional data the most suitable models are Maximum Likelihood Estimator (MLE) or Ordinary Least Squares (OLS). Based on MacDonald (2008) and Banker *et al.,* (2008), this study adopts a two limit Tobit model in the second stage procedure to determine the socioeconomic and farm specific variables that are likely to influence efficiency in smallholder crop production in Tanzania. The Tobit regression model is normally employed when the dependent variable is limited or censored at both sides.

The Tobit model at first was developed in Tobin's pioneering work (1958), with the assumption that the dependent variable has a number of its values clustered at a limiting value, usually zero. This kind of regression fits DEA scores well, as these scores are limited and fail in case of a corner solution as mentioned previously. The corresponding assumption of the Tobit model is that the DEA scores are normally distributed in terms of the population, whilst the sample distribution of the scores follows a mixed distribution. However, the distribution of DEA scores is not normally distributed, and is usually skewed either to the right or left [CITATION Kha16 \l 1033]. If the data to be analysed contains values of the dependent variable that is truncated or censored, then ordinary least square (OLS) is no longer appropriate for coefficient estimation. If OLS is directly used it will lead to biased and inconsistent parameter estimates. Meanwhile the Tobit model, using maximum likelihood estimator, becomes a better choice to estimate a regression coefficient (Liang *et al.,* 2008). The present study therefore, uses a censored regression model to analyse the role of socio-economic, demography and institutional attributes in explaining variation in technical, allocative and economic inefficiency in crop production.

2.5.5 Determinants of efficiency

Efficiency estimation without clearly identifying important socio economic, demographic and institutional variables, has limited importance for policy and management purposes. Thus, the estimated level of efficiency among producers is not enough to derive recommendations for policy intervention. Several studies have been conducted to determine the sources of the variations in technical, allocative and economic efficiency in agriculture (Wang *et al.*, 2017; Anyaegbunam *et al.*, 2016; Kidane *at el.*, 2013). Similarly, a number of improvements have been made to increase the power of estimation and advance modification of efficiency measurement has been made to include other factors that were assumed to affect efficiency. Thus, in this study, the identification and analysis of the underlying factors of inefficiency was given the main concern.

Initially, the DEA model was applied only with controllable variables whereby production efficiency scores were estimated, at the second stage, efficiency scores were regressed against factors that influence farmer’s production. The aim was to simultaneously study the relationships among a set of socio-economic and demographic factors as well as the management practice variables with the efficiency score response obtained at the DEA in the first stage. There are various socio-economic, demographic, institutional and non-physical factors that affect efficiency (Kumbhakar and Bhattachury, 1992). These factors include age of household head, family size, distance to the field, distance to the market, farm size, sex of household head, education level of household head, access to credit, access to extension services, frequency visit by extension officers and marital status of household head.

Akamin *et al.* (2017) conducted a study on efficiency and productivity analysis of vegetable farming within root and tuber-based systems in the humid tropics of Cameroon reported that, technical efficiency was positively and significantly influenced by education level and farm size. This implies that as farmers' level of education increased inefficiency decreased because education level enhances the managerial and technical skills of farmers. According to Battese and Coelli (1995) education is hypothesized to increase the farmers' ability to utilize existing technologies and attain higher efficiency levels. Contrarily, the study by Owour and Shem (2009) has shown a negative relationship between education and technical efficiency of farmers. The author pointed out that technical inefficiency tends to increase after 5 years of schooling which could probably be explained by the fact that high education reduces the desire for farming and therefore, the farmer probably concentrates on salaried employment instead which could further reduces labour availability for farm production thereby lowering efficiency.

Gender is another factor that influences the efficiency of farmers. Sienso (2013) reported male farmers are more efficient than female farmers. He argued that women face restrictions to have access to new information and technologies due to customs and traditions, social norms and religious beliefs. Therefore, male farmers are more efficient and hence closer to the frontier. Further females have lower access to credit facilities than men which make them difficult to buy inputs such as fertilizer, seeds and the use of other farming techniques in production. His findings were similar to those of Mango *et al.* (2015) who reported that male farmers are more efficient in maize production than female farmers. He argued that male farmers are efficient because farm management activities such as planting, weeding and harvesting are labour intensive of which female headed cannot afford hence male farmers tend to be more efficiency. Female headed household also have less access to productive resources than their men counterparts which make them more inefficient in production.

In addition, Addai and Owusu (2014) in Ghana, argued that the household who are headed by women despite their involvement in farming activities are also perform other important domestic and economic roles which make them inefficient than their counterparts. Some of their activities done by female's households are non-economic and cannot be measured such as taking care of children, cleaning and cooking. In Tanzania Kidane *et al.* (2015) also found that male farmers are more efficient in tobacco production than their female counterpart though not significant. Contrarily to these studies Dolisca and Jolly (2008) studying the situation in Haiti, revealed that male farmer increases technical inefficiency. The authors argued that after land preparations women normally carry out the remaining activities involved in production at the farm.

Farming experience is gathered from the act of agricultural production-that is conscious accumulation of know-how from farming practices, farmers experience is a proxy to age. Several studies in developing countries (Mohammednur and Negash, 2010; Kitila and Alemu, 2014; Gebregziabher *et al.*, 2012) revealed that there is a positive relationship between age of household head and efficiency. Implies that older farmers are more efficient than younger farmers. Mohammednur and Negash (2010) argued that age can be used as a proxy variable for farming experience arguing that farmers become more experienced as they grow old and further argued that older farmers can easily accumulate resources, the availability and use of these resources on time enhance increase efficiency. Kitila and Alemu (2014) and Gebregziabher *et al.* (2012) they both argued that the efficiency of farmers increases as they become older but after reaching to a point their efficiency state to declines. They further argued that the decline of efficiency is due to loss of their physical strength after they reach probably to the middle age. As age is used as a proxy of experience therefore older farmers becomes more experienced thus increasing efficiency. This has been also supported by Mbanasor and Kalu (2008) and Bifarin *et al.* (2008). On the contrary however, Opaluwa *et al.* (2014) and Kidane *et al.* (2015) found that age decreases technical efficiency of the farmers arguing that older farmers cannot supervise farming activities more efficiently thus increasing inefficiency in production.

Access to credit improves liquidity and enhances use of agricultural inputs in production as it is often claimed in development theory. Javed (2009) pointed out that access to credit has negative influence on technical inefficiency. He explained that, it actually reduces the financial difficulties farmers face at the beginning of the crop year, thus enabling them to buy inputs. Addai and Owusu (2014) confirmed that, apart from formal education, experience and access to extension services, the amount of financial credit obtained used is a key factor that can increase technical efficiency in coffee production.

Another important factor that affects efficiency is access to extension services. A farmer' regular contact with extension officers facilitates the practical use of modern technologies and adoption of agronomic norms of production. Msuya *et al.* (2008) investigated the technical efficiency of maize producers in Mbeya and Manyara regions in Tanzania, the author observed that frequent access to extension services increased technical efficiency. Similarly, William (2017) conducted a study on Productivity analysis of small scale cotton farms in Bariadi district, Tanzania. The study found that, technical efficiency is positively influenced by among others access to extension services.

Household family size is another factor that influences the efficiency of farmers. Kidane *et al.,* (2014) pointed out that although large household size puts extra pressure on farm income for food and clothing, but at times ensure availability of enough family labour for farming activities to be performed on time. Opposite to this is that farmers with surplus labour force are likely to use the rest of the family labour, and hence operate inefficiently or farmers with bigger household size would have to allocate more financial resources to health, education and so on for members of the household and thus affect production Ilembo and Kuzilwa (2014).

As we can see from the above empirical evidences, the effect of some variables such as education, age credit and extension services is found to be unknown, a mixture of positive and insignificant effects. However, the basic problem of the researches is the choice of the dependent variable and the input variables. Most of the research except Watkins *et al.* (2014) identified the factors effecting efficiency estimated from only one type of efficiency (technical efficiency) and from only one crop. This might lead to a wrong conclusion because farmer's production efficiency can differ by crop type or estimated type of efficiency. Furthermore, studies on technical efficiency on agriculture production are increasing but studies on economic efficiency using Data Envelopment Analysis (DEA) involving whole farm are still rare. This study therefore, used data from tobacco, maize, paddy rice and beans as major crop produced by smallholder farmers in Urambo, Kaliua and Namtumbo district using DEA approach. In doing so, the study attempted to fill the knowledge gap on the current level of efficiency particularly on the use of DEA methodology to estimate efficiency.

CHAPTER THREE

3.0 METHODOLOGY

This chapter provides details of the methodology used to address the objectives of the study. It includes description of the study area, sampling design, data type and collection method, methods of data analysis and important variables selected for the study. The choice of analytical models and variables are made in view of the empirical and analytical reviews discussed under chapter two.

3.1 Study Area

3.1.1 Selection of the study area

The study is conducted in three districts, namely Urambo and Kaliua which are located in the Central western zone and Namtumbo which is located in the Southern zone of Tanzania. Urambo and Kaliua districts were purposively selected for this study due their leading potential in Virginia flue cured tobacco producer while Namtumbo district was the leading potential in Dark fire cured tobacco producer. In these Districts tobacco has been the most important traditional cash crop for many years. Their contribution to the country's economy and long-time experience. It should be noted that, 60% of the total tobacco produced in the country comes from Urambo and Kaliua districts. Of important, although, Namtumbo district was chosen due to its potential in the production of Dark fire tobacco, currently tobacco farmers in the district shifted to Virginia flue cured tobacco mainly due to the change in world market demand.

3.1.2 Description of the Study Area

Urambo District is among the seven districts of Tabora region. The district was established on 1st January 1984. However as of recent, the district has split into two more Districts namely, Urambo and Kaliua. In this study therefore, due to administrative arrangements which are so far not yet fully settled in the two districts and due to the fact that the two districts lie in the same geographical location and same agro ecological zone, this study considered Urambo District to include Kaliua district.

Geographically, The District shares borders with Shinyanga Region in the North, Uyui District in the East, Sikonge District on the South East, Rukwa and Mbeya Regions in the

South and Kigoma Region on the Western side of the District. In terms of international identification, Urambo, Kaliua districts lies between latitudes 40 and 5080' south of the Equator and between longitudes 310 and 32050' east of Greenwich and covers an area of 20,160 Km^2 with a population of 369 329 persons and annual mean temperature of 30^0C and a minimum of 16.4^0C. These districts receives an annual rainfall ranging from 900mm-1200mm and have well drainage medium-textured soil of loamy sand and with sub soil texture of sandy clay loam (District profile-DED Urambo and Kaliua, 2015).

Accordingly, Namtumbo District is one of the five Districts that form Ruvuma Region. Namtumbo District was split from Songea District in the 1st July 2002. It was the leading producer of Dark fire tobacco. However, since 2013/14 season all farmers have been required to cultivate flue cured tobacco to meet buyers' needs. Geographically, Namtumbo District is bordered by the Republic of Mozambique in the South, whereby the Ruvuma River forms an International Boundary. It borders with Songea District in the West, Tunduru District in the East and Ulanga District (Morogoro Region) in the North. Administratively, Namtumbo District is divided into 3 divisions and 18 wards with a total of 60 villages and 37 924 randomly distributed households. Internationally, the district lies between 310 24' and 320 47' Longitudes, and 50 30' and 60 20' latitude South of the Equator. The District covers an area of 20 375 Km^2; with a population of 222 651. The District is characterized by lowlands in the South of between 200m to 300m above the sea level with some rolling hills towards the North ranging from 300m to 500m above the sea level. The District receives average annual rainfall of between 800mm to 1200mm. Temperatures vary from 20^0C to 25^0C during the day and between 15^0C to 17^0C during the night (District profile-DED Namtumbo, 2015). Figure 4 shows a map of the study area.

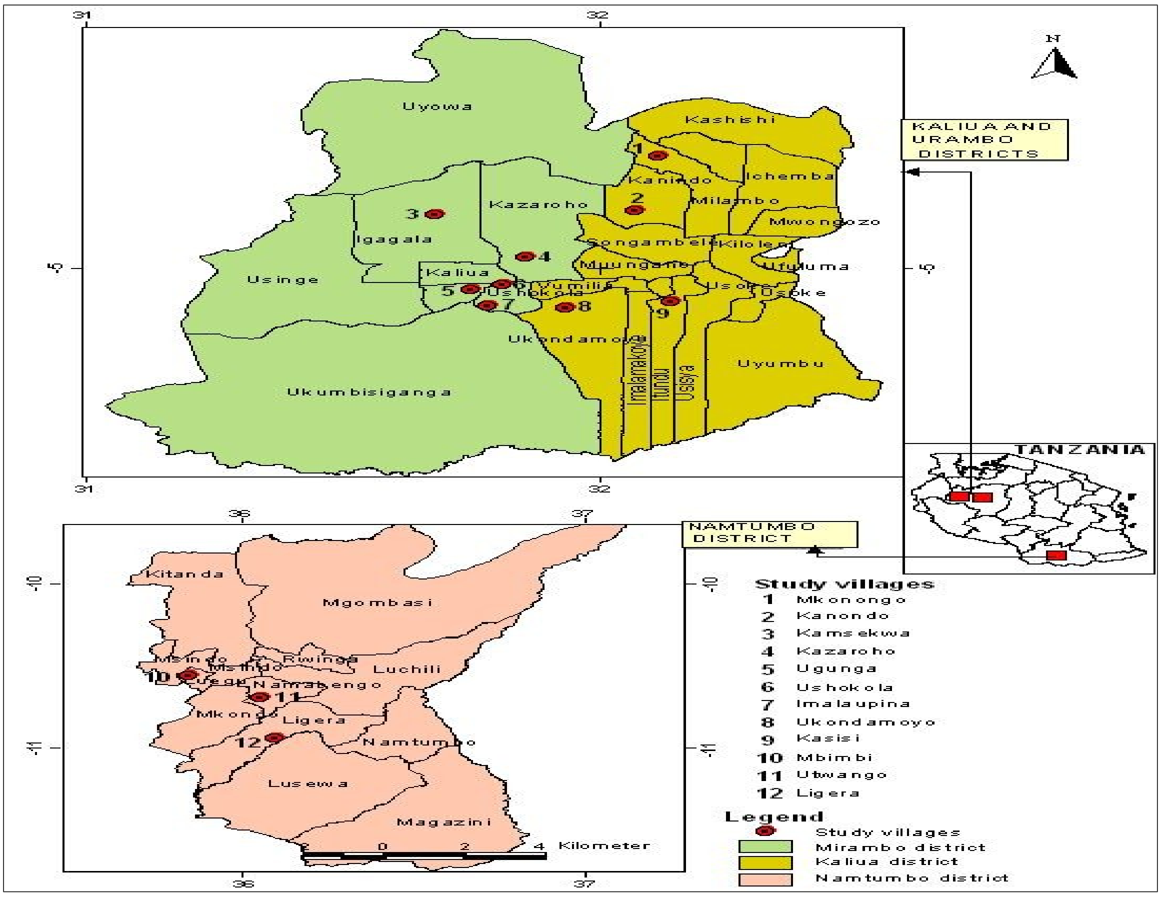

Figure 3: Map of the study area

Source: National Bureau of Statistics

The agricultural production system in the study areas is mixed involving crop and livestock production. Tobacco and cotton are the major cash crops produced in Urambo and Kaliua districts; however, cotton is grown in small quantities. Maize, paddy and beans are the dominant staple food crops grown by farmers. Other crops include cassava, beans, groundnuts, and vegetables. Similarly, tobacco is a major cash crop grown by farmers in Namtumbo district, followed by, cashew nuts, sunflower, simsim, coconuts and ground nuts. Likewise, maize, paddy and beans are the dominant staple food crops in the district; other staple food crops include cassava, beans, finger millets and potatoes. However nowadays, maize, rice, and beans are grown for food consumptions as well as for trade (District Profile-District Executive Director (DED) Urambo, Kaliua and Namtumbo, 2015)).

3.2 Conceptual Framework

This conceptual framework based on the production theory, by applying the DEA model to estimate technical, allocative and economic efficiency. The conceptual framework illustrated in Figure 4 shows how various sets of factors interrelate to determine crop management and production decisions to influence crop production efficiency within a farming system organized in terms of feedback and influence mechanisms of production efficiency levels. The conceptual framework focuses on input-output transformation efficiency, policy recommendations, and its effects to smallholder farmers.

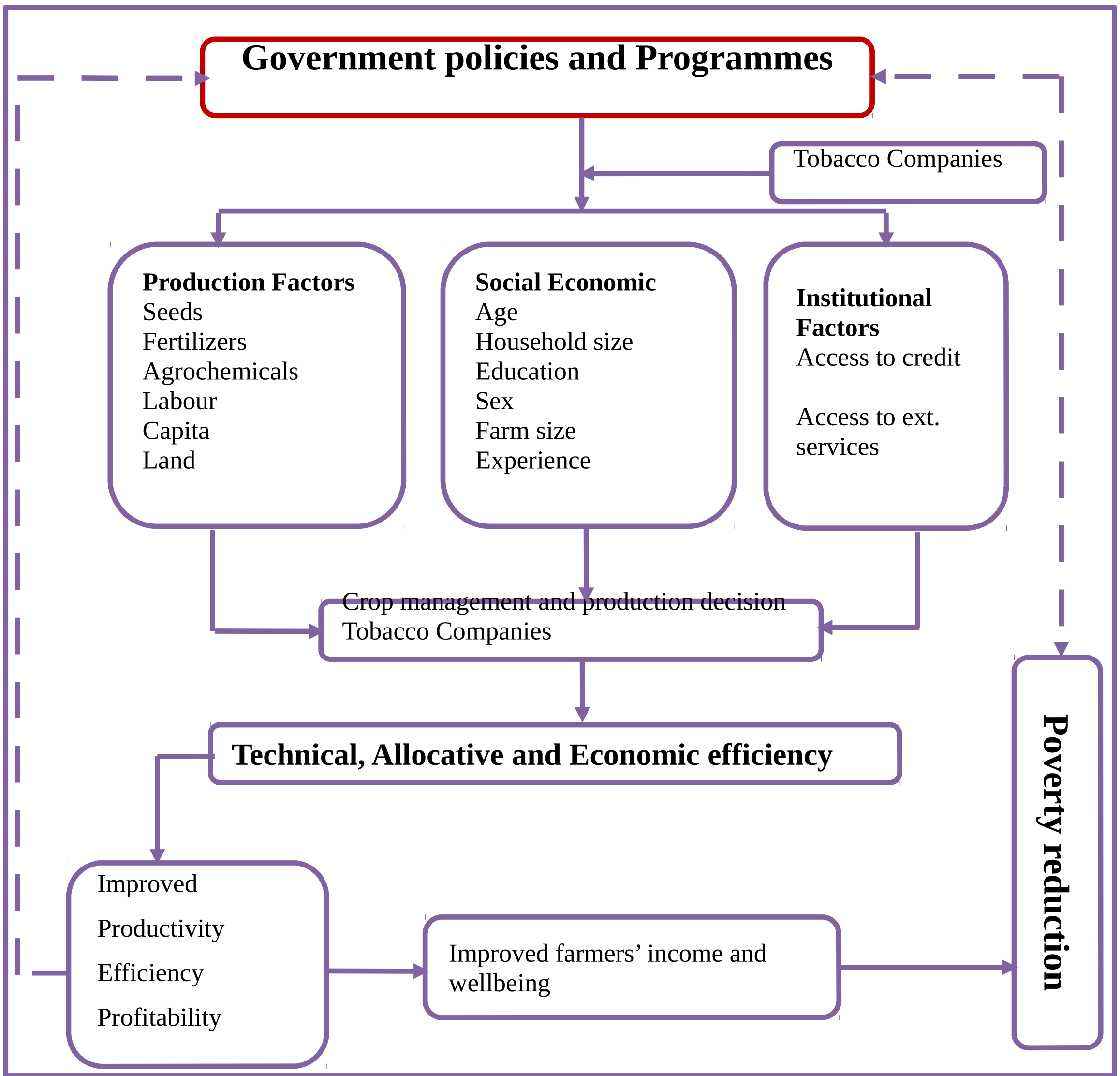

Figure 4: Conceptual framework of the Study

Source: Modified from Philip, (2007)

Note: Input – Output Influence effect

Direction of influence

The production factors (land, labour, NPK fertilize, CAN fertilizer, urea fertilizer, capital and agrochemicals) were used as inputs in crop production activities. These factors were also used to determine resource allocation decisions on the production mix that a farmer chooses and also determine physical output. It was therefore anticipated that, as more inputs were applied by a farmer; crop yields would increase but to some extent it may result to a negative effect in cases of overuse. Optimality was therefore a crucial factor in deciding the level of inputs that were to be applied. Thus, production efficiency levels were affected by the efficiency of production of a farmer. Accordingly, institutional factors such as access to credit and extension services enhance the capacity of tobacco farmers to use improved technologies on the farm. The institutional factors that expected to influence production efficiency included access to credit access and extension services and frequently of extension contact

Furthermore, the socio-economic factors were expected to influence a farmer’s efficiency as these factors play a key role in influencing decisions on the farm. The socio-economic and demographic factors expected to influence efficiency of a farmer included; age, household size, level of education, gender, farming experience, farm size, distance from home to the field plot as well as distance from the field plot to the market. Production efficiency and its influencing factors were expected to influence policy which the study had proposed to recommend. The recommended policies were expected to play a feedback effect in improving productivity, efficiency and profitability levels of tobacco smallholder farmers which in turn leads to improved livelihoods and income levels to farmers.

Besides, the improved productivity, efficiency and profitability levels among tobacco farmers expected to have a feedback effect on efficiency, institutional and socio-economic factors through improved and informed use of inputs. Thus, for a production process to be effective and efficiently, attainment of technical and allocative efficiency which leads to achieving production efficiency is of paramount important. A farm that is efficient in crop production is expected to get higher output of both crops per hectare compared to one that is inefficient (Kumbhakar and Lovell, 2003).

3.3 Research Design

This study was designed such that it employed a cross-sectional survey which was conducted during 2014/15 tobacco production season. The study adopted a cross-sectional survey as opposed to longitudinal survey research design due to financial and time constraints. Longitudinal survey requires taking a repeated measurement on continuous basis while cross-sectional survey requires one-time data collection and analysis which in turn is time-saving and cost effective (Kothari, 2004). The suitability of the research design adopted in this study in getting the correct data that answers the objectives of the study is elaborated in details in the analytical framework in the following section.

3.4 Analytical Framework

In this study, profitability and efficiency indicators were used to discuss and summarize important farmers' characteristics and their effect on the output at the farm level and thereby evaluating farmer's performance. To come up with the acceptable conclusion both quantitative and qualitative analysis were used in analysing data gathered from the surveys. Profitability was estimated using farm budget techniques while technical, allocative and economic efficiency results were estimated using Data Envelopment Analysis (DEA), and then factors for efficiency variation among farmers were identified using two-limit Tobit model and the results of factors affecting resource use efficiency were discussed. It should be noted that, to examine resource use efficiency in crop production need to highlight the variables that could be better managed to improve farmer's crop productivity.

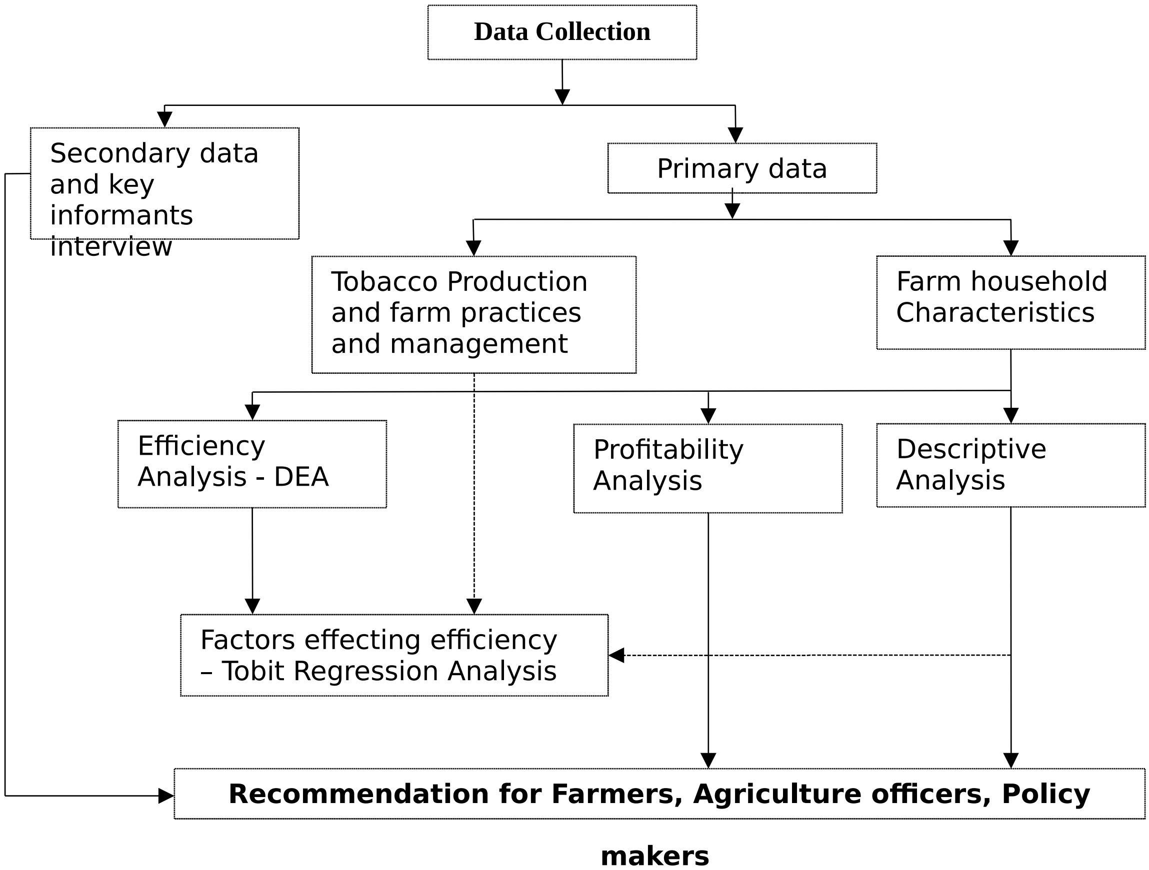

Figure 5: Analytical framework guiding

3.4.1 Descriptive analysis

Relevant data were analysed using descriptive statistics such as mean, frequency distribution, percentage, standard deviation, graphs, tables and figures. This was done for the purpose of characterizing smallholder farmers and the supporting institutions in the study area. The descriptive statistics analysed involved demographic, socio economic characteristics, institutional characteristics, rate of input use per hectare, crop yields per hectare and variables used in DEA. The choice of these descriptive was on based on the literature review on the analysis of tobacco farmers (Kuboja and Temu, 2013; Kidane *et al.*, 2013; Ilembo and Kuzilwa, 2014; Ntibiyoboka, 2014 and Hassan *et al.*, 2015).

3.4.2 Objective 1: Estimation of tobacco farming profitability

Profitability analysis includes calculation of detailed costs of production and return from tobacco per hectare. The total cost (TC) is comprises of the total variable costs (TVC) and total fixed costs (TFC). The TVC includes the costs of human labour (both family and hired labour). In this case, the cost of family labour is estimated by using market wage rate while the cost of tobacco seeds were estimated from tobacco seed production dealers who are the main supplier of tobacco seeds[4]. Quantification of costs of production was conducted using enterprise budgeting technique. The technique involved quantification of input costs such as imputed land cost, seeds, fertilizer, herbicides, pesticides, firewood, cost of loan, marketing cost and labour measured as a total expenditure in TZS while the amount of labour is measured in man-days[5.]. The Analysis of Variance (ANOVA) test was used to compare profitability across districts; this is used in comparing mean of more than two groups at the same time to determine whether a relationship exists between them. The result allows for the analysis of multiple groups of data to determine the variability between samples and within samples. The main software's used for the analysis were SPSS, STATA version 12 and Microsoft excels spread sheet.

Labour is an important factor of production, especially in developing countries where agriculture remains labour intensive and for certain activities that require an important

4 Tobacco seed varieties are supplied for free by leaf companies to tobacco farmers, however, the cost were established from the leaf dealers tobacco seeds producers whereby 1ha requires about 30 grams packet of tobacco seed (1packet contains about 12 000 tinny seeds) [CITATION Nti14 \l 1033]. 1packet = USD 0.5 (1USD = TZS 1 700)

5Man-days are computed according to the rule that one adult male, one adult female and one child (< 18 years) working for one day (8 hours) equal 1-man day; 0.75 man days; and 0.50 man days respectively. Battese *et al.*, (1995) and Coelli and Battese (1996) also employ these ratios, this is simply, the number of labourers times hours/day times No of days [CITATION Msu08 \l 1033] amount of manual labour. Labour expenses typically represent a significant proportion of the total costs of production, to the point that it is often the largest cost item when family labour has been accounted for. However, there is no doubt in tobacco production labour is one of the very critical issue that is still under debate. Several studies on tobacco production revealed that, the crop production is highly labour intensive enterprise (Hu and Lee, 2015; Ilembo and Kuzilwa, 2014; Leppan *et al.*, 2014). For instance, Kidane *et al.*, (2015), conducted a comparative analysis of technical efficiency of smallholder tobacco and maize farmers in Tabora region, Tanzania. The study revealed that tobacco season was found to last for approximately ten months a year from ploughing the land to harvesting the crop.

Furthermore, it has been observed that, tobacco production is highly dependent on family labour. However, within the study area, the costs of family labour are often ignored by farmers in their decision to engage or not to engage in tobacco farming in the study area. In these areas, most of the farmers are family members, including women and children. As a result, the calculation of profitability of tobacco production under the farmer's eye is a profitable investment and thus, the economics of tobacco farming as promoted by the tobacco industry is incorrect. Thus, in assessing the performance of the sector, this study includes all the total cost of tobacco cultivation by incorporating comprehensive labour costs of both family as well as hired labour (Drope *et al.*, 2016).

Thus, the cost of labour was quantified from only tobacco production activities, to estimate the cost of family and hired labour which is used in tobacco leaf production, the study identified various activities in the leaf production. For each activity, the respondents were asked to state the number of people (labour unit) who were involved from the household; the total number of days that each household member worked on the activity and how many average hours per day each member of the household worked on that activity. The data on the total number of hours for all household members for each particular activity were calculated. Thus, the number of people required to perform a particular amount of work was estimated to enable the quantification of price of labour.

It should be noted that, the amount of work that can be done by one labour unit in one day is called man/days (1man/day is equivalent to 8 working hours). Thus, the number of days spent on doing a particular activity in the field was estimated. The price of labour was then obtained by taking the total cost of labour divided by the number of days taken on that activity. In situations where family labour was used, equivalent wage cost of working off-farm for a wage was used. Other cost items were purchase of bagging materials, marketing cost, firewood cost and transport costs were estimated.

The total revenue (TR) is computed by multiplying the tobacco quantity of output with the market price in the auction. This is the amount of money received from the sale of tobacco output. The GM was used as a proxy for profit to evaluate tobacco farmer's performance, this is the difference between the gross incomes earned (TR) and the total variable cost (TVC) incurred. Depreciation for TFC was not considered for farm equipment, since the same tools are used in all the enterprises undertaken by the farmer and not exclusively for tobacco and other crops produced by the farmer. For curing barns, mostly are subjected to re-building each season. In addition, farmers use buildings and some farm implements, but they could not recall the actual cost in order to derive a satisfactory depreciation costs and hence not included. Thus, the total variable cost (TVC), and the total revenue (TR) which is defined as the product of tobacco quantity produced in Kg and the unit price in TZS was calculated.

❖ **Cost Analysis**

Profitability analysis includes calculation of detailed costs and return from tobacco production as follows: -

✓ TC = TVC + TFC (however TFC is zero)

✓ TC = TVC

✓ TVC = $\sum P_i X_i$ = C_i (i = 1, 2, 3,….8)

Where,

C_1 = Costs of labour,
C_2 = Cost of NPK (10:18:24) fertilizer
C_3 = Cost of CAN 27% fertilizer
C_4 = Cost of agrochemicals
C_5 = Cost of seeds
C_6 = Cost of firewood
C_7 = Cost of loan
C_8 = Marketing Cost

Thus, the deduction of the average total revenue TR to the average total variable cost (TVC) of tobacco production leads to the average gross margin (GM) as follows: -

❖ TR = $\sum P_y Q$ - $\sum P_x X$ …………………………………………….………….. (1)

❖ GM(π) = $\sum P_y Q$ - $\sum P_x X$ ……………………………………….………..(2)

❖ **Profitability Analysis**

The profitability of the tobacco enterprise was calculated using the Rate of Returns on Investment (ROI) and return to labour (ROL) as follows: -

❖ ROI = GM/TVC……………………………….…………………………...…(3)

❖ Return per man/days = GM/Man-days…………………...….……………….….….(4)

Where,

GM = Gross Margin

TR = Total revenue,

TC = Total cost

TFC = Total fixed cost (assumed to be 0)

TVC = Total variable costs,

Then, a simple budgeting technique was used to estimate the costs and returns among tobacco smallholder farmers. Indicators such as GM percentage and return per TZS invested and return on labour were analysed. From the above analytical modelling, the variables the identified to be used in objective one is as shown in Table 1.

Table 1: Description of variables used for tobacco farming profitability

Variables	Descriptions	Unit
Output variables		
Y_1	Tobacco	Kilograms
Input Variables		
X_1	Total land size for tobacco	Hectares
X_2	Total labour (family and hired) utilized	Man-days
X_3	Amount of NPK (10:18:24) used	Kilograms
X_4	Amount of CAN used	Kilograms
X_5	Amount of agro chemicals used	litres
X_6	Amount of tobacco seed used	Gram's
X_7	Quantity of firewood	-
X_8	Quantity of tobacco sold	Kilograms
Inputs Costs Variables		
C_1	Land rent (Cost of Land)	TZS
C_2	Total wage for labour (cost of labour)	TZS
C_3	Cost of NPK Fertilizer used	TZS
C_4	Cost of CAN Fertilizer used	TZS
C_5	Cost of agrochemicals used	TZS
C_6	Cost of tobacco seed used	TZS
C_7	Cost of firewood used	TZS
C_8	Charges per Kilogram sold	TZS

3.4.3 Objective 2: To estimate farm level efficiency among tobacco farmers

3.4.3.1 Mathematical specification of technical efficiency

Estimation of the technical efficiency model can be stated as the ratio of sum of weighted outputs to sum of weighted inputs (Watkins *et al.,* 2014). In formulating mathematical programming models, assume that, a typical study will have *n* farmers with each farmers consuming varying amounts of *m* different inputs to produce *s* different outputs. Specifically, farmer *j* consumes amount x_{ij} of input *i* and produces amount y_{rj} of output *r.* It is usually assumed that $x_{ij} > 0$ and $y_{rj} > 0$. Using the ratio-form of DEA and taking the output orientated approach the producer maximizes the output level given fixed inputs, the function to be maximized can be presented as:

❖ *Maximize* h_o: $\sum_{r=1}^{j} u_r y_o / \sum_{i=1}^{m} v_i x_o$ ……………………….….……….….…..….(5)

Subject to: $\sum_{r=1}^{s} u_r y_{rj} / \sum_{i=1}^{m} v_i x_{ij} \leq 1,$

$(j = 1,2,3,\text{-----------}n;\ r = 1,2,3,\text{------------}s)$

$(i = 1,2,3,\text{-------------}m;\ u_r, v_i \geq 0,)$

Where,

y_{rj} and x_{ij} (*all positive*) are the observed amounts of outputs and inputs of the r^{th} type for the j^{th} decision making unit; and , u_r, $v_i \geq 0$ are the variable weights to be determined by Linear Programming (LP) problem (Coelli *et al*, 2005). The j^{th} farmer uses an *m* dimensional input vector to produce *s* dimensional output vector. In our case, $(x_{io}\ y_{io})$ is the input-output vector of the farmer. The objective function *ho* attempts to maximize the ratio of virtual outputs to virtual inputs subject to constraint $0 \leq h_o \leq 1$. When $ho < 1$, it represents some relative inefficiency; otherwise it is 100% efficient when $h_o=1$. Equation (5) tells us that the maximum level of efficiency we can get is 1. A notable problem with equation (5) is that it has an infinite number of solutions.

This is avoided by introducing an additional constraint $\sum_{i=1}^{m} v_i x_{i0} = 1$. The notations *(u, v)* change to *(μ, v)* to reflect the intended transformation. In this way, we obtain the multiplier form of LP problem. Weights reflect the relative importance of inputs and outputs for efficient firms and weights assigned to peers for inefficient firms. They are used to linearly combined inputs and outputs. They will be calculated by solving the linear programming problem. In order to solve equations 17, the following equation developed by Charnes, Cooper and Rhodes (CCR) (1978) was used.

$$\text{Maximize } h_o = \sum_{r=1}^{s} \mu_r y_{ro} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$\text{Subject to: } \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$$

$$\sum_{i=1}^{m} v_i x_{i0} = 1$$

(j = 1,2,3,-----------n; r = 1,2,3,------------s)

(i = 1,2,3,-------------m; $u_r, v_i \geq 0$*,)*

The equations above are known as the multiplier form of DEA linear programming problem. Using the duality property of this LP problem, the dual for DMU_0 can be derived:

$$\text{Minimize } z_0 = \varphi_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$\text{Subject to: } \sum \lambda_j x_{rj} \geq y_{ro}$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \varphi_0 x_{io}$$

(j = 1,2,3,-----------n; r = 1,2,3,------------s)

(i = 1,2,3,-------------m; $u_r, v_i \geq 0$*,)*

Where:

λ is N x 1 vector of constant and ϕi is the efficiency score for the i^{th} farmer If ϕi is equal to 1, a farmer is located on the efficiency frontier under constant return to scale conditions as per CCR model. The constant return to scale assumptions under CCR model are appropriate only when all farmers are operating at an optimal scale; otherwise variable return to scale is required. To account for the variable return to scale in the LP, it is necessary to add a convexity condition λ_j , $\sum_{i=1}^{m} \lambda_j = 1$

The model to incorporate variable return to scale, which is known as Banker, Charnes, and Cooper (BCC) model, is written as:

$$\min_{\lambda} z_o = \varphi_o$$ ……………….……………………………………..........

(8)

Subject to $\sum \lambda_j x_{ro} \geq y_{ro}$

$$\varphi_o x_{io} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0$$

$$\sum_{j=1}^{m} \lambda = 1$$

(j = 1,2,3,-----------n; r = 1,2,3,------------s)

(i = 1,2,3,-------------m; λ_j ≥ 0*,)*

3.4.3.2 Estimation of economic efficiency

With the availability of price data, the above Charnes, Cooper and Rhodes (CCR) and Banker, Charnes, and Cooper (BCC) models can be extended to measure the economic (cost) efficiency. Coelli *et al.* (2005) observed, one of the objectives of extending these models is to find a point where the cost can be minimized. In the case of input-orientated CCR model under constant return to scale condition, the first step of computing economic efficiency is by solving the following linear programming:

$$\textit{Minimize} \quad \sum_{i=1}^{m} c_{io} x_{io}^{¿} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (9)$$

$$\textit{Subject to} \quad \sum x_{rj} \lambda_j \leq x_{io}^{¿},$$

$$\sum_{j=1}^{n} y_{rj} \lambda_j \geq y_{io}$$

(j = 1,2,3,-----------n; r = 1,2,3,------------s)

(i = 1,2,3,-------------m; λ_j ≥ 0*,)*

In equation (9), $x_{io}^{¿}$ is the optimal solution denoting cost minimizing input quantities given the input prices c_{io} and output level y_{io}. This equation (9) would then be compared to the actual cost at which particular a DMU_{jo} delivers its output, which is denoted as, $c_{io}\, x_{rj}$ to compute the economic efficiency as follows:

$$EE = \ C_{iox} X_{io}^{*} / C_{io} X^{*}_{rj} \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (10)$$

For the case of input-orientated Baker, Charnes and Cooper (BCC) model with VRS assumption, as in equation (9), the cost minimizing input quantities would be computed with the same equation but with added constraint of $\sum_{j=1}^{n} \lambda_j = 1$ so that it can be written as follows:

$$\textit{Minimize} \quad \sum_{i=1}^{m} c_{io} x_{io}^{¿} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

$$\textit{Subject to:} \quad \sum x_{rj} \lambda_j \leq x_{io}^{¿},$$

$$\sum_{j=1}^{n} y_{rj} \lambda_j \geq y_{io}$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

(j = 1,2,3,-----------n; r = 1,2,3,------------s)

(i = 1,2,3,-------------m; $\lambda_j \geq 0$*,)*

Cost-minimizing quantities computed from equation (11) would then be compared as a percentage of the actual cost faced by particular DMU_{j0} to calculate the economic efficiency as in equation (10).

3.4.3.3 Estimation of allocative efficiency

Allocative efficiency for both constant and variable return to scale condition could be calculated as follows (Coelli *et al.,* 2005):

$$AE = EE / TE \quad \text{……………………..……………………………..…………..} \quad (12)$$

Where AE is Allocative Efficiency, EE is Economic Efficiency calculated from equation (10) TE is technical efficiency calculated from equation (12)

3.4.3.4 Data variables definition for the DEA model

One of the major issues to be considered when applying DEA approaches is the selection of appropriate inputs and outputs. The primary data collected adequately defined the variables for data analysis. These variables were used as the database for estimating the impact of policies on technical, allocative and economic efficiency scores of a cross-section of tobacco farmers in the three selected districts in Tanzania. It could be noted that, one of the most critical steps in order to conduct a DEA analysis is careful examination of the output and input variables and establishing an appropriate combination. It is necessary to combine the data to form a smaller number of inputs and output variables.

According to Coelli *et al*. (2005) there are important issues to be considered during input and output aggregation processes. Firstly, it is important to ensure that aggregates formed are meaningful; this implies that, aggregates are formed across variables that exhibit similar movements in relative prices or quantities. Secondly, prices data are integral part of the work when multiple outputs are aggregated. Thus, value aggregation can be formed by the product of price and quantity and summing it over all the commodities included in the aggregate. Following Coelli *et al.* (2005), in this study aggregation of outputs and inputs was made keeping that values formed are meaningful and price values are incorporated in value aggregation.

Concerning the reconciliation of zero value data in the DEA analysis different, approaches for outputs and inputs were used. Accordingly, for a farmer producing any of outputs (single or multiple positive outputs) regardless of the type and quantity they produced zero level output was taken as zero for the analysis. This is due to the fact that outputs can be zero in the DEA analysis. However, unlike zero outputs, zero inputs were treated differently. For farmers having zeros values in the inputs an arbitrary very small positive value greater than zero but less than the smallest positive observation was assigned during analysis. However, the descriptive statistics for variables of DEA were presented before replacement is made. Description of variable used in DEA model is as shown in Table 2.

Table 2: Description of Variables used for Data Envelopment Analysis

Variables	Descriptions	Unit
Output variables		
Y_1	Tobacco	Kilograms
Y_2	Maize	Kilograms
Y_3	Paddy	Kilograms

Y_4	Beans	Kilograms
Input Variables		
X_1	Total land size of the four crops	Hectares
X_2	Total labour (family and hired) utilized	Man-days
X_3	Amount of NPK (10:18:24) used	Kilograms
X_4	Amount of CAN used	Kilograms
X_5	Amount of Urea used	Kilograms
X_6	Amount of agro chemicals used	liters
X_7	Amount of tobacco seed used	Gram's
X_8	Amount of other crops seed used	Kilograms
Inputs Costs Variables		
C_1	Land rent (Cost of Land)	TZS
C_2	Total wage for labour (cost of labour)	TZS
C_3	Cost of NPK Fertilizer used	TZS
C_4	Cost of CAN Fertilizer used	TZS
C_5	Cost of Urea Fertilizer used	TZS
C_6	Cost of agrochemicals used	TZS
C_7	Cost of tobacco seed used	TZS
C_8	Cost of other crops seed used	TZS

Model diagnostics test for DEA model

One of the weaknesses of DEA is its vulnerability to outliers. In order to identify possible outliers in the computation of efficiency scores for tobacco, maize, paddy rice and beans production, the total quantity of harvested was regressed on area planted and quantity of seed planted in order to identify potential outliers and influential observations. Two observations were identified and the mean value of outputs and inputs were used so as to remain with the same sample size.

Selected Hypothesized Variables for DEA

A number of the dependent and the independent variables were chosen to be included in DEA model was explained previously. Further, descriptive statistics for farm variables characteristics of the study sample was presented and this was used to examine their effects on crop production. Descriptions of these variables, their measurements, and associated hypotheses to be tested under each analytical framework are as explained in Table 3.

Table 3: Summary of variables used in DEA model and their signs

Variable name	Definition	Hypothesized signs
Land	The area of farm land that the farmer allocated under the crop cultivation during the season 2014/15 in hectares	+
NPK Fertilizer	The amount of NPK fertilizer used on the plot of land for the crop production during the farming season in Kg	+
CAN Fertilizer	The amount of CAN fertilizer used on the plot of land for tobacco production during the farming season in Kg	+
Urea fertilizer	The amount of urea fertilizer used on the plot of land for crop production during the farming season in Kg	+
Agro-chemicals	The amount of pesticides/chemical in litre used on the plot of land for the tobacco production during the farming season in litres	+
Labour	family and hired labour used (man-days)	+

3.4.4 Objective 3: Source of technical and economic inefficiency

3.4.4.1 Tobit model specification

Since the present study attempted to explain efficiency differences among farms using farm specific dependent variables and since the efficiency scores lie between 0 and 1, showing that efficiency scores are double-truncated or censored at 0 and 1, then, a limited dependent variable model is appropriate. In this modelling framework, the underlying production function is not observed, what is observed is a set of farm and farmer specific socio-economic and demographic factors that influence farmers' decision to produce a given crop using a certain level of technology, hence, A Tobit regression analysis is used since it uses all observations, both those at the limit, usually zero and one (those below and above the limit) to estimate a regression line. Tobit regression model which can apply for this type of dependent variable is a two-limit Tobit model (Maddala, 1983) where 0 is the lower limit and 1 is the upper limit as it has been adopted and explained by

[CITATION Wat14 \l 1033]. The Tobit model censored from below at the value of zero is defined as:

$$y_i^{¿} = \beta_0 + \sum_{m=1}^{M} \beta_m x_{im} + \varepsilon_i, \varepsilon_i \sim N(0, \sigma^2)$$ ……………………..….(13)

Where:

$y_i^{¿}$ is a latent variable representing the efficiency score for farmer *i* ; β_0 - β_m are unknown parameters to be estimated; x_{im} = 1 up to *m* explanatory farmer *i* characteristics variables associated with farmer *i*; and ε is an error term that is independently and normally distributed with zero mean and constant variance σ^2 . The latent variable $y_i^{¿}$ is expressed in terms of the observed variable y_i (the efficiency score calculated using DEA analysis) as follows:

y_i = zero if $y_i^{¿}$ ¿ 0,

y^* = y_i = $y_i^{¿}$ if zero $¿ y_i^{¿} \leq 1$ ……….……………………………..(14)

y_i = one if $y_i^{¿}$ ¿ 1

Description of Tobit regression model variables

Table 4 presents the hypothesized effects of different farmer's socio-economic and demographic characteristics as well as institutional related variables on inefficiency. In the model, the dependent variables were technical and economic inefficiency score computed as one minus the efficiency scores for farmers considered.

Table 4: Summary of variables used in the Two-limit Tobit Model

Two - limit Tobit Regression Model Variables (dependent Variable - Inefficiency scores)		
Explanatory Variables	**Description of Variables**	**Hypothesized Sign**
Age	It takes a value greater than zero	+
Education	A dummy variable which takes the value 1 if the household head has primary level education, and 0 otherwise	+
Gender	A dummy variable representing the sex of household head taking a value of 1 for male headed households and 0 for female headed households	-
Household size	The total number of dependent household members to the independent household member (active labour force) of a family	+
Access to ext. services	A dummy variable which takes the value 1 if the farm household receive extension services at the survey time and 0 otherwise	+
Access to cash credit	A dummy variable which takes the value 1 if the farm household used any form of credit at the survey time and 0 otherwise	+
Distance of a farm from homestead (Km)	Distance of field from residence of the household (in minutes)	-
Distance to the market (Km)	Walking distance to the nearest main market	-
Frequency visit by extension officers	Number of contacts with extension agents	+
Marital status	Dummy 1 = Married, 0 = Otherwise	+
Farm size (ha)	Number of plots in hectares	-

3.4.4.2 Marginal effects for a two-limit Tobit regression model

The Tobit regression model coefficients do not directly give the marginal effects of the associated independent variables on the dependent variable. But their signs show the direction of change of the dependent variable as the respective explanatory variables change (Maddala, 1983). According to Sigelman and Zeng (1999), in the Tobit model there are the expected values each for latent (y*), uncensored observed ($y/y > 0$) and both censored and uncensored observed (y) values of the dependent variable. However, as Greene (2003) notes, there is no consensus on which value to report as much depends on the purpose of the analysis. The author suggests that if the data are always censored, then focusing on the latent variable is not particularly useful. Wooldridge (2002) also argues that if one is employing a corner solution model then the interest probably is not in the latent (unobserved) variable. If the interest is in the effects of explanatory variables that may or may not be censored, then probably E(y) is important. But if the interest is in just the uncensored observations, the focus probably lies on E (*y/y > 0*).

Greene (2003) seems to support the idea that E(y) as the most useful mode; the author suggests further that the intended particular purpose of the study must be taken into consideration. Accordingly, the Tobit Regression model results can provide three possible marginal effects for the corresponding expected values mentioned above.

Marginal effect on the latent dependent variable, $y^{¿}=\frac{\partial E(y^{¿}/y)}{\partial x_k}=\beta_x$

Thus, the reported Tobit coefficients indicate how a one unit change in an independent variable x_k alters the latent (unobserved) dependent variable.

Marginal effect on the expected value for y for uncensored observations:

$$\frac{\partial E(y^{¿}/y)}{\partial x_k}=\beta_x\left\{1-\lambda(\alpha)\left[\frac{x_i\beta}{\sigma}+\lambda(\alpha)\right]\right\}$$

Where, $\lambda(\alpha)=\left[\frac{\varphi\frac{x_i\beta}{\sigma}}{\Phi\frac{x_i}{\sigma}}\right]$ ………………………………………………………..……..… (15)

This indicates how a one unit change in an independent variable x_k affects the uncensored observations.

Marginal effect of an explanatory variable on the expected value for y (dependent variable) (both censored and uncensored)

$$E(y)=\frac{\partial E(y/y)}{\partial x_k}=\Phi\left(\frac{x_i\beta}{\sigma}\right)\beta_x \quad \text{……………………..……….……..…} (16)$$

Where:

X_i are explanatory variables;

$\delta=\frac{x_i\beta}{\sigma}$ is the Z-score for the area under the normal curve; x_k is a vector of Tobit maximum likelihood estimates; σ is the standard error of the error term; ϕ and Φ are the probability density and cumulative density functions of the standard normal distribution, respectively.

This is called McDonald - Moffitt's decomposition. It allows us to see that a change in x_k affects the conditional mean of y* in the positive part of the distribution and it affects the probability that the observation will fall in that part of the distribution (McDonald and Moffitt, 1980; Long, 1997). The expression $\Phi\left(\frac{x_i\beta}{\sigma}\right)$ which is called the Scale Factor for effects is simply the estimated probability of observing an uncensored observation at the values of x_i or it is the sample proportion of non-limit observations in the total observation.

The maximum likelihood estimation consists of the product of expressions for the probability of obtaining each observation. For each non-limit observation this expression is just the height of the appropriate density function representing the probability of getting that particular observation (Long, 1997). However, which of these marginal effects should be reported will depend on the purpose of the study. Wooldridge (2002) recommends reporting both the marginal effects on E(y) (both censored and uncensored) and E (y/y > 0) (uncensored). In this study, the Marginal effect of explanatory variables represented as $\left(\partial y / \partial x \right)$ on the expected value for inefficiency scores (dependent variable) (both censored and uncensored) was considered.

3.4.4.3 Test of Multicollinearity

The problem of multicollinearity occurs when one or more of the explanatory variables indicate a linear combination of other variables. This problem can result to wrong signs in the estimated regression coefficients and smaller *t*-ratios thereby having wrong conclusions. A strong correlation coefficient may be an indicator of this problem and can be examined further by computing VIF for each of the independent variables. According to Gujarati (2004), Multicollinearity occurs when there is more than one exact linear relationship between variables in the model. When multicollinearity exist in a regression model, it is difficult to identify the independent variables that may affect the dependent variables. The pair-wise correlations between regressors can be used to test for multicollinearity among variables. When the correlation among two regressors exceeds 80%, it indicates serious multicollinearity. The variance Inflation Factor (VIF) and Tolerance level can also be used in the detection of multicollinearity in the model. This can be calculated as follows: -

$$\text{VIF} = \frac{1}{\left(1 - R_{12}^2\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(17)}$$

Where:

R^2_{12} is the coefficient of determination between x_1 and x_2 variables. As the collinearity increase the variance of the estimators' increases also. When the variance inflation factor (VIF) is more than ten 10, it implies that, there are serious multicollinearity might exist among variables.

The literature shows that strong linear dependence might be source of collinearity problems and can be investigated further by calculating the Variance Inflation Factor (VIF) for each of the explanatory variables. Chatterjee and Price (1991) provided the 'Rules-of-Thumb' for evaluating the existence of Multicollinearity problem in the model. The authors suggested that if VIF values are larger than 10 or if the mean of the factors (1/VIF) is considerably larger than one; there is evidence of Multicollinearity problem that calls for serious concern. Meanwhile, if the variance inflation factor (VIF) is less than ten (10) it indicates that, multicollinearity among variables is not serious. When the VIF is equivalent to one 1 it implies that, there is no multicollinearity among variables. Accordingly, the Tolerance (TOL), is the inverse of VIF, the same is shown as follows: -

$$\text{TOL} = \frac{1}{VIF} = (1 - R^2_{12}) \quad \ldots\ldots (18)$$

There is an inverse relationship between multicollinearity and Tolerance. The multicollinearity problem is not serious as Tolerance increases, this means that serious multicollinearity occurs when Tolerance decreases.

3.4.4.4 Test for Heteroscedasticity

Heteroscedasticity test exist when the variance of error term is not constant. This implies that, it violates the assumptions of homoscedasticity where the variance of the error term is constant/equal across the observation. Therefore, if the variance of the residuals is not constant overtime then the residual variance is considered to be "heteroscedastic" (Gujarati, 2004). Maddala (1983) illustrates the effects of heteroscedasticity in estimates for various models and Arabmazar and Schmidt (1981) provided further analysis on the robustness of the Maximum Likelihood (ML) estimator to heteroscedasticity. However, Maddala and Nelson (1975), Hurd (1979), Arabmazar and Schmidt (1982), and Brown and Moffitt (1982) all have varying degrees of pessimism regarding how inconsistent the maximum likelihood estimator will be when heteroscedasticity occurs (Greene, 2003).

Furthermore, Maddala and Nelson (1975) showed that the ML estimators of Tobit regression model are inconsistent if their heteroscedasticity exists. There are several ways of detecting heteroscedasticity. They including White test, Breusch-pagan-Godfrey test, ARCH test, Harvey test and Glejser test. However, for the purpose of this study, the Breusch-pagan-Godfrey test was used. The null hypothesis for both test is that; the variance of residual is homogenous. This hypothesis can be rejected if the *p-value* is less than significant level. If the null hypothesis is not rejected it implies that, the regression model is free from heteroscedasticity. The existence of heteroscedasticity causes the regression results to be biased and inaccurate. Results of entire diagnostic test including normality, Heteroscedasticity and multicollinearity are provided in chapter four.

3.4.5 Objective 4: To identify challenges facing tobacco farmers

The five point Likert scale technique

Tobacco farmers mainly depend on credit for inputs sourced through their respective primary cooperative societies. Both the government and leaf dealers emphasize on the production of food crops by these farmers, as a result, the inputs obtained on credit for tobacco are used for producing all other crops, that is, tobacco and other food crops. Thus, in order to determine whether there would be a smooth supply of production inputs, the present study undertook a detailed analysis of the production of various crops mainly tobacco, maize, paddy and beans which are the main crops produced in the study area. The analysis entailed, amongst others, identification of the main challenges encountered by smallholder tobacco farmers.

A number of studies have been conducted to identify the challenges/problems facing farmers in developed and developing countries in crops production. Descriptive statistics are widely used and presented in mean, mode, frequency and percentages. However, in this study the collected data were analysed using a five point Likert scale type to identify the respondents' main problems during 2014/15 crop season. The Likert scale was used to analyse the respondents' perceived extent of the listed problem. Due to its strength and its simplicity, the method was used in this study. The Likert Scale is often interesting for respondents to complete the questionnaire (Bassey, 2016; Omotesho *et al.,* 2016 and Abdullah, 2013). The Likert scale used by Itama *et al.* (2014) for the analysis of the resource use efficiency among small scale fish farms in Cross River State, Nigeria.

To achieve the fourth objective (farmers were asked to state their opinion regarding the severity of the main problems encountered in their day to day farming activities. The respondents were provided with a five-point scale in order to facilitate the analysis. The scale also provided an option for farmers who were not sure whether certain issues, such as availability of inputs, shortage of labour and access to extension and credit services, were critical problems or not. Microsoft Excel spread sheet programme were used as a tool for analysis. This section enabled the present study to identify areas for improvement in crop farming, that is, if improved; they would help the government on poverty reduction strategy.

A 5-point Likert scale was used to measure smallholder farmers' attitude towards risk. The farmers were asked questions graded on a five point Likert scale, the responses are Strongly Disagree (1), Disagree (2), Undecided/Neutral (3), Agree (4) and Strongly Agree (5). The responses were given scores of 1,2,3,4 and 5, respectively. The values were added to obtain a score of 15, which was then divided by 5 to obtain 3.0, recorded as the mean (neutral). Farmers with mean score less than 3.0 were taken as risk averse while those with mean score above 3.0 were risk preference. To avoid bias in the result, both negative and positive responses were analysed. Also, how well the statements reflect on the risk attitude of the farmers, they were tested based on the score obtained, before making conclusions (Itama *et al.*, 2014). The cutoff point was determined as follows:-

$$\overline{X} = \frac{\sum f}{n}$$ ………………………………………………………………………………

(19)

Where,

X = Critical mean score, f = Total scale score that is (5,4,3,2,1), n = Scale points.

Thus, $\frac{5+4+3+2+1}{5} = 3$

Then, the mean score was compared with the critical mean, 3. If the calculted mean of the contraints is greater than the standard critical value, the challenge is regarded as a very serious problem. The variable mean score is given as follows:-

$$\overline{X_i} = \frac{\sum I}{n} \quad \text{..(20)}$$

Where,

$\overline{X_i}$ = Variable mean score, I = Variable (e.g Constraints 1, 2, 3, 4, -, 14)

$\sum I$ = Total scores of all the respondents on a variable,

n = Number of respondents.

Both secondary and primary data was used in this study, secondary data were collected to supplement data obtained through the household farm survey. These were obtained from various documents, mainly from Ministry of Agriculture Food Security and Cooperatives (MAFC); Sokoine National University Library (SNAL), the Bank of Tanzania (BOT) and from respective district profiles. Further, data from the Western Zone Tobacco Growers Cooperative Union 1994 Ltd (WETCU) and the Songea and Namtumbo Agricultural Marketing Cooperative Union Ltd (SONAMCU) were obtained.

3.5 Data collection methods and sources of data

This was a cross sectional study and involved collecting data from a single agricultural season, 2014/15. Primary data (data on production, socio-economic factors, factors effecting efficiency and field management factors) were collected from farmers using semi-structured questionnaire (Appendix 5). Data from key informants were collected using a checklist (Appendix 6).

3.5.1 Primary Data Collection

A structured instrument was prepared and primary data were collected by trained enumerators from the households using a structured questionnaire. The questionnaire was prepared in English but was translated into Kiswahili language, which is the official and widely spoken language in the study areas. Prior to the main field survey, the structured questionnaire was pre-tested for adequacy and usefulness. This is normally done as preparation for the main study to check whether there exist some mistakes, evaluate relevance of given questions, to add or exclude some relevant or irrelevant questions from the questionnaire. A corrected version of the structure questionnaires was used for data collection from smallholder farmers.

The survey collected valuable information on several factors including household composition and socio-economic characteristics (farmer's age, gender, years of schooling, farming experience, main occupation, household size, income and asset profiles, distance to the market, marketing information, extension contacts), information on tobacco, maize, paddy and beans farming operations such as tobacco, maize, paddy and beans quantity harvested (kg), quantity consumed (kg), quantity sold (kg), land size (ha), labour production cost (both family and hired labour as well as women and child labour- both measured in man/days), quantity and type of inputs used in production such as the seeds in Kg, fertilizer (NPK, CAN and Urea) in Kg and the amount of chemicals (confidor and yamaotea) in litres. Information on farming implements, source of capital and storage facilities as well as farming constraints were also collected during the survey. Land area under crop production (hectares) was then used to standardize the rest of the inputs, so that each input was considered in terms of the quantity per hectare. Moreover, information on the grading techniques during the auction and associated selling problems as well as information on off-farm income information were also collected.

3.5.2 Sample Size Determinations

The size of the sample depends on; the nature of the universe, number of classes proposed, the nature of the study, the type of sampling, standard of accuracy required, availability of finance and time constraint (Kothari, 2004). The population of interest for this study comprised heads of households that grew tobacco in the 2014/15 cropping season (as listed in their Primary Cooperative Societies (PCSs) in their respective districts).

According to the District profile, in Urambo, a total of 23 690 farm households out of 192 781 households grew tobacco during the 2014/15 cropping season; in Kaliua District only 32 524 out of 393 358 farming households grew tobacco during the season. Likewise in Namtumbo only 16 270 out of 201 639 farming households grew tobacco during the same cropping season[6]. Thus, a total of 72 484 tobacco farm households in the three districts made up the sampling frame for the study. To obtain a representative sample size for cross-sectional household survey, the study employed the sample size determination formula provided by Kothari (2004) as follows:-

$$n=\frac{z^2 pqN}{e^2(N-1)+z^2 pq} = \frac{72484}{1+72484(0.05)^2} = 397.2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (21)$$

Where:

n = Sample size for a finite population,

N = Size of the population

p = is 0.5 for the population reliability (or frequency estimated for a sample size n),

q = is 0.5 which is taken for all developing countries population;

$p + q = 1$,

e = margin of error considered to be 5% for this study.

6The statistical information was provided by District Executives Directors of Urambo, Kaliua, Namtumbo, 2015).

$Z_{\alpha/2}$ = Normal reduced variable at 0.05 level of significance,

z = is 1.96.

i. Proportional from each District was calculated as follows:-

For Urambo $\frac{23690}{72484} * 100$ = 32.41%

For Kaliua $\frac{32524}{72484} * 100$ = 44.50%

For Namtumbo $\frac{16270}{72484} * 100$ = 22.26%

ii. Sample size (n) from each district was therefore calculated as follows: -

For Urambo $\frac{32.41}{100} * 397.8$ = 128.95 Equals to 129

For Kaliua $\frac{44.50}{100} * 397.8$ = 177.00 Equals to 177

For Namtumbo $\frac{22.26}{100} * 397.8$ = 88.56 Equals to 89

Thus, a total sample size of 395 farming households was randomly selected to forma a sample size of 395 farmers represents an average of 30 respondents selected from each village/primary cooperative societies. According to Bailey (1994), a minimum sample size of 30 is normally sufficient for studies in which statistical data analysis is to be done in social sciences. Similarly, according to Boyd *et al.,* (1981), it is recommended that a sample size of 5% of the total population should be used to form a sample for the study. As a rule of thumb, a 5% of the total population should not be less than 30 (n >30).

3.5.3 Sampling procedure

The data used for this study originates from household heads who grew tobacco during the 2014/15 cropping season in Urambo, Kaliua and Namtumbo districts. The sampling frame for tobacco farmers was obtained from Primary Cooperative Society officers in the study area. The list comprised of farmers who were registered by Tanzania Tobacco Board

(TTB). A multi-stage sampling procedure was used to select, villages/primary cooperative societies Figure 6. In the first and second stages two regions Tabora and Ruvuma and three districts Urambo, Kaliua and Namtumbo were purposively selected based on the intensity of crops production particularly tobacco and ecological similarities. In the third stage, the sample covered five primary cooperative societies from Kaliua, four from Urambo and three from Namtumbo Districts to make a sample of 12 primary cooperative societies (Table 5).

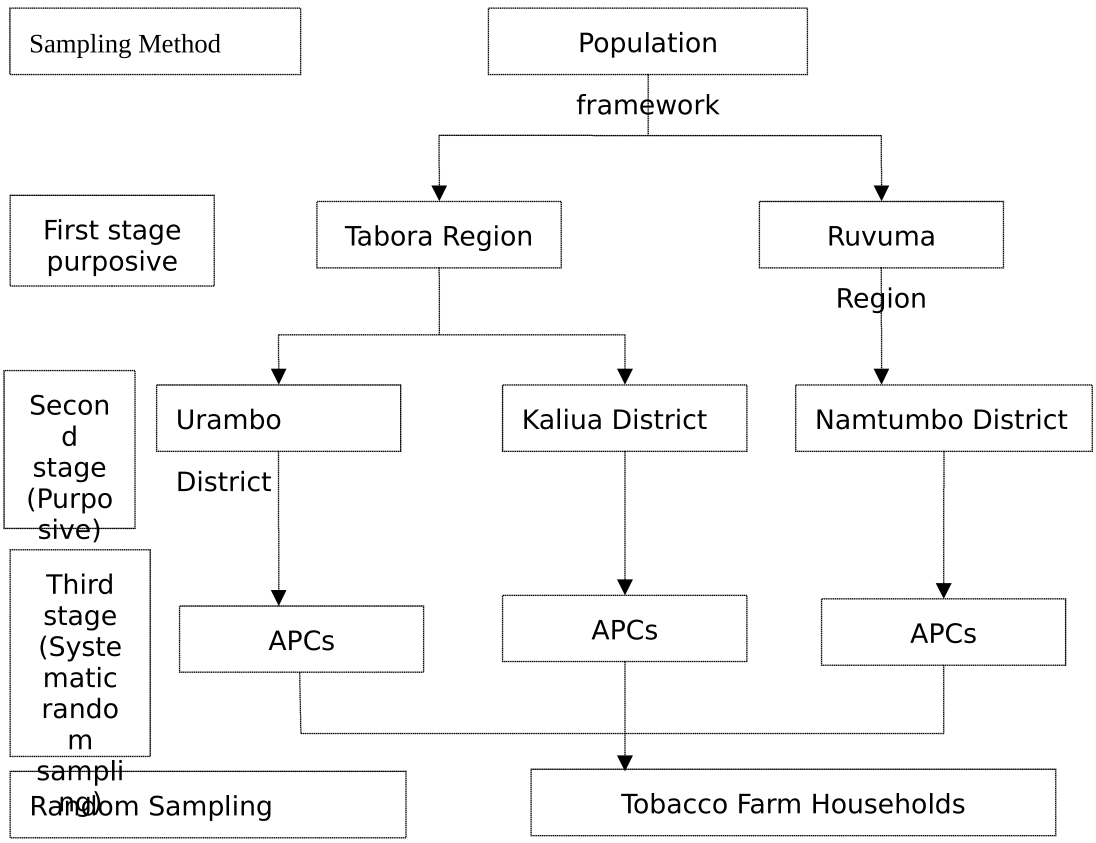

Figure 6: Sampling method of primary data collection

Note: APCs denotes Agricultural Primary Cooperative societies

Thus, a representative sample of 395 households (177 farm households from Kaliua, 129 from Urambo and 89 from Namtumbo districts) were randomly selected to form the sample for the study Table 5. It should be noted that, the households from each village/cooperative society were selected proportional to the village tobacco farmer's population size.

Table 5: Number of respondents from Primary cooperative

Districts	Primary Cooperative Societies	Villages	Number of Members	Sample Proportion	Sample size
Kaliua	Chimbuko	Kamsekwa	731	0.21	39
	Usindi	Ushokola	619	0.19	33
	Usaguzi	Ugunga	580	0.17	31
	Amahoro	Imalaupina	685	0.21	36
	Usigala	Kazaroho	725	0.22	38
	Total		3340	1	177
Urambo	Imalamakoye	Kanindo	610	0.35	45
	NyotayaMuungano	Mkonongo	343	0.2	25
	Wema	Kasisi	394	0.22	29
	Kazimoto	Ukondamoyo	409	0.23	30
	Total		1756	1	129
Namtumbo	Libango	Utwango	237	0.32	28
	Jitume	Ligera	256	0.34	31
	Namkeke	Litola	250	0.34	30
	Total		743	1	89
Grand Total					**395**

3.6 Empirical Models used in the study

This section present the summary of the empirical models used in this study with respect to the stated objectives. Further it should be noted that the Likert scale analytical tool is a type of psychometric information but other models underlying in production economics theory as have been detailed in section 3.4, these model are summarized hereunder.

Analytical tool for objective one

- TR = $\sum P_y Q$ - $\sum P_x X$
- GM(π) = $\sum P_y Q$ - $\sum P_x X$

Analytical tool for objective two

- *Maximize h_o*: $\sum_{r=1}^{j} u_r y_o / \sum_{i=1}^{m} v_i x_o$

  Subject to: $\sum_{r=1}^{s} u_r y_{rj} / \sum_{i=1}^{m} v_i x_{ij} \leq 1,$

Analytical tool for objective three

- $$y_i^{¿} = \beta_0 + \sum_{m=1}^{M} \beta_m x_{im} + \varepsilon_i , \varepsilon_i \sim N\left(0, \sigma^2\right)$$

Analytical tool for objective three

- $\overline{X} = \frac{\sum f}{n}$
- $\overline{X_i} = \frac{\sum I}{n}$

3.7 Limitations of the Methodology

The DEA frontier technology is formed as a non-parametric, piece-wise linear combination of observed “best-practice” activities. Data points are enveloped with linear segments, and efficiency scores are calculated relative to the frontier (Coelli *et al.* 1998). One of the limitations of the DEA model is that efficiency is measured relative to the frontier, where all deviations from the frontier are assumed to be inefficient (Johanson, 2005).

Coelli (1996) reported that where all farmers are not operating at optimal scale, due to a number of constraints limiting their ability to do so, the use of variable returns to scale (VRS) to characterize the production process is ideal. The use of VRS specifications permits the calculation of technical efficiency devoid of scale efficiency effects. Thus, these results are subject to statistical testing. Hence the DEA results should be interpreted with caution. Despite its shortcoming, the DEA model has been widely used to estimate farm efficiency (Awerije and Rahman, 2016; Debebe *et al.,* 2015; Pen and Kong, 2015; Lubis *et al.,* 2014; Umanath and Rajasekar, 2013 and Kidane *et al.*, 2013) due to its ability to handle many inputs and many outputs.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter presents the results and discusses the core findings of the study. It is organized in two sections. The first section provides descriptive analysis on the demographic, socio-economic and institutional characteristics of sample farm households. It further provides a results and discussion on descriptive of households' tobacco farming profitability and crop efficiency characteristics, the section presents summary statistics of outputs and inputs variables used. The second section provides results and discussion on profitability, efficiency scores, factors affection efficiency and problem facing smallholder farmers.

4.1 Descriptive Analysis

4.1.1 Demographic and socio-economic characteristics of tobacco farmers

Socio-economic characteristics are economic and sociological combination of total measure of a person's economic and social position relative to others, based on experience, gender, age, marital status, household size and education level, among others. These characteristics as they relate to tobacco smallholder farmers are discussed below.

The distribution of the respondents by gender is presented in Table 6. Majority (92%) of tobacco farming households in the study area are male headed, female household heads constitute only 8% of the total number of farmers interviewed during the survey undertaken for the present study which is lower than the national average of 22%. Thus, the gender distribution of the interviewees of the present study reflects that tobacco is a male dominant crop which is typical of cash crops in many countries (Drope *et al.,* 2016). The dominance of male respondents and the low percentage of women participation in tobacco production activities may be explained by the fact that tobacco farming is laborious and not due to technical and managerial inefficiency of women. Besides, Tobacco being a cash crop is mostly controlled by male members of the households especially in selling the produce and in deciding the use of farm produce, hence they stand to benefit more than their female counterparts. This conforms to the assertion by (Mayuya, 2013) who found that, 87.7% of male owns tobacco farms in Kondamoyo village in Urambo District.

The distribution of age as presented in Table 6 shows that about 82% were in the most economically active age group of above 31 years old while very few (18%) were below 30 years old. The mean age of the respondents was 42 years with standard deviation of about 12 years which implies that, there is little involvement of youth below 30 years in farming activities. Besides, as age increase farmers are more likely to acquire experience to improve production efficiency. This can be explained by lack of access to land for farming activities as compared to their older counterpart whose age implies experience and cumulative knowledge as well as wealth.

Table 6: Descriptive statistics of household characteristics across Districts

Variables (Household head)	Total Mean	Std deviation	Districts Urambo	Kaliua	Namtumbo	p-value
Age (years)	41.9**	(11.7)	44	40.4	42.3	0.045
Family size (Number)	5.3	(2.3)	4.9	5.5	5.6	0.254
Experience (years)	13.5**	(10.1)	14.7	12.3	14.2	0.004
farm size (ha)	2.5**	(1.5)	2.9	2.4	2.2	0.015
Sex of household	Frequency	Percentage	Percentage	Percentage	Percentage	
Male	365	92.4	89.9	95.5	89.9	0.115
Female	30	7.6	10.1	4.5	10.1	
Education level	Frequency	Percentage	Percentage	Percentage	Percentage	
Illiterate	20	0.05	0.05	0.06	0.03	
Primary	336	0.85	0.84	0.83	0.91	0.350
Secondary	35	0.09	0.09	0.11	0.04	
Diploma	4	0.01	0.02	0.01	0.01	

Note: Variables in parentheses are frequency and percentage

Table 6 further shows the distribution of respondents' farm size in the study area. It is revelled that about 13.7% of the respondents cultivated only up to 1.3 hectares of farm land, while about 81.0% cultivated 1.27 to 5.0 hectares. Only 5.3% of the respondent cultivated 5.0 hectares and above. However, the mean farm size of the respondents is about 2.5 hectares. This reveals that tobacco farmers in the study area are mainly small scale farmers (URT, 2016). Accordingly, there is no significant difference in farm size across district at 5% level of significance.

The mean household size in the study area is 5.3 person (Table 6) which is relatively large compared to the national average 4.7 (NBS, 2012). The number of persons in the households is very important in determining the labour available for farming activities though it also affects household income and its food requirements. The greater the family size, the high the efficiency mainly due to the fact that, most smallholder farmers are financially constrained and thus, availability of family labour will reduce the need for hired labour. Consequently, there is no significant difference in family size across districts at 5% level of significance ($p > 0.05$),

Education is an important factor that determines the ability of an individual to understand policies or programs that affect production. The educational distribution of the respondents reveals that about 7.4% of the respondents had no formal education, 83%, 8.6% and 1.0% of the respondents had attained primary, secondary and diploma level of education respectively. Thus, about 92.6% of the respondents had some form of formal education in the study area. The mean years of formal education is about 7 while the mode is about 15, which indicates that majority of the respondents have attained at least primary education. Thus, the study reveals that the literacy level is high among respondents and this could have implication on agricultural production. Education affects productivity through the choice of better inputs and outputs, and through better utilization of existing inputs. Adoption of agricultural innovations is also easier and faster among educated farmers than uneducated farmers and thus, the educated move closer to the frontier output Muktar *et al.* (2018). Across districts, there are no significant differences in the level of education at 5% level of significance.

4.1.2 Institutional support services and access to the market

This section presents summary statistics of some institutional characteristics for households in the study areas. All the sample farmers were members of the primary cooperative societies. Such participation in the cooperative is believed to enhance information exchange and experience sharing on the use of improved technologies and recommended agronomic practice. Cooperatives have key roles in the provision of cash credit and inputs credit to smallholder farmers. The most important institutional factors which are vital for crop production include access to extension services and credit facilities. Access to credit facilitates to purchase the required farming inputs during the season and extension services play a major role in disseminating new and improved farming technologies. Training is an important tool for transferring knowledge, particularly for equipping farmers with new technologies, improvement of farm management practices and skills on marketing and farm record keeping. Generally, training increases farmers' level of skills with regards to production practices and marketing aspects. Further, extension services assist farmers to increase income, improve production quality, raise living standards and improve social and educational standards in the villages (Zivkovic *et al.*, 2009).

The findings in Table 7 show that about 94.7% of the respondents accessed extension services. although the extension programme covers all crops, the focus is on tobacco production, consequently, the table shows that, about 84.8% of the respondents' accessed extension services from tobacco leaf dealer's extension officers. Table 6 also shows respondents' access to credit. About 50.9% of the respondents had received credit at the market interest rate from leaf companies. Such credit was supposed to cover the cost of firewood collection, grading and cash credit for other farm operations during the season. The remaining 49.1% households could not receive the service either due to previous loan defaults, absence of the service for the intended purposes, interest rate being too high or absence of demand for the credit service during the season. All farmers in the study area had the opportunity of accessing agricultural inputs (*i.e.* seeds, fertilizers and others). Further, all farmers had the opportunity to access education and health care services and also purchase some agricultural inputs as wealth accumulation. Accordingly, while there is no association between access to extension services and the district under review ($p > 0.05$), there is a strong association between access to credit and the district a farmer belongs to at 5% level of significance ($p < 0.05$).

Table 7: Access to extension services and credit

	Districts			
Services received (Percentage)	**Namtumbo**	**Urambo**	**Kaliua**	**Overall**
Access to extension services (Dummy)				
1 = Accessed	93.3	91.5	90.4	91.4
0 = Otherwise	6.7	8.5	9.6	8.6
Source of extension services				
Government	6.7	4.7	10.7	7.8
Tobacco leaf dealers	88.8	89.1	80.2	85.1
AMCOS	4.5	6.2	8.5	6.8
Banks Institutions	0.0	0.0	0.6	0.3
Frequency of extension services				
Once per season	23.6	23.3	49.7	35.2
2-3 times per season	61.8	50.4	16.9	38.0
4-5 times per season	13.5	22.5	25.4	21.8
Throughout the season	1.1	3.9	7.9	5.1
Place for provision of extension services				
Training centre	11.2	10.9	16.4	13.4
Farmers plot	83.1	73.6	57.1	68.4
Demonstrations plot	3.4	7.0	6.8	6.1
During meetings	2.2	6.2	18.1	10.6
Farmers group	0.0	2.3	1.7	1.5
Received credit (Dummy)				
1 = Received	34.8	48.8	50.8	46.6
0 = Otherwise	65.2	51.2	49.2	53.4
Walking distance	4.2	4.8	5.1	5.5

In addition, Table 6 shows the extent of extension contact for famers. It was revealed that about 91.4% of tobacco smallholder farmers had contact with extension officers in the study area. However, about 38% of these farmers have an average contact with extension officer of at least 2 to 3 times during the season. Furthermore, walking distance to the farming plots was found to be about 5.5 Kilometres on average, with a standard deviation of 7.2 Kilometre, such a distance discourages extension agents from visiting farmers. Thus, it can be concluded that, government extension service is relatively inaccessible in the study. Across districts however, there is a statistically significant different between access to extension officers and the distance from farmers' homestead at 10% and 5% level of significance.

4.1.3 Descriptive statistics of output and production inputs

The selection of inputs to be used in farm budgetary techniques and DEA analysis is an important aspect in order to determine profitability and obtain efficiency estimates. Due to their usefulness output quantities were estimated and their respective output prices which are useful in estimating allocative efficiency were recorded. The quantity of output was measured using kilograms. Table 8 shows that, a farmer in the study areas produces on average (1 745.86kg) of tobacco, (1 721.22kg) of maize, (323.62kg) of paddy rice and (163.48kg) of beans. When we compare across the three districts, farmers in Kaliua district tend to have the highest mean output for tobacco (2 116.51kg), maize (1 831.64kg) and (210.02kg) of beans while farmers in Namtumbo district have the lowest mean output (1 040.51kg) of tobacco and Urambo district tend to have the lowest mean output (1 534.57kg) of maize, (170.70kg) of paddy rice and (109.18kg) of beans

Table 8: Descriptive statistics of outputs, plot size and yield

Variables	Districts Urambo (n = 129)	Kaliua (n = 177)	Namtumbo (n = 89)	Sample Mean	*p-value*
Average output per ha					
Tobacco (Kg/ha)	1 723.78	2 116.63	1 040.51	1 745.86	0.000
Maize (Kg/ha)	1 534.57	1 831.64	1 772.13	1 721.22	0.303
Paddy rice (Kg/ha)	170.7	404.58	384.27	323.62	0.174
Beans (Kg/ha)	109.18	210.02	149.64	163.48	0.001
Average plot size					
Tobacco (ha)	1.06	0.89	1.05	0.98	(0.74)
Maize (ha)	1.23	1.04	1.11	1.12	(0.63)
Paddy rice (ha)	0.22	0.24	0.21	0.23	(0.13)
Beans (ha)	0.35	0.32	0.16	0.29	(0.22)
Yield					
Tobacco	1 626.21	2 378.24	990.96	1 781.49	(1 694.35)
Maize	1 447.71	2 058.02	1 687.74	1 756.35	(1 149.61)
Paddy rice	161.04	454.58	365.97	330.22	(322.61)
Beans	103.00	235.98	142.51	166.82	(157.66)

Note: figures in parentheses is standard deviation

Similarly, the inputs quantities were estimated and their respective input prices which are useful in estimating allocative efficiency were recorded. Table 9 show that, on average 403.5 Kg of NPK, 97.2 Kg of CAN, 119.1 Kg of urea fertilizers and 5.2 litres of agrochemicals was used in crop production. The results indicate further that Kaliua district has the highest mean usage of NPK (420.1 Kg), CAN (100.6 Kg) and agrochemicals (5.6 litres). Further, the district has the highest usage of labour inputs (710.6 man/days) and tobacco seeds (76.2 grams); while Urambo district has the highest usage in cereal crop seeds (88.2 Kg) and land input (3.1 ha) and Namtumbo district has the highest usage in urea fertilizer (148.3 Kg). Generally, the results signifying that Kaliua District has the highest mean usage of inputs while Namtumbo district has the least. The low NPK and CAN fertilizer use in Namtumbo district was largely attributed to inaccessibility of credit from banks for accessing inputs and cash loans from leaf dealers due to previous loan defaults.

Table 9: Descriptive statistics of inputs and input costs

	Districts				
	Urambo	**Kaliua**	**Namtumbo**		
Variables	**(n = 129)**	**(n = 177)**	**(n = 89)**	**Sample Mean**	***p-value***
Average input used					
Plot size (ha)	2.86	2.49	2.53	2.62***	0.002
Tobacco seeds (gm)	72.18	76.18	67.45	72.91***	0.017
Crops seeds (Kg)	88.23	56.51	74.83	71.00***	0.000
Labour (man/days)	235.10	285.03	281.22	267.12	0.291
NPK fertilizer (Kg)	404.26	420.06	369.66	403.54***	0.000
Urea fertilizer (Kg)	132.95	94.35	148.31	119.11***	0.000
CAN fertilizer (Kg)	92.64	100.56	97.19	97.22**	0.025
Agrochemicals (lts)	5.02	5.59	4.91	5.25***	0.000
Land size used (ha)	3.13	2.1	2.75	2.58***	0.015
Average cost of inputs					
Tobacco Seeds (TZS)	1 344.19	1 834.46	1 738.20	1 652.66***	0.000
Crops Seeds (TZS)	294 967.83	190 044.91	251 581.79	238 176.15**	0.014
Labour (TZS)	2 360 765.46	2 862 081.27	2 823 878.60	2 689 752.72***	0.000
NPK fertilizer (TZS)	570 259.61	755 836.00	724 605.11	688 193.21***	0.001
Urea fertilizer (TZS)	204 473.16	189 722.27	232 523.91	204 183.56***	0.006
CAN fertilizer (TZS)	89 424.54	120 514.50	117 026.35	109 575.13***	0.001

Agrochemicals (TZS)	60 516.27	60 695.99	76 148.88	64 119.08***	0.001
Land (TZS)	132 775.97	89 057.28	116 899.02	109 608.24	0.659

However, it should be noted that to determine tobacco profitability urea fertilizer was not included as farmers use NPK and CAN fertilizer for tobacco growing and urea is used only in other cereal crops. Accordingly, while there is a significant difference in input usage across districts under study, there is no statistically significant difference in labour usage across districts at 5% level of significance. Moreover, there is no significant difference in inputs cost across districts at 5% level of significance except that of land input ($p > 0.05$). This is mainly because majority of smallholder farmers purchase agriculture inputs on credit bases from a single inputs supplier hence little variation in factor prices.

4.1.4 Tobacco Production Labour cost per hectare

In this study, labour is measured in terms of man/days and as cost in monetary terms in Tanzania Shillings (TZS). For the purpose of the analysis, labour is grouped into family and hired labour. Table 10 shows the mean total labour cost in tobacco farming, the bases of the labour cost was calculation as the mean wage paid to the hired labour per day in the study area, the results indicated that the total labour used in tobacco production is about TZS 267.90 per hectare. This finding is relatively lower than that observed by Ilembo and Kuzilwa (2014) who reported maximum total labour at 290 man/days for tobacco production in Urambo district and high than the findings reported by Ntibiyoboka (2014) who reported a maximum total labour at 219 man-days for tobacco production in Mpanda district. Furthermore, Gumus (2008) reported the contribution of labour cost to be about 65% of the total cost of tobacco production in Turkey. This implies that the proportion of labour costs in tobacco production in the study area is relatively lower when compared to other countries.

Table 10: Estimation of tobacco labour cost of production per hectare

Cost on Labour cost (activity)	Family L-days	Hired L--days	Total Labour	Percentage of TL cost
Nursery Management	55.32	6.11	61.43	22.93
Land preparation	14.63	4.41	19.04	7.11
Transplanting	7.80	1.43	9.23	3.45
Fertilizer and pesticides application	3.10	0.88	3.98	1.49
Chemicals application I	4.60	0.45	5.05	1.89
Weeding	10.80	2.44	13.24	4.94
Chemicals application II	7.25	1.05	8.30	3.10
Pruning	11.80	8.42	20.22	7.55
Topping	3.20	0.56	3.76	1.40
Desuckering	0.44	0.17	0.61	0.23
Harvesting	46.42	6.24	52.66	19.66
Curing	20.22	13.53	33.75	12.60
Grading	16.10	2.66	18.76	7.00
Packaging	11.74	6.13	17.87	6.67
Total Labour (man/days)	213.42	54.48	267.90	100.00

Note: 1man/days = TZS 10 041.37 for agriculture production (URT, 2016) = TZS 2 690 982.10

FL, HL and TL stands for family labour, hired labour and total labour days respectively.

4.1.5 Tobacco Production Profitability Level

This subsection examines the profitability of tobacco production in the study area. To determine the profit level, attempts were made to estimate the cost and return from tobacco farming, the gross margin associated with tobacco production were estimated. However, due to the fact that the fixed cost for smallholder tobacco production is negligible. Thus for this study, only variable costs were considered and hence calculated. The major components of the total cost of production are divided into three groups that is, labour costs, physical inputs costs and marketing costs. Furthermore, returns were calculated based on the average price that farmers received per kg of tobacco. The average cost of producing one hectare of tobacco was calculated for all the categories of farms as presented in Table 11. The result reveals that cost of labour accounted for the largest proportion (63.3%) of the total variable cost. This is followed by physical input costs (fertilizer, agro-chemicals, firewood, cost of loan and other small items) which accounted for about (29.7%).

Table 11: Farm budget Analysis summary

	Activities	Units	Quantities	Mean Value	Percentage to the TVC
	Tobacco quantity harvested			1 745.9	
	Selling price per Kg in TZS			3 358.5	
1	Gross Return			5 863 554.8	
	NPK (10:18:24) fertilizer	50 (Kg)	403.5	688 193.2	
	CAN 27% fertilizer	50 (Kg)	97.2	109 575.1	
	Chemicals (Confidor)	30 Grams	5.2	64 119.1	
	Cost of Firewood	TZS	-	127 953.1	
	Cost of Loan	TZS	-	39 939.5	
	Imputed land cost	TZS	-	16 555.0	
	Other costs			217 869.6	
2	Physical and other costs			1 264 204.6	29.7
3	Marketing Cost (Tax Levy)			297 785.4	7.0

4	Labour Cost (Man/days)	Man/days	267.9	2 690 982.1	63.3
5	Total Variable Cost of Production (TVC)			4 252 972.1	
6	Gross Margin			1 610 582.7	
7	Return on Investment	GM/TVC		0.38	
8	Return per Labour	GM/TCL		0.60	

Note: other costs include the cost of thermometer, sprayer, flue piper, J and Ctwine

Profitability analysis of tobacco farming in the study area was estimated. Table 11 shows the gross margin analysis of tobacco farmers. On average a farmer received total revenue amounting to TZS 5 863 554.8 per hectare. The average seasonal cost incurred for tobacco production was about TZS 4 252 972.10 per hectare. Thus, on average a famer was left with an average Gross Margin of TZS 1 610 582.7 per hectare. The Return on Investment of tobacco farming was 0:38, which implies that, for every one Tanzania Shillings a farmer invested in tobacco cultivation one realize about TZS 0.38 as return. This implies that tobacco business is profitable enough to keep farmers interested in producing the crop since the total revenue significantly outweighs the total variable cost. This finding is confirmed by Hassan *at el.* (2015) in Bangladesh and Gumus *et al.* (2008) in Turkey who assert that, though tobacco production is labour intensive and relies on significant usage of paid labour, the crop is profitable.

4.1.6 Descriptive statistics for efficiency estimation

This section endeavours to evaluate the extent of farm households' technical, allocative and economic efficiency of crop production in the study area. It should be noted that, due to the widely accepted way of carrying out DEA in efficiency analysis, it was opted for executing multiple inputs and outputs and avoided the possibility of encountering problems associated with functional form misspecifications. The output variables were crop productions defined as quantity of tobacco, maize, paddy rice and bean harvested in kilograms whereas the inputs were land, labour, seeds, fertilizer and agrochemicals together with their respective prices. Efficiency of farmers was estimated through Data

Envelopment Analysis Program (DEAP) Version 2.1 using cross section data set. The DEA model was applied to compute the efficiency of crop production. However, the program has a challenge in process zero inputs and hence in the event the data contained a zero value of inputs, the value was replaced by a very small positive number near to zero as suggested by; (Fried *et al.,* 2008; Fekadu, 2004 and Battese, 1997).

According to the DEAP model result of input-oriented efficiency indexes, there exists a difference in efficiency scores among the three efficiency measures. The distribution of production efficiency of tobacco farmers in the study area is presented in Table 12. Farmers technical efficiency vary from 0.009 to 1 with the average production efficiency score is 68% implying that the average farm producing crops could increase production for about 32% by improving their technical efficiency. In this study the benchmark has been set such that all farmers' attained efficiency score greater than 0.60 were considered as EFFICIENCY and all below 0.60 were considered as INEFFICIENCY. Table 12 shows that from the total sample households 59.2% had a technical efficiency score of greater than 0.60 indicating that they are efficiency whereas 40.8% were less efficient or inefficient since their efficiency scores below 0.60.

Table 12: Technical, Allocative and Economic efficiency in crop production

Efficiency Scores	**Technical efficiency**		**Allocative efficiency**		**Economic efficiency**	
	Freq.	**Percent**	**Freq.**	**Percent**	**Freq.**	**Percent**
0.00 - 0.10	2	0.5	13	3.3	46	11.7
0.11 - 0.20	4	1	54	13.7	120	30.4
0.21 - 0.30	25	6.3	63	15.9	95	24.1
0.31 - 0.40	34	8.6	84	21.3	57	14.4
0.41 - 0.50	39	9.9	58	14.7	37	9.4
0.51 - 0.60	57	14.4	53	13.4	19	4.8
0.61 - 0.70	44	11.1	31	7.9	8	2
0.71 - 0.80	48	12.2	14	3.5	2	0.5
0.81 - 0.90	40	10.1	17	4.3	4	1
0.91 - 1.00	102	25.8	8	2	7	1.8

Total	395	100	395	100	395	100
Summary statistics						
Efficient > 60	234	59.2	70	17.7	21	5.3
Inefficient < 60	161	40.8	325	82.3	374	94.8
Mean Scores	0.68		0.42		0.28	
Minimum	0.09		0.04		0.02	
Maximum	1		1		1	
Std. deviation	0.25		0.21		0.18	

Accordingly, the DEA result of allocative efficiency and economic efficiency scores confirmed that 82.3% of farm households were less efficient or inefficient. Consequently, the DEAP results indicated that the average farm households' technical efficiency of 0.68, indicating farm households are producing 0.32 less than the potential output given their prevailing level of technology and input use. Alternatively, the farmers could still produce their current outputs of these crops with fewer inputs if they were more efficient. Under the assumption of constant return to scale, the efficiency scores remain the same in both input minimization and output maximization. Thus, if we had chosen to keep inputs constant and measure efficiency as output increases the efficiency score is also indicating that outputs should be increased by 0.32 to become efficient. Such low efficiency in production indicates potential for improvements in crop production given the current levels of technology among farmers. This further implies that if the producers have to achieve at least greater than 0.60 technical efficiency level, then they will have to bridge the gap between their current performance level and the maximum potential performance of the crop production, by addressing some inefficiency factors discussed in section 4.2.3

Likewise, the average farm households' allocative efficiency was found to be 0.42, indicating that allocative efficiency of farm households required 0.58 increase in output to improve allocative efficiency, using the existing technology. The combined effect of technical and allocative efficiency factors shows that the average economic efficiency level to be 0.28. This result indicated that if these farmers operate at full efficiency levels, they could, on average, reduce their costs of production by 0.72 and still produce the same level of output. Therefore, this result shows the existence of significant technical, allocative and economic inefficiency in crop production among tobacco smallholder farmers in the study area. The mean level technical efficiency does not differ significantly with that of 0.62 of Babati as reported by Baha, (2013), 0.61 of Kiteto and Mbozi as reported by Msuya *et al.*, *(*2008) in maize production.

4.4.6.1 Distribution of technical efficiency (TE)

As it is shown in Table 12, smallholder producers had a mean technical efficiency score of 0.68. The result indicates that on average smallholder farmers can increase their major[7] crops output by 0.32 using existing resources and level of technology. Figure 7 shows the graphical distribution of technical scores in the study area, the figure illustrates that 102 farmers (26%) achieved technical efficiency scores between 0.91 and 1. Moreover, about 234 farmers (59.2%) have technical efficiency scores above 0.60 which is considered to be technically efficient.

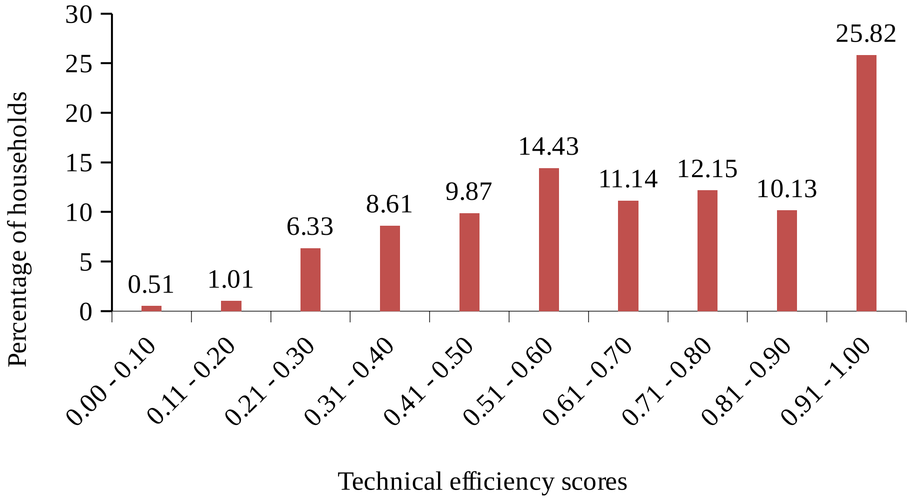

Figure 7: Frequency distribution of major crops TE scores (n = 395)

7 In estimating farmers efficiency only major crops produced by a farmer during the season were considered, in this case, tobacco, maize, paddy and beans

Characteristics of the higher Technical efficiency performer

Due to its importance on policy recommendations farmers with higher technical efficiency were identified and examined. Table 12 shows that they were 25.8 % of tobacco farmers who attained efficiency score above 0.90. Table 13 show that about 50 famers in Kaliuam 44 in Urambo district and only 8 in Namtumbo district attained the efficiency score of above 0.90 in crop production. This implies that, among others availability of inputs on credit in Kaliu and Urambo district favoured the production while Namtumbo district experienced some difficulties in access the input on credit during the time of this survey.

Table 13: Efficiency score for higher performer across districts

	District					
Technical efficiency	**Urambo**	**percent**	**Kaliua**	**percent**	**Namtumbo**	**percent**
0.91 - 0.95	6	13.64	4	8.00	0	0.00
0.96 - 1.00	38	86.36	46	92.00	8	100.00
Total	44		50		8	

In general, socio- economic and demographic characteristics are presented in Table 14. The Table show that these higher performance individuals have the same mean age as their counterpart farmers. However, the Table indicates that they have higher mean family size of 8.7 compared to the 5.2 of the whole sample. This implies that labour constraints were not a challenging issue to them. Further, issues of education and marital status were observed to be just similar to the whole of the study area. The notable issue which is crucial in crop production is access to credit and extension services. The Table shows that about 92% of these respondents received credit for production slightly above the whole sample of 91.4%. Regarding farm size majority 66.7% cultivate land size between 0.5 to 2.5 hectares which is a typical range for smallholder farmers.

Table 14: Socio-economic characteristics for higher technical efficiency farmers

Variables	Mean	Std. Deviation
Age	41.7	11.3
Family size	8.7	2.6
Sex	No of sample	Percent
Female	4.0	3.9
Male	98.0	96.1
Marital status		
Married	91	89.2
Single	9	8.8
Widowed	2	2.0
Education level		
Illiterate	5	4.9
Primary	90	88.2
Secondary	7	6.9
Access to credit		
Yes	46	45.1
Otherwise	56	54.9
Access to extension services		
Yes	92	90.2
No	10	9.8
Household family size		
1 - 5	2	5.9
6 - 10	68	66.7
11 - 15	28	27.4
Farm size		
0.5 - 2.5	66	64.7
2.6 - 5.5	34	31.4
5.6 - 7.5	2	2

4.4.6.2 Distribution of allocative efficiency (AE)

Table 12 further showed that the average level of allocative efficiency score was 0.42. The result indicates that on average smallholder farmers in the study areas could increease major crops output by 0.58 if they used the right inputs and produced the right outputs relative to input costs and output prices. The distribution of allocative efficiency scores presented in Figure 8 also indicates that, allocative efficiency scores are left skewed. It is also showed that out of 395 farmers, only 17.7% achieved allocative efficiency scores above 00.60.

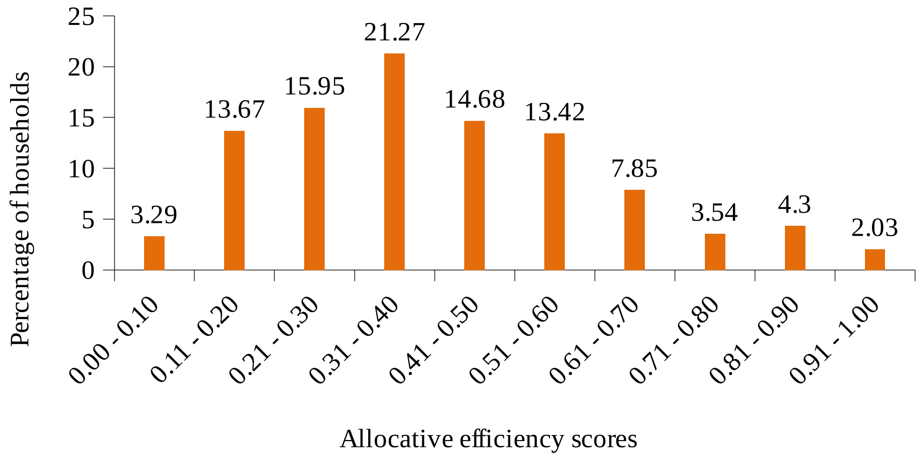

Figure 8: Frequency distribution of major crops AE scores (n = 395)

4.4.6.3 Distribution of economic efficiency (EE)

Economic efficiency was estimated for sample farmers using an input oriented DEA model. The average economic efficiency score was 0.28, which indicates that on average smallholder producers in the study areas could reduce cost of crop production by 0.72, at the current level of outputs. Figure 9 presents a relatively left skewed distribution of economic efficiency scores. It is also found that only 21 farmers (5.3%) had economic efficiency scores above 0.60.

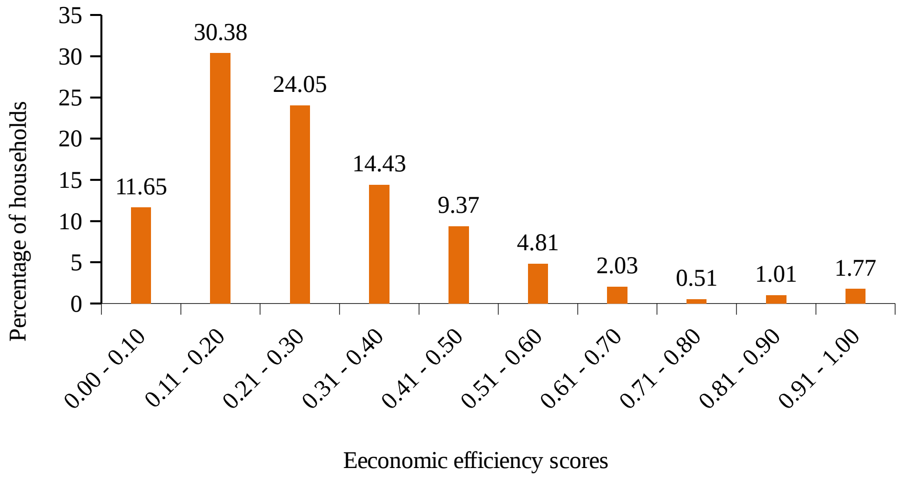

Figure 9: Frequency distribution of major crops scores (n = 395)

4.4.6.4 Efficiency scores across gender

Table 15, presents the efficiency estimates across gender of the household head. The finding reveal that, male headed household had relatively higher technical efficiency (0.69) than their female counterparts (0.63). However, female household farmers had relatively higher allocative and economic efficiency of 0.48 and 0.31 respectively compared to 0.41 and 0.28 for their male counterpart. This implies that female household allocated the resource efficiently than their male counterpart. Thus, it can be concluded that, while there is no statistically significant difference in technical and economic efficiency across gender ($p>0.05$), there is statistical significant difference in allocative efficiency across gender at 10% level of significance Table 15. However, the literature has comparing the productivity of men and women in agricultural activities in developing countries. Doss, (2018) argued that, the productivity of men and women is a challenging task, starting from conceptualizing, measurement, estimation, and interpretation.

In addition, Doss addressed the following question; what could we hope to find from this literature, if we find that women have lower measured productivity than men, what can we concluded about the potential returns to investments that target women? If we want to increase aggregate productivity, should we invest less in women, since they are inefficiency? or If we find that productivity differs, but only because of inputs, what is an appropriate response? and the author concludes that, the literature has little to say to these questions; even the most powerful econometric tools do not allow us to answer the key policy questions.

Table 15: Efficiency scores across gender

Type of Efficiency	Statistics	Gender			ANOVA
		Male	**Female**	**Mean**	
Technical Efficiency	Mean	0.69	0.63	0.68	0.224
	Std. Deviation	0.24	0.27	0.25	
	Minimum	0.10	0.09	0.09	
	Maximum	1.00	1.00	1.00	
Allocative Efficiency	Mean	0.41	0.48	0.42	0.088
	Std. Deviation	0.21	0.22	0.21	
	Minimum	0.04	0.12	0.04	
	Maximum	1.00	1.00	1.00	
Economic Efficiency	Mean	0.28	0.31	0.28	0.316
	Std. Deviation	0.18	0.23	0.18	
	Minimum	0.02	0.02	0.02	
	Maximum	1.00	1.00	1.00	

Despite the argument, this study come with some interesting results, Table 16 shows that, there is an assumed gap in efficiency between male and female farmers. Using DEA, we compare the efficiency of men and women in crop production. The results show that the average technical efficiency of women is lower than that of men. However, given their constraints in place, women are highly allocative and economic efficient. Similar findings were also reported by Akamin (2017) among veritable famers in Cameron whereby female farmers were more efficient than male farmers. However, Kinkingninhoun-Mêdagbé *et* *al.*, (2010) revealed that female farmers are more efficient compared to males in resource utilization. Women's inefficiency may be associated with several household factors such as, women are time constrained by the efforts they put into household productive work. There also seems to be an association between efficiency and cash-crop farming, disadvantaging women who are commonly grow crops for household consumption (Mango *et al.*, 2015)

Table 16: Efficiency scores across gender

		Level of efficiency (% of No of farms)						
Efficiency scores	**Gender**	**<0.50**	**0.51-0.75**	**>0.76**	**Min**	**Max**	**Mean**	**STD**
Technical Efficiency	Male	22.1	30.7	39.4	0.10	1.00	0.69	0.24
	Female	2.4	2.3	3.1	0.09	1.00	0.63	0.27
Allocative Efficiency	Male	64.5	20.7	7.1	0.04	1.00	0.41	0.21
	Female	4.3	2.3	1.1	0.12	1.00	0.48	0.22
Economic Efficiency	Male	83.5	6.3	2.5	0.02	1.00	0.28	0.18
	Female	6.3	0.8	0.5	0.02	1.00	0.31	0.23

4.4.6.5 Efficiency scores by educational level attained by the household head

Education is an important factor that could influence efficiency levels. It was hypothesized that household heads who spent relatively more years in formal school would be more efficient than their counterparts who spent less years in formal school. This is because educated members perceive things differently from their counterparts who may be relatively less educated. For example, in terms of accepting new technologies, relatively educated households would accept the technology without difficulties. Results from Table 17 show that efficiency levels of household heads in all levels of education were almost the same. However, households with heads who had attained primary and secondary education had a slightly higher technical efficiency level while in other three efficiency categories depicted mixed results though the differences are marginal. The main reason for this could be that a majority of household heads had only attained relatively lower level of education mostly primary education hence no major difference in terms of efficiency. This is also affirmed by Shahzad (2019) who's found that, the impact of education on technical inefficiency is negative, meaning that, educated farmers are more technically efficient than illiterate farmers in Punjap and it has been supported by Owour and Shem (2009) who also report a negative relationship between education and technical efficiency of farmers.

Table 17: Efficiency levels by educational level attained by the household head

Efficiency scores	Education level	Mean	Minimum	Maximum	Std. Deviation
Technical efficiency	Illiterate	0.62	0.18	1.00	0.29
	Primary	0.69	0.09	1.00	0.24
	Secondary	0.66	0.24	1.00	0.24
	Tertiary/Diploma	0.60	0.39	0.82	0.18
	Total	0.68	0.09	1.00	0.25
Allocative efficiency	Illiterate	0.49	0.20	0.94	0.18
	Primary	0.41	0.04	1.00	0.21
	Secondary	0.39	0.10	0.96	0.21
	Tertiary/Diploma	0.45	0.35	0.61	0.11
	Total	0.42	0.04	1.00	0.21
Economic efficiency	Illiterate	0.29	0.07	0.56	0.15
	Primary	0.28	0.02	1.00	0.18
	Secondary	0.26	0.04	0.96	0.20
	Tertiary/Diploma	0.27	0.17	0.38	0.10
	Total	0.28	0.02	1.00	0.18

4.4.6.6 Efficiency scores by age of the household head

Age is an indication of experience and capacity of the household in agricultural operations. It is assumed that the high the age the more the experience and thus the high the technical efficiency. The results in figure 10 show that as age increases technical efficiency also increase. This implies that in the study area young farmers are more technically efficiency than their older counterpart. The results are similar to those reported by Shahzad (2019) who found that younger farmers are technically more efficient than the older farmers, and added that, older farmers are rigid in the adoption of new technologies while younger farmers are more innovative to adopt modern production practices

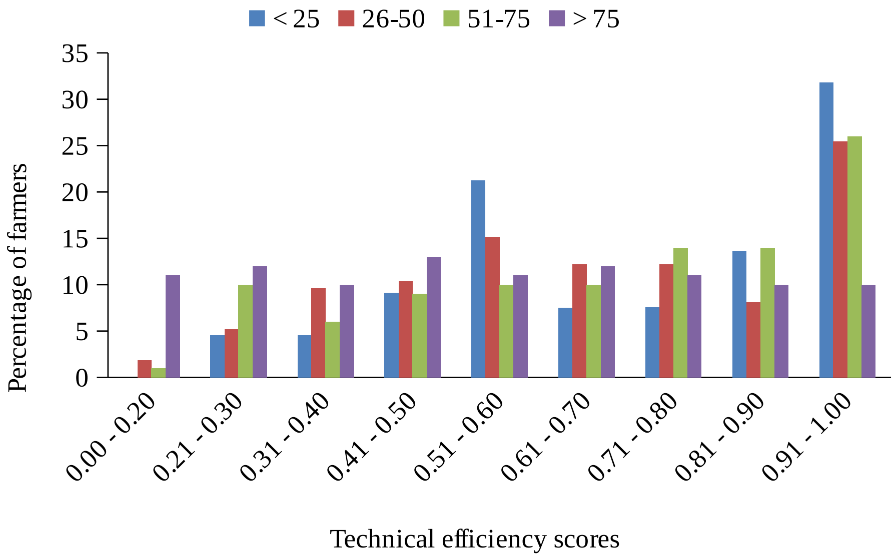

Figure 10: Age of respondents' vs technical efficiency scores

4.4.6.7 Tobacco production efficiency summary results

Tobacco technical efficiency was estimated using stochastic frontier analysis (SFA), this is due to the fact that the model is best when farmers use many inputs to produce only one output. Before proceeding with the analysis of the stochastic frontier production analysis different diagnostic test was conducted to check the validation of the data set. This section estimates tobacco production efficiency model, particularly technical efficiency estimates, obtained from FRONTIER version 4.2. The model includes other variables as guided by theory in the model estimation. Many of the variables used in estimation were transformed into natural logarithms prior to parameter estimates so as to minimize noise in the data and ease in interpretation. However, due to agricultural nature of data used and the cross-sectional design survey as well as the model used (SFA) then; the data was tested for multicollinearity. It is expected that no single regressor should be a linear function of another. The collinearity diagnostic was conducted prior to estimation of the model. The results gave the allowable variance inflation factor (VIF) which is tolerable (VIF<5) as shown in Table 18 indicating no multicollinearity issues.

Table 18: Collinearity of all the explanatory variables in the model

Variables	VIF	Tolerance	Eigen value	Condition index
Land size	1.050	0.952	4.658	1.000
NPK fertilizer	2.020	0.494	0.974	2.187
CAN fertilizer	1.150	0.870	0.221	4.594
Agrochemicals	1.070	0.937	0.137	5.838
Labour (Man/days)	1.980	0.506	0.008	24.822

4.4.6.8 Technical Efficiency Levels of Tobacco Farmers

The summary of the technical efficiency scores for the respondents is presented in Table 19. The result presented shows that technical efficiency in the sampled farms is less than 1.0 indicating that all the farmers were producing below the maximum efficiency frontier. A range of technical efficiency is observed across the sampled farmers and the spread is relatively large.

Table 19: Technical efficiency scores of the sample farms

Technical Efficiency (%)	No of Sample	Percentage	Cumulative (%)
TE < 0.60	95	24.05	49.62
0.61 - 0.70	68	17.22	41.27
0.71 - 0.80	172	43.54	84.81
0.81 - 0.90	58	14.68	99.49
0.91 - 1.00	2	0.51	100
Total	395	100	
Efficient > 60	300	24.05	
Inefficient < 60	95	75.95	
Mean	0.67		
Maximum	0.94		
Minimum	0.09		

Table 19 show that, the best farmer in tobacco production had technical efficiency of 0.94 while the worst farmer had a technical efficiency of 0.09 and the mean technical efficiency was 0.67. Moreover, the efficiency distribution had shown that, about 76% of the tobacco farmers attained efficiency level of above 0.60 while about 24% has technical inefficiency. This implies that, on average; the tobacco farmers were 67% technically efficient with a substantial technical inefficiency in tobacco farming. Consequently, the observed output of about 33% is less than the maximum frontier output. The main implication of this result is that tobacco farms could reduce their inputs by just about 33% without reducing their tobacco production, simply by improving technical efficiency and hence reduces production costs and increases tobacco gross margin.

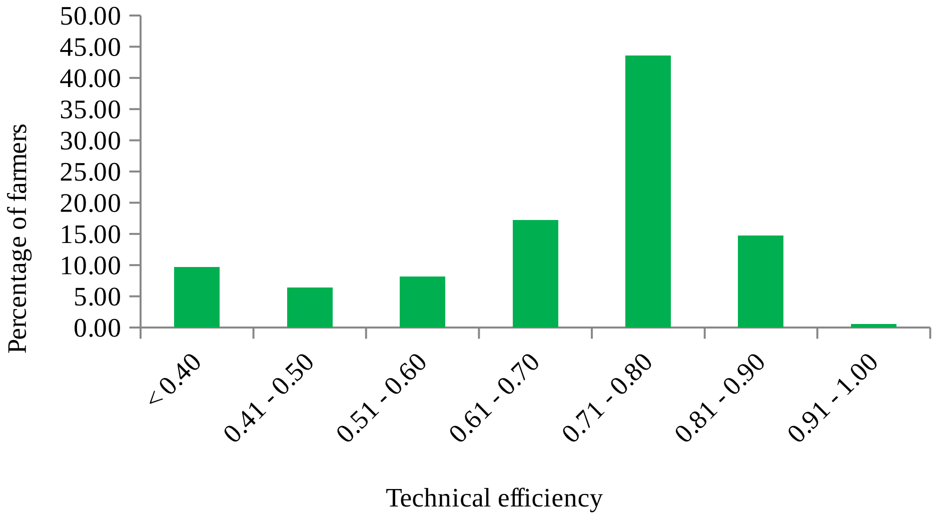

Figure 11: Distribution of technical efficiency scores

4.4.6.9 Technical efficiency of tobacco farmers across districts

Table 20 shows the mean tobacco production efficiency. The mean technical efficiency vary significantly among all the districts under consideration. The results indicate that Kaliua district has the highest mean technical efficiency (0.69) followed by Urambo district (0.68) and Namtumbo district (0.65). The Table further shows that about 80%, 70% and 77% in Kaliua, Urambo and Namtumbo district attained technical efficiency of above 0.60.

Table 20: Distribution of technical efficiency by districts

Technical efficiency	District Name Namtumbo	Percent	Urambo	Percent	Kaliua	Percent	Total
< 0.60	21	23.0	38	30.0	36	20.0	95
0.61 - 0.70	18	20.0	15	12.0	34	19.0	67
0.71 - 0.80	40	45.0	56	43.0	76	43.0	172
0.81 - 0.90	10	12.0	18	13.0	30	17.0	58
0.91 - 1.00	0	0.0	2	2.0	1	1.0	3
Total	89		129		177		395
Efficient > 60	68	77.0	91	70.0	141	80.0	95
Inefficient < 60	21	23.0	38	30.0	36	20.0	300
Mean	0.65		0.67		0.69		0.67
Minimum	0.09		0.16		0.11		0.09
Maximum	0.85		0.94		0.93		0.94

The mean technical efficiency of (0.67) in tobacco production is almost similar to the mean technical efficiency of (0.68) obtained when all crops were involved in the estimation using DEA approach. This implies that, a smallholder farmer crop production is depends much on the production of tobacco. This findings is a bit supplies because contradicts with that of Kidane *et al.,* (2015) who reported technical efficiency of 0.74 in tobacco production but similar to Ilembo and Kuzilwa (2014) who reported technical efficiency of 0.64.

4.2 Economic Analysis

4.2.1 Estimation of tobacco profitability across districts

Generally, tobacco farmers receive reasonable profit under average prices in the study area. Table 21 shows the profitability distribution across districts. The findings reveal that, profitability measured by gross margin is highest in Urambo district having ROI of (0.67) followed by Kaliua district with ROI of (0.63) while the ROI for Namtumbo district is the lowest (0.25). This is an indication that despite the differences across districts every shilling invested in tobacco production returned over and above the original investment in both districts. While farmers in Urambo obtained net returns of 2 111 096.80 TZS/ha, farmers in Kaliua and Namtumbo districts farmers earned 2 755 290.60 and 865 319.90 TZS/ha respectively. This variation can mainly be explained by farmer’s access to inputs on credit (cash or in kind). For instance, most of the farmers in Kaliua and Urambo districts received cash credit to facilitate faming activities. They also received the inputs timely during the season while farmers in Namtumbo district didn’t receive any credit (cash) during the season; most of them purchased the inputs from shop vendors. Such, financial constraints, reduces the quality and quantity of tobacco produced during the season. Further, farmers in Urambo and Kaliua invested more labour and inputs purchased compared to farmers in Namtumbo. Thus, holding other factors constant, tobacco production is more profitable in Urambo and Kaliua districts than in Namtumbo district.

Table 21: Gross margin analysis of tobacco enterprises across districts

	District				
Profitability (TZS)	**Urambo**	**Kaliua**	**Namtumbo**	**Mean**	**ANOVA**
Quantity (Kg)	1 723.80	2 116.60	1 040.50	1 745.90	0.000
Price sold	3 359.60	3 378.90	4 216.50	3 358.50	
TR	5 791 211.30	7 151 881.10	4 387 310.40	5 863 554.90	
Labour cost	2 360 765.50	2 862 081.30	2 823 878.60	2 689 752.70	
TVC	3 680 114.50	4 396 590.50	3 521 990.50	4 252 972.10	
GM	2 111 096.80	2 755 290.60	865 319.90	1 610 582.80	0.474
ROI	0.67	0.63	0.25	0.38	0.062
Return on Labour	0.89	0.96	0.31	0.60	0.122

From Table 21, it can be concluded that, there is statistically significant difference in tobacco profitability across district ($p>0.05$) at 10% level of significance and thus, we reject the null hypothesis which states that there are no significant differences in tobacco probability across districts. Contrarily to that, there is no statistically significant difference in return to labour across districts at 10% level of significance.

4.2.2 Estimation of farmer’s efficiency scores across district

The *Kruskal-Wallis H Test* is a non-parametric test similar to ANOVA. *Kruskal-Wallis H test* is used to compare more than two sets of categorical data or can be used to compare data that are not normally distributed. In fact, efficiency scores data are not normally distributed, they are either skewed to right or left.

4.2.2.1 Efficiency test (One-sample t-test)

The test aims to identify if smallholder farmers were technical, allocative, and economically efficient in the study areas. The null hypothesis tested in objective two was that "smallholder farmers in Urambo, Kaliua, and Namtumbo districts are technical, allocative and economically efficient". It could be noted that the One-Sample t-test procedure measures whether the mean of a single variable differs from a specified constant. Consequently, the results in Table 22 indicate that *t*-values are statistically significant at a 5% level of significance. Unfortunately, the table shows that efficiency scores are statistically different from one. Given the statistical tests, all the null hypotheses were rejected. Therefore, it is concluded that smallholder farmers in the study area were technically, allocatively, and economically inefficient ($p < 0.05$).

Table 22: Results for a one-sample t-test

Efficiency Scores	t-test	df	*p-value*	95% Confidence Interval	
				Lower	Upper
TE	-25.694*	394	0.000	0.658	0.707
AE	-56.227*	394	0.000	0.395	0.436
EE	-78.883*	394	0.000	0.261	0.297

Note: * the test is significant at 1% level of significance

4.2.2.2 Crop yield variation across districts

A one-way ANOVA and *kruskal wallis tests*

The study investigates crop production across districts, mainly due to the reason that, agriculture activities are the main employer of the majority in the rural area. Thus the study null hypothesis was formulated which states that there is no significant difference in crop productions across districts. Consequently, a One-Way ANOVA was used to test the hypotheses. From the result, Table 18 shows that the F-statistic[8] of the ANOVA test takes the value 10.4790 for tobacco, 1.199 for maize, 1.756 for paddy rice, and 6.981 for beans production at a 5% level of significance. Thus, the result shows that there is no statistically significant difference in maize and paddy production across districts ($p>0.05$). Besides, Levene statistic to test for the equality of group variances showed that the test is statistically significant for tobacco and beans outputs implying that there is a significant variation across population variances where the respective samples come from. Thus, it is important to look at the results of an appropriate alternative non-parametric test for tobacco and beans outputs such as the *Kruskal Wallis Test.*

The *Kruskal Wallis test* is used to test the null hypothesis that 'k' independent random samples come from identical universes against the alternative hypothesis that the means of these universes are not equal (Kothari, 2004; Singh, 2007). Accordingly, using the *Kruskal Wallis Test* with a chi-square distribution, the results for tobacco and beans outputs are 39.865 and 34.765 at a 5% level of significance ($p < 0.05$). Thus, it is concluded that the three districts have different average tobacco and beans outputs which mean there is evidence to reject the null hypothesis in favour of the alternative. As a result, the hypothesis made in the study on the similarity of major crop outputs across districts was

8 The F-Statistics is also called the F critical value; the rule is that if the calculated F value in a test is larger than the F statistic you reject the null hypothesis.

rejected for tobacco and beans outputs in favour of the alternative and it was accepted for maize and paddy rice output Table 23.

Table 23: One-Way ANOVA and *Kruskal wallis tests* for crop outputs

Yield (Kg)	**ANOVA**		**Test of Homogeneity of variance**		***Kruskal Wallis Test***	
	F	***p-value*.**	**Levene Statistics**	***p-value*.**	χ^2	***p-value*.**
Tobacco	10.479**	0.000	12.541**	0.000	25.208**	0.000
Maize	1.199	0.303	1.067	0.345	1.827	0.401
Paddy rice	1.756	0.174	2.941*	0.054	15.212**	0.001
Beans	6.981**	0.001	23.101**	0.000	7.924**	0.019

Note: * and ** are for decisions rejected and accepted, respectively.

4.2.2.3 Efficiency variation across districts (Kruskal Wallis Tests)

In addition to a one-sample t-test, One-Way ANOVA was used to test the null hypothesis of efficiency scores; this was done to know if there is significant variation in technical, allocative, and economic efficiency across districts. The null hypothesis state that, "efficiency scores are equal across districts". However, the Levene statistic indicated that the test is statistically significant for allocative and economic efficiency scores ($p < 0.05$). Thus, the *Kruskal Wallis Test* was employed and the result showed that the chi-square value of mean allocative and economic efficiency was 21.386 and 7.285 respectively at a 5% level of significance ($p<0.05$). Consequently, it is concluded that allocative and economic efficiency scores significantly vary across districts. As a result, the null hypothesis is rejected in favour of the alternative hypothesis Table 24.

Table 24: Variation of efficiency scores across districts; A One-Way ANOVA

Efficiency Scores	One-Way ANOVA		Test of Homogeneity of variance		*Kruskal Wallis Test*	
	F	*Sig-level*	Levene Statistics	*Sig-level*	Chi-Square	*p-value*
TE	0.810	0.445	1.401	0.248	1.078	0.583
AE	10.52*	0.000	13.788*	0.000	21.386*	0.000
EE	3.56**	0.029	5.872**	0.003	7.285**	0.026

Note: * and ** shows that, the test is significant at 1 and 5% level of significance.

Moreover, a One-Way ANOVA test was conducted to know if there is a significant variation in technical efficiency scores across districts. The F-statistic takes the value 0.86 with an associated significant level of 0.445 that is less than critical F-value at a 5% level of significance. This concludes that there is no significant variation of TE across districts. Moreover, the Levene statistics revealed also that the test is statistically insignificant for technical efficiency. Finally, using appropriate a non-parametric *Kruskal Wallis H Test*, the result suggests that technical efficiency scores were significantly different across districts ($p > 0.05$); as a result, the null hypothesis was rejected in favour of the alternative hypothesis. Generally, contrary to the hypotheses of the study, the tests showed that there is significant variation in allocative and economic while there is no significant variation in technical efficiency scores across districts under the study consideration Table 25.

Furthermore, Table 25 shows the summary statistics of technical, allocative and economic efficiency across districts. This was done so that we can observe other statistical measures such as standard deviation, minimum and maximum which is also important in analysing efficiency scores.

Table 25: Summary statistics of TE, AE, and EE across districts

Type of Efficiency	District

	Statistics	Urambo	Kaliua	Namtumbo	Mean	*p-value*
Technical efficiency	Mean	0.66	0.69	0.70	0.68	0.445
	Std. Deviation	0.26	0.23	0.25		
	Minimum	0.09	0.10	0.24		
	Maximum	1.00	1.00	1.00		
Allocative efficiency	Mean	0.48	0.37	0.41	0.42***	0.000
	Std. Deviation	0.20	0.17	0.26		
	Minimum	0.10	0.04	0.06		
	Maximum	1.00	1.00	0.99		
Economic efficiency	Mean	0.31	0.26	0.28	0.28**	0.029
	Std. Deviation	0.19	0.15	0.21		
	Minimum	0.02	0.02	0.05		
	Maximum	1.00	1.00	0.99		

The Table indicating that, the mean efficiencies vary significantly among all the districts under consideration. The test statistics further shows that Namtumbo had relatively higher technical efficiency than their counterparts from Urambo and Kaliua farmers while Urambo farmers had relatively higher allocative and economic efficiency than their two counterpart's districts. Thus, from the findings in Table 25, it is concluded that, while there is no statistically significant difference in technical efficiency across districts ($p>0.05$), there is a statistically significant difference in allocative and economic efficiency across districts ($p < 0.05$). This implies that there is over use of some farming inputs like family labour and underutilization of other inputs like fertilizer, pesticides.

4.2.3 Source of technical and economic inefficiency

4.2.3.1 Test for multicollinearity

A multicollinearity test was done using the variance inflation factor and Eeigen values and the results of the test ruled out the presence of multicollinearity among the independent variables. Because none of the tested variables registered a variance inflation factor (VIF) that is greater than 2. The variance inflation factor (VIF) range from 1.01 to 1.81, similarly, the tolerance values ranges from 0.35 to 0.74 which is deferent from zero, confirming that they are acceptable and devoid of multicollinearity. The VIF mean was 1.25 Table 26.

Table 26: Multicollinearity test results for continuous dependent variables

Variable	VIF	TOL
Age	1.81	0.3535
Experience	1.76	0.5674
Distance to the field	1.07	0.4379
Distance to the market	1.06	0.7464
Farm size	1.04	0.4614
Frequency of extension visit	1.02	0.6830
Family size	1.01	0.5898
Mean VIF	1.25	

Besides, the underlying assumption that there is no directional relationship between variables in the two-limit Tobit regression model was checked for dummy variables as well. A contingency coefficient which is derived from chi-square ($\chi 2$) was used to test the null hypothesis that there is no directional relationship between dummy variables in the two-limit Tobit regression model. The results revealed that, the coefficients vary between 0.0184 and 0.0875 which indicates that, there is no evidence for strong correlation between the dummy variables Table 27.

Table 27: Contingency coefficient results for dummy dependent variables

Dichotomous variables	**Sex**	**Education**	**Access to credit**	**Access to extension**
sex	1.0000			
Education	0.1251	1.0000		
Access to credit	0.0196	0.0783	1.0000	
Access to extension	0.0198	0.0184	0.0875	1.0000

Though the assessment of the degree of efficiency is important, one cannot count on it for policy recommendation. Similarly, the estimated level of technical and economic efficiency among producers is not enough to derive recommendations for policy intervention. It is also necessary to identify the sources of variation in the technical and economic efficiency estimates among the producers and quantify their effect. This was made possible by specifying an inefficiency model whose regressors are exogenous factors related to the production unit. Using two-limit Tobit model factors affecting the efficiency of smallholder farmers were determined and the results of technical and economic inefficiency were presented in Table 28 in section 4.2.3.2.

4.2.3.2 Test of heteroscedasticity

Heteroscedasticity refers to a situation where the assumption that the classical linear regression model has equal variance of residuals is violated. There exist several tests for heteroscedasticity detection such as the Koeker Basset, the White's and the BreuschPagan tests among others (Gujarati and Porter, 2009). This study used the Breusch-Pagan with null hypothesis of constant variance for heteroscedasticity. Breusch-Pagan is a chi-squared test whereby if the statistical test gives a p-value that is below suitable threshold of 0.05 then the null hypothesis of homoscedasticity is rejected (Gujarati and Porter, 2009). The calculated chi square value was 0.43, with a p-value of 0.5102 which is greater than 0.05 indicating homoscedasticity in the data set.

4.2.3.3 Empirical results for technical and economic inefficiency

The aim of objective three is to identify factors that could affect efficiency level of crop production. Though the assessment of the degree of efficiency is important, one cannot count on it for policy recommendation. Even the estimated level of technical and economic efficiency among farmers is not enough to derive recommendations for policy intervention.

Thus, to identify sources of variation in technical and economic efficiency estimated among farmers and quantify their effect is of important. This was made possible by specifying an inefficiency model whose regressors are exogenous factors related to the production unit. Using a two-limit Tobit model factors affecting the efficiency of smallholder farmers were determined and the results of technical and economic inefficiency presented in Table 28.

The results in Table 28 shows that, while age of household head and farm size have significant negative effects on technical inefficiency, walking distance to the field, access to extension services and frequently visit by extension officers positively and significantly affect technical inefficiency. This result is in line with priori expected sign of age of household head and farm size efficiency relationship but contrary to walking distance to the field, access to extension services and frequency of visits by extension officers. This can be explained by the reason that extension services are provided by tobacco companies whose main interest is on tobacco production with less interest on other crops. Thus, frequent visits by extension officers mean farmers will spend more time in tobacco field and have less time for other crops.

Table 28: Sources of technical inefficiency

Variable	Technical efficiency			Economic efficiency		
	$[\partial y / \partial x]$	**Std. Err.**	***p-value***	$[\partial y / \partial x]$	**Std. Err.**	***p-value***
Age of household head	-0.003	0.00	0.041**	0.000	0.00	0.192

		1			0	
Family size of household head	0.004	0.004	0.249	0.004	0.035	0.237
Distance to the field (Km)	0.006	0.001	0.460	0.001	0.036	0.816
Distance to the market (Km)	-0.005	0.005	0.029**	0.000	0.004	0.139
Farm size (ha)	-0.030	0.006	0.001***	-0.055	0.025	0.004***
Sex of household head	-0.075	0.040	0.272	0.044	0.040	0.272
Education level of household head	-0.009	0.004	0.643	-0.002	0.004	0.643
Access to credit	-0.024	0.017	0.014**	-0.042	0.065	0.035**
Access to extension services	0.147	0.031	0.008***	0.061	0.031	0.048**
Frequency visit by extension officers	0.035	0.009	0.037**	-0.007	0.009	0.402
Marital status of household head	0.016	0.022	0.538	-0.013	0.022	0.538

Note: ** and *** significant at 5 and 1% level of significance, respectively.

Tobacco farmers who have access to credit were found to have a positive and significant effect on technical inefficiency at 1% level of significance. The sign is contrary to the expectation; other variables keep constant, for a household head having access to credit increases the expected value of technical inefficiency by a score of 0.024 at 1% level of significance. This study is contrary to Javed (2009) who pointed out that access to credit has negative influence on technical inefficiency, explaining that, credit reduces the financial difficulties farmers face at the beginning of the crop year, thus enabling them to buy inputs. In Tanzania context, the reasons for the unexpected sign could be that some farmers may divert the financial loan obtained from loan provider. High interest rate and/or short term of loan repayment period. It should be noted that banks provide agriculture loans that could be repaid immediately after harvest which forces farmers to sell their produce when prices are still low, especially for those crops other than tobacco. In Tanzania, the credit systems and input supply systems particularly for imported inputs are organised by the government. Thus, this could have negatively impacted on the timeliness and quality of services which could also be one of the reasons why the impact of credit is positive and significant to technical inefficiency. Similar result was also obtained by Goibov *et al.* (2010). However, Nyagaka *et al.,* (2010) reported mixed results.

Furthermore, Table 28 shows that, the coefficients for age of household head has negative and had a significant effect on farmers' technical inefficiency at 5% level of significance. This implies that technical efficiency increases with age. Coelli (1996) concludes that the age of a farmer can be expected to have a positive or negative effect on inefficiency because as age increases farming experience increases, and hence efficiency increases. However, depending on the effects of other socio-economic factors, the farmers age can either enhance or reduce technical efficiency. According to empirical literature older farmers are more technically efficient than younger farmers (Erhabor and Emokaro, 2007). Further, older farmers are thought to be more reasonable and adhere to extension information and other agronomic practices which increase their efficiency. Other studies however, conform to the finding that young farmers as being more technically efficient than older farmers (Samuel *et al.,* 2014; Sibiko *et al.*, 2013). They hold the conclusion that older farmers may be reluctant to change and sometimes their unwillingness or inability to adopt technological innovations reduces their technical efficiency. This implies that, age and efficiency have an inverted u-shaped relationship. Hence, middle aged farmers are more efficient than old aged and younger farmers. Findings of this study conform to that of Battese *et al.* (1996), where age was found to be negatively and significantly affect resource use inefficiency. Table 20 further shows the marginal effect age, which indicates that as a year increase in the age of a household head decreases the expected value of technical inefficiency by a score of 0.003 at 5% level of significance. This is contrary to Ilembo and Kuzilwa (2014) who reported that age of household head has a positive relationship with inefficiency.

Regarding the economic inefficiency, the factors affecting economic inefficiency are presented in the same Table 28. The Table shows that, the coefficient for farm size is negative and significant affects level of economic inefficiency at 1% level of significance, the sign is in line with the priori expectation. This implies that as the farm size increases, the level of economic inefficiency decreases. Hence larger farms were found to be more economically efficient than their small and medium counterparts, mainly due to economies of size in purchasing the inputs and or in outsourcing the market for the crops produced, and this decreases economic/cost inefficiency. This finding is in contrast with what Fleteschner and Zepeda, (2002) found that small farms are more efficient than large farms but similar to what [CITATION Usm16 \l 1033].

The inverse relationship in this sample may be explained by the argument that farmers with large farms are enjoying economies of size in employing production inputs for crop production and have more capital to access other production inputs such as labour, fertilizer and agrochemicals. Meanwhile, the coefficient access to credit was found to have a negative and significant effect on economic inefficiency (p>0.05). The sign is in line with the expectation. Table 28 shows that if a household head with access to credit increases the expected value of economic inefficiency decreases by a score of 0.042 at 5% level of significant. Extension services, however, has a positive relationship with economic inefficiency which is quite the opposite of the expected sign. This means those who had extension contacts are performing poorly. The negative effect reflects the poor extension services provided which is supported by Ilembo and Kuzilwa (2014). Conversely, other variables such as an increase in age, family size, farming experience, and distance from the homestead to the field do not have any significant effect on economic inefficiency.

4.2.4 Problems facing tobacco farmers and companies

The aim of objective four was to identify challenges facing tobacco farmers as an important step to improve agriculture production both for tobacco and other food crops. However, there is a fragile linkage between farmers, researchers and extension officers in the study area. This is because majority of tobacco farmers complained about many challenges they face in their area. Thus, assessing challenges facing farmers in the study area is important for informed policy decision. The main challenges facing tobacco farmers were listed and analysed in the subsequent section.

4.2.4.1 Problems facing tobacco farmers

Production related challenges

Table 24 shows factors that constraints smallholder farmers' productivity in the study area and these were ranked according to their degree of seriousness. According to these findings poor management (3.7) is leading followed by drought and climate change (3.3), poor infrastructure (3.3) and lack and high cost of labour (3.2). These variables were considered as serious constraints by farmers because their values were above the critical mean of 3 which was calculated in subsection 3.4.5.1. Other constraints were below the critical mean and hence were considered not serious.

Table 29: Constraints to crop production

Problems/Constraints	Calculated mean	Ranks
Low price of outputs	4.5	1st
Lack of credit	4.3	2nd
High cost of inputs	4.3	3rd
Complicated grading system	4.3	4th
Side selling	4.0	5th
Late input supply	3.9	6th
Poor management	3.7	7th
Drought and climate change	3.3	8th
Poor infrastructure	3.3	9th
Lack and high cost of labour	3.2	10th
Lack of extension services	2.5	11th
Incidence of pest and disease	2.4	12th
Shortage of land	2.0	13th

Table 29 presents the results regarding the challenges facing smallholder farmers. Among the cited problems include complicated grading systems which received the response average rank of (4.3). This is also considered as an institutional challenge since verifiers are claimed to downgrade the leaf quality during the auction. The present study also assessed farmers' perceptions regarding the availability of markets for major crops grown in the area. The survey revealed that apart from tobacco, which is produced under contract, farmers sell their other crops in the local markets, such market for maize, rice and beans are very unreliable, because these crops are mostly produced remote villages where transport is another challenge due to poor road conditions.

Marketing related challenges

The marketing of crop produced is another challenge facing tobacco farmers. Usually tobacco production requires more input than the remaining crops. Imperfect information on input and output prices leads to risks and uncertainty. A study by Baltzer and Hansen

(2011) on input prices shows that application of agricultural input raises productivity, however most farmers in Sub Sahara African countries fail to apply optimum input levels because of high input prices and low output prices. Furthermore, smallholder farmers lack awareness about sources of input, inability to access information on input and output price due to weak links in the crops value chains. Unfortunately, in the case of tobacco production, though the market is available there are many contract related problems that hinders farmers from getting profit.

4.2.4.2 Problems facing tobacco companies

The tobacco industry is also facing many challenges, including marketing, pricing, production and transportation. These challenges had to be discussed in advance for policy recommendations. Qualitative interviews were conducted with some tobacco firms (TLTC, JIT and DIMON) to enrich this study, some of the challenges mentioned by tobacco leaf companies are as explained in the next subsections.

They are several challenges facing tobacco firms; some are country oriented such as numerous tax and poor roads infrastructure. However, the most prominent challenge includes tobacco side selling. This is a violation of contract whereby a farmer sale crop to unregistered tobacco firm or middle men. Interventions to address this problem by tobacco companies in partnership with the Governments are required. There is a need for government to government partnerships to reduce the incidence of tobacco speculators. For instance in Ruvuma region farmers tend to sale their tobacco to tobacco companies in Malawi.

Further tobacco companies reported that good exist laws and regulations are there but they are not enforced, thus a need to strengthen the enforcement of the laws is of important.

Moreover, tobacco firms reported wide price fluctuations in the World market; unfortunately, there is no information flow to farmers on the reasons for such fluctuations. Regarding tobacco production, tobacco firms reported that, production should be aligned with the agreed contract to reduce repeated trends of tobacco underproduction which affects leaf firms' confidence. Unfortunately, it has been reported by tobacco firms to reduce the quantity purchase the near future, and the TLTC has already closed up its production process which have negatively affected both the farmers and the government.

Another challenge cited by tobacco firms is regarding the framework convention on tobacco control (FCTC) on reducing tobacco production. The FCTC has a negative impact on the global market. The Framework on Tobacco Control in in the country ought to be updated to suit the interest of some countries, it needs to be revised. The governments need to create a forum together with the tobacco companies. The Framework Convention urges government to protect public health from the vested interests of the tobacco companies but does not talk anything to protect companies. Apart from FCTC the industry is burden by a lot of tax (village levy, region levy, OSHA, inspections up to Tanzania revenue tax) this is a burden to our operations. Other mentioned challenges include infrastructure, Lack of relevant and clear laws and regulations governing tobacco, Access to finance, inadequate government support in extension and research, difficulties in farmer's adoption on reduction of cost of production technologies.

4.3 Summary of Results on Hypotheses

This study was guided by three hypotheses as per specific objectives. The first hypothesis of no statistical difference in tobacco profitability across districts was tested through return on investment and labour. It has been found that, there is statistically significant difference in tobacco profitability across district ($p>0.05$) at 10% level of significance and thus, the hypothesis was rejected. Further it has been found that there is no statistically significant difference in return to labour across districts at 10% level of significance. The second hypothesis which stated that smallholder farmers are technically, allocatively and economically efficiency and revealed that, there is significant variation in allocative and economic efficiency while there is no significant variation in technical efficiency scores across districts.

Regarding the factors influencing production efficiency, while age of household head and farm size have significant negative effects on technical inefficiency, walking distance to the field, access to extension services and frequently visits by extension officers positively and significantly affect technical inefficiency. Further, the coefficient for farm size is negative and significant affects level of economic inefficiency at 1% level of significance while extension services has a positive relationship with economic inefficiency which is quite the opposite of the expected sign. Implies that most extension officer in the study area are from tobacco leaf companies hence there interest is on tobacco production only.

Lastly, the study identified the challenges facing tobacco farmers as well as tobacco firms, the Likert scale results revealed that, poor management (3.7) is leading followed by drought and climate change (3.3), poor infrastructure (3.3) and lack and high cost of labour (3.2). These variables were considered as serious constraints by farmers because their values were above the critical mean of 3 which was calculated in subsection 3.4.5.1. Other constraints were below the critical mean and hence were considered not serious while numerous taxes, side selling and poor roads infrastructure were mentioned by tobacco firms as the main challenges.

CHAPTER FIVE

5.0 CONCLUSION(S) AND RECOMMENDATIONS

5.1 Conclusions

The present study examined the level of profitability as well as technical, allocative and economic efficiency of crop production (tobacco, maize, paddy rice and beans) in the study area as assed determinants of efficiency using a sample of 395 farmers from the three selected district (Urambo, Kaliua and Namtumbo), Tanzania. This study was guided by four specific objectives, the first objective was to compare the profitability of tobacco farming in Urambo, Kaliua and Namtumbo Districts; the second was to estimate farm level technical, allocative and economic efficiency among smallholder tobacco farmers in the study area; the third was to analyse socio-economic determinants affecting technical and economic inefficiency among smallholder tobacco farmers in the study area and the fourth was to identify the main problems encountered by smallholder tobacco farmers in the study area. Profitability and efficiency indicators were used to measure farmers' performance in this study.

The most important variable cost components for tobacco production were labour, fertilizer and chemicals. Labour cost alone accounted for about 63.3% of the total cost of production. Urambo district earned the highest return on investment compared to Kaliua and Namtumbo Districts. But, tobacco production is profitable across districts. Meanwhile, to estimate resource use efficiency and underlying determinants of inefficiency in resource utilizations, four main crops (tobacco, maize, paddy and beans) which are produced by farmers, were considered. Using DEA model, it was concluded that tobacco farmers were technically, allocative, and economically inefficient in crop production. Hence there is a room for improvement in efficiency even at the existing level of technological inputs if policy measures are taken. Among the policy measures in tobacco production is to improve credit guarantee scheme that would help farmers to acquire input credit on time. Thus, corroboration development efforts to improve the current level of input use and policy measures are needed. This is essential in improving productivity of smallholder agriculture and their living standards.

Furthermore, analysis from the two-limit Tobit regression model revealed that while distance to the field plot, access to extension service and frequency of visits by extension agents positively and significantly influence technical efficiency; the age of the household head, farm size, and access to credit were found to have a negative and significant influence on technical efficiency. The finding revealed further that while economic inefficiency was positively and significantly affected by the age of the household head and access to extension services, was negatively and significantly affected by farm size and access to credit.

Thus, the study established that farm size and access to credit are variables which have double effect that simultaneously had a significant negative effect on technical and economic inefficiency and hence were prioritized as the most critical factors in determining resource use inefficiency in the study areas. In contrast, it is concluded that except for farm size and access to credit other factors were either insignificant or significant but with a single effect variable. Finally, according to the finding based on the Likert scale, low price of outputs, grading system, side selling, credit and high costs of inputs (NPK, CAN and chemicals) were found to be critical challenges facing smallholder farmers in Urambo, Kaliua, and Namtumbo districts while late inputs supply, shortage of labour and insufficient inputs supply were less critical challenges.

5.2 Recommendation(s)

Based on the findings of this study, policy recommendations are designed to improve resource use efficiency and increase crop productivity and thus profitability among farmers in the study area. The study findings have shown that farmers with access to credit services are more technically inefficient than those with no such access mainly due to high bank interest rates. This implies that access to credit services should be enhanced among smallholder farmers at a reasonable market interest rate, provided on time and in the required amount to help farmers acquire inputs on time. This should be combined with availability of complementary agricultural support services, including extension services and training. These will facilitate transfer and adoption of new technologies by farmers leading to improved productivity, efficiency, and increased income among smallholder farmers.

Moreover, it has been observed that, age increasing resource use efficiency and agricultural productivity in the study area. This is because results showed that younger farmers are technically more inefficient than older ones. It implies that there should be policies to improve resource use efficiency of younger farmers and encourage them to be in farming activities by providing them incentives. Trainings about the agricultural business environment and follow up during agricultural operation for younger farmers should be provided. However, this should not be at the expense of older ones.

Regarding the challenges facing smallholder farmers, the synergy between the Government, tobacco companies and smallholder farmers should improve the grading systems and standardization of tobacco should be revised to increases output prices. Moreover, farmers should not engage in side selling rather they should be honesty to pay their loans in their respective primary cooperative societies. This would assure them access to inputs credit in the coming farming seasons. The Government policies and strategies targeting at increasing the supply and access to inputs should consider the redistribution of these agriculture production inputs to all the three districts.

5.3 Suggestions for Further Research

Since the empirical analysis of this study has employed cross-sectional data to assess farm performance; it would be interesting to look at technical efficiency, allocative efficiency and economic efficiency using panel data to evaluate how these efficiency categories would change over time. If panel data was available, further methodological advances could be achieved by using fixed and random effects stochastic frontier models that account for unobserved heterogeneity. Future researchers can feasibly employ panel data to analyse smallholder farmers' production efficiency at the regional or country level. Cross-sectional data only provides a snapshot of efficiency estimates, while panel data provides a wider temporal overview and also allow for technical change estimates which is important in measuring variation in technical efficiency (Syp and Osuch, 2018).

Therefore, even though the construction of panel data sets is costly, researchers in Tanzania should pay special attention to appropriately collect these data. The uncertainty around the level of output prices could also be incorporated in the models by adding the price variability attached to different crops. The seasonality effect of output prices is another issue to research on in order to assess whether a producer's marketing inefficiency varies across districts and seasons. It would therefore be interesting to look at technical, allocative and economic efficiency using panel data to evaluate how these efficiency categories would change over time.

Since the current study was the first endeavour in Tanzania to analyse both technical, allocative and economic efficiency of tobacco smallholder farmers, hence more studies for determination of production efficiency of smallholder farmers should be carried out in the future to have a clear understanding how the factors of production such as labour have performed over time for smallholder farmers crop production, in this study for instance, labour was found to be the key factor contributing a higher share in the cost of tobacco production. Thus it would be interesting to conduct a study on farm household labour allocative efficiency so that farmers could be advised on how efficiently can allocated their labour resources.

Furthermore, agriculture in Tanzania at most farms combines crops, livestock and poultry. Thus, it could be plausible sometimes in the future to analyse the efficiency of the whole farm enterprises instead of focusing on individual crops. Few researchers have reported a positive correlation of technical efficiency with enterprise mix

REFERENCES

Abdullah, A. (2013). Factors That Influence the Interest of Youths in Agricultural Entrepreneurship. *International Journal of Business and Social Science*, Vol. 4(3), 288-302.

Addai, K. N., and Owusu, V. (2014).Technical efficiency of maize farmers across various agro ecological zones of Ghana. *Journal of Agriculture and Environmental Sciences*, Vol. 3(1), pp. 149-172.

Adeoye, I. B., and Balogun, O. L. (2016). Profitability and Efficiency of Cucumber Production among Smallholder Farmers in Oyo State, Nigeria. *Journal of Agricultural Sciences*, 61(4), 387-398.

African Union (2018). Inaugural Biennial Report of the Commission on the Implementation of the June 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared prosperity and Improved Livelihoods. Assembly Decision (Assembly/AU/2(XXIII)) of June 201. Addis Ababa, Ethiopia.

Aigner, D. J., Lovell, C. K., and Schmidt, P. (1977). Formulation and estimation of stochastic frontier production models. *Journal of Economics,* Vol. 6, 21-37. http://dx.doi.org/10.1016/0304-4076 (77) 90052-5.

Ajibefun, I. A. 2008. An evaluation of parametric and non-parametric methods of technical efficiency measurement: Application to small scale food crop production in Nigeria. *Journal on Agriculture Science,* Vol. 4(3): 95-100

Akamina, A., Bidogeza, J., Minkoua, J.R. and Afari-Sefa, V. (2017). Efficiency and productivity analysis of vegetable farming within root and tuber-based systems in the humid tropics of Cameroon. *Journal of Integrative Agriculture,* 16 (8): 1865–1873.

Akhter F, Mazhar F, Sobhan M. A, (2008). From Tobacco to Food Production: Assessing Constraints and Transition Strategies in Bangladesh. Final Technical Report Submitted to the Research for International Tobacco Control (RITC) Program of the International Development Research Centre (IDRC). Ontario, Canada: International Development Research Centre, 2008:20.

Ali, M. and Flinn, J.C. (1989). Profit Efficiency among Basmati Rice Producers in Pakistan, Punjab. *American Journal of Agricultural Economics* 71:303-310.

Alrashidi, A. N. (2015). Data Envelopment Analysis for Measuring the Efficiency of Head Trauma Care in England and Wales. University of Salford Manchester, Salford Business School. Unpublished.

Ambetsa, L. F., Mwangi, C. S., and Ndirangu, N. S. (2020). Technical efficiency and its determinants in sugarcane production among smallholder sugarcane farmers in Malava sub-county, Kenya. *African Journal of Agricultural Research*, Vol. 15(3), 351-360.

Andreu, M.L. (2008). Studies on the Economic Efficiency of Kansas Farms. An Abstract of unpublished PhD Dissertation, Kansas State University, Manhattan, Kansas.

Anyaegbunam, H. N., Okoye, B. C., Nwaekpe, J. O., Ejechi, M. E., and Ajuka, P. N. (2016). Technical Efficiency of Small-holder Sweet potato Farmers in Southeast Agro-ecological Zone of Nigeria. *American Journal of Experimental Agriculture*, Vol. 12(1), 1-7.

Arabmazar, A. and Schmidt, P. (1981). Further evidence on the robustness of the tobit estimator to hetroscedasticity. Journal of Econometrics 17(2): 253-258.

Arabmazar, A. and Schmidt, P. (1982). An investigation into the Robustness of the Tobit Estimator to Nonnormality. Econometrica, 50 (4): 1055-1063.

Araral, E. (2009). What explains collective action in the commons? Theory and evidence from the Philippines. *Journal of World Development*. Vol. 37(3): 687 – 697.

Awerije, B., and Rahman, S. (2016). Profitability and efficiency of cassava production at the farm-level in Delta State, Nigeria. School of Geography, Earth and Environmental Sciences, University of Plymouth, Drake Circus, Plymouth, PL4 8AA, United Kingdom

Baha, R. M. (2013). Sources of technical efficiency among smallholder maize farmers in Babati District, Tanzania. *International Journal of African and Asian Studies*, Vol.1, 34-41.

Bailey, K. D. (1994). Methods of social research, The Free Press. A division of MacMillan Incorporation, New York. Pg. 97.

Banker, R. D., and Natarajan, R. (2008). Evaluating contextual variables affecting productivity using data envelopment analysis. Operation Research 56 (1), pp. 48–58.

Banker, R. D., Charnes, A., and Cooper, W. W. (1984). Some models for estimating technical and Scale Inefficiencies in Data Envelopment Analysis. *Journal of Management Science*, 30, pp. 1078-1092.

Bassey, J. I. (2016). Comparative Analysis of System of Rice Intensification and Traditional System of Rice Production in Abi L.G.A, Cross River State, Nigeria. *European Journal of Agriculture and Forestry Research*, 4(2), 9-23.

Battese, G. E and T. J Coelli, (1995). A model for technical inefficiency effect in stochastic frontier production for panel data. Empirical Economics 20 (2) pp 325-345

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(1/2), 152- 169.

Besanko, D., and Braeutigam, R. (2010). In D. Besanko, and R. Braeutigam, Microeconomics, 4th edition (4 Ed).

Bifarin, J. O., Alimi, T., Baruwa, O. I., and Ajewole, O. C. (2008). Determinant of technical, allocative and economic efficiencies in the plantain (Musa spp.) production industry, Ondo State, Nigeria. In IV International Symposium on

Banana: International Conference on Banana and Plantain in Africa: Harnessing International 879 (pp. 199-209).

Binam, J.N., Gockowski, J. and Nkamleu, G.B. (2008). Technical Efficiency and Productivity Potential of Cocoa Farmers in West Africa Countries. The Developing Economics, XLVI-3, 242-63

BoT (2015). Economic bulletin for the quarter ending September, 2016. Vol. xliv no. 1. Economic research and policy, Dar es salaam, Tanzania. 117pp.

BoT. (2019). Bank of Tanzania Annual Report. Director of Economic Research and Policy. Dares Salaam, Tanzania. 201pp.

Boyd, H. K., Westfall, R. and Stasch, S. F. (1981). Marketing Research, Texts and Cases. Richard D, Illinois, Irwin, Inc. USA.

Bravo-Ureta B.E, Solís, D., López, V.H.M., Maripani, J.F., Thiam, A. and Rivas, T., 2007, “Technical Efficiency in Farming: A Meta-Regression Analysis”, *Journal of Productivity Analysis*, 27 (1), pp. 57-72.

Bravo-Ureta BE and Pinheiro A., (1993), “Efficiency Analysis of Developing Country Agriculture: A Review of the Frontier Function Literature” *Agriculture Resource Economy Review*, 22 (1), pp. 88-101.

Bravo-Urets, B. E., and Pinheiro, A. E. (1997). Technical, economic and allocative efficiency in peasant farming: Evidence from the Dominican Republic. *The Developing Economics*, 35(3), 48-67.

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

Chatterjee, S., and Price, B. (1991). Regression Analysis by Example (2nd Ed.). New York: Wiley.

Chidi, I, Chinaza, A. and Priscilia. (2015). Analysis of Socio-Economic Factors and Profitability of Rice Production among Small-scale Farmers in Ebonyi State. *Journal of Agriculture and Veterinary Science* (IOSR-JAVS), 8(2), 20-27.

Chikobola, M. M. (2016). Profit Efficiency of Groundnut Production: Evidence from Eastern Province of Zambia. *Journal of Economics and Sustainable Development*, *7*(8), 38-53.

Chiona, S., Kalinda, T., and Tembo, G. (2014). Stochastic Frontier Analysis of the Technical Efficiency of Smallholder Maize Farmers in Central Province, Zambia. *Journal of Agricultural Science*, 6 (10), 108-118.

Coelli, T. J. and D. S. P. Rao (2003). Total Factor Productivity Growth in Agriculture. School of Economics, University of Queensland, Australia.

Coelli, T. J., (1995). “Recent Developments in Frontier Modeling and Efficiency Measurement” *Australian Journal of Agricultural Economics* Vol. 39 no. 3: 219-245.

Coelli, T.J. (1996). A Guide to DEAP version 2.1: A Data Envelopment Analysis (computer) Program. CEPA working paper no. 8/96. Centre for Efficiency and Productivity Analysis, University of New England.

Coelli, T.J., Prasada Rao, D.S. and Battese, G.E. (1998). An Introduction to Efficiency and Productivity Analysis. Kluwer Academic Publishers, London.

Coelli, T.J., Prasada Rao, D.S., O’Donnell, C.J. and Battese, G.E. (2005). An Introduction to Efficiency and Productivity Analysis (2nd Edition). Springer Science and Business Media Inc.

Coelli, T.J., Rahman, S. and Thirtle, C. (2002). Technical, allocative, cost and scale efficiencies in Bangladesh rice cultivation: a non-parametric approach. *Journal of Agricultural Economics*, 53(1): 607-626.

Cooper, W.W., Seiford, L.M. and Tone, K. (2000). Data Envelopment Analysis: A Comprehensive text with Models, Applications, References, and DEA-solver software. Kluwer Academic Publishers, USA.

Cooper, W.W., Seiford, L.M. and Tone, K. (2007). Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software (2nd Ed.). New York: Springer Science Business Media.

Cooper, W. W., Seiford L. M., and K. Tone (2000). Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software, Kluwer Academic Publishers, Boston.

Cooper, William W., Lawrence M. Seiford, and Joe Zhu. (2011). Handbook on Data Envelopment Analysis, 2nd ed. Cham: *Springer International Publishing* AG, ISBN 978-1-4419-6150-1.

Cooper, William W., Lawrence M. Seiford, and Kaoru Tone. (2007). Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software, 2nd ed. Cham: *Springer International Publishing* AG, ISBN 10-0-387-45281-8.

Debertin, D. L. (2012). Agricultural Production Economics, Second Edition (pp. pp, 14). Upper Saddle River.

Dolisca, F. C. & M. Jolly. (2008). Technical efficiency of traditional and non-traditional crop production: A case study from Haiti. *World Journal of Agric. Sciences*, 4(4): 416-426.

Doss, R. C. (2018). Women and agricultural productivity: Reframing the Issues. *Development Policy Review*, 36, 35–50. DOI: 10.1111/dpr.12243

Drope, J., Makoka, D., Lencucha, R., and Appau, A. (2016). Farm-Level Economics of Tobacco Production in Malawi. Revised Report, Centre for Agricultural Research and Development (CARD), Lilongwe.

Ekise, I., Nahayo, A., Mirukio, J. d., and Nsengiyumva, B. (2013). Analysis of the Impact of Agricultural Input Subsidies Voucher Programme on the Livelihoods of Small Scale Maize Producers in Kirehe District, *Eastern Rwanda. New York Science Journal,* 6(9), 32-44.

Erhabor, P. O. and Emokaro, C. O. (2007). Relative Technical Efficiency of Cassava Farmers in the Three Agro-Ecological Zones of Edo State, Nigeria. *Journal of Applied Sciences,* 7(19):2818-2823.

Emrouznejad, A., and Cabanda, E. (2015). Introduction to Data Envelopment Analysis and its applications. In the "Handbook of Research on Strategic Performance Management and Measurement Using Data Envelopment Analysis": 235-255. IGI Global, USA.

Euromonitor International (2017). Philip Morris International Inc in Tobacco. *http://www.euromonitor.com/philip-morris-international-inc-nobacco/report.* Site visited on 16th February, 2017.

Euromonitor International, (2012). Global Tobacco Findings: Tobacco in a New Era:

Euromonitor International, (2013). Cigarettes in the US Category Briefing. London:

FAOSTAT 2017. Production Data. http://www.fao.org/faostat/en/#data. Site visited on 16th February, 2017.

Färe, R.; S. Grosskopf and C. A. Lovell (1994). Production Frontiers, Cambridge: Cambridge University Press.

Farrell M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society.* Series A (General), Vol. 120, No. 3, pp 253-290.

Fekadu G. (2004). Analysis of technical efficiency of wheat production: A study in Machakel Woreda, Ethiopia. Unpublished MSc Thesis, Alemaya University.

Fleteschner, D., L. Zepeda, (2002). “Efficiency of Small Landholders in Eastern Paraguay” *Journal of Agricultural and Resource Economics* 27(2): 554-572.

Fogarasi, J., and Latruffe, L. (2009). Technical Efficiency in dairy farming: A comparison of France and Hungry in 2001-2006. *Studies in Agricultural Economics*, 110, 75−84.

Fried, H.O., Lovell, C.A. and Schmidt, S.S. (2008). The Measurement of Productive Efficiency and Productivity Growth. Oxford University Press Inc.nNew York.

Galluzzo, N. (2018). Analysis of Economic Efficiency in Some Irish Farms Using the DEA Approach. *Turkish Journal of Agriculture - Food Science and Technology*, Vol. 6(2), 156-162.

Gebre, G. G., Isoda, H., Rahut, B. D., Amekawa, Y., and Nomura, H. (2019). Gender differences in agricultural productivity: evidence from maize farm households in southern Ethiopia. *Journal of Geography*, 1-17.

Gebregziabher, G., Namara, R. E., and Holden, S. (2012). Technical efficiency of irrigated and rain-fed smallholder agriculture in Tigray, Ethiopia: A comparative stochastic frontier production function analysis. *Quarterly Journal of International Agriculture*, 51(3), 203.

Goibov, M., Schmitz, P.M. and Alemu, B.A. (2010). Technical Efficiency of Cash and Food Crops Producing Farms across Three Districts in Northern Tajikistan: a Non-parametric Approach. *Australian Journal of Basic and Applied Sciences* 4(11): 5705-5716.

Green, W. (2008). The Econometric Approach to Efficiency Analysis. Pearson Education, Inc. Upper saddle river, New Jersey.

Greene, W.H. (2003). Econometric Analysis (5th edition). Pearson Education, Inc. Upper saddle river, New Jersey.

Gujarati D. N, Porter D. C., (2009). Basic Econometrics (4th ed.). New York: Mc Graw Hill Inc.

Gujarati, N.D. (2004). Basic Econometrics. Fourth Edition. McGraw-Hill Publishing Co: New York.

Gumus, S. G. (2008). Economic Analysis of Oriental Tobacco in Turkey. *Bulgarian Journal of Agricultural Science*, 14(5), 470-475.

Hadi, P. U., Kustian, R. and Anugrah, I. S. (2008). Case study of tobacco cultivation alternative crops report, WHO, Jakarta, Indonesia. 59pp.

Hassan, M. M., Parvin, M. M., and Resmi, S. (2015). Farmer’s Profitability of Tobacco Cultivation at Rangpur. *International Journal of Economics, Finance and Management Sciences*. Vol. 3(2), 91-98.

Henningsen A, Mpeta D F, Adem A S, Kuzilwa J A, and Czekaj T G. (2015). The Effects of Contract Farming on Efficiency and Productivity of Small-Scale Sunflower Farmers in Tanzania. *International Conference of Agricultural Economics*, (pp. 1-24). Milano.

Hibbert, P., Hannaford, N., Long, J., Plumb, J., and Braithwaite, J. (2013). Final report: Performance indicators used internationally to report publicly on healthcare organisations and local health systems. Australian Institute of Health Innovation, University of New South Wales.

Hu, T.-w., and Lee, A. H. (2015). Tobacco Control and Tobacco Farming in African Countries. *Journal of Public Health Policy*, 36(1), 41–51.

Ilembo., B., and Kuzilwa, J. (2014). Technical Efficiency Analysis of Tobacco Production in Tanzania. *Interdisciplinary Journal of Contemporary Research in Business*, 6(3), 246-265.

Itama, K., Etuk, E., and Ukpngo, U. (2014). Analysis of Resource Use Efficiency among Small Scale Fish Farms in Cross River State, Nigeria. *International Journal of Fisheries and Aquaculture*, 6(7), 80-86.

Javed, M.I. (2009). Efficiency Analysis of Cotton-Wheat and Rice-Wheat Systems in Punjab, Pakistan. Unpublished Doctoral Thesis, University of Agriculture, Faisalabad.

Jenkinson, C. (1998). Measuring health status and quality of life: Question bank topic commentary on health. *http://qb.soc.surrey.ac.uk/topics/health/jenkinson.htm* site visited on 24 May 2015.

Jensen, M.C. and Meckling, W.H. (1976), Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure, *Journal of Financial Economics*, 3(4):305-360.

Justice, O. B., and Blackson, O. A. (2016). A study of the challenges of small scale farmers in accessing credit in Taraba State, Nigeria. *African Journal of Agricultural Economics and Rural Development*, 4(4), 359-364.

Kagaruki LK (2010). Community-based advocacy opportunities for tobacco control: experience from Tanzania. Glob. Health Prom. 17(2):41-44.

Kahan, D. (2010). Farm Business Analysis: using benchmarking. FAO, Roma.

Kamau M. (2007). Farm Household Allocative Efficiency. A Multi-Dimensional Perspective on Labour Use in Western Kenya. PhD Thesis, Wageningen University (2007).

Kavoi, a. M., Mwangi, J. G., and M, K. G. (2014). Challenges Faced by Small Land Holder Farmer Regarding Decision Making in Innovative Agricultural Development: An Empirical Analysis from Kenya. *International Journal of Agriculture Extension*, 02(02), 101-108.

Kibwage J, A, Odondo and G Momanyi. (2009). Assessment of livelihood assets and strategies among tobacco and non-tobacco growing households in south Nyanza region, Kenya. *African Journal of Agricultural Research* 4(4), 294-304.

Kidane, A., Hepelwa, A., Ngeh, E. T., and Hu, T.-w. (2013). Agricultural Inputs and Efficiency in Tanzania Small Scale Agriculture: A Comparative Analysis of Tobacco and Selected Food Crops. Tanzanian Economic Review, 3 (1), 1–16.

Kidane, A., Hepelwa, A., Ngeh, E., and Hu, T. (2015). A comparative analysis of technical efficiency of smallholder tobacco and maize farmers in Tabora, Tanzania. *Journal of Development and Agricultural Economics*, 7(2), 72–79. doi:10.5897/JDAE2014.0616

Kinkingninhoun-Mêdagbé, F. M., A. Diagne, F. Simtowe, A. R. Agboh-Noameshie, and P. Y. Adégbola. 2010. "Gender Discrimination and Its Impact on Income, Productivity, and Technical Efficiency: Evidence from Benin." Agriculture and Human Values 27 (1): 57–69.

Kirsten, J. and K. Sartorius. (2002). Linking agribusiness and small-scale farmers in developing countries: Is there a new role for contract farming? Development Southern Africa 19 (4): 503—528.

Kirsten, J., Dorward, A., Poulton, C. and Vink, N. (Eds). (2009). Institutional Economics Perspectives on African Agricultural Development. *International Food Policy Research Institute*. Washington DC. 501pp.

Kitila, G. M., and Alemu, B. A. (2014). Analysis of Technical Efficiency of Small Holder Maize Growing Farmers of Horo GuduruWollega Zone, Ethiopia: A Stochastic Frontier Approach. *Science, Technology and Arts Research Journal*, Vol. 3(3), 204-212.

Kokkinou, A. (2010). A Note on Theory of Productive Efficiency and Stochastic Frontier Models. European Research Studies, XIII (4), 110-118.

Kokkinou, A. (2012). An industry and country analysis of Technical Efficiency in the European Union, 1980-2005. PhD thesis. The University of Glasgow, Department of Economics, Business School, College of Social Sciences. Unpublished.

Koopmans, T.C. 1951. An analysis of production as an efficient combination of activities, in Koopmans, T.C. Activity Analysis of Production and Allocation, Cowles Commission for Research in Economics Monograph No. 13. New York: John Wiley and Sons.

Kothari, C. (2004). Research Methodology-Methods and Techniques, New Delhi: K.K. Gupta for New Age International (P) Ltd.

Kuboja, N. M, Isinika, A. C and Kilima F. T. M (2017). Determinants of economic efficiency among small-scale beekeepers in Tabora and Katavi regions, Tanzania: a stochastic profit frontier approach: *Journal of Development Studies Research* 4(1) 1-8

Kuboja, N. M., Kalala, A., and Mrutu, M. (2011). Tobacco production baseline survey in Serengeti, Tarime and Rorya Districts, Mara region. 4th International e-Conference on Agricultural Biosciences 2011, (pp. 13-14).

Kuboja, N. M., Kazyoba, S., Lwezaura, D. and Namwata, B. M. L. (2012). Adoption and impact of tobacco recommended varieties among smallholder farmers in Tabora Region. *Journal of Agricultural Science and Technology.*Vol.2, pp. 553-562.

Kuboja, N., and Temu, A. (2013). A Comparative Economic Analysis of Tobacco and Groundnut Farming in Urambo District, Tabora Region, Tanzania. *Journal of Economics and Sustainable Development*. 4(19), pp 104-111.

Kumar, P and Kumar, J (2008), Contract Farming: Problems, Prospects and its Effect on Income and Employment. *Agricultural Economics Research Review*, pp 243-250.

Kumar, S. and, Gulati, R. (2008). An Examination of Technical, Pure Technical, and Scale Efficiencies in Indian Public Sector Banks using Data Envelopment Analysis. *Eurasian Journal of Business and Economics* 1(2): 33-69.

Kumbhakar, S. C. and Lovell K. C. A. (2003). Stochastic Frontier Analysis. Cambridge University Press, Cambridge. 333pp.

Lecours, N, Almeida, G.E, Abdallah J.M, Novotny, T.E. (2012). Environmental health impacts of tobacco farming: a review of the literature. Tobacco Control, 21(2), 191–106.

Leppan, W, N, L., D, and Buckles. (2014). Tobacco Control and Tobacco Farming: Separating Myth from Reality. Ottawa. Anthem Press.

Liang L, Wu J, Cook WD, Zhu J (2008). Alternative secondary goals in DEA cross efficiency evaluation. *International Journal of Production Economics*. 113(2):1025–30.

Loeper, W. V., Musango, J., Brent, A., and Drimie, S. (2016). Analysing Challenges Facing Smallholder Farmers and Conservation Agriculture in South Africa: A System Dynamics Approach. *South African Journal of Economic and Management Sciences*, Vol. 5, 747-773.

Long, J.S. (1997). Regression Models for Categorical and Limited Dependent Variables. Advanced Quantitative Techniques in the Social Sciences Series (7). Sage Publications. California, USA.

Louw, D. (2018). Social, Economic and Environmental Impact of the Tobacco Growing Activities in Africa. Paarl: OABS Development (Pty) Ltd.

Lovell, C.A.K. 1993. Production frontiers and productive efficiency. In: Fried, H.O., Lovell C.A.K. and Schmidt S.S. (Eds.). The Measurement of Productive Efficiency: Techniques and Applications. Oxford University Press, New York, 3-67.

Lubis, R., Daryanto, A., Tambunan, M., and Purwati, H. (2014). Technical, Allocative and Economic Efficiency of Pineapple Production in West Java Province, Indonesia: A DEA Approach. *Journal of Agriculture and Veterinary Science* (IOSR-JAVS), 7(Issue 6 Ver. III), 18-23.

Lwelamira, J., Safari, J., and Wambura, P. (2015). Grapevine Farming and its Contribution to Household income and Welfare among Smallholder Farmers in Dodoma Urban District. American *Journal of Agriculture and Forestry*, Vol.3 (3), 73-79.

Maddala, G.S. (1983). Limited Dependent and Qualitative Variables in Econometrics. New York: Cambridge University press.

Mango, N., Makate, C., Hanyani-Mlambo, B., Siziba, S., and Lundy, M. (2015). A stochastic frontier analysis of technical efficiency in smallholder maize production in Zimbabwe: The post-fast-track land reform outlook. *Cogent Economics and Finance*, Vol. 3(1), 1-14.

Mangora, M. M. (2012). Shifting Cultivation, Wood Use and Deforestation Attributes of Tobacco Farming in Urambo District, Tanzania. *Current Research Journal of Social Sciences* Vol. 4(2): 135-140.

Marwa, N., and Aziakpono, M. (2014). Efficiency and Profitability of Tanzanian saving and Credit Cooperatives: Who is a Star? *Journal of Economics and Behavioral Studies*, 6(8), 658-669.

Mataba, L., and Aikaeli, J. (2016). Empirical Analysis of Efficiency Community Banks in Tanzania. International Journal of Economics and Finance, 8(12), 77-94.

Mayuya, S. (2013). Impact of tobacco production on poverty reduction at household level: a case of Urambo district in Tabora, Tanzania. SEGi Review 6(1), pp 42-59

Mbanasor J A, Kalu K C. (2008). Economic efficiency of commercial vegetable production system in Akwa Ibom state, Nigeria: A translog stochastic cost function frontier approach. Tropical and Subtropical Agroecosystems, Vol.8, 313–318.

Mbehoma, P. M., and Mutasa, F. (2013). Determinants of Technical Efficiency of Smallholders Dairy Farmers in Njombe District, Tanzania. *African Journal of Economic Review,* Vol. 1(2), 15-29

McDonald J. (2008). Using Least Squares and Tobit in Second Stage DEA Efficiency Analyses. *European Journal of Operational Research* 197(1), 792-798

McDonald, J.F. and Moffitt, R.A. (1980). The use of Tobit Analysis. The Review of Econometrics and Statistics 62 (2):318-321.

Meeuseen, W., and van den Broeck, J. (1977), "Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error," *International Economic Review*, 18pp, 435–44.

Minot, N. (1986). Contract farming and its effect on small farmers in less developed countries. Working paper no. 31. East Lansing: Michigan State University.

Minot, N. (1986). Contract farming and its effect on small farmers in less developed countries. Working paper no. 31. East Lansing: Michigan State University.

Mkanthama, J., Makombe, G., Kihoro, J., Ateka, E. M., & Kanjere, M. (2017). Technical efficiency of rain fed and irrigated rice production in Tanzania. *Journal of agriculture science*, 1-9.

Mohammad, H., Mosammod, P., and Samira, R. (2015). Farmer's Profitability of Tobacco Cultivation at Rangpur District in the Socio-Economic Context of Bangladesh: An Empirical Analysis. *International Journal of Economics, Finance and Management Sciences*, 3(2), 91-98.

Mohammednur, Y. and Negash, Z. (2010). Effect of Microfinance Participation on Farmers' Technical Efficiency: Panel Evidence from Tigray, Northern Ethiopia. Mekelle University, Department of Economics, Mekele, Ethiopia.

Mpandeli, S., and Maponya, P. (2014). Constraints and Challenges Facing the Small Scale Farmers in Limpopo Province, South Africa. *Journal of Agricultural Science*, 6(4), 135-143.

Msangya, B., and Yihuan, W. (2016). Challenges for Small-Scale Rice Farmers: A Case Study of Ulanga District Morogoro, Tanzania. *International Journal of Scientific Research and Innovative Technology*, Vol. 3(6), 65-83.

Msuya, E., Hisano, S., and Nariu, T. (2008). "An Analysis of Technical Efficiency of Smallholder Maize Farmers in Tanzania in the Globalization Era". XII World Congress of Rural Sociology of the International Rural Sociology Association. Goyang, Korea.

Mukhtar, U., Mohamed, Z., Shamsuddin, M. N., Sharifuddin, J., and Iliyasu, A. (2018). Application of Data Envelopment Analysis for Technical Efficiency of Smallholder Pearl Millet Farmers in Kano State, Nigeria. *Bulgarian Journal of Agricultural Science*, 24 (No 2), 213–222.

Musimu, J. J. (2018). Economics of small holder common beans production in Mbeya, Tanzania. *African Journal of Agricultural Research*, 541-568.

Mussa, E. C. (2011). Economic Efficiency of Smallholder Major Crops Production in the Central Highlands of Ethiopia. Nairobi: Egerton University. A thesis submitted to the Graduate School in partial fulfilment for the requirements of the award of the Masters of Science Degree in Agricultural and Applied of Egerton University.

Mwajombe, K. K., and Mlozi, R. S. (2015). Measuring Farm-level Technical Efficiency of Urban Agriculture in Tanzanian Towns: The Policy Implications. *World Journal of Social Science*, Vol. 2(1), 62-72.

Mwasimba, M., and Abdul, N. (2017). Challenges Facing FCV Tobacco Famers in India and Tanzania: An Empirical Scrutiny. International *Journal of Management and Social Science Research*, 1(36), 59-67.

Mwimo, L., Mbowe, W., Kombe, C., Kibesse, B., Mziya, M., Maduhu, K., Ndunguru, E. (2016). Contract Farming Schemes in Tanzania: Benefits and Challenges. Bank of Tanzania, Directorate of Research and Economic Policy. Dar es Salaam:

NBS, (2009). Kilimo kwanza: Towards tanzania green revolution. Technical report, Tanzania

Ndomba, H.H. (2018). A History of Peasant Tobacco Production in Ruvuma Region, Southern Tanzania, 1930-2016. PhD Dissertation. Stellenbosch: Stellenbosch University.

Necat, M. R., and Alemdar, T. (2006). Technical Efficiency Analysis of Tobacco Farming in Southeastern Anatolia., (pp. 165-172).

Ngailo, J. A., Mwakasendo, J. A., and Kisandu, D. B. (2016). Rice Farming in the Southern Highlands of Tanzania: Management Practices, Socio-Economic Roles and Production Constraints. European *Journal of Research in Social Sciences*, 4(3), 1-13.

North, D. 1984. Transaction costs, institutions, and economic history. *Zeitschrift Für Die Gesamte Staatswissenschaft / Journal of Institutional and Theoretical Economics* 140 (1): 7-17.

Novickyte, L., and Droždz, J. (2018). Measuring the Efficiency in the Lithuanian Banking Sector: The DEA Application. *International Journal for Financial Studies*, Vol. 6(37), 1-15.

Ntibiyoboka, J. (2014). Economics of Smallholder Tobacco Production and Marketing in Mpanda District. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 91pp.

Nyagaka, D.O., Obare, G.A., Omiti, J.M. and Nguyo, W. (2010). Technical Efficiency in Resource Use: Evidence from Smallholder Irish Potato Farmers in Nyandarua North District, Kenya. African Journal of Agricultural Research 5(11):1179-1186.of Tanzania and the Food and Agriculture Organisation of the United Nations.

Ogunleye, A. S., Adeyemo, R., Bamire, A. S., and Kehinde, A. D. (2017). Assessment of profitability and efficiency of cassava production among government and non-government assisted farmer's association in Osun State, Nigeria. African *Journal of Rural Development*, 2(2), 225-233.

Olubandwa, A. M., Kathuri, N. J., and Odero-Wanga, D. (2011). Challenges Facing Small Scale Maize Farmers in Western Province of Kenya in the Agricultural Reform Er. *American Journal of Experimental Agriculture*, 1(4), pp. 466-476.

Omotesho, K. F., Ogunlade, I., Lawal, M. A., and Kehinde, F. B. (2016). Determinants of Level of Participation of Farmers in Group Activities in Kwara State, Nigeria. *Journal of Agricultural Faculty of Gaziosmanpasa University*, 33(3), pp. 21-27.

Oni, O. A., Nkonya, E., Pender, J., Phillips, E. and Kato, E., (2009). Trends and Drivers of Agricultural Productivity in Nigeria: NSSP.

Onumah, E.E. and Acquah, H.D. (2010). Frontier Analysis of Aquaculture Farms in the Southern Sector of Ghana. *World Applied Sciences Journal*, 9(7), 826-835

Opaluwa, Haruna I., Otitoliaye Justin O., Ibitoye Stephen J. (2014). Technical Efficiency Measurement among Maize Farmers in Kogi State, Nigeria. *Journal of Biology, Agriculture and Healthcare*, 4(25), 240-246.

Otañez, M. (2008). Social disruption caused by tobacco growing: In proceedings of the study on alternatives to tobacco growing; Tobacco control research and education, University of California, San Francisco. 46pp.

Owuor, G. and Shem, O. A. (2009). What Are the Key Constraints in Technical Efficiency of Smallholder Farmers in Africa? Empirical Evidence from Kenya. A Paper Presented at 111 EAAE-IAAE Seminar ‘Small Farms: decline or persistence’ University of Kent, 26-27th June.

Park C., Wilding M. and Chung C. (2014). The importance of feedback: Policy transfer, translation and the role of communication. *Journal of policy studies*. Vol.13 (1) 1-31.

Pen, Y.-l., and Kong, R. (2015). Technical Efficiency on Flue-cured Tobacco Production and Its Hierarchical Influencing Factors: An Empirical Study in China. International Conference of Agriculture Publication (pp. 1-21). Milan-Italy: Northwest and University.

Peter, K. (1998). A Guide to Econometrics (5th ed). Cambridge, MIT Press.

Philip, H. D. (2007). An Exploration of the Potential of Producing Biofuels and the Prospective Influence of Biofuels Production on Poverty Alleviation among Small-Scale Farmers in Tanzania. *Diese Dissertation ist auf dem Hochschulschriftenserver der ULB Bonn*, German. Unpublished.

Pradhan, A. K. (2018). Measuring Technical Efficiency in Rice Productivity Using Data Envelopment Analysis: A Study of Odisha. *International Journal of Rural Management*, 1-21.

Quattara, W. (2012). Economic Efficiency Analysis in Côte d'Ivoire, American Journal of Economics. 2(1), 37-46.

Rios, A., G. Shively, 2005. "Farm size and nonparametric efficiency measurements for coffee farms in Vietnam" Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, July 24-27, Rhode Island.

Sambuo, D. (2014). Tobacco Contract Farming Participation and Income in Urambo; Heckma's Selection Model. *Journal of Economics and Sustainable Development*, 5(28), 230-237.

Samuel, T. A., Debrah, I. A. and Abubakari, R. (2014). Technical Efficiency of Vegetable Farmers in Peri-Urban Ghana Influence and Effects of Resource Inequalities. American *Journal of Agriculture and Forestry*, 2(3): 79-87.

Saysay, J. L. (2016). Profit Efficiency among Smallholder rice farmers in Bein Garr and Panta Districts Central Liberia. A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Agricultural Economics of Sokoine University of Agriculture.

Shahzad M. A., (2019). Measuring technical efficiency of wheat farms in Punjab, Pakistan: a stochastic frontier analysis approach *Journal of Agricultural Studies 2019*, Vol. 7(1). pp 115-127

Sharma, K.R., Leung, P.S., Zaleski, H.M., 1997. Productive efficiency of swine industry in Hawaii: stochastic frontier vs. data envelopment analysis. J. Prod. Anal. 8, 447-459.

Sharma, R. K., Leunga, P., and Zaleskib, H. M. (1999). Technical, allocative and economic efficiencies in swine production in Hawaii: a comparison of parametric and nonparametric approaches. *Journal of Agricultural Economic*, Vol. 20, 23-35

Shephard, R.W., 1953. Cost and production functions. Princeton, NJ: Princeton University Press 104 p.

Sibiko, K. W., Ayuya, O. I., Gido, E. O. and Mwangi, J. K. (2013). An Analysis of Economic Efficiency in Bean Production: Evidence from Eastern Uganda. *Journal of Economics and Sustainable Development*, 4(13):2222-2855.

Sienso, G., Asuming-Brempong, S., andAmegashie, D. P. (2013). Estimating the efficiency of maize farmers in Ghana.In 4th International Conference of the AAAE.

Sigelman, L. and Zeng, L. (1999). Analysing Censored and Sample-Selected Data with Tobit and Heckit Models. Political Analysis 8:167–182.

Singh, K. (2007). Quantitative Social Research Methods. Sage Publications, New Delhi, India.

Siva, G. S., Gupta, D. S., Bask, S., Sarker, S. C., Saha, A., and Debnath, M. K. (2018). Technical, Allocative, Scale and Economic Efficiencies of Paddy Production farms in Terai and Coastal Zones of West Bengal using Data Envelopment Analysis. Bulletin of Environment, Pharmacology and Life Sciences, Vol 7(1), 44-52.

Suleiman, R., and Rosentrater, K. (2015). Current Maize Production, Postharvest Losses and the Risk of Mycotoxins Contamination in Tanzania. 2015 ASABE Annual International Meeting, (pp. 1-125). New Orleans, Louisiana.

Sutton, J., and Olomi, D. (2012). An Enterprise Map of Tanzania. London: International Growth Centre.

Syp, A., and Osuch, D. (2018). Assessment of Farm Efficiency and Productivity: A Data Analysis. Research for Rural Development, Vol.2, 146-153. Doi: 10.22616/rrd.24.2018.065

Tanzania Tobacco Board (2015). Tobacco Production and Marketing Statistics.

Tasie, L., Kuku, O., and Ajibola, A. (2011). A Review of Literature on Agricultural Productivity, Social Capital and Food Security in Nigeria. *International Food Policy Research Institute.*

Tchale, H. (2009). The efficiency of smallholder agriculture in Malawi. World Bank, Lilongwe, Malawi. AFJARE 3 (2): 101-121.

Thanassoulis. E and Silva. M.C (2018). Measuring Efficiency through Data Envelopment Analysis, Impact, 2018:1, 37-41, DOI: 10.1080/2058802X.2018.1440814

Tobin, J. (1958). Estimation of relationships for limited dependent variables. Journal of Econometrics, 26(1): 24–36

Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Journal of Econometrics*, 26(1): 24–36

Toma, E., Dobre, C., Dona, I., and Cofas, E. (2015). DEA Applicability in assessment of agriculture efficiency on areas with similar geographically patterns. Agriculture and Agricultural Science Procedia, 6, 704−711.

Tran, N.A., Shively, G., and Preckel, P. (2008). A New Method for detecting Outliers in Data Envelopment Analysis. Applied Economics Letters 1–4.

Tshilambilu, B. (2011). Technical Efficiency in Maize Production by Small-Scale Farmers in Ga-Mothiba, Limpopo Province, South Africa. A Thesis Submitted to Department of Agricultural Economics and Animal Production, University of Limpopo, South Africa

Ul Haq, S., and Boz, I. (2019). Estimating the efficiency level of different tea farming systems in Rize Province Turkey. *Ciência Rural, Santa Maria*, Vol.49:12, e20181052, 2019, Vol. 49(12), 1-12.

Ullah, S., Mahmood, S., Karim, U., Rehmat, U., Ally, M., and Farid, U. (2015). Economic Analysis of Tobacco Profitability in District Swabi. *Resources Development and Management*, 10(1), pp. 74-79.

Umanath, M., and Rajasekar, D. D. (2013). Data Envelopment Analysis to Estimate Technical and Scale Efficiency of Farms in Periyar-Vaigai Irrigation System of Tamil Nadu, India. *Indian Journal of Science and Technology*, 6(10), 5331-5356.

UN Comtrade. (2013). retrieved from: http://comtrade.un.org/. Accessed on 23 July 2017.

Unite Republic of Tanzania (URT) (2019), Tanzania Agriculture Statistics Strategic Plan (2014/15– 2018/19)

United Republic of Tanzania (URT) (2015/2016-2024/2025). Agricultural Sector Development Strategy-II.

Unite Republic of Tanzania (URT) (2013). 2012 Population Distribution by Age and Sex, National Bureau of Statistics. Dar Es Salaam: NBS, Dar es Salaam.

Usman, M., Ashraf, W., Jamil, I., Mansoor, M. A., Ali, Q., and Waseem, M. (2016). Efficiency Analysis of Wheat Farmers of District Layyah of Pakistan. *American Journal of Experimental Agriculture*, pp. 1-11.

Vanni, F. (2014). Agriculture and Public Goods. The Role of Collective Action. Springer Dordrech Heidelberg, New York. 150pp.

Wang, Y., Shi, L., Zhang, H., and Sun, S. (2017). A data envelopment analysis of agricultural technical efficiency of Northwest Arid Areas in China. *Journal on Agriculture Science Engineering*, Vol. 4, 195–207.

Watkins, B. K., Hristovska, T., Mazzanti, R., Wilson, C. E., and Schmidt, L. (2014). Measurement of Technical, Allocative, Economic, and Scale Efficiency of Rice Production in Arkansas Using Data Envelopment Analysis. *Journal of Agricultural and Applied Economics*, 46(1), 89-106.

WHO (2015). Status of Tobacco Production and Trade in Africa. Factsheets, United Nations Conference on Trade and Development. Switzerland.

WHO (2015). Tobacco Atlas16 pdf. *http://www.who.int/tobacco/en/atlas16.pdf.* Site visited on 6 February Friday, 2016, WHO, (2003) Framework convention on tobacco control, World Health Organization Geneva,*witzerlandtobacco+use+and+tobacco+control+world+health+organization+pdf&oq* Site visited on May, 2015.

WHO-FCTC, (2012). Economically sustainable alternatives to tobacco growing (in relation to Articles 17 and 18 of the WHO Framework Convention on Tobacco Control). Seoul, Republic of Korea.

William M. (2017) a Dissertation Submitted in Partial Fulfilment of the Requirement for Award of the Degree of Master of Science in Economics of Mzumbe University, unpublished.

Wooldridge, J.M. (2002). Econometric Analysis of Cross Section and Panel Data. Cambridge, MIT Press.

World Bank (2013). CIA World fact book. Hpp//www.cia.gov//library/publications-world-factbook/field/2012.html. Site visited on May 2016.

World Bank, (2007): Country Economic Memorandum-Main report: Investment and Behaviour Change for Growth. Washington D.C.

World Bank, (2019). Tanzania Economic Update, Human Capital: The real wealth of Nations: Africa Region Macroeconomics, Trade and Investment Global Practice.

World Bank. (2008). World Development Report. World Bank.

Xaba, T., Marwa, N., and Helm, M. M. (2019). Efficiency and Profitability Analysis of Agricultural Cooperatives in Mpumalanga, South Africa. *Journal of economics and behavioral studies,* Vol. 10(6), 1-10.

Zivkovic, D., Jelic, S. and Rajic, Z. (2009). The role of knowledge, innovation and human capital in multifunctional and territorial rural developments. In: Proceedings of EAAE seminar 9 – 11 December, 2009, Belgrade, Republic of Sebia.1-4pp.

APPENDICES

Appendix 1: Research permit from DPSRTC to National Bureau of Statistics

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000, MOROGORO, TANZANIA
Phone: 023-2604523/2603511-4; Fax: 023-2604651

Our Ref. SUA/ADM/R.1/8 **Date: 6th April 2016**

National Bureau of Statistics,
P.O. Box 796,
DAR ES SALAAM.

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by Universities Act No.7 of 2005 and SUA Charter of 2007 which became operational on 1st January 2007 repealing Act No.6 of 1984. One of the mission objectives of the University is to generate and apply knowledge through research. For this reason the staff, students and researchers undertake research activities from time to time.

To facilitate the research function, the Vice-Chancellor of the Sokoine University of Agriculture (SUA) is empowered under the provisions of SUA Charter to issue research clearance to both, staff, students and researchers of SUA.

The purpose of this letter is to introduce to you **Mr. MBUJILO, ALOYCE MARTIN** a bonafide **Ph.D (AGRICULTURAL ECONOMICS)** student with registration number **HD/T/SUA/FOA/03/2014** of SUA. By this letter **Mr. Mbujilo** has been granted clearance to conduct research in the country. The title of the research in question is **"Economic performance of tobacco farmars operating under contract farming in Urambo and Namtumbo Districts, Tanzania "**

The period for which this permission has been granted is from **April 2016 to October 2016.** The research will be conducted in **Urambo and Namtumbo.**

Should some of these areas/institutions/offices be restricted, you are requested to kindly advice the researcher(s) on alternative areas/institutions/offices which could be visited. In case you may require further information on the researcher please contact me.

We thank you in advance for your cooperation and facilitation of this research activity.

Yours sincerely,

Prof. Gerald C. Monela
VICE-CHANCELLOR

VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to: Student

Appendix 2: Research permit from DPSRTC to MAFSC.

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000, MOROGORO, TANZANIA
Phone: 023-2604523/2603511-4; Fax: 023-2604651

Our Ref. SUA/ADM/R.1/8

Date: 6th April 2016

Ministry of Agriculture. Food Security and Cooperation,
P.O. Box 9192,
DAR ES SALAAM.

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by Universities Act No.7 of 2005 and SUA Charter of 2007 which became operational on 1st January 2007 repealing Act No.6 of 1984. One of the mission objectives of the University is to generate and apply knowledge through research. For this reason the staff, students and researchers undertake research activities from time to time.

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Prof. Gerald C. Monela
VICE-CHANCELLOR

VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to: Student

Appendix 3: Research permit from DPSRTC to DED-Urambo

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000, MOROGORO, TANZANIA
Phone: 023-2604523/2603511-4; Fax: 023-2604651

Our Ref. SUA/ADM/R.1/8 **Date: 6th April 2016**

The District Executive Officer,
P.O. Box
URAMBO-TABORA.

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by Universities Act No.7 of 2005 and SUA Charter of 2007 which became operational on 1st January 2007 repealing Act No.6 of 1984. One of the mission objectives of the University is to generate and apply knowledge through research. For this reason the staff, students and researchers undertake research activities from time to time.

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Prof. Gerald C. Monela
VICE-CHANCELLOR

VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to: Student

Appendix 4: Research permit from DPSRTC to DED-Namtumbo

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000, MOROGORO, TANZANIA
Phone: 023-2604523/2603511-4; Fax: 023-2604651

Our Ref. SUA/ADM/R.1/8 **Date: 6th April 2016**

The District Executive Officer,
P.O. Box
NAMTUMBO-SONGEA.

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by Universities Act No.7 of 2005 and SUA Charter of 2007 which became operational on 1st January 2007 repealing Act No.6 of 1984. One of the mission objectives of the University is to generate and apply knowledge through research. For this reason the staff, students and researchers undertake research activities from time to time.

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VICE-CHANCELLOR

VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to: Student

Appendix 5: Questionnaire for contracted tobacco farmers

Economic Performance of Smallholder Tobacco Farmers in Tabora and Ruvuma Regions, Tanzania

Confidentiality:

This questionnaire is being administered for academic purpose. The information will be used to analyse economic performance of tobacco farmers operating under contract farming, their production and marketing challenges and the underlying determinants among tobacco farmers in Tabora and Ruvuma Regions, Tanzania.

NB: The information provided herein will remain strictly confidential.

1.0 Section A: Information of the Study Area

Interviewer's Name---

Interviewee Name--

Village/Primary Co-operative Society's Name----------------------------

Division…---

Ward--

Date for interview--

Questionnaire Number (TBR) --

1.1 Section B: Respondent Demographic Information

1.1 For how long have you been growing tobacco? --------------------- (Years)

Household Socio-Economic and Demographic Characteristics

No of household members (head of the household must be the first)	1.2	1.3	1.4	1.5	1.6	1.7	1.8
	Age	Sex*	Marital status**	Education level***	Relationship with HH****	Primary occupation*****	Time of work (Hours)

*****1 = Male, 2 = Female,
**1 = Single 2 = Married 3 = Divorced 4 = Widowed 5 = Separated 6 = others (specify),
*****1 = Primary, 2 = Secondary, 3 = Diploma, 5 = Adult education 6 = others (specify),
****1= Spouse 2 = Child 3 = Parent 4 = Grandchild,
*****1 = Crop production, 2 = Livestock keeping, 3 = labour, 4 = Salary job, 6 = business, 7 = other (specify),

1.9.1 Apart from farming what other type of business are you engaged to? -------------------

1.9.2 Did you born in this village? 1= Yes, 2 = No ---

1.9.3 If no in 1.9.1 above where did you come from? ---

1.9.4 When did you came in this village? ---

1.9.5 What were the reasons for you to shift into this village?

1. Due to marriage
2. To follow up my parents
3. To look for cattle shelter
4. Due to transfer from my formal job
5. To look for employment
6. To look for farming areas

1.9.5.1 What is your availability status in this village? (Please Tick whichever appropriate to you)

1. Permanent resident
2. Permanent resident in local employment
3. Permanent resident in full employment
4. Resident hired labour
5. Other (specify)---

2.0 Section C: Land ownership, allocation and use

2.1	Do you own land in this village?			2.2	If Yes, No of acreages
	Yes = 1 and No = 0				

2.3 What is the highest cost of purchasing the land in this area------------------TZS/ha?

2.4 What is the highest cost of renting the land in this area ----------------------TZS/ha?

2.5 In your farm what type of crops are you growing?

Land allocation to crops by order of preference (all in ha)

No.	Type of crop	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7
2.6	Crop type							
2.7	Plot size (ha)							
2.8	Quantity harvested (Kg)							
2.9	Quantity sold in Kg							
2.10	Quantity consumed (Kg)							
2.11	Price sold per Kg/bag							
2.12	Mode of acquisition of the land**							

Note" Plot 1 – 7 denote plots located to tobacco, paddy rice, maize, beans, groundnuts, simsim and sunflower respectively

******1= Purchased, 2= Hired, 3= Family inheritance, 4 = other (specify)

2.13 What is the distance from your farm to the balling center/store? ------------------------ (Km)

3.0 Section D: Labour inputs in tobacco production

3.1 What is the main source of labour for tobacco production? *(Circle appropriate one)*

1. Family labour
2. Hired labour
3. Both family and hired labour

3.2 What other sources of labour inputs were used in tobacco production last season 2014/15

1. Tractor
2. Drought animals
3. All together

3.3 What was the cost of tractor/Drought in tobacco cultivation per acre in 2014/15 cropping season TZS--

3.4 Did you employed any permanent labour in your farm in 2014/15 cropping season? ------ (1 = Yes; 2 = No)

3.5 If yes; how many persons were employed in your farm in 2014/15 cropping season? -----

3.6 How much did you pay a permanent labour per season in 2014/15 cropping season? -----

3.7 What was the cost of labour per acre in performing these farm activities in 2014/15 cropping season?

1. Land preparation per acre-------------------------------------
2. Harvesting per day---
3. Grading and classification per day---------------------------
4. Tobacco drying per day---------------------------------------

3.8 How many labour units in total worked in tobacco field in the in 2014/15 cropping season?

Type of Labour	Men	Women
Family labour		
Hired labour		
Children		
Total		

3.9 Indicate labour patterns for input used in tobacco productions in 2014/15 cropping season

Activity/type of work	Family Labour			Hired Labour		
	Men	Women	Children	Men	Women	Children
Firewood collection						
Barn constructions and						
maintenance						
Land preparations and ridging						
Transplanting						
Fertilizer and pesticides						
application						
Topping and suckering						
Harvesting						
Curing						
Sorting, grading, bailing and						
marketing						
Other works						

Key: men/women = > 18yrs, children <18.

1 = Man/day = 6 person hours for a man = (0.75*6) person hours for woman = 12 child hours.

3.10 How many trips of firewood did you used for tobacco curing in 2014/15 cropping season?

3.11 What was the cost of firewood per trip in 2014/15 cropping season?? ------------

---

4.0 Section E: Inputs supply and Prices

4.1 What was the tobacco variety grown on farm in 2014/15 cropping season?

(1 = flue cured tobacco; 2 = Dark fire tobacco)---------------------------------------

4.2 Who supplied inputs with you in 2014/15 cropping season? -----------------------

4.3 Did you apply fertilizer? (Yes = 1; No = 2) ---

4.4 What types of inputs supplied and its price in 2014/15 cropping season? (Fill in the box below)

Operation/Types of inputs	Source	Quantity supplied	Unit Price	Total Cost
Tobacco seed (packets)				
Fertilizer NPK (Bags)				
Fertilizer (CAN)				
Pesticides				
Firewood				

4.5 What was the system used to help you to acquire the inputs in 2014/15 cropping season?

1. To purchase it from shop vendors
2. Input credit from AMCOS
3. Input credit from tobacco companies
4. Others (Specify)

4.6 Were the inputs supplied in time? (Yes = 1; No = 2) ---------------------------------

4.7 If No, what was the reason for the delays? (Mention)

4.8 Were the inputs supplied to you sufficient for tobacco farming requirements?

(1 = Yes; 2 = No)-----

4.9 What inputs was supplied in shortage (list them)

1. ------------------------------------
2. ------------------------------------
3. ------------------------------------
4. ------------------------------------
5. ------------------------------------
6. ------------------------------------

4.10 What was the reasons for shortage supply of these inputs?

1. Poor estimates
2. Limited stock by the suppliers
3. Farmer's indebtedness
4. Late distribution of inputs to grower
5. Other specify---

4.11 What is the trend of input prices compared with the previous seasons?

1. Increased
2. Decreased
3. Constant

4.12 What are the major tobacco structures do you have?

Equipment	When was the most recent item constructed and source of money?			
	Owned	Rented	Time of construction	Source of money
Permanent curing barn				
Bulking chamber				
Farm store				
Others (Specify)				

1= Not have, 2 = owned, 3 = Rented, 4 = Borrowed

4.13 What are the major farm Mechanization, transportation and communication equipment do you have?

Equipment	Ownership	When was the most recent

				item constructed and source of money	
	Owned	Rented	Borrowed	Time of Purchase	Source of Money
Tractor					
Car/Truck					
Oxen/ Donkey					
Motorcycle					
Bicycle					
Wheelbarrow					
Mobile phone					
Radio					
Others (specify					

*1 = Not have, 2 = owned, 3 = Rented, 4 = Borrowed

5.0 Access to credit

5.1 Besides input credit, during the year 2014/2015 cropping season; did your household have access to cash credit services for daily operation in tobacco production? (1 = Yes; 2 = No)-

5.2 If yes in 5.1 above, please fill the table below.

Source of credit	Amount received	Interest rate	Total amount paid	Payback period	Use of credit
AMCOSs					
Bank					
SACCOs					
Relatives					

5.3 How was cash credit acquired used?

1. Purchase seeds
2. Purchase fertilizer
3. Purchase herbicide
4. Pay for labour
5. Hired tractor/drought animal services
6. Others, specify---

5.4 How much loan did you get for these specific activities?

1. Firewood--
2. Grading--
3. Cash advance---------------------------------------

5.5 Have you paid the full amount of your loan in 2014/15 cropping season?
(1 = Yes; 2 = No)--------------

5.6 If no. in 5.5, how much of the debt have been currently paid?

1. Half the amount
2. Quarter the amount

3. Not at all

5.7 If no in 5.6, what were the reasons for not repaying the loan?

6.0 Section F: Extension Services

6.1 Did your household receive extension service during 2014/2015 cropping season? (1 = Yes; 2 = No)---------------------

6.2 If No in 6.1 above; why?

6.3 If yes in H01 above, who was the main provider of extension services?

1. The government
2. Tobacco leaf dealers
3. AMCOS
4. Banks institutions

6.4 If yes in 6.1 how many times

1. Once per season
2. 2-3 times per season
3. 4-5 times per season
4. Throughout the season

6.5 At what place were the extension services conducted?

1. Training center
2. Farmers plot
3. Demonstrations plot
4. During meetings
5. Farmers group

7.0 Section H: Marketing Information

7.1 How do you classify your tobacco for marketing (rank the criteria).

1. Colour
2. Leaf size

3. Weight
4. Moisture contents
5. Others (Specify)

7.2 Whose is responsible for determining tobacco market prices?

1. A Farmer
2. Classifiers
3. Leaf dealers
4. Primary cooperatives
5. Tobacco stakeholders (WETCU, Board, Buyers)
6. Others (Specify)……………………

7.3 Do you know where classifications and price determination takes places?

1. At the market floor
2. At the farm
3. At Primary cooperatives offices
4. Others (Specify)------------------------------

7.4 What are your concerns about classification procedures?

1. Reasonable
2. Good
3. Favorable
4. Discouraging

7.5 What are your views about the 2014/15 season tobacco prices per Kg?

1. Reasonable
2. Good
3. Favorable
4. Discouraging

7.6 It takes how long to be paid your money after selling your tobacco? (Tick)

1. Immediately after selling crops
2. 1= 2 month after selling
3. 3=4 months after selling
4. 4= 5 months after selling
5. 5= other (Please specify) --

7.7 What were the major challenges you experienced in tobacco production in 2014/15?

8.0 Section B: Household Income

8.1 What was your main source of income last crop season in 2014/15?

1. Sales of crops
2. Off-farm activities/business

3. Sales of livestock
4. Labour sales
5. Remittances
6. Other (specify) --

8.2 Besides income received from crop production, what other income sources did you earn in 2014/15 cropping season, specify the source (s) and amount earned.

Activity	Hour per day spent on the activity	Average income per month
Retail/petty trading		
Salary employment		
Unskilled wage labour		
Natural resource use (e.g bricks, charcoal)		
Bee keeping		
Livestock keeping		
Handcraft		
Others		

8.3 Given the tobacco quality produced in 2014/15 cropping season, what was the quantity and price of different grades did you obtained? (Attach *Kalamazoa**)

Grades	Quantity harvested in Kg	Quantity sold in Kg	Price/Kg TZS	Point of sale

Note' *Kalamazoa* is a list of all the grades and its respective price farmers got during cropping season.

9.0 Farmer's General Comments about input credit under the Export Credit Guarantee Scheme

9.1 do you know that your loan has been guaranteed by the government? (1 = Yes; 2 = No)--

9.2 If yes in item 9.1 above; what are your comments about the performance of the whole contract arrangements under the currently inputs credit through ECGS?

9.3 Tick (V) indicating your perception on the extent of severity of the challenges facing in farming activities in 2014/15 cropping season.

(1 = strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = strongly agree)

Problems/Challenges	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Drought and climate change					
Lack and high cost of labour					
Late input supply					
High cost of inputs					
Shortage of land					
Lack of credit					
Lack of extension services					
Pest and disease					
Grading system					
Side selling					
Infrastructure					
Low price of outputs					
Management					

9.4 In your views, what should be done to improve tobacco contract farming under the current arrangements whereby inputs are outsourced through commercial banks?

Thank you for your cooperation

Appendix 6: Questionnaire for government and primary cooperative societies

1.0 Section A: Cooperative Society Information

1.1 Questionnaire Number------------------------------

1.2 District---

1.3 Ward---

1.4 Division---

1.5 Village---

1.6 Name of Primary Cooperative Society------------

1.7 TBR Number---

1.8 Your Designation in the PCS----------------------

1.9 Date of Interview------------------------------------

2.0 **Section A: Cooperative Society Information**

2.1 For how long have you been in this designation in the PCS?---------------------------(Years)

2.2 How many member have been register in 2014/5 cropping season in your PCS?

i. Men ---------------------------

ii. Women------------------------

2.3 What is your view regarding members tobacco production?

1. Increasing
2. Decreasing
3. Constant

2.4 If they are decreasing in 2.3 above, why?

2.5 Where did you get loans to outsource agricultural inputs in 2014/15 cropping season?

2.6 Is your PCS received inputs credit under the Export Credit Guarantee Scheme (ECGS)? (1 =Yes; 2 = No)-----------------

2.7 If yest in 2.6 above, How many shillings of loans did you received in your PCS?----------

2.8 If not in 2.6 above, where did you get the loans in 2014/15 cropping season?---------------

2.9 How many Kg of tobacco did you produce in 2014/15 cropping season in your PCS? ----

2.10 In 2.9 above, what was the value of tobacco produced in 2014/15 cropping season ---------

2.11 If you received loan in 2.6 above, what percent was the loan interest -------------------------

2.12 What what were the main challenges you experience in provision input loans to tobacco farmers in 2014/15 cropping season?

2.13 What were the main challenges you faced in applying input loans through the Credit Guarantee Scheme (ECGS)?

2.14 What were the main challenges you faced in tobacco marketing in 2014/15 cropping season?

2.15 In your option, what could be done to improve loans accessibility to tobacco farmers?

Thank you for your Cooperation

Appendix 7: Enumerators

In all districts the researcher trained and assisted by cooperative officers to guide on data collection.

Urambo District

Mr. Musa Mwakalebule

Mss. Grace Kileo

Kaliua District

George Hango

Mr. Mashaka Abdallah

Namtumbo District

Mr. Seleman Kalinga