COST EFFICIENCY OF SMALL SCALE SUNFLOWER PROCESSORS IN DODOMA REGION IN TANZANIA

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ABSTRACT

This study was undertaken to analyse the cost efficiency of sunflower processing firms in Dodoma Region. The specific objectives were to: (i) analyse the level of cost efficiency, and (ii) determine the factors affecting the cost efficiency in small scale sunflower processors. Simple random sampling was employed to select 70 sunflower processors from Kongwa and Dodoma urban districts in Dodoma Region who were then interviewed using a semi-structured questionnaire. Data analysis techniques included the collating field data and decomposing it into descriptive statistics and estimating translog cost frontier. Descriptive statistics showed that cost of raw materials accounted for 61.21% of total cost of production (whereby sunflower seed accounted for 94.5% of raw material cost, transport cost (5.1%), and storage cost (0.5%)) followed by cost of fixed assets (22.68%), overhead costs (11.45%), and labour (4.67%). The sunflower processing sub-sector is dominated by male (92.7%) compared to 7.8% of their female counterpart. Empirical results also indicate that the average cost efficiency of sunflower processors was 112%; however, this ranged from 110% to 129%. Additionally, the output elasticity and cost elasticities due to materials, energy and transport significantly affected the total cost of sunflower oil production. Formal education, type of machine used by processors, access to finance had positive effect on the Cost Efficiency (CE) while membership to processors' association had negative effect on CE. In general, the study found that the high cost of production of sunflower oil was due to high sunflower seed prices and unreliable power supply which significantly affect sunflower processors' in Dodoma Region. The study recommends a number of measures to enhance sunflower processing efficiency in the study area to include: improving processors' skills through capitalizing on specific efficiency-enhancing trainings e.g. KAIZEN's and TFDA's; upgrading the type of machinery i.e. integrating the currently in use Chinese technology with the up-coming

Indian technology; improvement of individual processor's credit rating through relocation of plants to the municipality's planned industrial area which well versed with requisite infrastructure (building, electricity, water etc.), expanding creditor base to include also non-bank and other informal lenders, building internal competencies for processors in developing their business plans in a manner that enables them to have better appraisal of their financial transactions.

DECLARATION

I, Cuthbert William Mushi, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has not been or concurrently being submitted for a higher any other institution.

…………………………..   …………………………..

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The above declaration is confirmed by;

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(Supervisor)

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DEDICATION

This work is dedicated to my mother Mrs. Elina William Mushi and my guardian Mr. Thomas Elikana Mtimia who laid the foundation of my education.

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AE	Allocative Efficiency
CE	Cost Efficiency
CEZOSOPA	Central Zone Sunflower Processors Association
CRDB	CRDB (1996) Plc
DEA	Data Envelopment Analysis
DOWASCO	Dodoma Water Supply Company
ESRF	Economic Social Research Foundation
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Statistics
GoT	Government of Tanzania
Ha	Hectare
IAD	Institutional Analysis and Development
ICT	Information, Communication and Technology
IFC	International Financial Corporation
MITM	Ministry of Industry, Trade and Marketing
MLE	Maximum Likelihood Estimation
MMA	Match Maker Associates
MT	Metric Tons
NIE	New Institutional Economics
PLR	Public Legal Records and Related Services in Slovenia
QDS	Quality Declared Seeds
RLDP	Rural Livelihood Development Programme
SFA	Stochastic Frontier Analysis

SIDO	Small Industries Development Organization
SNAL	Sokoine National of Agricultural Library
SNV	Netherland Development organization
SPSS	Statistical Package for Social Science
SSEs	Small Scale Enterprises
STATA	Data Analysis and Statistical Software
TBS	Tanzania Bureau of Standards
TE	Technical Efficiency
TEOSA	Tanzania Edible Oils and Seeds Association
TFDA	Tanzania Food and Drug Authority
TFP	Total Factor Productivity
TZS	Tanzanian shillings
UNESCO	United Nations Education and Science Organization
URT	United Republic of Tanzania
USA	United States of America
USDA	United States Department of Agriculture
VAT	Value Added Tax
VIF	Variance Inflation Factor
WHO	World Health Organization of the United Nations

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The world population is expected to grow by over a third, from 7.2 billion in 2009 to 9.6 billion people in 2075 (FAO, 2009). It is estimated that nearly 90% of this growth will take place in developing countries, with Sub-Saharan Africa growing fastest at 114%. This growth in population will demand food production and productivity to increase by 70% in developed countries and more than 70% in developing countries (FAO, 2009).

In addition to that, market demand for food and animal feed uses will reach 3 billion tons in 2050, and, for the products with higher income elasticity such as livestock, dairy products and vegetable oils are expected to grow faster than that for cereals. Nonetheless, vegetable oil production and supply in world market will largely depend on the world energy prices and government policies (Reeder *et al.* 2003; FAO, 2009).

According to Mielke (2013), cereals and vegetables are important feedstock biofuel production. Thus, in the event of increased world energy prices, the producers of cereals and vegetable oils will supply more stocks for biofuel production than for food production, in expectation of better profits, other factors being equal. Nonetheless, this can be curtailed by vegetable oil producing countries' policies and laws which restrict market to produce only for energy purposes.

In spite of the rivalry needs for vegetable oils, the global production for food uses have more than doubled from 200 million tons in 1988/99 to 490 million in 2013/14, with most of the oilseed production coming from Russia, Ukraine, Turkey and Brazil (Mielke, 2013).

Likewise, the area harvested has soared in the past eight years from 200 million hectares in 2004/05 to 265 million hectares in 2013/14. These good prospects have been influenced by favourable weather condition in the oilseed producing countries[1].

Nonetheless the global production of vegetable oil is highly skewed towards palm oil. Palm oil production has been rising over the years, with major production coming from Malaysia and Indonesia which accounted for 4.6 million tons out of 11.6 million of the world stock in 2012. This is illustrated in Figure 1 which shows a large gap between the palm oil stock and other edible oils in the world market. The growing production for palm oil has been accelerated by demand from European governments for bio-fuels (Rosillo-Calle *et al.,* 2009).

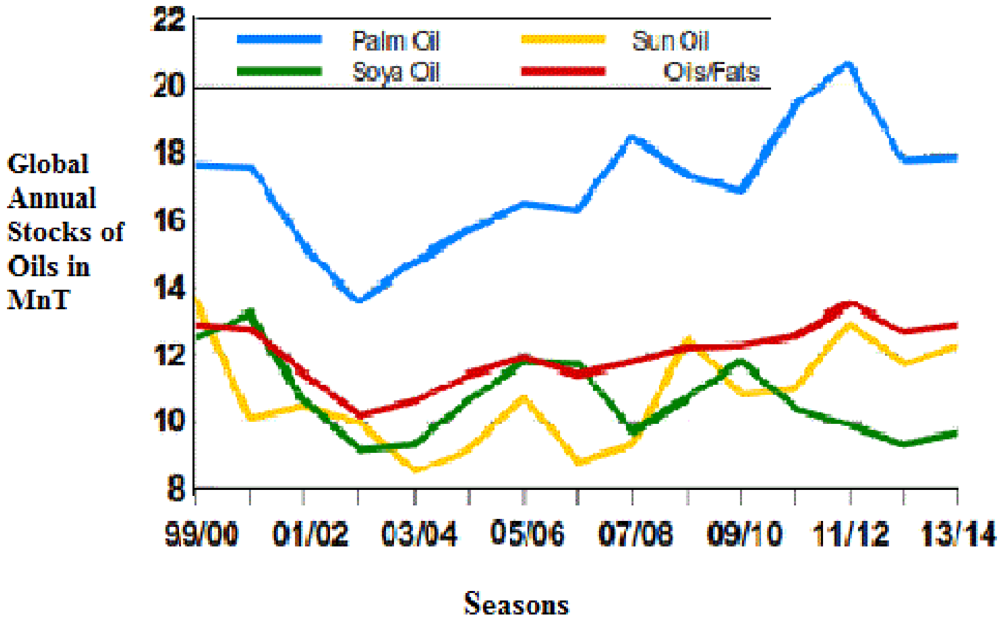

Figure 1: Global Annual Stocks of Oils in Percentage between 1999 and 2014
Source: Mielke (2013)

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[1] Other oil-seed producing countries include Canada and USA accounting for 24%, Argentina (12%), China (10%), India (8%), EU (6%) and other countries (15%).

Notwithstanding the high potential of palm oil in producing more oil per hectare compared to other vegetable oils, there is an increased debate over health risks associated with daily dietary intake of palm oil such as high blood cholesterol and increased risk of cardiovascular disorder (WHO, 2003; Jensen *et al.,* 1999; Clarke *et al*., 1997) since palm oil contain about 44% palmitic acid and 5% stearic acid. This has caused consumption and commercial refocusing by consumers and industries respectively to lean towards low saturated fat oils such as rapeseed, soy, cotton and sunflower (Fry and Fitton, 2010).

1.1.1 Overview of sunflower sector worldwide

Sunflower seed production rank fourth after soybeans, rapeseeds and cottonseeds in terms of quantity (FAO, 2010). In the 2012/13 season, the crop accounted for 35.6% of the total world production for oilseeds, with major production coming from Russian Federation and Ukraine. These two countries account for almost 50% of world sunflower production. Other major producing countries include Argentina, USA, China and India.

According to FAO (2010), the world bumper production of sunflower depends largely on the favourable weather condition in major producing countries and increased demand for oilseed in the world market. The better prices in the market spiral for increased production in the coming season due to high expectation for better returns to producers. Other factors include increased preferences from consumers in the market and favourable government policies which promote production and trading of the crop in both local and international markets.

In a broader spectrum, sunflower is used in the production of oil, cakes and confectionery products. This is usually conducted through crushing and refinery process. Crushing processes offer income and employment opportunities to different actors involved in the value chain. Globally, sunflower producing countries are the major sunflower oil producers due to their high production of seeds which attracts huge investment from edible-oil companies from around the globe (Mielke, 2013).

1.1.2 Overview of sunflower sector in Africa

South Africa is the largest producer of sunflower seed in Africa, ranking eighth in the world (www.indexmundi.com/agriculture). The country's production stands at an average of 696 000MT per annum. More than 80% of the seed produced comes from two provinces of Free State and North-West which account for 51% and 30%, respectively, while the remaining 19% is produced in Limpopo, Gauteng and Mpumalanga. Most of the seed produced is marketed locally to sunflower processors, animal feed manufacturers and for seed. Only 3% of the seeds produced in South Africa are marketed to international markets such as Kenya (53.8%), Pakistan (14.5%) and France (9.3%) (Republic of South Africa, 2015).

In Africa tropical countries, Tanzania production stands at 108 000 MT per annum, Sudan (18 000 MT), Kenya (12 000 MT), Angola, Mozambique, and Zambia (each about 11 000 MT). Most of the sunflower oil is consumed in these countries of origin and less than 30% reaches the international markets. Low exports of sunflower oil are attributed to high demand in domestic markets, low quality and standards which restrict entrant to international markets, and low output of most small-scale processors (Berglund, 2007).

Nonetheless, most of the processors in tropical countries experience almost similar problems which include: (1) sunflower processing sub-sector is dominated by small scale firms which account for more than 90% of all processors, (2) limited supply of raw materials such as sunflower seeds due to low production by most farmers who depend on rain-fed agriculture, poor mechanization and low quality seeds, (3) poor transport and communication facilities to reach remote areas for supplies, and (4) defragmented and uncoordinated market actors (MMA, 2009;Berglund, 2007).

1.1.3 Sunflower sector in Tanzania

Tanzania is ranked second and tenth largest producer of sunflower seed in Africa and world respectively (FAOSTAT, 2015). The country accounts for 2.4 percent of the world share in sunflower seed production, which has increased nine-fold from 135 000 MT in 2000 to 1 083 000 MT in 2013 (http://www.factfish.com/statistics). Notwithstanding the tenth ranking above, production, processing and marketing of sunflower are still very low in Tanzania compared to other countries in the world due to large dependence on rain-fed agriculture, poor mechanization for cultivation using hand-hoe, small-size of most processors, unbranded and low quality products.

Sunflower is cultivated by around 250 000 households in Tanzania. These households are smallholder farmers owning an average of 0.4 to 2 hectares using hand-hoe with a few medium and large scale farmers cultivating over 405 hectares (MMA, 2012; TEOSA, 2012). It is estimated that more than 80% of these smallholder farmers are located in Eastern and Central corridor (Manyara, Singida, Dodoma and Morogoro) and Southern highland region (Kigoma, Iringa and Mbeya).

The seed type, which is popularly grown by these smallholder farmers is *record*. The seed was introduced in Tanzania before 1950s and it is patented by ARI-Ilonga. These seed cultivars can be grown in the drier regions, up to 2 000 metres altitude, but they are unsuitable for humid climates. Temperature for optimum growth are 23-27^{o}C and yield of 1.0- 2.0 tons per hectare. When the sunflower seed is grown in hotter climates, the oil content is lower and the composition of the oil changes with less linoleic and more oleic acid content, which in turn reduces the nutritional content of the oil. Other seed varieties include CRN 1435 introduced in the country in 1995 by Monsanto Kenya Seed Company, PAN 7352 (2002) by Pinnar Kenya Seed Company and K. Fedha (2006) by Kenya Seed Company. These seed varieties are grown in altitude 500-2 250 with yield of 1.5-3.5 tons per hectare (MMA, 2009).

According USDA (2014), about 98% of all oil is contained in the seed (kernel) and 1-2% is contained in the hull. With high oil content sunflower cultivar such as *Record* has high oil content (>40%) and low hull fraction (20-25%). Their composition includes: palmitic acid 3-4%, stearic acid 4-5%, oleic acid 80-90% and linoleic acid 3-9% against traditional seed with low oil content (25-30%) and high hull fraction (43-52%) with palmitic acid 5-7%, stearic acid 3-6%, oleic acid 16-36%, linoleic acid 3-9%, with high palmitic and stearic acid reduce the oil nutritional content.

High oil content seeds are the most preferred by the crushers due to potential of increasing their volume of oil produced, which is highly marketable compared to cake. Moreover, even with the use of high content seed the output can be reduced if the processor uses low capacity machine which can only extract about 18-20% of the oil from the seed compared to high capacity plant with capacity of extracting 30% of oil from oil seeds. Other factors include: small size of the seed and low quality seeds (undried seeds with foreign materials such as dust) (Malk and Sain, 2016).

Sunflower production in the country has risen sharply by 218% from 2005 to 2013 (FAOSTAT, 2015). This was largely attributed to the government of Tanzania and other development stakeholder’s initiatives such as the Rural Livelihood Development Program

(RLDP), Techno-Serve and SNV which enabled smallholders to access quality seeds, credits and field trainings which in turn stimulated crop production and productivity (Iringo *et al*., 2013; Salisali, 2012; MMA, 2012).

Intervention by the Rural Livelihood Development Program (RLDP) was with broader objectives of introducing Quality Declared Seeds (QDS) for increasing the smallholder farmers' output and yield, promoting contract farming between smallholder farmers and processors for steady supply of inputs and stable prices for output to smallholder farmers and processors, and enhancing access to loans through discount window at CRDB and NMB Bank to expand processors' production and efficiency (Salisali, 2012).

Furthermore, intervention by SNV aimed at developing cluster areas for sunflower processor so as to increase their economies of concentration and markets for their products. This has led to identification of two industrial clusters in Kizota and Chamwino areas in Dodoma for small scale sunflower crushers, who more than 92% are located in residential areas. The intervention intends to increase processors capacity to meet TFDA standards, access loans, and thus offer an opportunity for further growth and expansion of the firms (MMA, 2012). Other initiatives include those of SIDO to offer assistance in the establishment of the firm and rules and guidelines to be adhered to and TFDA provides information on how to meet guidelines for establishment in terms of location of the firm, required facilities for handling oil and packaging (Iringo *et al.,* 2014; RLDC, 2012).

These initiatives have increased sunflower production from 220 000 tons in season 2005/06 to 1 083 000 in 2013/14 while subsequently crop yield doubled from 6 471 hectares in 2005/06 to 13 370 hectares in 2013/14, (Table 1). Moreover, the sunflower oil has less than doubled from 60 030 tons out of 220 000 tons of seed produced in 2005/06 to

120 000 tons out of 1 083 000 tons in 2013/14 (FAOSTAT, 2015). This raises the question of whether the firms in the sector are operating efficiently given the resources endowed to them.

Table 1: Annual Sunflower production in Tanzania from season 2005/06 to 2013/14

Seasons	Area Harvested (Ha)	Production (Tons)	Yield (Tons)
2005/06	340 000	220 000	6 471
2006/07	380 000	250 000	6 579
2007/08	348 000	239 000	6 868
2008/09	389 000	305 000	7 841
2009/10	388 830	304 730	7 837
2010/11	431 540	313 110	7 256
2011/12	753 759	786 902	10 440
2012/13	840 000	1 125 000	13 393
2013/14	810 000	1 083 000	13 370

Source: FAOSTAT Database (2014).

1.1.4 Sunflower processing in Tanzania

Sunflower processing in Tanzania is dominated by small scale processors (Iringo *et al.,* 2014; Ziliona *et al.,* 2013), who account for 95% of all sunflower processors in the country. These small scale processors are scattered across the sunflower producing areas especially in central corridor part of the country. With high competition in the industry and low capital investment required, the industry continues to attract new firms which could help in increasing the efficiency of the existing firms in the market (Ziliona *et al.,* 2013; Dillman and Ijumba, 2011).

Normally, these processors' activities are centred on bulking, seed crushing and refining. Bulking involves packing seed into sacks and then storing them in warehouse. Seed crushing involves removing all foreign particles, crushing, filtering and oil storing. This is what is done by most small scale processors in Tanzania with only few firms[2] doing refining. Lack of refinery machines hinder improvement of quality of crude sunflower oils produced by these small scale sunflower processors (Ziliona *et al.,* 2013; MMA, 2012; Salisali, 2012).

In the case of large scale sunflower processors, they are less than 10% of all plants in Tanzania (ESRF, 2009). But, they have processing capacity of over 50 MT per day and employ more than 100 workers in the production lines. Their large scale of production demands large amount of raw materials; therefore, these firms source their sunflower seed from both domestic and international markets such as South Africa, Malaysia and Indonesia. Their products are well branded and packaged and sold in the domestic and neighbouring regional outlets such as Kenya, Rwanda and Congo from processing plants such as Murza and Mount Meru Millers (InfoDev, 2011; URT, 2011; Salisali, 2012).

Despite the presence of large scale firms, different studies such as Mpagalile *et al*. (2008) and Ziliona *et al*. (2013) have identified huge potential of small scale sunflower processing firms in Tanzania in creation of employment to youth and families, rural industrialization, economic growth, and poverty alleviation. Also, as a potential import substitution strategy for highly imported palm oils if their resources are allocated efficiently.

[2] The firms which refine sunflower in Tanzania includes Glory Farm (Heshima) in Dodoma, Murza (Sundrop) in Dar es Salaam and Mount Meru Millers (Sunola and Floral) in Arusha.

Worldwide, studies such as World Bank (2004), Bloom *et al.* (2010), and Ahmed and Ahmed (2012) found that most developing countries fail to produce efficiently due to poor infrastructure, informality, over-regulation, unfriendly trade policies, human capital and poor management of the firms. Other factors include limited access to finance, low human capital (i.e. lack of skilled labours and extension service), low level of education and experiences, weak contract enforcement in the market and power outage. These factors lead to underutilization of resources which is reflected in their lower output and increased costs of production.

The sunflower processing industry is characterized by free entry and exit of firms in the market, easy disposal of assets and factor inputs determined by the market. Nevertheless, the market is highly fragmented and uncoordinated, where average processors deal with more than 800 smallholder farmers and 140 retailers. This increases the transaction costs to processors in searching for inputs, communication costs, and arrangement for transport services which will affect directly their cost efficiency (Dillman and Ijumba, 2011).

1.1.5 Marketing of sunflower oil and meals in Tanzania

Small scale processing firms in Tanzania usually sell sunflower oil and cake. Other by-products include *ulogi "sediment oil remain in the bottom of oil preserving tanks after crushing sunflower seeds".* It is sold to traders in oil-processing and the price is determined by sunflower production season and rate of sunflower oil production. Market for crude sunflower oil by these small scale processing firms largely depend on the high demand from wholesaler traders from regions such as Iringa, Mbeya, Dar es Salaam, Arusha and Kilimanjaro. The cake is mainly bought by large Indian traders who buy in bulky and export to India and China and other is bought by domestic traders and household for poultry feeding.

Studies by Ziliona *et al.* (2013) and Dillman and Ijumba (2011), have shown that the sub-sector is very profitable due to high demand of sunflower oil in the domestic market. But, this lucrative potential could be lost due to small scale operation of most processors which is justified by low national sunflower oil supply which is about 180 000 tons per annum compared to demand of 350 000 tons per annum. On the other side, lack of well branded and packaging products, poor quality and standards make difficult to these processors to access super markets and neighbouring countries market outlets. The low sunflower oil production problem, could raises questions like are sunflower processors efficiently? If not, what are the factors that lead to their inefficiency?

Consequently, following the failure of these firms to increase their production capacity in the nearly up to 360 000 MT per annum, the country will continue to import palm oils from Malaysia and Indonesia. Palm oil is the second largest import next to fuel, where its imports have increased from 169 473 MT in 2009 to 227 171 MT in 2011 (FAOSTAT, 2014). Annually palm oil imports amount to 1 234 568 USD dollars which spent from Tanzania's foreign reserve coffer. Nonetheless, the country has opportunity to reverse the negative outcomes through increase the production capacity of domestic sunflower processors by improving their technical and financial capabilities (RLDC, 2012).

1.1.6 Constraints facing the sunflower processing firms in Tanzania

A number of constraints have been itemized by various studies such as Iringo *et al*. (2014), MMA (2012), Dillman and Ijumba (2011), and RLDP (2011) as facing the sunflower processing firms in Tanzania. These factors include weak coordination of the actors in the supply chain which lead to increase in the transaction costs, unreliable supply of raw materials due to bad weather condition or withholding sunflower seeds by speculating farmers and dealers, and poor roads which lead to high transport costs.

In Dodoma Region, processors are charged double taxes for sunflower seeds and cake, which affects their cost of production. Other challenges include frequent power outage and high voltage power which damages machine motors, therefore, processors have to incur costs to replace damaged motors which costs about 150 000-250 000 TZS. The inspection and replacement costs by qualified machine technician cost about 45 000-75 000 TZS, which in turns increases the processors' cost of production and could reduce their cost efficiency.

1.2 Problem Statement

Small scale sunflower processing enterprises act as middlemen between producers and final consumer of various sunflower products in Tanzania. These processed products include sunflower oil, cake and confectionary products which contribute to job creation and generation of income for poverty reduction (Ziliona *et al.,* 2013; Dietz *et al.,* 2000). Studies indicate that, the value added to agricultural produce from farm-gate to the consumer's household through processing, storage and trading is very significant, usually increasing several-fold. This in turns translates into income and employment generation, with possible spill-over effects on the supporting industries through technical workshops and other services providers (Wangwe *et al.,* 2014; Kawamala, 2012; Dietz *et al.,* 2000).

In Tanzania, the increasing gap between production and consumption of edible oils is bridged by imports, particularly from Malaysia and Indonesia. Imported edible oils are usually cheaper and of high quality than that produced locally which leads high concentration of imported edible oil in the domestic market (RLDC, 2012; FAOSTAT, 2014). Nonetheless, the government decided to impose tariffs to protect domestic processors of edible oil, which consequently raised consumer prices (RLDC, 2012). This situation creates a food price dilemma: it protects those few processors who are net sellers while imposing heavy cost on low income edible consumers in both urban consumers and rural net consumers who are edible oilseed producers. Public recognition of this phenomenon has increased policy makers' interest in reducing processing cost rather than raising sunflower oil prices, as the latter would compromise demand for nutritious sunflower oil (MMA, 2012). The biggest facing policy makers in the sunflower processing sub-sector is how increase sunflower oil production through reduction of processing and marketing costs and use of appropriate inputs. This strategy should ensure high profitability for the processors and lower prices for consumers of sunflower oils, thus increase their competitiveness in domestic and international markets.

Most of the research studies in Tanzania have focused on sunflower value chain analysis and adoption (Iringo, 2013; Kawamala, 2012; Dillman and Ijumba, 2011; InfoDev, 2011; Rucodia and Enerm, 2007). The studies have explained the marketing different channels that exist in the sunflower sub-sector and challenges facing the participating actors. Those focused on adoption have attempted to explain smallholder farmers' willingness to adopt technologies available to them so as increase sunflower productivity. The study by Ziliona *et al.* (2013) has for instance explained how actors realize their benefit shares along the value chain and their contribution towards poverty alleviation in Singida region. Nevertheless, little has been said on the performance of the actors along the value chain in terms of their cost efficiency in the utilization of resources in transforming sunflower seeds into products of desirable quality given the level of output and input prices. This is vital for assessing the development of viable sunflower processing industry in Tanzania.

There are a number of interventions that have been undertaken in Dodoma region by the government and development stakeholders such as RLDC and SIDO aiming at providing both technical and financial assistance to boost productivity of small scale sunflower processors (Iringo *et al.,* 2013; RLDP, 2012; MMA, 2009). RLDC have intervened to boost crop productivity at the smallholder farmers' level by providing improved sunflower seeds, extension services and contract farming between processors and smallholder farmers. SIDO uses resource-based strategy by offering technological and technical support services like sourcing machinery and equipment through regional offices, assisting in machinery installation and trial production, training processors on procedure to follow and getting TBS and TFDA certification and offer, micro-loans to processors at lower interest rates. These strategically aimed at reducing transaction costs so as to increase profitability and make viable business undertaking for small scale processors' development.

According to Dillman and Ijumba (2011) and Ziliona *et al*. (2013) investment in the sunflower processing industry is still profitable and viable due to competitiveness of the market and low investment costs. Nonetheless, the industry is handicapped by over-dependence on raw materials from smallholder farmers who produce in small quantities and are seasonal. This affects the level of production of most small scale processors who have to compete with large scale processors and dealers for the seeds in the market. It has also led to increased transaction costs to find right sellers of the input in the market. Furthermore, the processors are hindered by high costs of power and outage, high cost of technicians and spare parts. Since, performance in terms of cost efficiency is tantamount to determining how processors are in terms of utilizing resources to minimize cost given level of output and input prices which improve their competitiveness in local and international markets. Furthermore, cost efficiency can also be influenced by the nature of quality of inputs, ownership form and managerial characteristics (Kumbhakar and Lovell, 2000).

Therefore, the aim of conducting this study was: *First,* to analyse how efficiently these small scale processors are operating given the input prices and level of output. *Second,* how different factors such as firm's ownership, age, membership to processing association, education level of the processor, age and type of seeds used have influenced their cost efficiency. By understanding the magnitude and sources of sunflower processors cost inefficiency, it will help policy makers and developmental stakeholders in designing policies and strategies which will help a wider cross-section of Tanzania sunflower's processors to achieve management success of their more efficient peers.

1.3 Research Objectives

1.3.1 General objective

The general objective of this study is to analyse the cost efficiency of small scale sunflower processing firms in Dodoma. The focus on the industry is important given its potential to reduce post-harvest losses, creation of employment opportunities and its capability for income generation and insulating smallholder sunflower farmers from the woes of sunflower price volatility. The general objective will be addressed through the following specific objectives.

1.3.2 Specific objectives

a) To analyse the level of cost efficiency for small scale sunflower processing firms in Dodoma Region.

b) To determine firm-specific and institutional factors affecting the cost efficiency in small scale sunflower processing in Dodoma Region.

1.3.3 Research questions

(i) What is the level of cost efficiency for sunflower seed processors in the research area?

(ii) What are the firm-specific and institutional factors that influence cost efficiency of small scale sunflower processing firms in Dodoma Region?

1.3.4 Research hypothesis

On the basis of the above specific objectives, one hypothesis was tested as follows:

(i) In relation to the specific objective one,

The Null Hypothesis

The level of cost efficiency differs between small scale sunflower processors in Dodoma region.

The Null Hypothesis

The selected firm specific characteristics have no significant effect in the cost efficiency of the ith firm

Mathematically,

Ho;$\rho_1 = \rho_2 = \rho_3 \dots \dots \rho_i = 0$ .... (1.1)

Where;

ρ_i represents parameter estimates with respect to variable Z_1, Z_2,......... Z_i of the selected processing firm characteristics.

1.4 Organization of the Study

This dissertation is organized as follows: The introductory Chapter 1 presents the study's background information, problem statement and justification, research objectives, questions and hypotheses. Chapter 2 clarifies and explains key important theoretical and empirical concepts of the study whereas, chapter 3 outlines the methodological contemplations of the study to include discussions around the conceptual framework, the approaches used for sampling and data collection procedures, and techniques of analysis. Chapter 4 discusses the study findings by focusing on the discussion of descriptive statistics and econometric analysis results. Chapter 5 concludes the study by summarising key research findings and drawing policy implications emanating thereon.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Key Concepts

2.1.1 Small scale enterprises

According to Adjei (2012) there are various underlying definitions of Small Scale Enterprises (SSE's). These definitions vary from country to country, depending on criteria used such as investment, employment, total assets, and turnover. Nonetheless, there is no agreed consensus into what constitutes a small scale enterprise in the literature. Authors from different studies have usually given different definitions on this category of enterprise. Some of these authors used firm size, legal status and method of production. Some attempt to use capital assets while other used labour and turnover level (Adjei, 2012; Ghatak, 2008).

Bolton Committee (1971) provided the best description of the key characteristics of a small firm. In their definition they defined small firm "as an independent business, managed by its owner or part-owners and having a small market share". According to the report a firm is "small" if it satisfies at least two these criteria: (1) a turnover less than £2.8 million (TZS.8.6 billion), (2) a balance sheet total of not more than £1.4 million (TZS. 4.3 billion), and (3) not more than 50 employees. The report went step further by providing various definitions of the firm to different sectors. Whereas firms in manufacturing, construction and mining were defined in terms of number of employees while those in service sector were defined in terms of monetary turnover. There are criticisms of the Bolton definitions based on inconsistencies between defining characteristics based on number of employees and those based on managerial approach (Dababneh and Tukan, 2007).

In European Union member states, the distinction of SSEs is made in terms of self-employment, micro, small and medium sized enterprises. Where 0 number of employees is defined as self-employment, 2-9 employees (micro enterprises), and 10-49 (small enterprises). The EU definition recognizes that SSE group are not homogeneous since the distinctions are made between micro, small, and medium sized enterprises (Storey, 1994). This definition is more suitable than the Bolton definition and many countries have formulated their definition to a small firm in light of the EU definition to reflect their particular countries (Nkonoki, 2010).

In India, SSEs are defined in in terms of investment level, where a micro enterprise is one which investment in plant and machinery does not exceed twenty-five lakh[3] rupees (TZS. 8.2 million) while a small plant and machinery investment is between twenty-five lakh and five crore rupees (TZS. 1.6 billion) (Ghatak, 2008; UNIDO and OECD, 2004). By the contrast, in the United States and Canada, the small scale enterprises is defined by the number of employees; it often refers to those with fewer than 100 employee (if the firm is a goods-producing enterprise) or fewer than 50 employees (if the firm is a service-based enterprise) (Carsamer, 2009; Elaian, 1996; Mead, 1994).

In the context of Tanzania, the SMEs are classified in terms the number of workers employed or capital investment. Micro enterprises are those engaging between 1 and 4 people or capital investment of up to TZS. 5 million, with most of their undertakings done in the informal sector, which is fragmented and uncoordinated (Musonda *et al*., 2008; URT, 2003). In the case of small scale enterprises, are mostly formalised business

[3] A lakh is equivalent to one hundred thousand rupees while a crore rupee equals to ten million rupee.

engaging between 5 and 49 employees or with capital investment from TZS 5 million to TZS. 200 million. And most of these SSEs operate in non-farm economic activities such as manufacturing, mining, commerce, and services (ESRF, 2009; URT, 2003).

Similarly, Iringo *et al.* (2014) adopted the same definition for Tanzania to classify SMEs in the sunflower sub-sector. Whereas, a micro enterprises employed 1 to 2 people or capital investment capital investment of less than TZS. 10 million, micro (2-5 people and capital investment TZS. 10-15 million), small (5-15 people and capital investment of TZS. 50-500 million), medium (15 people or capital investment TZS. 500 million to 1.2 billion). Nonetheless, this definition ignores that some enterprises can very small in terms of employees and turnover but it has significant access to significant additional resources because it owned by, linked to or partnered with larger enterprises. Thus, it might not be legible for SME status (Ghatak, 2008).

Due to existence of SMEs in different sectors of the economy, this study focused on manufacturing aspect. Manufacturing means producing or making physical items. The pure service activities such as government services, retail trade, banking, recreation and insurance services not included. Only repair services are included in the manufacturing enterprises, which ensures efficient running of the machinery (Adjei, 2012; Chapman and Walker, 1987 cited by Dinye, 1991).

2.1.2 Efficiency concept

Koopmans (1951) defined efficiency in terms of technical efficiency. A producer is said to be technical efficient if and only if “an increase or decrease in an output will lead to reduction or increase in at least one of the other input.” Koopmans’ definition acknowledges important economic concepts of Pareto optimality condition, scarcity and alternative uses of the resources. Nonetheless, this definition did not explore concept of slackness. Lovell *et al.* (2002) defined slackness as unproductive excessive which can be observed in non-productive frontier; and they are not easy to discriminate or place it on theory since it is generally combined into technical and allocative efficiency. In measurement they cannot be captured by parametric function since there are included in the statistical error in the functional form (Tutulmaz, 2014).

Another study by Debreu (1951) defined efficiency as a coefficient of resource utilization. Using radial measures, the contraction of input and expansion of output leads to technical efficiency. This definition was highly criticized by Fare (1975) and Fare and Lovell (1978) for foregoing the Pareto optimality condition. According to Makdissi (2006) Pareto optimality implies that that it is impossible to increase resource allocation to one good without decreasing resources allocation to another good. It literally referred to point for efficient utilization of the resource and it is comparative in nature but not cardinal or absolute (Chambers and Millers, 2012). Farrell (1957) extended the work of Koopmans (1951) and Debreu (1951) in his seminal paper entitled “The Measurement of Productive Efficiency”. He decomposed the concept of efficiency into two components: Technical efficiency (TE) (sometimes referred to a pure efficiency) and allocative efficiency (AE) (price efficiency). The first measure is conducted in terms of quantities (inputs or outputs) and the second refers to values (cost, revenue, and profit). According to Farrell’s definition a firm is said to be technical efficient, if there is no way of producing more output with same sets of inputs. Thus, it measures position of the production unit relative to the production frontier.

According to Aigner *et al.* (1977) technical efficiency is based on a frontier production function, which shows whether a firm is able to attain the maximum potential output given a set of input and technology. Firm level of technical efficiency in a given industry is measured relative to the best performing firms in that industry. The deviation from production frontier is considered technical inefficiency. This happens if there is excessive usage of resources needed relative to its level of production (Cummins and Weiss, 1993). This variation in productivity, either across producers or through time is thus described as residual. The residual can be attributed to differences in production technology, differences in scale of operation, differences in operating efficiency, and difference in the operating environment in which production occur (Lovell *et al.,* 2002).

Furthermore, according to Lovell *et al.* (2002) it is important to note that selection and weighting of indicators is still controversial, especially in choosing what to include, how to weight them and how to define potential in measuring efficiency. Nevertheless, concerning potential the comparison are appropriately made relative to best practice rather than to some potential ideal standard.

The second dimension of efficiency is allocative or price efficiency. In production theory, allocative reflects the ability of the firm to use inputs in optimal combinations, for a given input prices and level of output. The allocative measurement requires information on prices. According to William (2011) allocative efficiency deals with extent to which producer make efficient decisions by using inputs up to the level at which marginal contribution to production is equal to the factor cost. An allocative efficient firm would produce that output using the lowest cost combination of inputs. A product of technical and allocative efficiency measures economic (cost) efficiency. Papadogonas *et al.* (2013) and Eltivia *et al.* (2014) defined cost efficiency as lowest cost of producing goods and services given input prices and output level.

Vitaliano (2005) defined technical efficiency and allocative efficiency in terms of input and output perspective. In terms of input perspective technical efficiency entailed producing given level of output using smallest set of inputs while allocative efficiency meant ability of firm to allocate the input bundle in the cost minimizing way. On the other side of output perspective, technical efficiency is the maximum output produced while inputs are kept constant while allocative efficiency given input prices then it is the revenue maximizing problem. In both scenario, input-output perspective can coincide for technical efficiency under constant return to scale but not for allocative and economic efficiency since they are completely different in nature.

Tutulmaz (2014) offers general overview of the concept of efficiency which has been widespread used many times as replaceable with allocative or economic efficiency. He noted that technical efficiency which has been defined through production function is suitable for performance measurement and serves as a theoretical base for performance measuring. In case of allocative, it is important despite its practical measurement difficulty in measurement optimum situation using market price. In short usage the concept of allocative efficiency concept is the most suitable as “efficiency” because of its referring the optimum situation. Therefore, in economic theory, allocative efficiency measures firm’s success in choosing optimal set of inputs with given set of input prices while technical efficiency is associated with firm’s ability to produce maximum output from given bundle of inputs.

2.2 Contribution of SMEs to Economic Growth in Tanzania

The performance of small scale firms plays significant roles in country’s economy (Abor, 2008). They have high socio-economic potential contribution in terms of job creation, innovations, wealth creation and as a catalyst for rural area industrialization (Kira and He, 2012; Fatoki and Asah, 2011). A study by Mnenwa and Maliti (2008) indicated that SMEs in Tanzania account for a significant share of GDP up to 35% and employ about 20% of the labour force. Small scale food processors play a very crucial role in reducing post-harvest losses, transportation cost for unprocessed agricultural product, reduces storage space and promotes rural economy. Therefore, efficient operation of small scale firms in Tanzania is paramount for ensuring lower cost of production, improved quality of their products, promoting their competitiveness in domestic as well as global market, and hence higher profits.

2.3 Factors affecting Small Scale Firm Efficiency

Traditional microeconomics theory assumes all firms maximize profits and that firms that do not succeed in attaining this objective are not of interest because they will not survive (Vitaliano, 2005). Modern frontier efficiency analysis creates a framework to analyse firms that do not succeed in optimization and, as a result, are not fully efficient (Farrell, 1957). Efficiency is evaluated by comparing firms to "best practice" efficient frontiers formed by the most efficient firms in the industry.

The measurement of firm specific cost inefficiency is based on deviations of observed cost from the best efficient cost frontier. If it lies below the frontier then it is cost inefficient, with the ratio of the actual to the potential cost defining the level of efficiency of the individual firm. There are factors which are explained in the literatures as the main cause of that divergence including: poor infrastructure, informality, regulation, trade policies, human capital and poor management of the firms (Ahmed and Ahmed, 2012; Bloom *et al.,* 2010; World Bank, 2004; Tybout, 2000).

Moreover, a study by Gumbau-Albert and Maudos (2001) went a step further by categorizing the factors affecting firm's efficiency into 4 specific groups namely:(1) characteristics of firm itself such as size, type of organisation, location, age of the firm and the firm size, type of ownership of the firm either public or private, collectively known as firm-specific characteristics; (2) external factors to the firm such as degree of competition existing the market in the which they operate, (3) dynamic disturbances in terms of demand faced by the firm, and (4) a degree of technological innovation. On the other side Birungi *et al.* (n.d) identified two broad determinant of efficiency which are: (1) Human capital which comprises age, sex, education and experience in production; and (2) socio-economic factors that comprises access to finance, extension services, farm size, and labour type among others.

a) Firm Size

Gumbau-Albert and Maudos (2002) and Alvarez and Crespi (2003) explicitly showed that there is positive relationship between firm's size and technical efficiency. This means larger firm can easily penetrate in the market and they can exploit economies of scale compare to small firms. Nonetheless, this positive relationship between firm size and efficiency holds only the firm is well coordinated and operates in an optimal size (Maksimovic and Phillips, 2002). Nonetheless, these findings contradict findings by Badunenko *et al*. (2013) who analysed the technical efficiency of manufacturing firms in Germany using stochastic frontier approach. They found that the firms' technical efficiency was positively affected by industry effects and outsourcing activities but not firm's location and size.

Similarly, Tingum (2014) investigated the technical efficiency and manufacturing export performance in Cameroon using the Stochastic Frontier Analysis (SFA). He found that firm size, foreign ownership, lower taxes rates had positive effect on export performance of food processing and textile sector estimated using Probit and Logit models. Niringiaye and Luvanda (2010) established the relationship between firm size and technical efficiency in East African manufacturing firms using panel data for 403 firms in Uganda, Kenya and Tanzania estimated using DEA. They found positive correlation between firm size and technical efficiency for firms in Kenya but negative for firms in Uganda and Tanzania.

b) Firm Age

There are mixed views found in the literature regarding the relationship between firm age and firm efficiency. Pitt and Lee (1981) investigated Indonesian weaving industry, they found there is positive relationship between age of the firm and efficiency. Veterans firms were considered to be more efficient than younger firms because they have gained experience from their past operations and have survived in the market. Nonetheless, a study by Little *et al.* (1987) in India and other economies, they noted that veterans' firms may be less efficient if they fail to upgrade to new production technology and adapt to changing market conditions. Lundvall and Battese (2000) pinpointed that the relationship between age of the firm and efficiency lies on nature of industry. They found a positive correlation between age and efficiency among Kenyan firms in textile sector, but no effect of age of the firm on efficiency was identified in the food, wood, and metal sectors.

c) Firm Ownership

The type of ownership of a firm plays a crucial role in explaining economic performance since different ownership structure create different incentives to economic actors (Jehu-Appiah *et al.,* 2014). According to Demsetz (1983) firm ownership structure is important to understand since it define clearly separation of power between owners and managers, thus, reducing conflict of interest which could affect efficiency. Furthermore, the conflict of interest can result into agency problem which could further lead to rent extraction in firm dealings, control of output and constraints with suppliers, which affects firm efficiency.

In case of Mahadevan (2000) explored the differences on ownership in terms of domestic and foreign-owned firms. He noted that domestic firms may improve efficiency since the foreign firms are less familiar with local environment and local shareholders could set in and improve firm efficiency. But, studies by Melitz (2003) and Temouri *et al.* (2008) found that foreign-owned firms had more knowledge-based advantage of the market, uses more superior technologies and access external credit which give them an eager over domestic firms. A study by Beirne *et al.* (2013) focused on privately-owned firms and state-owned firms. They found that private-owned firms were more efficient compared to state-owned firms since they used labour saving technologies, offered bonuses and allowances workers which reduced the possibility for shirking.

d) Access to Finance

Kinda *et al.* (2008) explained that firms need access to finance which allow them to finance more investment projects which would result into increased productivity through capital intensity and acquiring new and modern production equipment. Nevertheless, Levine (1997) pinpointed that not only access to finance is important but availability of developed financial system creates more profitable investment opportunities by mobilizing and allocating resources to the most profitable business ventures. This is similarly to Besley and Burgess (2004) who found that efficiency of firms may result when there is a perfect credit market and favourable environment for business. This means government have to ensure through it policies made access to finance very favourable for business, it will incentivise firms to access loans.

Moreover, a study by Ahiakpor and Dasmani (2013) tested the hypothesis that perceived financial constraints adversely affect output and efficiency of firms in Ghana using 2007 data from the World Bank Enterprise Survey on 270 firms. They found that two thirds of the indicated that perceived lack of access to finance as severe constraint and small firms perceived it as major obstacles to growth compared to larger firms which were able to acquire loans through collateralization. Also, it hindered the firm ability to keep up with technology, competition and it affected their productivity.

e) Level of Education and Experience of Workers

Tingum (2014) investigated technical efficiency of export manufacturing sector in Cameroon. He found labour had a positive impact on the output of the firm, and it was the highest coefficient. This indicated that firm relied heavily on labour in their production but the human capital component was an insignificant explanatory variable of the firm's output. The reason behind this was due to lack of on the job training and low level of education for the employees. Kinda *et al.* (2008) analysed firm-level productivity and technical efficiency in MENA manufacturing industry found that level of education of the labour force as important factor determined industry growth. They pinpointed that skilled workers are better in dealing with changes, a skilled worker force is essential for firms to manage new technologies that require a more efficient organizational know-how. Similarly, Bresnhan *et al.* (2002) found that skilled workers are important in managing new technologies and opportunity to the firm to expand or enter new markets.

2.4 Empirical Approaches in Efficiency Analysis

2.4.1 Stochastic frontier analysis

The concept of stochastic frontier analysis was originally proposed by two papers of Meeusen and van den Broeck (1977) and Aigner, Lovell and Schmidt (1977) which were inspired by the idea that deviations from the production frontier' might not be completely under the control of the firm being studied. Since then, it has received a lot of attention from researchers in subfield of econometrics in estimation of cost function and cost efficiency, revenue functions and revenue efficiency, and multi-output and multi-input distance functions (Nguyen, 2010; Fare *et al*., 1994). The original approach was explicitly presented using the production function to present technical efficiency using the cross sectional data set with a two component error term, one relating to stochastic inefficiency and other one to statistical errors. According to Nguyen (2010) estimation of frontier models require assumption about probability density function of the inefficiency parameter μ_i to be either half-normal, exponential, normal-gamma or truncated normal distributed.

The original work by Aigner *et al.* (1977) was estimated using half-normal distributed model, which estimated σ_u^2 as the variance of μ_i, thus creating misleading picture on the amount of inefficiency that could be suggested in the data (Greene, 2008). In contrast, Stevenson (1980) proposed the stochastic frontier production function which truncated normal model, that is, the one-sided error term, μ_i is obtained by truncating at zero the distribution of a variable with possibly nonzero mean. Nevertheless, a study by Greene (2008) noted that one disadvantage of using truncated normal model is that log-likelihood can sometimes ill-behaved when μ_i is unrestricted. An estimation of non-zero μ_i often inflates the standard errors of the parameter estimators considerably which impedes convergence of the iterations. In the literature, it is unclear how to restrict μ_i to zero which affects efficiency estimates. But, a study by Holloway *et al*. (2005) faced less difficulty estimating the model using Bayesian model.

2.4.2 Strength and weakness of stochastic frontier model

There is no consensus in the literature as to which method should be used, choosing between Stochastic Frontier Analysis (SFA) and Data Envelopment Approach (DEA). According to Kamberoglou *et al.* (2004) and Wadud and White (2000) who explained the choice between the two approaches usually depends on available data, objective of the study and sometimes personal preference of the researcher. Nevertheless, Resti (2000) pinpointed that there is no clear merit of one method over the other. In case of DEA, it can easily handle multiple inputs and multiple output, it allows direct comparisons of production possibilities without requiring additional input price data and no specification of production or cost function required. But, one of the major weakness of this approach is failure to measure inefficiency (Banker *et al*., 1984).

According to Alemdar and Oren (2006) in SFA, parameters of production or cost function are determined statistically and stochastic noise is taken care of. And most important however, stochastic model is preferred over deterministic models due to their ability to measure inefficiency. Also, stochastic frontier models are considered to be relatively robust and for this reason such a model will be used in this study. On the other side, the stochastic frontier analysis major weakness lies on formulating a proper production (cost) functional form for specification of the model. A wrong formulation of the function of the frontier will cause the increase of the degree of correlation of regressors with inefficiency (Tingum, 2014).

2.4.3 Model specification

2.4.3.1 Functional forms

The translog form was recommended since it is a flexible functional form and it can be used approximate by any twice-differentiable function without placing a prior restriction on the production technology (Vitaliano, 2005). Kumbhakar and Lovell (2000) added that the function allows returns to scale to vary with output and non-homothetic expansion path, which implies a changing elasticity of substitution among inputs and its plasticity comes at the expense of demanding many more parameters to be estimated, most of which can be collinear. Nevertheless, the efficiency estimation of translog demands a system of equations that require data about the quantities of inputs used in auxiliary equations, which is not always available (Vitaliano, 2005). The model can be specified as follows:

$$\ln(C) = \propto_0 + \sum_j \propto_j \beta_k \ln(Y_k) + {}^1\!/_2 \sum_j \sum_i \gamma_{ji} \ln(P_j)\ln(P_i) + {}^1\!/_2 \sum_k \sum_l \delta_{kl} \ln(Y_k)\ln(Y_l) + \sum_j \sum_k \rho_{kl} \ln(P_j)\ln(Y_k) + \varepsilon \qquad \text{..} (1)$$

Where, P_i is the price of input i, Y_k is output k, C is total costs, and $\propto_0$, $\propto_j$, γ_{ji}, δ_{kl} and ρ_{kl} are parameters to be estimated and ε represents cost inefficiency. For a well-behaved production structure, the cost function must satisfy following regularity conditions: continuity, symmetry, linear homogeneity in prices, monotonicity in prices and outputs and concavity in prices (Fries and Taci, 2005). Other studies which have used the cost function in the study of the firm efficiency includes: Kamberoglou *et al*. (2004), Ogundari (2010), Papadogonas *et al.* (2013), and Eltivia *et al.* (2014).

2.5 Methodologies in Similar Past Studies

2.5.1 Studies in Africa and outside Africa

Ogundari (2010) examined the cost efficiency and its determinant in Nigerian sawmill industries using cross sectional data for more than 160 mills which were randomly selected from five states. The data was analysed using trans-log cost frontier. The study found that the average cost efficiency of saw mill industries was 126.2%, which suggested mill incurred 26% cost above the frontier cost when processing logs. Furthermore, the study revealed that cost efficiency of sawmills was determined by years of education of firm's owner and workers, experience of sawmill owner, age of workers and the level of capital investment which reduced cost inefficiencies between 7% and 16%.

Pusnik (2010) investigated the influence of technical and allocative efficiency on export performance of Slovenian Individual firms using data from Agency of the Republic of Slovenia for Public Legal Records and Related Services (APLR) for 39 833 firms. The data were measured using Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA). The study showed that efficiency firms than their competitors were more export oriented and technical efficiency was more significant for firm's export orientation than allocative efficiency. Nevertheless, the study reported that efficiency of export activity of individual firms was significantly influenced by firm size, capital invested, and if there are export oriented.

Papadogonas *et al.* (2013) used the longitudinal data set on manufacturing firms in Greece for the 2004-2011 periods to examine the relationship between market power, cost efficiency, and firm performance in post-crisis era. They found that market share and cost efficiency are significant determinants of the profitability for the whole time period and sub-periods tested. Also, age of the firm had positive correlation with profitability in both periods indicating that variables such as reputation and experience gave veteran firms edge over younger firms in food sector.

Moradi *et al.* (2013) compared between parametric and partially non-parametric methods in wheat production cost efficiency in Iran. The study used panel data from 1999 to 2005. The study estimated cost efficiency instead of production efficiency due to availability of information on input prices. The results showed that pesticides cost had no significant effect on frontier cost production while irrigated wheat areas had high cost efficiency. The comparison of the two methods of estimation showed that in terms of significant coefficients and differentiated production structure, parametric approach in each province was more appropriate. Nonetheless, both methods showed that cost efficiency of wheat production was over 90% since farmers were given the facilities and used them effectively.

According to Hyuha *et al.* (2007) studied the profit inefficiency among rice producers in Eastern and Northern Uganda using Stochastic Frontier Approach. The firm-specific characteristics were modelled and estimated using maximum likelihood procedure. The results revealed that the major causes of inefficiency among farmers were: level of education, limited access to extension services and finance. It was argued that educated farmers are able to gather, understand and use information from research and extension more easily than uneducated peers.

Kamberoglou *et al.* (2004) the study investigated the cost efficiency of Greek banks from 1993-99 using panel data. The results revealed that reforms in banking sector brought opportunity to Greek banks to improve their efficiency and enhanced their competitiveness which indicate by cost x-inefficiency was in place. Also bank characteristics such as bank size, type of ownership and risk behaviour played great role in explaining differences in measure inefficiencies.

Linna *et al.* (1998) analysed the determinants of cost efficiency of Finnish hospitals using Data Envelopment Approach and Stochastic Frontier Approach. The study found efficiency determined by specialization, sufficiency high proportion of physicians and increasing the relative share of physician input. They found teaching and research output increases hospitals cost directly and indirectly but they have long term benefit on productivity in patient care.

2.5.2 Studies in Tanzania

Aikaeli (2008) studied commercial banks in Tanzania using panel data from 1998-2004. The study used the DEA model in estimating technical and scale efficiency, while x-inefficiency was estimated using multi-product translog cost function. The study reported that commercial banks operated on the decreasing part of their average cost curves which provided room for increasing returns to scale while in terms of technical efficiency foreign firms ranked the highest, followed by small banks and then large domestic banks. In case of scale efficiency, small banks had the highest followed by international banks and large domestic banks. The reason behind x-inefficiency in banks was due to inadequate fixed capital, poor labour compensation, less management capacity as banks expanded, and excessive.

Nyaki (2014) used the translog cost function to analyse the institutions and cost efficiency along the formal and informal milk value chains in Bagamoyo district. Data were collected from 167 milk producers, 31 traders, 4 collection centres, 3 processors and 3 regulatory bodies. The study found that there was variation of added cost among collectors, processors and retailers while output elasticity and cost elasticities due to feeds and labour significantly affected the total cost. Smallholder farmers' efficiency was affected by household head age, education, household size, number of cows in milk breed type.

Kyarara (2011) in his study in analysing the impact of market competition on performance of Tanzanian manufacturing firms using the panel data and used Cobb Douglas production function and Hirschman-Herfindahl Index (HHI). The study found there is positive relationship between competition and productivity with 1 percent increase in competition resulting into 0.4 percent increase in productivity. Competition was found to have influenced on performance of Tanzania's manufacturing exports and also had positive correlation between firm specific characteristics (age of firms, ownership, size of the firms) with competition and profitability.

Sesabo and Tol (2008) examined the technical efficiency of small-scale fishing households in Tanzania using data from coastal villages (Mlingotini and Nyamanzi) using a stochastic frontier model. Results showed that the mean technical efficiency of small-scale fishing households was 52% and the efficiency of the individual's fishing was positively associated with fishing experience, size of farming land, distance to the fishing ground, and the potential market integration but negatively related to non-farm employment and bigger household sizes. Furthermore, the study explained that the scarce of financial institutions hindered access to capital resources which affects the efficiency of fishing farmers.

Ilembo and Kuzilwa (2014) analysed the technical efficiency of smallholder tobacco farmers in Tanzania using a stochastic frontier method in a Cobb-Douglas production function. The findings revealed that the technical efficiency was 64.7% which indicates there is still an opportunity to expand tobacco production. Variables such as farm size, input credit use, off-farm income and education negatively influenced technical efficiency while age of household had positive relationship with technical efficiency. Input credit use influenced technical efficiency level in tobacco production since is required for farm preparation stage to harvesting and grading before it is brought to the market for sale.

Msuya *et al*. (2008) estimated levels of technical efficiency of 233 smallholder maize farmers in Tanzania using a stochastic frontier production model. They found that technical efficiencies of smallholder maize farmers range from 0.011 to 0.910 with a mean of 0.606. Low levels of education, lack of extension services, limited capital, land fragmentation and unavailability and high input prices had negative effect on technical efficiency. Nevertheless, there was a positive and significant coefficient for formal education variable indicated that the farmers' education is important factors in enhancing agricultural productivity also access to fertilizer and household size also significantly affect technical efficiency positively.

The above body of empirical literature on efficiency covers both developed and developing countries. A number of studies conducted in Tanzania focused on estimation of efficiency and their potential to improve the productivity of smallholder farmers. The sectors which were covered in these studies include agriculture (Kalinga, 2014; Msuya *et al.* 2008; Mahoo, 2011; Wikedzi, 2012; Nyaki, 2014; Ilembo and Kuzilwa, 2014), fishing (Sesabo and Tol, 2008,), education (Ngodu, 2009; Mbelle, 2008; Wanjiku, 2005; Bangi, 2014), banking (Aikaeli, 2008; Kipesha, 2013; Marwa and Aziakpono, 2014), health (Saronga *et al*., 2014). Despite the extensive body of literature dealing with estimation of efficiency in Tanzania, the study about efficiency of Tanzanian small-scale food processing industry is still rare and has not received attention in the published literature.

In addition to that, the reviewed studies above used the Stochastic Frontier Analysis in the analysis. The stochastic frontier analysis presents the composite error which has two components which are cost inefficiency component and noise component. The latter captures the effects of statistical noise, which are beyond the control of firms while the former reflects the effects of economic inefficiency. The composite structure of the error helps each firm to be efficient or inefficient relative to its cost frontier. Also, it allows the decompose growth into changes in input use, changes in technology and changes in efficiency, thus extending the widely used growth accounting method (Nguyen, 2010).

2.6 Theoretical Framework of Efficiency

2.6.1 Theory of the firm

The theoretical underpinning that guides the efficiency is an extension of basic microeconomics of the firm and production/cost functions. Using the Pareto principle which is a welfare concept establishes the underlying principles for deriving efficiency analysis. According to the Pareto criterion, a choice could be justified if some people are better off without making other people worse off. Therefore, as firms are making decision on what, how and how much to produce given the available scarce resources and technology, they have to make resources are allocate efficiently. If the resource allocation is less efficient, it means there is wastage of resources, thus there is a room for manoeuvre to ensure the resources are allocated efficiently (Schenk, 2004). In this essence firm manager are try either maximize profits or minimize the costs of producing certain level of output while ensuring they are operating on production or cost frontier.

The theory of the firm provides three methods for analysing efficiency namely technical, allocative and economic efficiency. These methods have been defined and estimated by Debreu (1951), Koopmans (1951), and Farrell (1957). Farrell (1957) defines technical efficiency as ability of firm to produce maximum amount of output given set of inputs. Allocative efficiency reflects the ability of the firm to use inputs in optimal combinations, for a given input prices and level of output (William, 2011).

For instance, from Farrell's analysis which is illustrated in Figure 2, the assumption is that the firm exhibit constant returns to scale with a production possibility set fully described by unit isoquant SS' while considering two inputs X_1 and X_2 and one output Y. The implication is that every set of inputs X_1 and X_2 along the unit isoquant is considered as technical efficient while any point above and to the right of it, such as point P defines inefficient producer. If a given firm uses quantities of inputs defined by the point P to produce a unit of output of isoquant SS', the technical efficiency QP/0P in the context of physical inputs and output of that firm could be represented by the ratio of distance QP to 0P. This is the amount by which all resources could be proportionally reduced without a reduction in output.

Furthermore, if information on the input prices is known and a particular behavioural objective such as cost minimization is assumed in a such a way that the input price ratio is reflected by the iso-cost line AA', allocative efficiency 0R/0Q of a firm operating at point P could be also be derived as the ratio of 0R to 0Q from the unit isoquant shown in Fig. 2. In construction, this is a reduction in production costs that would occur if production were to occur (but at the allocative inefficient) point Q. The product of technical and allocative efficiencies as earlier indicated provides a measure of cost efficiency. This means, it is possible for a firm to exhibit technical or allocative efficiency without having economic efficiency. Technical and allocative efficiency are therefore necessary conditions for cost efficiency (Abdulai and Huffman, 1998). Cost efficiency defined cost efficiency as lowest cost of producing goods and services given input prices and output level (Eltivia *et al.,* 2014; Papadogonas *et al.,* 2013).

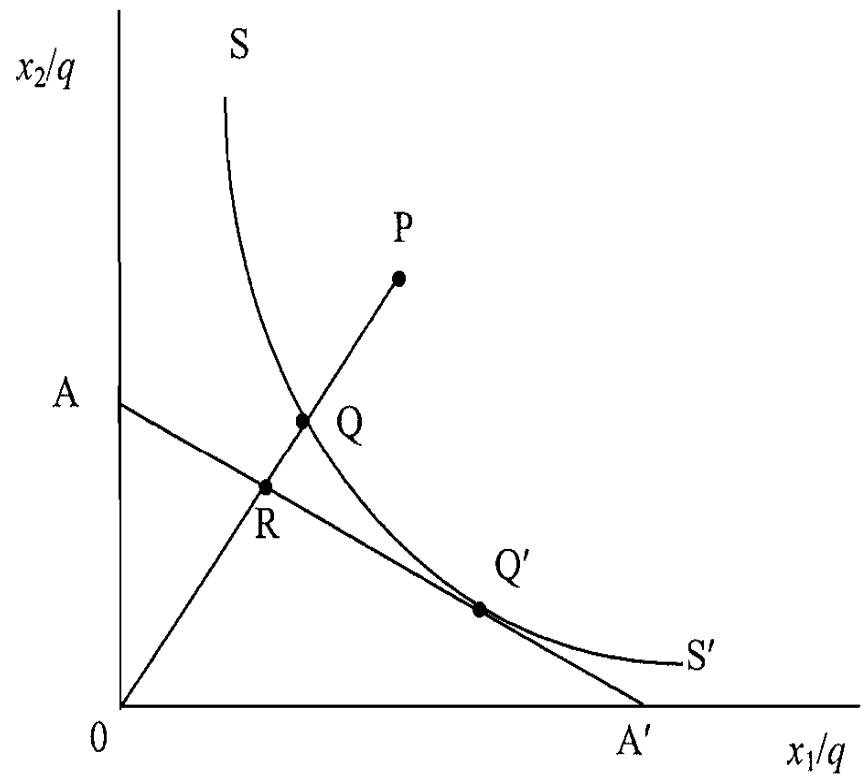

Figure 2: Technical and Allocative Efficiencies
Source: Coelli *et al*. (2005).

2.6.2 Duality theory

The duality theory implies that given certain regularity conditions of the cost function (non-negativity, non-decreasing in prices (P) and output (Y), concave and continuous in P, linearly homogeneous in P, and no fixed costs) there exist cost and production functions that are dual to each other. Hence, the structure of the production technology can be analysed using either a production function or a cost function. The choice is made based on statistical grounds. Production function estimation is appropriate under assumptions of profit maximization and endogenous output levels, whereas cost function estimation is preferred under the assumptions of exogenous outputs and inputs prices. Since, the sunflower processing industry is highly competitive (Dillman and Ijumba, 2011), where each firm tries to maximize profits, both outputs and inputs prices are exogenous to the processors. In general, sunflower processing firms meet the demand for their products as determined by the market. The competitiveness of the industry also suggests that firms compete for their inputs (raw materials, capital and labour), therefore, input prices are exogenous as well. It follows then that is reasonable to estimate a cost function rather than a production function.

2.7 Synthesis of the Literature Review

From the reviewed studies, there are significant very few studies that have concentrated on the cost efficiency in manufacturing sector not agro-processing sub-sector. This can be due to the fact that accounting for cost used in processing activity is very difficult task especially accounting for transaction costs which in most cases are invisible to the processors. In reality, the concept of a firm operating efficiently is an “ideal” since it will require a firm to operate in an environment with no externalities, which in most cases is unattainable objective due to market failures which arises from asymmetric information, transaction costs, incomplete markets, principal-agent problems and government failure when trying to remedy the shortcoming of the market. Therefore, the realistic measure of the efficiency can be done through comparing a firm’s efficiency against the peers in the same industry.

CHAPTER THREE

3.0 METHODOLOGY

3.1 The Research Conceptual Framework

According to Miles and Huberman (1994) a conceptual framework is a visual or written product which explains either graphically or in narrative form the main things to be studied which includes factors, concepts, or variables and presumes relationship among them. The conceptual framework guides a researcher in formulating conception of what is to be studied, what is going on these things, why and clear justification for the study. In this study, conceptual framework which is illustrated by Fig.2 was developed to look at the cost efficiency of small-scale sunflower processors in Dodoma Region.

It was based on the theory of the firm. The theory of firm solely explains that the main objective of the firm is to maximize profit or minimize cost through efficient allocation of resources (Schenk, 2004). The theory has been used to operationalize the inter-relationship that exists between sunflower oil extraction, minimization of cost of production by a firm, institutional, firm-specific and cost factors. Cost-effective sunflower oil extraction affected by sunflower seed processing, and firm output. Quantity of sunflower oil extracted by a firm will depend on cost of seed, labour, transaction and transport costs. Nevertheless, these cost factors are affected by institutional and firm specific factors where by factors such as nearness to market reduces the cost of acquiring inputs given the advantage on transport cost, whereas group membership reduces the problem of information asymmetry on input prices and time for procurement (Sibiko, 2012).

Furthermore, firm-specific factors such as age of the firm are expected to have positive influence on cost since veteran firms have more experience than newer firms on sources of raw materials and adoption of new technologies to reduce cost of production (Pitt and Lee, 1981). Ownership of the firm is expected to positively influence cost efficiency whereby sole proprietor firms are expected to perform less efficiently than jointly due to flexibility of firm owner/s in accessing market information (Mortmort, 2005).

High level of education and experience of firm's owner are hypothesized to have a positive impact on a sunflower firm's cost efficiency due to learning from past experiences, while firms with their own storage facilities are hypothesized to have positive impact on their cost efficiency since they will be able to buy the raw materials at lowest prices during high seasons and storing them for low seasons processing (Sibiko, 2012; Minai and Lucky, 2011; Soderbom and Teal, 2003; Gillespie *et al.* 1997). Basically, these institutional and firm-specific factors are identified so as to look for correct measures to improve them.

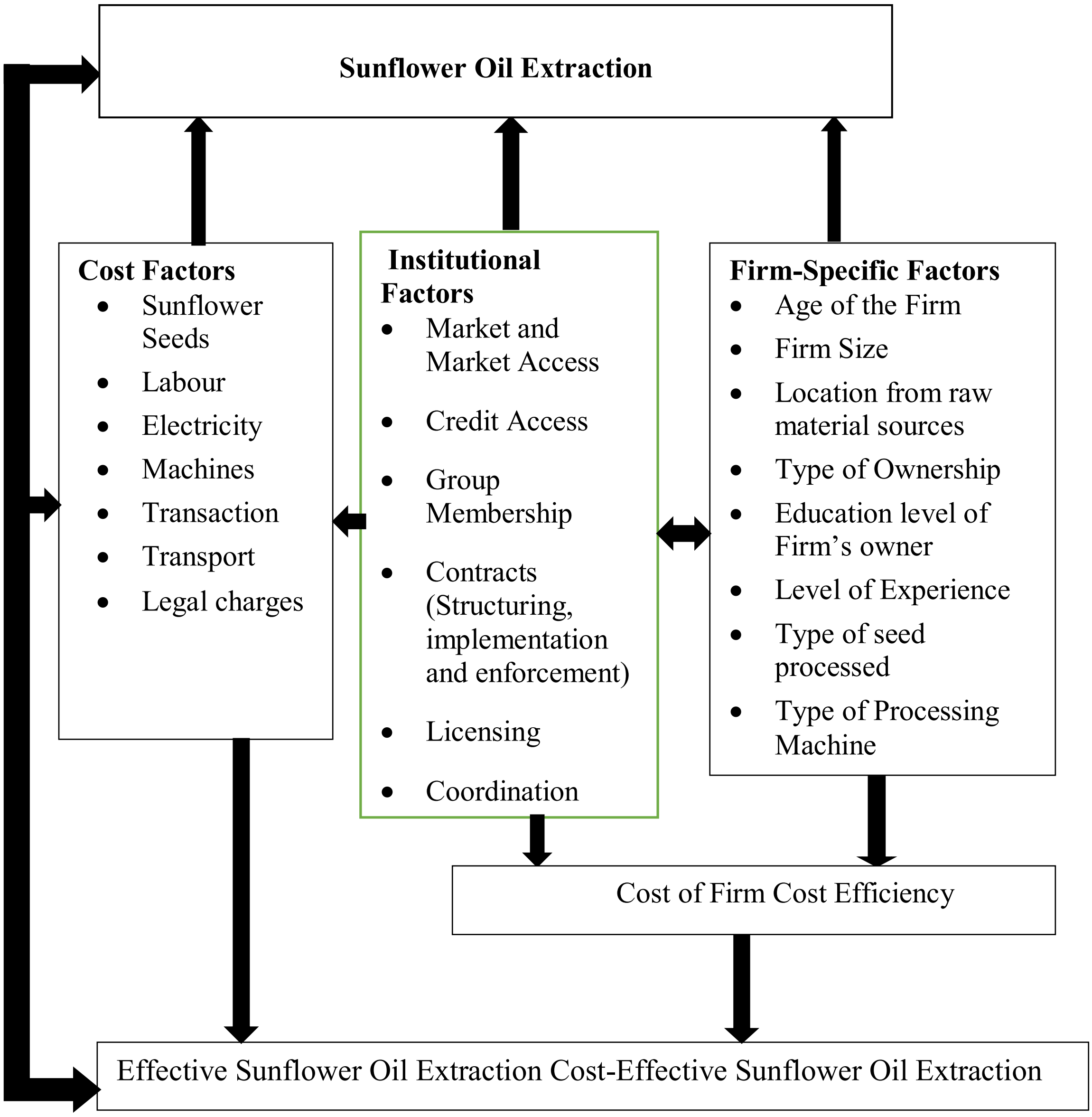

Figure 3: Conceptual Framework for Small Scale Sunflower Processing Firm

Source: Adopted and Modified from Sibiko (2012).

3.2 Description of the Study Area

3.2.1 Geographical location of Dodoma Region

The study was conducted in two districts namely Dodoma Municipality and Kongwa in Dodoma Region. Dodoma region was purposively selected for the study on the strength of the fact that a variety of interventions have so far been implemented by the government and development stakeholders in trying to revamp the sunflower processing firms in the region. Dodoma Region is located between 6^0 South and 36^0 East of the Equator. The region lies at the heart of Tanzania in the eastern-central part of the country, covering an area of 41 311 km^2 with population of about 2 083 588 (Figure 3). The Region consists of seven districts namely Bahi, Chamwino, Chemba, Dodoma Municipality, Kondoa, Kongwa and Mpwapwa (Iringo *et al*., 2014; NBS, 2012).

Dodoma Municipality is the de jure national capital of Tanzania since 1973. It is situated between Latitudes 6.00^0 and 6.30^0 South, and Longitude 35.30^0 and 36.02^0 East. The Municipality is bordered by Chamwino District in the East and Bahi District in the West. It is 456 kms from Dar es Salaam and 426 kms from Arusha city. The municipality is characterized by seasonal rainfall with long dry and short wet seasons, an average annual rainfall of about 500-600mm per year, falling between April and December. The temperature ranges between 20^0C in July to 30^0C in November months of the year.

Kongwa District is geographical located in coordinates 6.2^oS and 36.4^oE of the Equator. It is bordered to the North by Kondoa district, to the East by the Kilosa district, to the South by Mpwapwa district and to the West by Dodoma Rural district. Kongwa district is divided into 14 wards while Dodoma municipality is divided into one parliamentary constituency, 4 divisions, 41 wards, 18 villages, 170 streets and 89 hamlets (NBS, 2012).

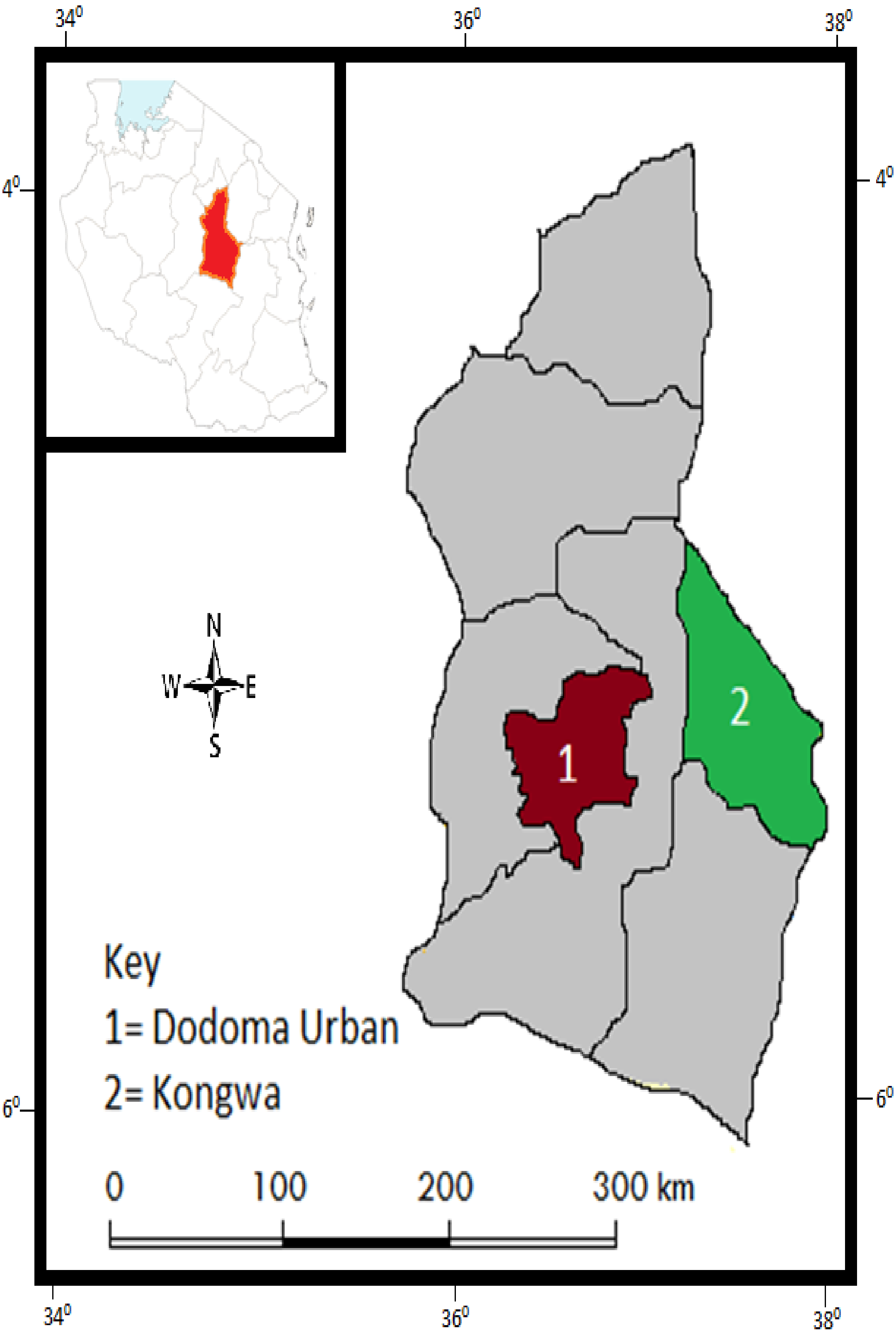

Figure 4: A Map of Dodoma showing the Study Area

3.2.2 Economic activities

The major economic activity in Dodoma region is agriculture which employ about 90% of the population. Production is undertaken at subsistence level, with sorghum, millet, rice and maize being the main food crops while groundnuts, simsim, sunflower and grapes are grown for commercial purposes. Maize is the dominant annual crop grown accounting for 52.5% of the total area planted with annual crops in the region. Other crops in order of their importance (based on area planted) are groundnuts, sorghum, sunflower, simsim and cassava. Fishing activities are practised at subsistence level due to insufficient water bodies and technology while livestock keeping is also some dominant activities with agro-pastoralism taking large part followed by pure pastoralism (URT, 2006).

Oilseeds production accounted for 43 948 tons planted on an area 120 211 hectares, on average. Groundnut is the most important oil crop 78 311 ha (65.1% of the total area planted with oilseeds), followed by sunflower (21 074 ha, 17.5%), simsim (20 709 ha, 17.2%) and soya beans (116 ha, 0.1%). Other economic activities include: livestock keeping, fishing, mining and industrial. Industrial activities are dominated by small scale processors of the produced agricultural commodities like sunflower, and maize (URT, 2006)

3.3 Research Design

The research design used was a cross-sectional survey done at a single point in time. This design is useful for descriptive purposes and in obtaining qualitative information as well as for determination of relationship between variables (Bailey, 1998). In addition to that, it allows a researcher to efficiently utilize the economic resources in terms of time and funds.

3.4 Sample Size

The study interviewed a total of 70 respondents. Primary data were collected from the respondents. Accurate sampling is important to minimize the risk of sampling bias and to be able to draw reliable inference about the population, therefore, data from 70 small-scale sunflower processors were collected using semi-structured questionnaire (Appendix 1).

3.5 Sampling Procedure

The study used from sample populations comprising of the small scale sunflower firms in Kongwa and Dodoma Municipality. The formal interview was carried out with small scale processors, sunflower association (CEZOSOPA) and government officials in the districts. Dodoma region was purposively selected for the study on the strength of the fact that a variety of interventions have so far been implemented by the government and development stakeholders in trying to revamp the sunflower processing firms in the region. Purposely sampling was employed to select two districts (Kongwa and Dodoma urban) out of seven districts in the region followed by random selection three and nine wards from Kongwa and Dodoma urban districts respectively. The two districts were considered ideal for the study because they have larger number of small scale sunflower processing firms compared to other districts in the region and survey was conducted in two districts to identify the number of processors who were operating and type of services needed by them. Therefore, this study built up from data which already collected by CEZOSOPA by systematically sampling 35 processors from each district. The detailed sample structure by sample area is given in (Table 2).

3.5.1 Selecting sunflower processors

The list of sunflower processors was obtained from Central Zone Sunflower Processing Association (CEZOSOPA) offices in Dodoma urban offices. The organization conducted a survey on the sunflower processing firms in Dodoma urban and Kongwa District titled "Processors Study Report 2014" by Ringo Iringo, Princess Elias and Sophia Majid. The study found that there were 67 sunflower processors in Kongwa and 61 in Dodoma municipality, therefore, 35 processors were selected randomly from each District (were some available processors who were operating at time of data collection) using list of names of processors provided. Also, the list contained location and phone numbers of the processor, this made it possible to contact specific processors for arrangement of meetings and identifying whether s/he is still processing or not.

Table 2: Distribution of Interviewees by District/Ward

Districts											
Dodoma Municipality									Kongwa		
Ward/Village											
Majengo	Mnadani	Chamwino	Mailimbili	Kisasa	Area A	Area B	Chadulu	Kizota	Kibaigwa	Pandambili	Hembahemba
Number of Interviewees											
4	7	7	2	1	1	2	3	3	20	8	2

3.5.2 Selecting enumerators

The enumerators were selected on the basis of the level of education and understanding of the sunflower processing in Tanzania. The first enumerator was a form six leaver who studied Economics, Geography and Mathematics (EGM) and was a resident in Dodoma Region. The second enumerator was from Kibaigwa district with well deep rooted knowledge and experience of sunflower processing firms in Dodoma region. Two days were used to familiarize the enumerators with research questionnaire and interview techniques and learning to fill it.

3.6 Data Collection

Primary data for this study were collected from 70 small scale sunflower processors from the two districts (Kongwa and Dodoma Municipality). The second stage involved a multistage sampling procedure in which ten wards were selected randomly based available number of sunflower processors in the specific area. A total of 35 small scale sunflower processors were selected from Kongwa while 35 were selected from Dodoma Municipality.

3.7 Questionnaire Design and Administration

Primary data collection took place between May-July 2015 using semi-structured questionnaire (Appendix 1). The information included data on total cost and firm specific characteristics shown in the empirical models. Cost data collected were on raw materials (bags of sunflower seed respective prices per month), transport (cost per distance travelled from market in TZS), storage (cost of storage per month in TZS), labour (wages per month to crashers, winnowing cost per bag per day, loading and off-loading of sunflower seeds per trip per month in TZS, depreciation (cost of fixed asset divided by number of years it has been used in TZS) and electricity (total power used per month and its respective price in TZS). All these used units were latter quantified to obtain figures for twelve months, this means from May 2014 to April 2015.

The qualitative data collected to address specific objective two includes: age of the firm (years since establishment), sex of the firm owner, marital status (single, married or divorced), level of education attained (primary, secondary or college level), type of ownership (sole proprietorship, partnership, limited liability company), membership to processors' association (CEZOSOPA or TEOSA), type of seed processed, type of machined used, Access to Finance (microfinance or commercial banks or private-sources), training received (Kaizen, CEZOSOPA).

3.7.1 Pre-testing of the questionnaire

Pre-testing of the questionnaire was conducted prior to the main fieldwork as a basis of improving the instrument. The pre-testing was done by interviewing three small scale sunflowers in Morogoro Municipality during May 2015. After the pre-testing, all the necessary modifications were made to the questionnaire before data collection to include questions on training processors received, access to finance and any support they receive from government.

3.7.2 Data processing and analysis

The Statistical Package for Social Science (SPSS), Microsoft excel and STATA version 13 were used for quantitative data, in order to achieve the stated objectives. The qualitative data were coded and summarized and then-after was analysed using means, variance and standard deviation. Quantitative data were entered in Microsoft excel were all necessary arithmetic were conducted and export to STATA version 13 for estimation of stochastic cost frontier.

3.7.3 Methods for data analysis

3.7.4 Descriptive statistics

Descriptive statistics were employed in this study were based on the specific objectives and hypotheses of the study. For descriptive statistics, the use of means, percentages and ranges were employed to describe the characteristics of the sunflower processors in the study area.

In answering the research question number one that "*what is the level of the cost efficiency of the small-scale sunflower processors in the study area*?" the stochastic cost frontier model was employed as explained in section 3.7.4. Consequently, the hypothesis that "cost *efficiency in sunflower processing firms is not influenced by firm-specific characteristics such as age of the firm, firm size, ownership, education level and experience of the firm's owner, membership to association, type of machine and type of seed used in processing"* was addressed by running the linear regression model as explained in section 3.7.4.2.

3.7.5 Stochastic frontier cost function estimation

Stochastic frontier of the cost function has been independently proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). The original specification implies a cost function generated for a cross sectional data set, with two-component error terms, one relating to stochastic effects and the other one to cost inefficiency.

This study used stochastic frontier model as per Battese and Coelli (1992; 1995) which defines minimum cost for given output level, input prices and existing production technology. Cost component is represented by Equation 2 in the function form.

$$C_i = C_i(w, y, \beta) + (v_i + u_i), v_i \sim N(0, \sigma_v^2, and\ u_i \sim |N(0, \sigma_u^2)| \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where C_i is the normalized total cost of ith processor, w is the vector of normalized input prices, y is the vector of sunflower oil extracted by the ith processor and β is a vector of the parameters to be estimated. The overall error term is decomposed into two components v_i and u_i. The deviation from the frontier due to random events is represented by v_i while u_i captures deviations from the frontier due to inefficiency which is represented by firm-specific characteristics and institutional factors.

From the properties of cost function, other factors being equal, total cost as function of inputs and output price will increase as output and input used increases. Also, when two factor inputs in production process increases it is also expected that the total cost will increase. This conforms to the quality of well-behaved cost function which should be concave and non-decreasing in input prices. Other authors who have contributed to this area of interest include: Forsund, Lovell and Schmidt (1980), Schmidt (1985), and Greene (1993).

3.7.5.1 Translog cost frontier

Due to linearity in other forms of production Cobb-Douglas and Constant Elasticity of Substitution (CES) function, the study adopted transcendental logarithmic (translog) cost function (Christensen and Green, 1976) due to its several possible interpretations and its mathematical similarity to the application of Shephard's duality theory and translog production functions. The cost function used for this study is specified as follows:

$$TC = f\ (Y, P_M, P_{Sf}, W, P_T, P_E, D) \quad \ldots\ldots (3)$$

Where, TC represents total cost of producing sunflower oil, Y is the quantity of sunflower oil produced by month in litres, P_M represents the price of sunflower seed per bag of 70 kg and storage cost, W stands for wages/salary payments per month, P_T stands for transport costs incurred in procuring inputs and other resources for the firm, P_E stands for price of electricity in kilowatts per month, and D represents depreciation of machines as proxy for fixed cost divided by number of years used per firm. This study followed the study by Ogundari (2010) who estimated and analysed the cost efficiency of sawmill industries in Nigeria. The translog cost function for cost function in (3) above can be written as follows:

$$\ln C_i = \beta_0 + \lambda_0 \ln Y_i + \frac{1}{2}\lambda_1 [\ln Y_i] + \beta_m \sum_{m=1}^{4} \ln W_{mi} + \frac{1}{2}\beta_{mn} \sum_{m=1}^{4} \sum_{n=1}^{4} \ln W_{mi} \ln W_{ni} + \alpha_m \sum_{m=1}^{4} \ln W_{mi} \ln Y_i + \sum_{m=1}^{4} \left(\frac{W_{mi}}{P_Y}\right) \ln D + V_i + U_i \quad \text{.....................} (4)$$

Where, C_i represents total cost of firm i, Y_i stands for output of firm I W_i represents weighted input price; i.e. total cost of machine, raw materials, electricity and labour, $\boldsymbol{V_i}$ represents statistical errors associated with random factors that the processor does not have control over. It has a zero means and variance equal to σ_v^2 such that the distribution is given as N $(0,\sigma_z^2)$. $\boldsymbol{U_i}$ represents random variable for cost efficiency. It is a non-negative half normal truncated at zero, with a distribution given as, N $(0, \sigma_u^2)$. Nevertheless, Ui can also have other distributions such as gamma and exponential. In this study the $\boldsymbol{U_i}$ is represented by firm-specific characteristics such as age of the firm, level of education, level of experience and firm location and institutional factors such as access to credit and membership to processors' association.

The translog cost function equation (4) was normalized in order to be able to estimate cost frontier equation (2). The normalization of the cost and input prices aimed at imposing linear homogeneity in input prices which is among properties of cost function. For this study, wages (W) is selected to normalize all prices of variable inputs (W_i) as well as total cost. The normalization was done through dividing all the variable and total costs by the wages in equation (7). For this study after normalization, translog cost function can be written as follows:

$$\ln\left(\frac{C_i}{W}\right) = [\beta_0 + \lambda_0 lnY_i + \frac{1}{2}\lambda_1 \ln[Y]^2 + \beta_m \sum_{m=1}^{4} \ln(\frac{W_{mi}}{W}) + \frac{1}{2}\beta_{mn} \sum_{m=1}^{4} \sum_{n=1}^{4} \ln\left(\frac{W_{mi}}{W}\right).\ln\left(\frac{W_{ni}}{P_W}\right) + \alpha_m \sum_{m=1}^{4} ln\frac{W_{mi}}{W}\, lnY_i + \sum_{m=1}^{4} \text{n}(\frac{W_{mi}}{W}) \ln D + V_i + U_i] \quad \text{…………} (5)$$

The suppose symmetry constraints ensure that:

$$\sum \lambda_1 = 1; \sum\sum \beta_m = 0 \sum\sum \beta_{mn} = 0; \sum\sum \alpha_m = 0$$

Where C_i is as earlier defined, P_T is the transport cost, W_m is the prices of k-1 inputs which include the price of raw materials, labour, electricity. D is price of fixed capital. V_i is a two sided independently and identically distributed (iid) while white noise to beyond the control of the firm such as measurement error and weather, with a mean of zero and constant variance. U_i is one sided (non-negative) independently and identically distributed random error which the firm has the capability to influence, in this study is assumed to be truncated normal distributed for U_i as $N^+(\mu_i, \sigma_u^2)$.

Table 3: Description of cost efficiency model

Cost efficiency variables	Definition	Expected sign
Annual sunflower oil produced (Y)	Total volume of sunflower oil in litres produced during the season 2014/15	+
Normalized Price of Raw Materials (Pm)	Weighted price of all raw materials used in the season 2014/15	+
Normalized Price of Labour (W)	Weighted price of labour used in the season 2014/15	+
Normalized Price of electricity (Pe)	Weighted price of electricity used in the season 2014/15	+
Cost of Capital (Pc)	Depreciation cost for fixed assets for season 2014/15	+

3.7.5.2 Inefficiency Model

According to Battese and Coelli (1995) inefficiency is allowed to be certain exogenous variable that are estimated jointly with stochastic frontier function in equation (3) above as U_i. The inefficiency error component U_i is assumed to follow a truncated normal distribution with mean as function of explanatory variables. These variables in this case are both institutional and firm-specific characteristics which helped to examine the sources of differences in cost efficiencies among the small scale processors. The cost inefficiency effects, Ui, can be specified by Equation 6 as:

$$U_i = Z_i\delta + W_i \text{..} (6)$$

Where, U_i is one-sided half normal, Z_i= vector representing possible inefficiency determinants, δ= vector of parameters to be estimated, W_i= random variable defined by truncation of the normal distribution with mean zero and variance σ^2, such that the point of truncation is -$Z_i\delta$. Therefore, the cost inefficiency equation (6) can be linearized as follows:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 + \delta_9 Z_9 + \omega \text{ ....} (7)$$

Where Z_1= Firm location, Z_2= Age of the firm, Z_3= Size of the firm, Z_4= Type of processed sunflower seed (1=Normal seeds, 2= QDS), Z_5= Level of education of firm owner (1=Primary, 2=Secondary and Tertiary), Z_6= Level of experience of firm's owner, Z_7= type of machine used, Z_8= Access to credit (1=Yes or 0=No), Z_9= Member to Processors' Association (1=Yes, 0=No) and ω is the two sided random error and $\delta_0 \ldots\ldots\ldots.. \delta_9$ are the parameters to be estimated.

Table 4: Description of cost inefficiency variables

Variable	Description	Expected Sign
Firm location	Distance from raw materials in kilometres	+/-
Age of the firm	Years of establishment	+/-
Level of Education	Number of years of schooling of firm operator	+
Level of experience	Number of years in operating the firm	+
Access to credit	If firm has access to credit or otherwise	+/-
Membership to Association	If member of association or otherwise	+/-

3.7.5.3 Estimation of Stochastic Frontier using Maximum Likelihood Method (MLE)

Green (1993) asserts the MLE is a consistent and asymptotically efficiency estimator and allows for random estimation as opposed to ordinary least square (OLS) which is inefficient in estimation. While equation (6) represents the cost function, equation (10) describes how the mean (Ui) inefficient is measured, representing the deviation of cost (Ci) by each respondent from minimum possible cost. The maximum likelihood estimation of equation (3) yields parameter estimates; β_m and δ. Where β_m is as parameters to be estimated and δ is the ratio of variances. The cost efficiency can be obtained from the conditional expectation of u_i given as εi.

This study employed two sequential steps for estimation of the stochastic frontier (Kalirajan and Shand, 1999). The first stage consisted of specifying and estimating the stochastic cost frontier and predicting the cost inefficiency effects, under the assumption that these inefficiency effects are identically distributed. Thus, the estimates of the model parameters are obtained by maximizing the log-likelihood function log (θ) where $\theta = (\propto, \beta' , \delta 2_v, \delta 2_u)$.

The second stage, a regression model for predicted and cost inefficiency effects was specified and estimated. Thus, point estimates of inefficiency can be obtained through mean (or the model) of the conditional distribution $f(u_i|\varepsilon)$, where $\varepsilon_i = y_i - \propto - x_i'\beta$. The derivation of the maximum likelihood is based on the independence assumption between u_i and v_i since the composite model ε_i is defined as $\varepsilon_i = v_i - u_i$. This method was highly defended by Coelli (1995) who specified that the use of inefficiencies as a dependent with assumption of identically distributed efficiency effect in the stochastic frontier.

3.8 Limitations of the Study

The study was undertaken for the time frame of only one year i.e. May 2014-April 2015. This means the information collected are subject to changes which could alter findings of similar studies in the future. Therefore, conclusions drawn from the study cannot be generalized for the whole country (mainly apply to Kongwa and Dodoma Urban district). The reasons for this, is that the situation in Dodoma urban and Kongwa districts may be different from the rest of Tanzania thus findings and recommendations revealed may not apply.

Majority of the respondents in the study area do not keep records. Therefore, this posed challenges during data collection whereby collection of data mainly depended on the memory recall of respondents, which the majority found it difficult to manage. On the other hand, some processors, purposely declined to give data on prices and revenue received fearing that data obtained might be given to the government for tax issues. However, after discussion most of them were convinced to cooperate after being assured that the information being solicited was meant for research only and not otherwise and that their privacy would be respected.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Overview

Descriptive statistics were used to discuss both processor and firm-specific characteristics for 70 processors in Kongwa and Dodoma urban. Then-after, stochastic cost frontier was used to estimate cost function for five variables: total cost, quantity of output, cost of raw materials, labour, electricity and capital which enabled us to ascertain of level of efficiency of individual processor. Lastly, the linear regression model was used to identify the sources of inefficiency and their influence on the cost efficiency level.

4.2 Socio-economic Characteristics of the Processors

The study examined different processor's characteristics which include: age of the processor, sex, marital status, level of education, level of experience in sunflower processing industry, how they acquired the knowledge of sunflower processing, membership to processors association, receive any training services on processing and marketing, and if they received any loans from financial institutions. These factors are well illustrated in Table 5 which shows description of each factor in terms of frequency and percentages.

Table 5: Socio-Economic characteristics of the Processors in the study area

Variable		Frequency		Distribution in Percentage %	
		Kongwa	Dodoma Urban	Kongwa	Dodoma Urban
Age Group	25-35 years	19	18	54.3	51.4
	36-45 years	10	13	28.6	37.1
	Above 46 years	6	4	17.1	11.4
	Total	**35**	**35**	**100.0**	**100.0**
Sex of the Respondent	Male	32	33	91.4	94.3
	Female	3	2	8.6	5.7
	Total	**35**	**35**	**100.0**	**100.0**
Marital Status	Single	6	4	17.1	11.4
	Married	29	31	82.9	88.6
	Total	**35**	**35**	**100.0**	**100.0**
Education Level	Primary school	20	15	57.1	42.9
	Secondary school	13	16	37.1	45.7
	Tertiary Level	2	4	5.7	11.4
	Total	**35**	**35**	**100.0**	**100.0**
Experience of the Processor	1-3 years	18	14	51.4	40.0
	4-6 years	10	9	28.6	25.7
	Above 7 years	7	13	20.0	37.1
	Total	**35**	**35**	**100.0**	**100.0**
Acquired Processing Knowledge	Apprenticeship	34	35	97.1	100.0
	Vocational training	1	0	2.9	0.0
	Total	**35**	**35**	**100.0**	**100.0**

4.2.1 Age of the processor

Findings in Table 5 show that majority of the sunflower processors in Kongwa district and Dodoma Urban are in age group between 25-35 years, who accounted for 54.3% and 51.4% of the total number of sampled processors respectively, followed by the age group between 36-45 years which represented 28.6% in Kongwa and 37.1% in Dodoma Urban and above 46 years had only 10% of sample processors. This means that large group of the processors engaging in sunflower oil extraction lie in a productive age and activity offer them an opportunity for self-employment, a source for income and wealth creation.

The study by Ziliona *et al.* (2013) found that 50% of the sunflower processors in Singida were in the age group between 36-45 years, while the age group between 25-35 and 46 years and above represented 25% each. Despite a little divergence from finding in Dodoma region, the study showed that sunflower processing activity acted as sources for employment opportunities to people in the growing areas. Also, it facilitated in value chain upgrading for sunflower seed and income creation for farmers and processors in the study area. Therefore, a better economic activity to alleviate income poverty in sunflower growing areas.

4.2.2 Sex of the processor

Findings in Table 5 show that the sunflower processing firms are dominated by males who represent 91.4% in Kongwa district and 94.3% in Dodoma Urban while female counterparts represented only 8.6% in Kongwa district and 5.7% in Dodoma Urban. Majority of these female sunflower processors are located in Kibaigwa market. These findings concur with those reported by Ziliona *et al.* (2013) which showed that 100% of all the sampled sunflower processors in Singida region were men. According to Chijoriga (2003) there is little participation of women in SSEs in Tanzania due to number of reasons such as to low level of education, lack of required skills and business experience, limited access to support services and adverse regulatory, cultural environment, and corruption and bureaucracy make women more vulnerable to physical pressure from corrupt officials.

In sunflower processing industry, there is competition with no protective barriers for entry of new firms or exit for existing ones. Capital requirements are low for new firm and disposal of assets is easy for exiting firms. Nonetheless, due to dominance of the males in the industry and facilities are dominated by men provide a smooth and easy opportunity to succeed compared to women who are limited by cultural environment such as traditional productive roles which limit them to start and run their enterprises smoothly compared to men (Chijoriga, 2003).

Table 6: Distribution of Cost Efficiencies for Sunflower Processors According to Gender

Variables	**Gender**	
	Male	**Female**
Number of Processors	65	5
Cost Efficiencies		
Range	110-129	110-114
Average	112.7	111.8
Maximum	129.0	114.0
Minimum	110.0	110.0
Standard Deviation	3.4	1.5

Despite cultural environment such as productive role which limit women to run their enterprises smoothly compared to men, the findings in Table 6 show that on average women had lowest cost efficiencies compared to their male counterpart. This depict the enterprises which were operated by women were performing better in term of control cost of production than male-owned enterprises. The reason behind this scenario is that most of these female-owned enterprises had direct involved of owners toward daily running of the business such as purchasing of raw materials, contracting with middlemen, arrangement for transport and hiring of workers and direct involvement with workers in production. These enabled them to direct control unnecessary rent seeking deals which could benefit the managers.

4.2.3 Marital status of the processor

Furthermore, the findings show that 82.9% of the processors in Kongwa and 88.6% in Dodoma Urban were married, while the remain 17.1% and 11.4% respectively were single. With most of these processors were managers and employees in those firms. Sometimes, some of these employees were employed as managers in the firms while other were workers but assumed the function of manager of firm when owner was absent. At the end of the month they were paid salary and allowances. Additionally, this enabled them to acquire managerial experience on running a business firms. Most of the married processors used the activity as source of self-employment and paid-employment which enable them to provide for their families.

Similarly, the study by Ziliona *et al.* (2013) found that 75% of the sunflower processors in Singida Region were married while 15% were single and 10% were divorced. They noted that sunflower processing activity offers opportunities for married individuals in terms of employment and stream of incomes which enable them to cater for family needs such as good foods, shelter, clothes, health and education.

4.2.4 Education level of the processor

Findings in Table 5 show that 57.1% of the processors in Kongwa District and 42.9% in Dodoma Urban had achieved primary school education, 37.1% in Kongwa and 45.7% in Dodoma Urban had acquired secondary school education and the remains 11% had tertiary level education. Education is important tool which will enable a processor to produce efficiency overtime. It provides them with enough understanding on how enterprises are structured and managed in order to generate enough revenues for growth and expansion of the firm in the foreseeable future. Efficiency and education are closely related, where efficiency increase in any firm is largely associated with three factors such as progress of knowledge, technology and human capital. Education enables the processors to identify suitable firm's location, raw materials sources and market channels for selling their output.

In sunflower processing, education of the processors is important in different aspect such as: (i) location for firm depend on close proximity to raw materials and markets, (ii) identifying better machines which are cheaper and efficient for oil extraction purposes and quality seeds with more oil content, (iii) how to increase their product quality and meeting TFDA standards to secure both local and international markets.

4.2.5 Experience of the processor

The study found that 51.4% of the processors in Kongwa and 40% in Dodoma Urban had experience of 1-3 years in the industry, 28.7% in Kongwa and 25.7% in Dodoma Urban had experience of 4-6 years while the remaining 20% in Kongwa and 37% in Dodoma Urban had experience above 7 years. These findings mean that the sunflower processing industry is dominated by newer and younger firms. Newer and younger firms' dominance shows that industry is less restrictive in terms of regulations which could deter entrant and participation of newer and younger firms in the market. Newer and younger firms' offer competition to the veteran firms in terms of innovation and better technologies which encourage efficiency operation in the industry.

Entrant of newer and younger firms in recent years have been incentivised by interventions by government and other development stakeholders to boost sunflower production in the central corridor of Tanzania, high demand for sunflower oil for its nutritional contents, access of loans from CRDB Bank and training and extension services from SIDO, CEZOSOPA, TFDA and TBS, and low entrant cost of less than 30 million TZS for new firms in the industry (Salisali, 2008; RLDC, 2012). Nonetheless, veteran firms have advantages in the market over the newer and younger firms since they have well established experience with farmers, dealers and transport for supply of raw materials. Also, they established reputation with bulk buyers of sunflower oil who come from Iringa, Mbeya and Dar es Salaam which could enable them to dispose their oil easily than newer and younger firms.

4.2.6 Main occupation of the firm owner

Nevertheless, sunflower processors in the study area also engaged in other economic activities than processing. These economic activities include farming which accounts for 77.1% of the all the respondents, this includes the cultivation of sunflower, maize, sorghum and millet, followed by trading which represents 11.4% while livestock keeping (5.7%) and employed (4.3%) shown by Table 7. These other economic activities were vital for creation of the additional income during low processing season which begins around November to April the following year. Also, for diversifying their risks and wide sources of income streams due to uncertainty of the sunflower seed production which depend on weather condition.

For those processors who engaged in trading, most of them bought sunflower seeds from the smallholder farmers at lower prices during high season from May to September of same year. They withhold the stock until when the prices increase during the lower seasons and selling them at a profit. Nevertheless, due to speculative behaviour in the market and withholding stocks by many sellers, therefore, it is difficult for them to obtain very high price and profit even lead sell at loss, hence, those processors who borrowed from commercial banks failed to repaying their loans which led to confiscation of their properties and shut down of their production facilities.

Table 7: Distribution of the Processors by their major occupation

Occupations	Percentage of the Processors by their Major Occupation (n=70)
Farming	77.1
Livestock keeping	5.7
Employed	4.3
Trader	11.4
Total	**100**

4.3 Firm-specific Characteristics

4.3.1 Overview

This sub-section explains major firm-specific characteristics in the study area which include: location of the firm, firm ownership, type of transport means used in transport sunflower seeds and other inputs and assets, ownership of storage facilities, firm ownership, market outlets for their output, type of seed processed, and type of machines used by processors.

4.3.2 Sources of the sunflower seed

From the sampled data, finding in Table 8 indicates that 69% of the sunflower processors procured their sunflower seeds from the smallholder farmers, followed by customer (16%), traders (14%) and own farmer (1%). Most of these smallholder farmers were located in other Dodoma Region such as Mpwapwa, Chamwino and Kondoa districts and in other regions such as Singida, Manyara, and Morogoro. Processors had to travel to deeper remote areas searching for sunflower seeds such as Ngosero and Kiwinde. These processors who fetch seeds from long distant areas are prone to seed adulterations such as adding sand and metal to seed sacks to make them look heavier, high prices of seeds from traders who speculate prices in order to obtain high chuck of profit, where a bag of 70 kg can be sold at a price of 48 000 to 53 000 TZS instead of 35 000 to 40 000 TZS per bag.

This situation has been escalated by existence of large Chinese buyers who have altered the accessibility of seeds to small scale processors. Smallholder farmers have forgone selling seeds to small scale processors at lower prices or crushing seeds for oil, now, there are selling their seeds to these large buyers at higher prices ranging from 51 000 to 56 000 TZS per bag of 70 kg while a 20 litre bucket of sunflower oil is about 42 000 to 45 000 TZS. With lower inspections by large buyers it has amplified the problem of adulteration by trader '*wachuuzi'* and smallholder farmer in turns increasing costs of inspection to small scale processors, cleaning and sorting, and if not well cleaned wearing of worms in shaft cylinder which increases the costs of wielding per month.

On other spectrum for customer who arrive at processing seeds mainly crush their seeds for oil and cake purposes. Sometimes for those customers intending to sell their oil, they tend to negotiate with processors for the price of their oil. Nonetheless, high existence of customers in lower season offer ample opportunity to processors to crush seeds in the low seasons. The possibility for withholding stock for crushing will be tenable if there is an incentive for higher profits in the foreseeable future in the sunflower oil and cakes market.

Table 8: Sources of Sunflower Seeds used by Sunflower Processors

Variable	**Distribution of Sunflower Processors by Sources of Sunflower seed in Percentage (n=70)**
Farmers	69
Own Farm	1
Customer	16
Trader 'Wachuuzi'	14
Total	**100**

4.3.3 Distance from sunflower seed sources

Farther distance will tend to inhibit full participation of the sunflower processing firms in the market due to increase in costs relating with searching for market information on seeds, oils and cakes, making transport arrangement with transporters and communication costs, which could be avoided if a processor stayed close to the market. Finding in Table 9 indicates that those firms were located 1-5 kilometres, 49% were not procuring sunflower seeds but rather they depend on the seeds which were brought by customers to the plant and 24% lived 5-10 kilometres from market sources. While those who procured everyday 14% and 11% were located 1-5 kms and 5-10 kms, respectively. Nonetheless, these results were not significant since chi-square estimate was greater than critical value at 2 degree of freedom.

Table 9: Distance from the market source with other variables

Variable		Distance from the source		χ^2	df	Sign.
		1-5 kms	5-10 kms			
Frequencies of Procurement	None	34	17	1.279	2	0.528
	Everyday	10	8			
	Monthly	1	0			
Form of Transport used	Customers to the firm	8	6	0.477	2	0.788
	Owned truck	3	2			
	Hired truck	34	17			
Processing capacity in litres per day	20-400	18	10	1.152	3	0.765
	201-400	11	4			
	801-1200	9	5			
	Above 1201	7	6			
Type of Seed processed	Normal seeds	1	0	0.564	1	0.453
	Qualified seeds	44	25			

There was a significant relationship between distance and form of transport used. The results in Table 9 showed that 73% of the processors used hired trucks to transport raw materials from sources to factory warehouse. This case is true because most of these processors purchased their seeds in bulky; therefore, they required trucks to transport the seed to their factory premises. While 7% used owned trucks, it was revealed from relatively larger small scale firms which had capacity to buy their own vehicles to transport their sunflower seeds. A good example was Glory Farm in Kisasa which owned the truck for carrying seeds and other supplies to the firm premises.

Moreover, there was no significant relationship between distance from the raw materials sources and firm's processing capacity. It was expected that the firms which were located nearer to the market will be better off in terms of easy access to market information on prices and seeds availability. This can be the case since the processing capacity tend to depend on other factors such as power supply, reliable supply of seeds at affordable prices, market for sunflower oil, type of machines and availability of spare parts etc. than only distance from the raw material sources.

Also, the findings depict that significant relationship between the type of seed used and distance from the market sources. Since most of processors never mind which type of seeds they processed, therefore, as long as it is a sunflower seed, they will buy it. The type of seeds which existed in the market were *Jupiter*, *Record*, and *Kilimo*, this means the processors who were close to the market had opportunity to know if the seeds were available in the market and at what price compared to those processors who were located a farther distance from the market.

4.3.4 Type of seed used

The statistics from the findings in Table 10 show that most of the seeds were used to about 97% level for each. The reason behind is due to scant supply of sunflower seeds which leave processors with no alternatives but procure the seeds which are available in the market. Despite the facts that some of the seeds have more oil content than other like *Record* which has oil content ranging from 45-50% which makes it better for crushing more oil. Nonetheless, quality of the seed is of much more important since the low quality seed even if been record the oil content will be scant. In the research areas, processors complain on poor quality of kernel, adulteration of the kernel by mix seeds with sands and other bio waste by farmers to make sunflower bags to look much heavier. This leads to wastage of time and cost to processors where they have to investigate the bags careful before buying which takes much their time otherwise could led to much costs if the bags are not careful investigated after purchasing.

Table 10: Distribution of Processors by Type of Sunflower Seed Processed

Variable		**Percentage Distribution of Processors by Type of Seed Processed (%)**
Type of Seed Procured	JVs	97
	Zebra	97
	Kilimo	63
	Record	97

Additionally, farmers still prefer recycling of local breed of sunflower seeds. Recycling reduces the quality of seed kernels which eventually reduces oil content of seed kernels. The availability and reliability of sunflower oil kernels is also not in stable condition. This year, there was critical shortage of sunflower kernels, which led to uncontrollably price fluctuations. Processors said that, there were invasion of big scale sunflower oil processors such as Murza Oil, Mount Meru, East Coast Millers and new Chinese factory in Kahama ward in Dodoma urban (Iringo *et al.,* 2013).

4.4 Institutional Factors

4.4.1 Overview

This sub-section explains major firm-specific characteristics in the study area which include: access to finance, membership to a processors' association, type of training and extension services received.

4.4.2 Access to finance

Access to finance for processors is vital for procuring seed at affordable prices during high seasons. Also, it facilitates buying of better machines and spare parts, and improves the product quality and standards. The firms which access the finance are expected to perform better than their peers who do not access the finance in terms of high processing level. Also, access to finance depend whether a firm was a member of producer association or not, therefore, being a member gives you a chance to access information on loan availability and training services than non-members.

Findings in Table 11 show that 11% of the processors who did procure seeds had access to loans from financial institutions compared to 61% who did not. Most, these firms who did not depend on sunflower seed brought to the plant by customers and they only procure seed at small quantity to produced oil that is only demanded by buyers who had placed orders. Also, 15 out 70 processors did not access loans to procure their seeds every day for production process, this means they either borrowed from friends or family members. The findings show significant relationship between access to finance and frequency of procurement of seed by sunflower processors in study at chi-square = 0.199 at 2 degree of freedom.

Table 11: Relationship between Access to Finance and Other Variables

Variables		Access Loans for FIs Yes	No	χ^2	df	Sign
Frequencies of Procurement	Customers to the Firm	8	43	0.199	2	0.905
	Everyday	3	15			
	Monthly	0	1			
Type of Machine used	Chinese type	8	38	0.285	1	0.594
	Other types	3	21			
Membership to Processors Association	Yes	8	14	10.33	1	0.001
	No	3	45			
Firm Ownership	Sole Proprietorship	9	59	11.04	1	0.004
	Partnership	1	0			
	Limited Liability company	1	0			
Current Processing level (bags per day)	1-30	7	34	2.241	3	0.524
	31-60	1	16			
	61-90	2	5			
	Above 91	1	4			

Also, findings in Table 11 show that was significance relationship between access to finance and type of machines used. Only 8 out 70 used the loans from banks to purchase their machines while 38 out 70 processors used their other sources than banks to procure the Chinese type machines which accounted about 90% of all machine in the industry, and their prices ranged from 5 to 8 million. While other types like those from UK and Indian type are few and command high cost up 30 million TZS and little availability from agents in Dar es Salaam. The low cost investment cost for fixed assets such as machine has attracted new processors into the industry.

Moreover, a membership to producer association such as CEZOSOPA had no any significant relationship with access to finance since most of processors shy away from loans due to fluctuations of seed market and high interest rate of about 18-22% and high penalty in case of failure to repay of loans on time sometimes confiscation of the property or shutdown of their plants by banks, until the repayment is done. Even those belonging to association most of them were inactive member, therefore, little benefits seen from being a member. But, in case of those who were active member enjoyed the benefits of information on loans, trainings and extension services.

In case of processing capacity of these firms and access to finance, only 12 out 70 in different processing level accessed loans while 58 out 70 did not access the loans to improve their current production processing in terms of buying new stocks, machines and rent building for plant and warehouse. There was no significant relationship between the variable since the chi-square calculated was greater than critical at 3 degree of freedom. The reason behind this is that most of firms did not access the loan from banks, which means their processing level may be influenced by other factors such as private sources of finances, supply of seeds in the market and reliable supply of power, and availability of cheap labours.

4.5 Sunflower Oil Mills Capacity Utilization in the Study Area

Most of the mills in the study area were privately owned by individual business persons who constituted to 97% of all the mills in the study while the remaining 3% were jointly owned and corporate. Most of these mills were more concentrated in bulking market areas such as Kibaigwa market in Kongwa district and Majengo in Dodoma urban. The reason behind this was to ensure easy access, timely and cost-effective sourcing of the sunflower seed. The bulking markets offer reliable area for easy disposal of sunflower oil and cake to trans-regional traders. Furthermore, all of the surveyed sunflower mills used electricity as main source of energy.

Figure 4 shows that 57% of all processors were using 6YL-95 Oil Press, machine of Chinese origin. The machine has a capacity of processing 25 bags of sunflower bags per day. On average, it can deliver oil output of 18 litres and 40 kgs of cake per 70 kg of raw sunflower. Whereas Chinese brand 6YL-105 which has a capacity to process 50 bags of raw sunflower per day producing 20 litres and 40 kgs of cake per 70 kgs of raw sunflower at a cost of around TZS 4 million. On the other hand, the Indian Rosedown machine has a capacity to process 100 bags per day and a bag of 70 kg of raw sunflower can deliver 25 litres of sunflower oil and 35 kg of sunflower cake and attracts TZS 25 million in investment cost.

Worth-noting is that the amount of by-product (cakes and *ulogi*[4]) obtained from each bag depends on the type of machine used and the demand of sunflower oil in the market. For lower capacity machines such as 6YL-95 Oil Press and 6YL-105 the processors get 18-20 litres and 40 kg of cake from 70 kg bag of raw sunflower while Rosedown set a gives about 25-28 litres and 35 kg of oil and cake respectively from 70 kg bag of sunflower seed. When oil is in high demand on the market, the processors will have no time to let the sedimentation process complete sale hence less “ulogi”. Conversely if the oil is left to settle for some time then more “ulogi” will be available for informal food vendors who use for frying chips in local kiosk.

[4] Sediments remaining at the bottom of oil preserving tasks during extraction of oil from sunflower seeds

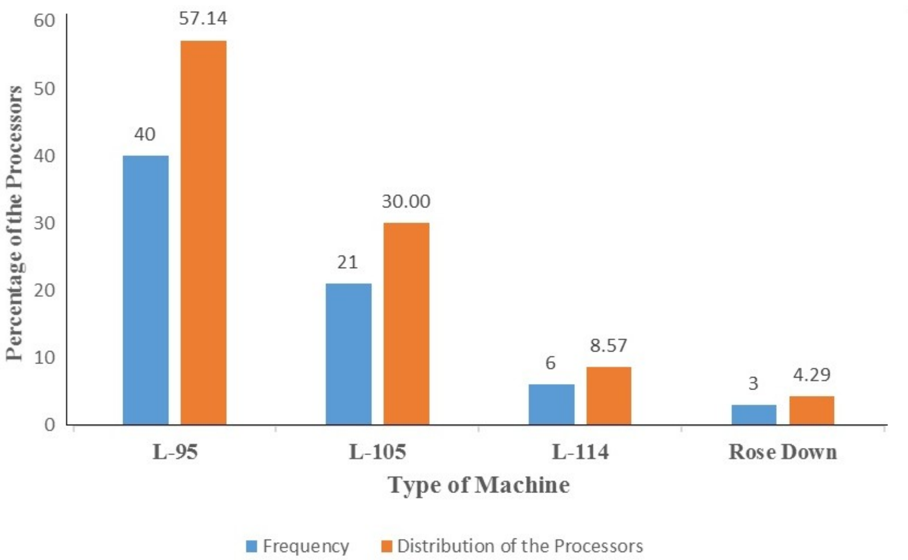

Figure 5: Distribution of the Processors according to Type of Machine Owned

The present capacity of the small scale sunflower oil pressing machines in the study area were 2 450 kgs/day in Kongwa district while in 3640 kgs/day in Dodoma urban which equivalent to 35 bags and 52 bags of 70 kg per day, respectively. The study revealed sunflower oil mills in the area only 45.98% of the total present processing capacity was utilized at peak period and only 20.69% is utilized at period of scarce raw sunflower (Table 12). These findings concur with Abdallah (2010) who found the sunflower processing mills had capacity utilization of 32% in peak seasons and 14% in low seasons in Kilosa district in Morogoro region.

Table 12: Distribution of Sunflower Oil Mills by District, Capacity Utilization in the study areas in 2015

Location	Present Capacity kg/day (bag/day)	Utilized capacity at Peak kg/day (bag/day)	Utilized Capacity at trough kg/day (bags/day)
Kongwa	2450 (35)	1260(18)	490 (7)
Dodoma Urban	3640 (52)	1540 (22)	770 (11)
Total	**6090 (87)**	**2800 (40)**	**1260 (16)**
Percentage (%)		**45.98**	**20.69**

Note: Figures in the parentheses are number of bags of raw sunflower of 70 kg each milled in a day (12 hours)
Source: Own survey data (2015)

Underutilization of the present capacity of the small scale sunflower processors in the study is largely attributed to unreliable supply raw sunflower due to low production, inaccessible of the deeper rural areas and speculative behaviour of traders in the market which spike the prices during low seasons. Frequently power outage deter the smooth production process and sometimes high voltage destroys motors which are very expensive to replace.

4.6 Stochastic Model Results

The subsequent sections present findings on variables that were used in the stochastic frontier model as they were discussed in Chapter Two and Three. These variables include cost of raw materials, electricity, capital and labour and level of output. This section presents the descriptive statistics of these variables in relation to cost efficiency.

4.6.1 Cost of raw materials

In the production of sunflower oil, sunflower seeds are the essential component of the whole process of sunflower oil production, without it no production can be undertaken. Sunflower seeds used by processors can be either procured in areas close to factory or distant markets. The cost involved in the procurement of the sunflower seeds include: cost of seeds per bags which could fluctuate depend on forces of demand and supply and environmental factor such as weather condition and government policies.

Other costs which are included in procurement of raw materials includes transport cost from the market to the factory premises and storage costs in either own premises or in public warehouses. Other indirect costs include the cost of search for sellers and dealers especially in low season involving communication costs, travelling cost by processors to search for raw materials especially in long distance areas such as Ngosero, Mpwapwa District, and Kondoa District.

The study found that the average cost of sunflower seed in Kongwa District was 46 447 TZS per bag of 70 kg while in Dodoma urban it was 46 937 TZS per bag of 70 kg. Kibaigwa town had lowest average in Kongwa district of 45 674 TZS per bag of 70 kg, followed by Hembahemba (46 333 TZS) and Pandambili (47 333 TZS), this can be illustrated by Figure 5. Kibaigwa District had the lowest prices of sunflower since the town acts as agricultural market centre where different agricultural products are marketed, thus it easy fetch point for processors to procure the seeds at lower prices through making arrangement with farmers and middlemen of the seeds in advance compared to other processors in other villages.

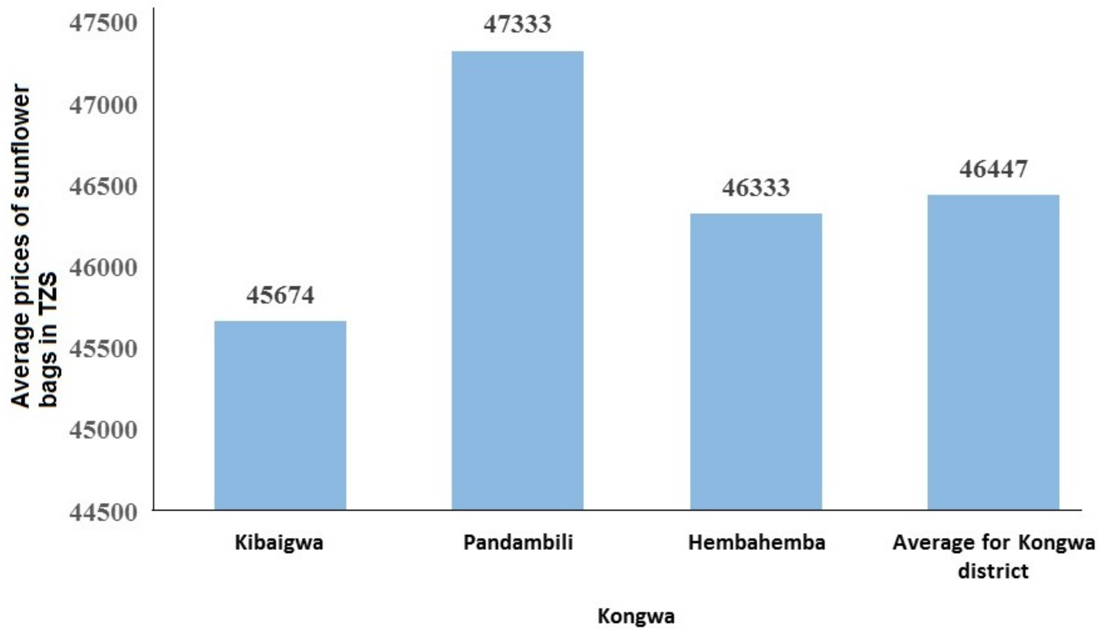

Figure 6: Average price of sunflower seed in Kongwa district in 2014/15

In Dodoma Urban District, the study found that Kisasa ward had the lowest average cost of 43 000 TZS per bag of 70 kg compared to 46937 TZS for total average of the whole district. The reason behind this is that the firm which was located in that area Glory Farm Sunflower processing firms had its own farm which they cultivated the sunflower they process and also had its own vehicle which was used for search and transporting seeds from long distance where the prices for seeds were lower and this can be captured by the Figure 6.

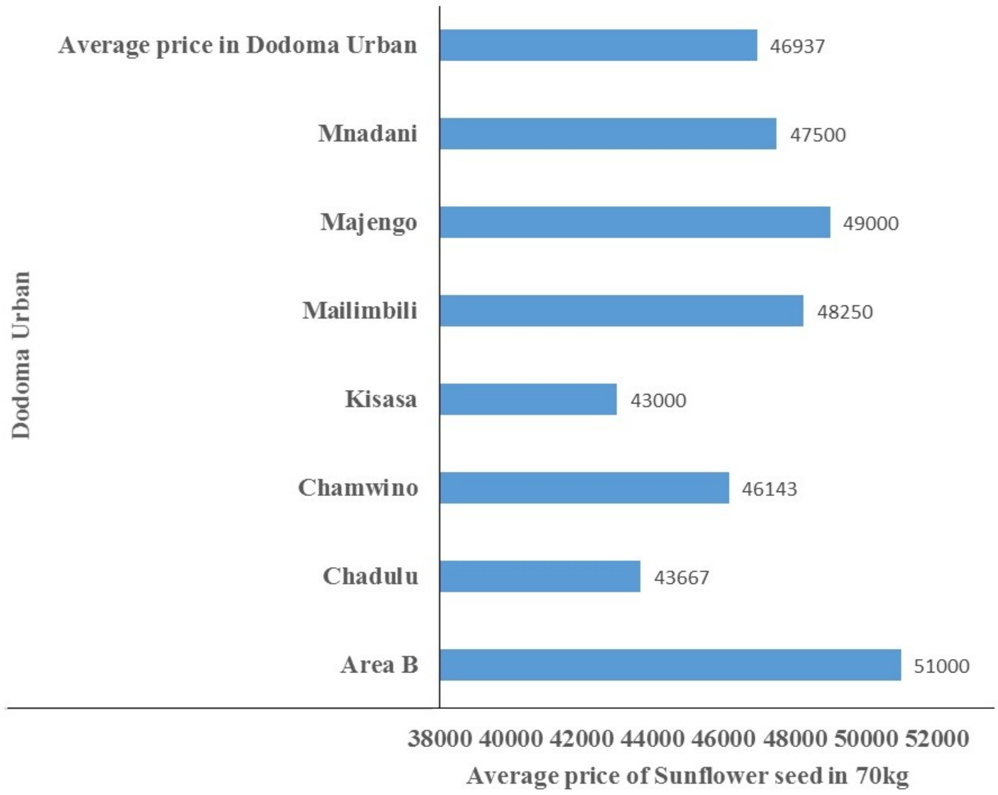

Figure 7: Average prices of sunflower seeds in Dodoma Urban District in 2014/15

4.6.1.1 Total cost of sunflower seeds

Table 13 shows that the total cost for the both Kongwa and Dodoma urban district stalled at 37 347 214 TZS per month, while the average number sunflower bags purchased per months was 163 bags. The minimum bags purchased by firm was 13 bags and maximum was 2 000 bags per month. The maximum price per bag was 52 000 TZS and minimum was 35 000 TZS while standard deviation of price per bag was 3 470 TZS per bag. The maximum total cost of the raw material procured was 450 000 000 TZS while minimum price was 2 730 000 TZS per month, with variation of total cost of seeds procured among firms was 85 436 566 TZS per month.

Table 13: Total cost of sunflower seeds in Dodoma Urban and Kongwa district

	Number of Sunflower bag per month	Price per bag(TZS)	Total Cost of Seed (TZS) Average bag size (70 kg)
Average	163	46564	37347214
Minimum	13	35000	2730000
Maximum	2000	52000	450000000

4.6.1.2 Total Transport Cost

Transport cost involved the cost transporting sunflower from the areas to the firm premises. Table 14 shows that the 72.9% used the hired truck which owners of the trucks charged in terms of each bag carried and distance in kilometres from the raw material sources.

Table 14: Form Transportation used in the study areas

Variables		Frequency	Distribution of Percentages (%)
Form Transportation	Customers to the Firm	51	20
	Owned Vehicle	18	7.1
	Hired Truck	1	72.9

Processors were asked to explain how transport cost was charged for different areas, in their answers it was revealed that for those in Kongwa mostly buy their seeds in Kibaigwa markets which cost 1 000 TZS per bag carried to the factory premises while in Dodoma Urban source was Majengo market which also charge per each bag at 1 000 TZS. For those procured outside the local areas the cost is depicted in Table 15.

Table 15: Cost of Sunflower Bag from Sources to Kibaigwa and Majengo market

Area (Source)	Average charge per 70 kg per bag (TZS)
Majengo	1 000
Chiwe and Sagara	1 500
Itolwa	2 250
Ulani	2 500
Malang	3 000
Mpwapwa	5 000
Ngosero	6 000
Pwaga	7 000

The average cost of transport was 2 031 530 TZS per month while minimum cost was zero for those firms which only depended on seed brought by customers to factory for oil extraction while maximum cost was 30 000 000 TZS per month with standard deviation among the firms being 5 661 229 TZS per months. In the case of storage cost, 67% of the processors stored their seeds while the remaining 33% did not. Out of those 67% who stored their seed 90% stored in their own premises and only 5% stored in public warehouses which were very few. Average cost for those stored public warehouses was 208 607 TZS per month, minimum cost being zero for those who did not store in public warehouse while maximum cost was 9 000 000 TZS per month, this shown in Table 16.

Table 16: Transport and Storage cost for Sunflower seeds bags in Dodoma urban and Kongwa district

Variables	Transport cost (TZS/Month)	Storage costs (TZS/Month)
Average prices	2 031 530	208 607
Minimum	0	0
Maximum	30 000 000	9 000 000

4.4.1.3 Share of each procurement cost

Finding in Figure 7 show that cost sunflower seeds had the percentages to the total cost of raw materials of 95% followed by transport cost standing at 5% and storage stalled at 1%. This means processors spend large chunk of money in procuring raw materials which was average of 37 347 214 TZS out 39 473 464 TZS while transport average cost was 2 031 230 TZS and storage cost was 208 607 TZS.

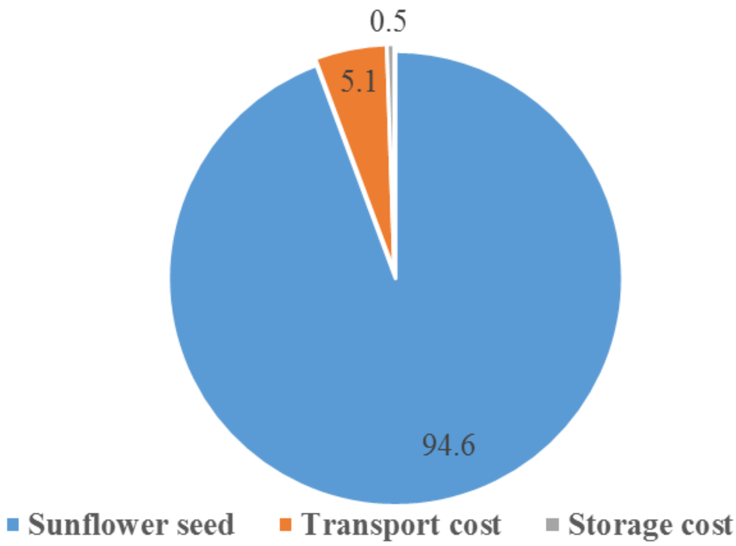

Figure 8: Share of each Procurement cost to Total Cost of Raw Material

4.4.2 Cost of utilities in extracting sunflower oil

Utilities cost includes cost of electricity which was the only main source of energy which was used by all processors in operating their machines. The average cost of electricity in the surveyed areas was 290 858 TZS per month, this cost depends much on how much machines was used per month, for those firm used less their machine the minimum cost was 11 000 TZS per month this due shortage of raw materials and high cost of raw material while those who used more of their machines the maximum 4 500 000 TZS per month with variation of 832 990 TZS between the firms. In the case of water which was mainly used in cleaning the utensils used by the firms such as oil containers, funnels, buckets and factory floor. The water charges were payable at the end of each month to Dodoma Water Supply Company (DOWASCO), the average cost of water per month 199 844 TZS in both districts, where minimum cost was 11 000 TZS per month and maximum cost being 45 000 TZS per month with standard deviation between the firms being 603 126 TZS per month. This can be shown by Table 17.

Table 17: Standard Measure of Utilities Cost for Processed Consignment in the Study Area

	Utilities Cost Per Month in TZS	
Variables	**Electricity**	**Water**
Average Price in TZS	290 858	199 844
Minimum price	11 000	11 000
Maximum Price	4 500 000	45 000

4.4.3 Labour cost in extracting sunflower oil

Labour costs incurred by processors are divided into three groups: *First,* temporary workers who's their major task is loading sunflower bags to the trucks and off-loading them to the factory premises, in each activity they are paid by the processor. These workers are found around the factory premises waiting to be hired temporarily to load and off-load the sunflower bags while others are those coming with the hired vehicles depending on agreement between truck owner and processors. *Second,* a group of women who are hired by firm's owner clean and dry the seeds before they are crushed. These women use winnowing pan '*Nyungo*' remove the dust and other bio waste from the seeds and then-after seeds are both filled on bags if they are dry or dried on canvas sheet and then filled in the bags waiting for processing. *Third*, those who are hired in the machine for operating machines that crush seeds while others are located at the filtering machines depending on the size of the firm and tasks it has more than four workers. Also, it includes firm technician who are called upon when there is break down and they are paid per day while operators are paid at end of the month. Additionally, in this group security guards are hired to protect the firm premises. The operator had highest average and maximum cost per month of 1 080 036 TZS and 4 500 000 TZS respectively while winnowing cost had minimum cost per which was 25 000 TZS per month. The recorded total variation of the labour cost of firms in the study areas was 2 595 272 TZS per month (see Table 18).

Table 18: Labour cost in extracting sunflower oil

	Costs of Labour in TZS per Month			
Labour Activity	**Average**	**Minimum**	**Maximum**	**Standard deviation**
Loading	307 094	25 000	3 000 000	555 762
Off-Loading	312 523	25 000	3 000 000	554 343
Winnowing	294 129	22 500	2 000 000	476 251
Operator	1 080 036	82 500	4 500 000	1 001 032
Technician	710 000	100 000	2 250 000	525 294
Kupiga Cake	537 083	97 500	1 000 000	323 846
Security Guard	886 271	60 000	1 800 000	410 890
Total Labour Costs	3 306 318	332 500	11 150 000	2 595 272

4.4.4 Share of each labour cost to the total labour costs

Figure 8 indicates the share of each labour cost to the total labour cost, the study found that the operator represented the highest share of cost with an average cost of 1 080 036 TZS per month accounting for 32.7% of the whole total labour cost followed by security guard (26.9%), technician (21.5%) which in total represents 80.9% of the total labour cost. The remaining costs such as loading, off-loading, *kupiga cake*, winnowing accounted for 19.1% of the labour cost.

The operator represented high cost due to the fact that in high season they are paid per number of bags crushed which cost about 1 000-1 200 TZS per bag with average being 163 bags per month but for other firms it goes up 2 000 bags per month. Also, technicians are expensive due to limited supply in the market, therefore, they demand more payment for each task performed.

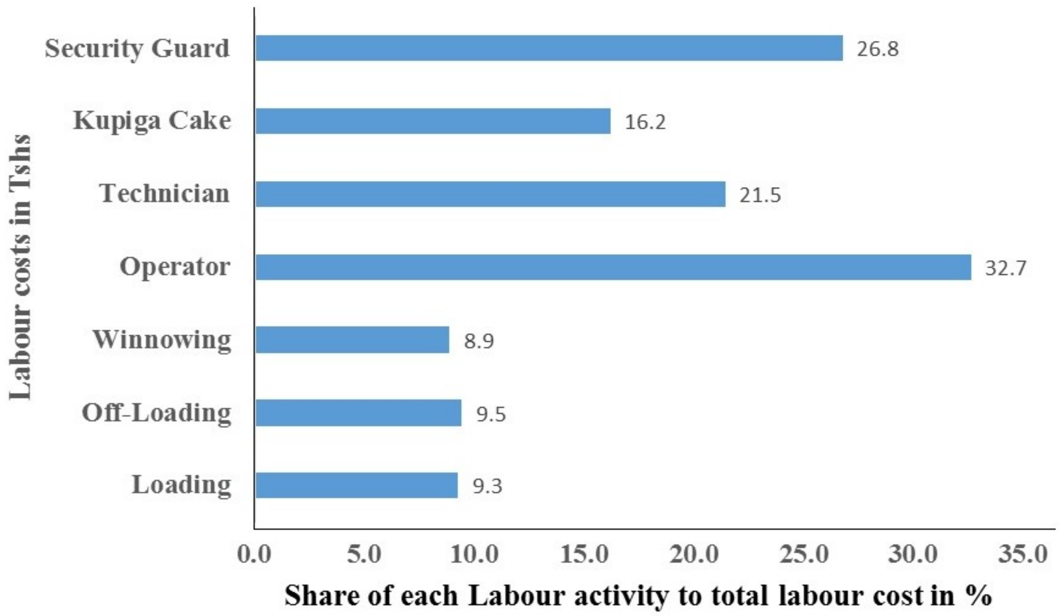

Figure 9: Share of each Labour activity to the Total Labour cost

4.4.5 Capital Investment in extracting sunflower oil

Amount for capital allowance was obtained taking initial price of asset when bought multiply number of asset owned divide by life span of the asset/s. Adding up the capital allowance cost for all fixed assets found in the firms which included; premises, motor vehicles, sieve, winnowing machine, crushing machines, filtration machine, canvas sheet, oil storage containers, and weigh balance gave us the total amount of capital allowance. Kongwa District had standard deviation of 7 874 148 TZS while Dodoma urban had 117 306 954 TZS, shown Table 18. The Dodoma urban had larger average cost of 28 993 455 TZS compared to Kongwa which was 9 433 333 TZS.

Table 19: Capital Allowance Costs in Dodoma Urban and Kongwa District

	Standard Measure of the Sample		
Variable	**Kongwa**	**Dodoma Urban**	**Sample**
Average	9 433 333	28 993 455	16 977 951
Minimum	1 410 000	1 296 167	1 296 167
Maximum	37 929 167	615 560 000	615 560 000
Standard Deviation	7 874 148	117 306 954	72 903 919

4.4.6 Average cost of capital investment

Findings in Table 20 show the averages of capital investment used in extraction by firms in Dodoma region. These include the average number of asset owned, cost of asset, year of procurement and depreciation cost. With the average number of asset owned being two while the average life span of the assets was 3 years. Premises had the highest cost stand at 64 101 714 TZS with an average depreciation cost of 20 819 950 TZS while Sped had lowest cost estimated at 17 743 TZS and depreciation cost of 8 132 TZS.

Table 20: Average cost of Capital Investment used by Sunflower Processors in Kongwa and Dodoma Urban

	Average costs of the Capital Investments			
	Number of asset owned	**Price of the asset**	**Year of procurement**	**Depreciation cost**
Machine	2	9 217 857	3	4 269 632
Premises	1	64 101 714	5	20 819 950
Sieves	1	265 859	2	112 662
Furniture	4	630 699	3	110 466
Tankers	3.1	490 329	3	212 421
Filter	1	2 683 382	3	1 302 762
Sped	1	17 743	3	8 132
Weigh Balance	1	1 000 429	3	531 671
Pallet	2	16 771	3	10 644
Canvas Tents	3	53 657	3	26 265
Buckets	2	31 833	3	14 975
Winnower	1.5	2 500 000	3.5	950 000

4.4.7 Overhead costs of extracting sunflower oil

Table 21 indicates the standard measure of firm's overhead costs which includes; contingency cost which is emergency amount to meet unforeseeable events such as machine broken down, buying spare parts which average of 425 938 TZS set by firms, inspection cost entailed cost of investigation to see if firms had fire extinguisher and meeting TFDA standard of constructing underground tanks, and tiles floor. In case of non-compliance the average amount of 126 625 TZS per annum to the firms was payable to the authority. Other important overhead cost includes vital in ensuring run of the plant were cost incurred on replacing belts, oil, grease, welding worms and replacing bearing without these the machines which fail to operate thus shutter the production process, the average costs was 394 888 TZS.

Table 21: Overhead Costs for Sunflower Processors in the Study Area

	Overhead Costs per month in TZS			
Variables	**Average**	**Minimum**	**Maximum**	**Standard deviation**
Contingency	425 938	50 000	7 500 000	1 113790
Inspection	126 625	20 000	1 500 000	2052 99
Telephone	427 869	75 000	2 250 000	466 840
Oil	57 493	12 000	400 000	58 482
Grease	26 246	5 000	90 000	18 005
Belts	53 443	14 000	240 000	38 068
Worms' Welding	129 868	20 000	450 000	77 570
Bearings	77 838	25 000	210 000	44 108
Rings	50 000	30 000	80 000	21 602
Crop cess	1 377 794	65 000	37 500 000	4 746 279

4.4.8 Fixed costs

Fixed cost was calculated by adding up cost of rent, premises repair, sanitation cost, and licence incurred in each month per annum. The summary is illustrated in Figure 9 which shows that the rent had highest average cost of 2 616 667 TZS with standard deviation of

2 394 015, followed by sanitation with an average cost of 188 387 TZS and standard deviation of 116 557. In most cases these costs are expected to remain even if there is a change in output produced the processors have to incur then anyway.

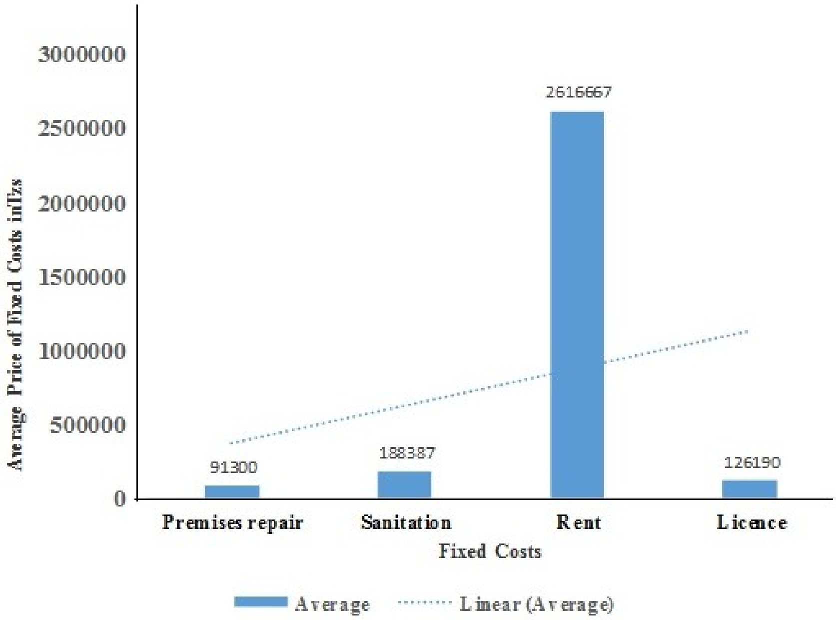

Figure 10: Fixed costs for sunflower processor in the study area

4.4.9 Amount of output produced by firms per district

The value of the output was obtained by adding up all the sunflower oil produced by per month by a firm. The summary of results in Table 22 shows that processors in Dodoma urban had higher quantity of output with an average of 164 444 kgs with standard deviation of 126 903 than processors in Kongwa District which had an average of 108 837 kgs and standard deviation of 99.

Table 22: Amount of Output of Produced by Processors in Dodoma Urban and Kongwa District

	Standard Measure of the Sample		
	Dodoma Urban	**Kongwa**	**Sample**
Average	164 444	108 837	130 286
Minimum	30 000	15 000	15 000
Maximum	600 000	600 000	600 000
Standard Deviation	126 903	99 338	113 218

4.5 Estimation of Stochastic Cost Frontier Model

4.5.1 Test for normality, multicollinearity and heteroscedasticity

Before any analysis was conducted for stochastic cost frontier and inefficiency model parameters in the model were tested for normality, multicollinearity, autocorrelation and heteroscedasticity.

4.5.2 Testing for normality

The parameters in the stochastic cost frontier model were tested for normality using Shapiro-Wilk test for normality test (Table 23). The finding showed that most of the critical values of V lied between 1.2 and 2.4 and significant at 95% confidence interval, which indicates the variables were normally distributed.

Table 23: Shapiro-Wilk W Test for 3-parameter lognormal data

Variable	Observation	W	V	z	Prob > z
lnY	70	0.99035	0.59	-0.642	0.7394
lnPm	70	0.8321	10.34	5.144	0.0000
lnW	70	0.9809	0.637	0.637	0.2622
lnPe	70	0.9819	1.116	0.438	0.3307
lnPc	70	0.8754	7.667	5.173	0.0000
Age	70	0.9708	1.799	1.910	0.7977
Experience	70	0.9911	0.547	-0.833	0.7977
Education	70	0.9491	3.135	3.2	0.0007
Ownership	70	0.5033	3.0571	8.42	0.0000
Typeseed	70	0.6667	20.51	7.42	0.0000
Typemachine	70	0.9802	1.22	1.027	0.1521
Membership	70	0.9805	1.198	0.987	0.1617

4.5.3 Testing for multicollinearity for the inefficiency model

The test is undertaken to measure the correlation of the regressors in the model, since the high correlation of the explanatory variables can lead to imprecise estimation of the regression and slight fluctuations in correlation may lead to large differences in regression coefficients. In case of the regression for this study, the VIF was 1.31 which indicates the non-correlation among the explanatory variables in the model (Table 24).

Table 24: Results for VIF test for Multicollinearity

Variable	VIF	Tolerance (1/VIF)
Access to Loan	1.85	0.54
Membership	1.38	0.72
Education	1.34	0.75
Type of Seeds	1.28	0.78
Ownership	1.26	0.79
Experience	1.25	0.80
Location	1.22	0.82
Acquired Knowledge	1.20	0.83
Type of Machine	1.18	0.85
Transport	1.14	0.88
Mean VIF	**1.31**	

4.5.4 Testing for heteroscedasticity for stochastic frontier model

Using the Breusch-Pagan/ Cook-Weisberg test for heteroscedasticity, we found that there is no problem of heteroscedasticity in the model. This means there is no variations means of error across the observation in the model were constant (Table 25).

Table 25: Breusch-Pagan/Cook-Weisberg test for heteroscedasticity

Ho: There is homoscedasticity of the variables in model	
Chi-square (1)	0.01
Prob> Chi-square	0.9330

Since the chi-square test statistics is less than chi-square critical value, there is enough evidence to support the claim that there is no heteroscedasticity in the model.

4.6 Cost efficiency of Sunflower Processors

Finding in Table 26 present the results of the stochastic cost frontier function estimated using maximum likelihood method. STATA program was used to compute estimates for the numerous single equation variant of the stochastic frontier cost model. The estimation of stochastic cost frontier based on equation 6, which enables us to determine the elasticities which are vital in estimating the degree of responsiveness of the total cost of sunflower processors due to the change in input prices and output produced.

The results show that most of the processors cost elasticities with respect to output and normalized input prices were positive as per theoretical expectation. The results show that cost elasticities were statistically significant at one, five and ten percent probability level. Output elasticity was 0.732 which implies that a percentage increase in sunflower oil production leads to a 0.732 percentage increase in the total cost of production. Similar results were also observed with respect to normalized raw materials, electricity and transport prices, where, a percentage increase in raw material price for processors led to

1.306 percentage increase in the costs of production. Also, a percentage increase of electricity price led to 0.496 percentage decrease in the costs of production, while, a percentage increase of transport price led to 0.176 percentage increases in the costs of production.

Table 26: Maximum Likelihood estimates of translog stochastic cost frontier and efficiency model for Sunflower Processors in Dodoma region

Variable	Parameter	Coefficient	Std. Error	z	P>|z|
Constant	β_0	13.277***	7.316	1.81	0.070
ln Y	β_1	-1.344***	0.715	-1.88	0.060
ln Pm	β_2	1.051**	0.513	2.05	0.041
lnPe	β_3	0.917**	0.455	2.01	0.044
lnPt	β_4	-0.578	0.516	-1.12	0.262
lnPc	β_5	0.074**	0.024	3.16	0.002
sqlnY	β_6	-0.138*	0.031	-4.45	0.000
sqlnPm	β_7	0.053*	0.016	3.23	0.001
sqlnPe	β_8	0.073**	0.023	3.13	0.002
sqlnPt	β_9	0.122**	0.041	2.96	0.003
sqlnPc	β_{10}	-0.084*	0.022	-3.81	0.000
lnPm*lnPe	β_{11}	-0.007	0.022	-0.32	0.747
lnPm*lnPt	β_{12}	0.528**	0.026	2.02	0.044
lnPt*lnPe	β_{13}	-0.028	0.020	-1.39	0.166
lnPm*lnPc	β_{14}	-0.016	0.034	-0.47	0.637
lnPt*lnPc	β_{15}	-0.039**	0.018	-2.13	0.033
lnPe*lnPc	β_{16}	0.105***	0.014	7.42	0.000
lnPc*lnY	β_{17}	-0.796***	0.016	-5.05	0.000
Sigma-square	δ^2	-20.587	6.152	-3.35	0.001
Log-likelihood					49.22
Mean efficiency					112%

***, **, and * Signicant at 1%, 5%, and 10% probability level, respectively.

The coefficient of output (y^2) was observed to be 0.05 and significant at 1% probability level. The combined output elasticity was positive which meant that a percentage increase in output produced led to a 1.138% increase in the total cost of production. Khalil (1992) reported the similar on cost efficiency for Jordanian manufacturing sector, where the output elasticity had a positive sign with significant effect on costs of production. This means there is a sufficient evidence for economies of scale as the coefficient of y^2 was significant. Furthermore, the estimated sigma of -20.587 implies that the variance of the inefficiency effects represents, a significant proportion of the total variance of the error terms. This further confirms an earlier finding in this study that cost inefficiency is present in the sunflower processing industry in Dodoma region.

Table 27 shows the frequency distribution of the cost efficiencies of all processors. The average cost efficiency index is 1.12 indicating that on average a processor's costs are 12% higher than the achievable efficiency level. This implies that on average 12% of the costs incurred can be avoided without loss in total output. From Table 26 shows that nearly 58% of the sunflower processors Cost Efficiency Index (CEI) equal to or below mean value of 1.12. This is also evident that there is variation of cost efficiency across the processors. The most efficient processors had a CEI of 1.10, almost on the frontier. Nonetheless, the least efficient processor had CEI of 1.28, implying cost of production over 28% greater than the frontier efficiency level.

Table 27: Distribution of Cost Efficiencies for Sunflower Processors

Class of Firm	Cost Efficiencies	Processors	Percentage of Processors in each level
A (Below Mean)	1.00-1.12	40.00	57.14
B (Above Mean	Above 1.12	30.00	42.86
Total		70.00	100.00
Mean	1.12		
Minimum	1.10		
Maximum	1.29		

4.6 Determinants of Cost Inefficiency

The focus of this section is to provide an empirical analysis of factor that contributes to variation in efficiency scores among small scale sunflower processors in Dodoma region.

Linear regression model in equation 7 was considered when estimated for inefficiency model. The estimated coefficient's signs in the inefficiency model have important implication on the cost efficiency of sunflower processing firms, whereby a positive sign indicates a higher level inefficiency while negative signs indicate improvement in the efficiency scores.

From Table 28, type of machine is negatively correlated with firm cost efficiency effects which imply a positive effect on cost. The results conform to Subramanian *et al.* (2010) note the introduction of semi-automated process line and even automated process line in order to cut cost in the long run and fulfil mass production output which intends to meet large market demands. Nonetheless, this machine can operate inefficiently which reduces yield and raises costs if improper maintenance of machines will result in low standards of produced parts and increases the maintenance of machines. The easy availability of spare parts in Dodoma and Dar es Salaam city has made processors to maintain their machines easy and at cheaper prices, thus increases their cost efficiency of the firms.

Table 28: Parameter estimates of the inefficiency model

Variables	Parameter	Coefficient	Std. Error	z	P>|z|
Age		0.210	0.560	0.38	0.707
Location		0.510	0.918	0.56	0.578
Ownership		-0.647	0.691	-0.94	0.349
Type seeds		0.457	0.997	0.46	0.647
Education		-0.890	0.532	-1.67	0.094*
Experience		0.509	0.501	1.00	0.318
Type machine		-1.785	0.424	-4.21	0.000***
Membership		2.419	0.737	3.28	0.001***
Access Finance		-3.241	0.850	-3.81	0.000***

***, **, and * Signicant at 1%, 5%, and 10% probability level, respectively.

Access to finance is also a major determinant of cost inefficiency of sunflower processing firms in Dodoma region, as it increases the cost efficiency of these firms. This argument is plausible since access to finance from financial institutions enables firms to keep up with up to date technologies, competition and increase their productivity in the long run (Ahiakpor and Dasmani, 2013). Therefore, having reliable sources of finance with less conditionality reduces firm search costs for better terms and private sources which in most cases there are inadequate and hard to find, may impact their cost efficiency negatively.

A significant relationship was found between membership to processors' association and cost inefficiency levels of individual firms. The variable has positive coefficient which indicates that it contributes negatively to cost inefficiency. This was case in the sunflower processing sub-sector since most of the processors were not member of the processors association and those who were members inactively participated to the meetings of the association (i.e. CEZOSOPA). This means important information on improved seeds, trainings, information on prices and markets were less available to them. Also, it hindered their collective bargaining on issues of double taxes on their products, could affect their cost inefficiency positively. Nevertheless, low willingness to join the processors could be because of the association size which was difficult for it to reach all of its members and membership fees which stands at 72 000 TZS per annum.

Another important variable which has an effect in determining the cost efficiency level is the level of education of processor. The result shows that increase formal education decrease the cost inefficiency by 8 percent. This finding concur with Kinda *et al.* (2008) who found that level of education of the labour force as important factor determined industry growth. They pinpointed that the skilled workers are better in dealing with changes, a skilled worker force is essential for firms to manage new technologies that require a more efficient organizational know-how. Thus, important factor in increasing firm cost efficiency.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study aimed at estimating the cost efficiency of sunflower processing firms in Dodoma urban and Kongwa district in Dodoma region in Tanzania. Moreover, the study intended to achieve the following specific objectives: (1) to analyse the level of cost efficiency among small scale sunflower processing firms in study area and (2) how their efficiency level was affected by firm-specific characteristics. Firm specific cost efficiency was computed using sample survey data collected in 2015. A stochastic frontier model was used to generate cost efficiency estimates. In addition to that the firm operator's views were deduced based on the observation and discussion to get a qualitative perspective of the problems facing them.

The results show that average sunflower crushing mill incurs costs of about 12 per cent above the frontier cost from the study. This means 57.14% of the sunflowers processing firms' costs are operating below the mean cost efficiency of 112% while 42.86% operates above the mean cost efficiency. The coefficient of price of raw materials (including cost of sunflower seeds and storage represented 131 percent of the price of materials) the highest cost elasticities imply that costs of raw materials constitute the highest cost share of sunflower processing firms in Dodoma region. With respect to economies of scale, the results are more consistent showing there is a room for expansion in size and this could be possible if the capacity utilization is increased which currently stands at 45.98% for peak season and 20.69% for trough season. Also, there is a reflection from the on-ground of unreliable public electricity supply is seriously undermining industrial production performance in the industry which is sole source of energy for the processors.

Firm-specific characteristics and institutional factors were evaluated to identify their effects on cost efficiency of sunflower oil production. The estimated marginal effects of the variables included in the inefficiency show that, cost inefficiency decrease significantly by increase in formal education, type of machine used, and access to finance of the sunflower mill operator. Observations made from the study area indicated that the sunflower processing sub-sector were male and also engaged in other major economic activities such as farming, livestock keeping and trading of agricultural outputs in study area. The negative sign on formal education indicated positive influence on cost efficiency which means that when processors have high level education and other formal training will enable them to cost effectiveness mechanism to lower their cost production compared to those with low level of formal education.

Access to credit influence positively on cost efficiency where firms which are able to access credit can expand their production capacity through invest in new machines, procuring sunflower seed in bulk, and buying spare parts thus increase their cost efficiency. Type of machine used by the processors was also an important factor in increasing the processors' cost efficiency whereby high capacity machine such as Indian machine extract more oil from seed kernel compared with Chinese type this means per 70 kg the processors could get 22-28 litres for Indian-type machine while for Chinese type 18-20 litres per 70 kg bag. On the other hand, the membership to processors' association associated with lower cost efficiency, since most members were inactive and received no market information on price, trainings, and loans also small-size of the association deter its ability to reach remote areas processors which in turns little representation and information of the market.

This study concludes that there is a need to ensure their reliable supply of supply seeds and power supply which could increase the processors' capacity utilization and efficiency. Also, improving firm specific characteristics such as formal education and type of machine and institutional characteristics such as access to finance which may contribute to good results to the sunflower oil production across and within the two districts.

5.2 Recommendations

Based on the findings, the following are the recommendations and policy implications directed towards improving the cost efficiency of sunflower processing firms in Dodoma region.

5.2.1 Intervention to increase sunflower seed production

The quantity of sunflower oil supply in the market it not enough to meet the current market demand. The quantity of oil supplied largely depends on availability and easy accessibility of the sunflower seeds. Increase the crop productivity without ensure the easy accessibility with not only deter future production but also increase the processors' transaction costs. This means improving road networks to reach remote rural areas is vital for sunflower oil production and reducing transport costs. Multiple charges on sunflower seeds disincentives the processors to buy in bulk which could have increased the economies of transport in bulk. Also, the sunflower processors should integrate the currently in use Chinese technology with up-coming Indian technology which enable them to extract high quality sunflower oil and cake which will meet both domestic and international market demands. Furthermore, easy access to sunflower seed throughout the year will increase the processors capacity utilization thus widening their production and profits.

5.2.2 Ensuring reliable supply of electricity

Electricity supply is very vital for operation of machines and ensures production process is on progress. Frequently power outage and incoming high voltage power not only deter the production process but also it destabilizes the machine by destroy motors which are very expensive to repair or replace. This could be possible if the processors are located in industrial clustered areas such as Chamwino and Kizota where the power infrastructure can be easily accessible to them. Also, industrial cluster offers potential for economies of information; transport and market to processors than being located in residential areas, which in most cases are unfriendly for expansion and waste disposal and meeting regulatory requirements by TFDA and TBS. The reallocation of plants to the municipality's planned industrial area will enable them to improve their individual processor's credit rating.

5.2.3 Strengthening and promoting processors' association

Processors' association are of great need to ensure right market information is available to processors at right time and place. Despite the positive sign in the inefficiency model, the association if strengthened and capacity is widened to reach majority processors it could play a very crucial role in bridging the gap of information asymmetry exist especially on access to loans and type loan offered by banks and cost of borrowing which could help processors to improve technologies and production facilities while information on trainings are crucial for ensuring processors obtain education on how to choose better seeds and machines to increase per unit of output. Information reduces the possibility for price speculation by traders and withholding of sunflower seed stock by farmers since they require information is available to both producers and processors. In response to this challenge, strengthening the capability of processors' association such as CEZOSOPA will bridge the gap of information exist between processors, traders and producers by facilitating the development of an integrated marketing system for sunflower sub-sector with other stakeholders.

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APPENDICES

Appendix 1: Questionnaire for Small Scale Sunflower Processors

Cost Efficiency of Small Scale Sunflower Processing Firms in Dodoma region.
Questionnaire No …………………………….. Date of Interview……………
Name of District ……………………………... Name of Ward/Village……….
Name of Interviewer ……………………….... Location ………………………

A. BASIC INFORMATION

A.1. Socio-Economic characteristics of the Firm's owner	
District	1=Dodoma Urban 2=Kongwa
Name of the Processor	……………………………..
Age	……………………………..Years
Sex of the Processor	1=Male 2=Female 9=Don't know/Missing
Marital Status	1=Single, 2=Married, 3=Divorced, 4=Widowed, 5=Separated
Experience of the	………………….(Years), 9=Don't know/Missing
Education level	1=None, 2=Primary, 3=Secondary, 4=University/College, 5=Others (specify)…………………
Major occupation than processing	1=Farming, 2=Livestock keeping, 3=Employed, 4=Trader, 5=Others, Specify …………………
How did you acquire the knowledge of processing?	1=Apprenticeship, 2=Vocational training, 3=Others (Specify)………………………..
Location of the firm	1=Residential 2=Industrial areas

B. INPUT USED

B.1. What are the input resources necessary for sunflower oil production?

1= Sunflower seeds 2=Labour, 3= Machinery, 4= Electricity, 5= other types of Inputs (Specify) ……….

B.2. Information on Sunflower Seed Procurement

B.2.1. What is the source of the sunflower seed you process?

1=Farmers 2=Own farm 3=Traders 4=others (specify)……………..

B.2.2. What type of seed do you mostly buy? 1= Jupiter 2=Zebra 3=Record

B.2.3. What is the frequencies of procurement of sunflower seeds?

1=Everyday, 2=Monthly, 3= Quarterly, 4= 6 months, 5= others (specify)….

Table 2.5. Sunflower seed cost incurred by processor

Sunflower Seeds			
Source of Seeds	**Quantity Procured**	**Cost per unit**	**Amount (TZS)**
Small Farmers			
- Jupiter			
- Zebra			
- Record			
Own Farms			
- Jupiter			
- Zebra			
- Record			
Traders			
- Jupiter			
- Zebra			
- Record			
Others (specify)			

B.3. Sunflower seed transportation

B.3.1. What is the form of transportation used in transporting your seed?

1=None [ ]	2=Own vehicle [ ]	3=Hired truck [ ]	4=others (specify)

B.3.2. How are the charges of transport accounted for?

1= per trip [ ]	2= per each bag carried [ ]	3= Distance in km [ ]	4= other (specify)

B.3.3. What are reasons for your choice?

1= More convenient [	2= Cheaper compare to others [ ]	3=More preferred by transporters [ ]	3= Specify

B.3.4. Transportation cost of sunflower seeds from sources

Source of Sunflower seeds	**Mode of transportation**	**Transport costs**	**Quality control**
Small farmers			
Own farm			
Traders			
Others (specify)			

B.4. Sunflower seed storage

B.4.1. Do you store the sunflower seed before processing? 1=Yes 2=No

B.4.2. If yes, where do you store the sunflower seed?

1= Own Premises [ ]	2= Public warehouse [ ]	3=Others (specify)

1= Per day [ ]	2= Per month [ ]	3=Others (specify)

B.4.3. If public warehouse, what is form of charges do the storekeeper use?

B.4.4. How much do you pay for storage cost per bag 60kgs? ………………

B.4.5. On average, how long do you store the seeds before processing? ………

B.4.6. Other storage cost incurred by processor

Cost Item	**Amount in TZS**
Treatment cost	
Rent of Premise	
Others (specify)	

B.5. Labour cost in extracting sunflower oil

	Activity	**Family Labour**	**Hired labour**		
			Man days	**Wage rate**	
				In kind	**Cash**
B51	Load and off-loading seeds				
B52	Sorting				
B53	Winnowing				
B55	Packaging				
B56	Machine operator				
B57	Machine technician				
B58	Cashier				
B59	Security Guard				
B60	Wages				
B61	Salary for permanent				
B62	**Others (Specify)**				

Man-day = Number of labourers*Hours/day*Number of days worked

B.6. Capital investment cost in extracting sunflower oil

	Type of Asset	No. Owned	Initial cost	Years of Purchases	Depreciation Cost (TZS)	Real Value (TZS)
B61	Machine					
B62	Premises					
B63	Motor vehicle					
B64	Sieves					
B65	Insurance					
B66	Furniture					
B67	Oil-Tankers (Metal/Plastic)					
B68	**Others (Specify)**					

B.7. Utilities cost

B.7.1.	On average, how much do you spend on electricity per month?	…………….TZS
B.7.2	How much of the average electricity charges are used in processing per month?	……..……TZS
B.7.3.	How much of average water charges are used in processing per month?	……...……TZS
B.7.4.	On average, how much do you spend on diesel per month?	……………..TZS

B.8. Indicate other cost outlay for the sunflower oil you process

COST ITEM	QUANTITY	COST PER UNIT	TOTAL COST IN TZS
Overhead Cost			
Contingency costs			
Premises Inspection			
Telephones			
Lubricants			
Spare parts			
Premises repairs			
Office expenses			
Factory Sanitation			
Road maintenance			
Fixed Cost			
Premise rent			
Interest on operating capital			
Municipal fees			
Contractual fees			

License			
VAT			
Crop cess			
Other taxes			
Others (specify)			
Total Cost			

C.1. FIRM-SPECIFIC CHARACTERISTICS

C10	How is the firm owned?			1=Sole Proprietorship, 2=Partnership, 3= limited liability company, 4= unlimited liability company 5= Others (specify)…………………..	
C11	What is reason the choice of firm's location?			1=Closeness to raw materials sources, 2=Cheap to rent, 3=Availability of required services, 4= Others (specify)………………..	
C13	To whom do you sell your products			1=Wholesaler, 2=Retailer, 3=Direct to consumers	
C14	What is the capacity of your plant?			…………………………litres/day	
C15	On average how much kilograms of sunflower seed do you process per day?			………………………….kg	
C16	What is the reason for this capacity?				
	1-Seasonal Supplies	2-Unreliable Supply	3-High Prices for inputs	4-High competition	5-Others (specify)
	( )	( )	( )	( )	
C17	What type of sunflower seeds do you process?			1=Normal 2=Qualified seeds	
C18	What is the reason for using seeds you mentioned in question C17 above?				
	Cheaper	Easy accessible	Produce more oil	Others (Specify)	
	( )	( )	( )		
C19	What is colour of seed do you most process?			1=Jupiter, 2=Zebra, 3=Record	
C20	What are reasons for processing a seed you mentioned in question C19.				
	1-Cheap to process	2-Easily accessible	3-Produce more oil	4-Others (Specify)	
	( )	( )	( )		
C21	What is type of machines do you use in processing?			1=Chinese, 2=Indian, 3=S/Africa, 4=UK, 5=Others (specify), 9=I don't know	
	What are reasons for this?				

	1=Cheaper in prices	2= More durable	3=Use less electricity	4=Easy access to spare parts	5=Others (specify)
	[ ]	[ ]	[ ]	[ ]	
C22	What is part of machine changed mostly?				
C23	On average, how much does it cost per spare part?			………………. TZS	
C24	How many times is it changes per year			………………	
C25	On what basis do you decide to hold the stock?				
	1= Reduce marketing costs	2= Avoid high prices in low seasons			4=Others (Specify)

C.3. PROCESSORS ORGANIZATION AND INSTITUTIONAL SUPPORT

C.4. Is there any sunflower processors' organization in your district? 1=Yes, 2=No

C.5. If yes, are you a member of the organization? 1=Yes, 2=No

C.6. If yes, how does this organization assist you?

1=Input Supply	2=Provision of Loan	3=Provision of trainings	4=Sell Products	5=Empowering of processors	6=Others (specify)
[ ]	[ ]	[ ]	[ ]	[ ]	

C.7. How can you evaluate these organizations in facilitating procuring inputs and marketing for products? 1=Helpful 2=Not Helpful

C.8. Did you get training on procurement, processing and marketing? 1=Yes 2=No

C.9. If yes, how was it learned?

Learning method	Duration of training	Where was training held	Qualification
Learn from family/friends			
Formal training			

C.10. Do you source your sunflower seed from contracting farmers? 1=Yes 2=No

C.11. If yes, how has it helped you in your production process?

1=Reliable supply of inputs	2=Reduce cost of inputs	3=Good relationships with farmers	4=Others(specify)
[ ]	[ ]	[ ]	

C.12. What are challenges you face in contract farming?

1=Difficult to enforce contracts	2=Side-selling	3=Difficult to control quality of seeds	4=Others(specify)
[ ]	[ ]	[ ]	

C.13. Do you get any support from government or any institution? 1=Yes 2=No
C.14. If yes, mention the support you get …………………………….
C.15. Do you get loan? 1=Yes 2=No
C.16. If yes, name the institutional from which you get loan

Commercial Bank [ ]	SACCOs [ ]	Credit organization [ ]	Others (Specify)

B.4. What is your future prospects regarding your business?

Maintain the same level of production [ ]	Abandon production [ ]	Expand production [ ]	Focus on other markets [ ]	Others (specify)

C. Processors' views regarding the cost efficiency of their sunflower processing firms

C.1.	What is your opinion regarding costs of producing sunflower oil? 1=High 2=Low 3=Affordable 4=Unaffordable due to low output 5=Others (Specify) ………………
C.2.	In your view, how has the cost of inputs changed since you started the business? 1=No significant change, 2= Cost have gone up, 3= costs have gone down, 9=I don't know/Missing
C.3.	What are problems do you face in sunflower processing? 0= No constraint 1=High taxes (cess) 3=Delay in delivery of inputs 4=lack of credit support 5= High transport cost 6=High storage cost 7=High labour cost 8=lack of enough knowledge on processing **(Please rank from most pressing to the least pressing challenge)**

"THANK YOU FOR YOUR COOPERATION"

Appendix 2: Frequency distribution of estimates of Cost Efficiencies Sunflower Processors in the study area

Firms	Cost Efficiency Index (CEI)
1	110.50
2	123.10
3	111.00
4	111.00
5	112.00
6	110.10
7	129.00
8	115.00
9	110.00
10	112.00
11	125.00
12	113.00
13	110.00
14	111.00
15	111.00
16	111.00
17	111.00
18	110.00
19	114.00
20	111.00
21	118.00
22	111.00
23	119.00
24	111.00
25	112.00
26	110.00
27	111.00
28	110.00
29	112.00
30	113.00
31	110.00
32	112.00
33	111.00
34	116.00
35	112.00
36	110.00
37	115.00
38	112.00
39	111.00
40	111.00
41	113.00
42	112.00
43	110.00

44	113.00
45	112.00
46	112.00
47	112.00
48	112.00
49	112.00
50	113.00
51	111.00
52	112.00
53	111.00
54	111.00
55	113.00
56	116.00
57	111.00
58	113.00
59	114.00
60	112.00
61	113.00
62	115.00
63	112.00
64	112.00
65	112.00
66	112.00
67	112.00
68	111.00
69	113.00
70	112.00
Mean Efficiency	**112.67**