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The Role of Economic and Social Factors Affecting the Efficiency of Small-Scale Sunflower Oil Production Companies in Tanzania

Maria Erasmus [a,b*] and Jignesh Kaungal [c]

[a] Gujarat University, Ahmedabad, India.
[b] The Open University of Tanzania, Dar es Salaam, Tanzania.
[c] Shree Narayana College of Commerce, Gujarat, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Most developing nations, including Tanzania, consider agro-processing a key to industrialization. Despite an attractive sunflower seed yield, Tanzania's sunflower oil processing and production have been staggering over the years. Sunflower oil production is inefficient, which leads to low output. So, this research studied sunflower oil production technical efficiency in the Singida region. The study examined the social and economic factors that affect technical efficiency in small-scale sunflower oil producers. It applied cross-sectional design and secondary data for the years 2016–2017, which were collected from the Central Zone Sunflower Oil Processors Association and Small Industrial Development Organization based on Singida sunflower oil producers. It also used stochastic frontier analysis and multiple linear regressions to find the empirical economic relationship between the variables. Sunflower oil producers averaged 30.1% less technical efficiency, as the average was 69.9%. It also revealed that labor, seed, capital, and electricity affect production, while age, experience, education, and locality also matter. Finally, processing

**Corresponding author: Email: nyaka14@gmail.com;*

techniques, socio-economic, and demographic differences affect sunflower oil production. So, producers must increase capital inputs to be technically efficient. Consider boosting producer capacity and abilities and observing a minimum number of productive staff.

Keywords: Technical efficiency; sunflower; Singida; stochastic frontier analysis.

1. INTRODUCTION

The concept of technical efficiency has been described by many researchers in different fields. The main knowledge is centered on the relationship between input and output. That is, when the maximum level of output is produced from a given set of production inputs or when the minimum inputs of production are used to manufacture a given amount of output [1,2,3].

Rahman et al. [4] also stated that a farm is technically efficient if it harvests the maximum possible output from the engaged production inputs, given environmental and locational limitations, and it lessens the resources used in production for any level of output given.

In Africa, agriculture has been the main economic activity. It employs two-thirds of the continent. The sector employs 69% of sub-Saharan African workers [5]. The rural people know its importance. According to Bachewe et al. [6] and Jayne et al. [7], 25% of urban families and 84% of rural families depend on agriculture. The sector accounts for 30% to 70% of national income and 30% of export value in each country. Only 7% of Africa's total land is arable and used for grain production [8].

Sunflowers are identified as one of the main crops produced in Tanzania and are quite considered one of the backbones in the agriculture sector alongside maize, rice, cassava, bananas, peanuts, and sweet potatoes. In addition, Tanzania has been one of the world's top producers of sunflower oil seeds, with an annual production of approximately 3,112,500 tons of sunflower seeds during 2017, corresponding to approximately 239,000 tons of oil [9]. Its production is mainly based on small scale producers throughout the country; therefore, sunflower oil production has tremendous potential to improve livelihoods and the wellbeing of comparatively poor households.

The central region—Dodoma, Singida, and surrounding areas produces almost 42% of the nation's goods [10]. Tanzania is one of three major African producers of sunflower seed oil, along with South Africa and Uganda, yet there is still a great demand for edible oil in the country [11]. The Rural Livelihood Development Program [12] in Tanzania evaluated annual edible oil demand at 440,000 tons and expected 3% annual growth. The country imports more than half of its edible oil. Large and small processors contribute 40% of the nation's edible oil needs [13].

However, Tanzania's sunflower oil seed output has declined from 1.1 million in 2017 to 767,188 tons in 2018, a 30.2% drop, and to 561,297 tons in 2019, a 26.8% drop and a staggering production process [9]. Moreover, despite the soaring production of sunflower seeds, most agro processors and small companies that process edible oil, notably sunflower oil producers, are still inefficient and incompetent. In 2019, the farms produced 561,297 tons of sunflower seeds but only 97,740 tons of oil, indicating that the industry is not fully utilizing its edible oil production potential [9].

Generally, this study is intended to bridge the empirical and specificity gaps arising from the reviewed literature by analyzing the technical efficiency in the production of sunflower oil among small scale producers. In precise terms, the study examined both rural and urban sunflower oil producers through well collected data, which was used to analyze the socio-economic factors affecting the technical efficiency in the production of sunflower oil among the small scale producers in the specific case of the Singida region as well as determine their level of technical efficiency in the production of sunflower oil

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Studies by Heriqbaldi et al. (2015), Kea et al. [14], Mwalupaso et al. [15], Gong et al. (2019), and several others all explored the concept of technical efficiency in different areas, especially in the agriculture and agro-processing sectors. More specifically, a study by Njiku [16] made a similar assessment in the case of two regions, specifically Singida and Dodoma. This study examined the technical efficiency of sunflower oil production in the Singida region. In specific, the study did determine the level of technical efficiency among producers of sunflower oil as well as analyze the socio-economic factors affecting the technical efficiency in the production of sunflower oil among the small scale producers

In developing countries like Tanzania, agriculture and agroprocessing inefficiency is a common complaint. The agricultural sector is inefficient since it has not fully grown into a sector that involves farm processing firms. Consequently, changing the economic return, considering the importance and demand of most agro-processed products like sunflower oil in Tanzania [17], sunflower oil production faces limited output potential and chronic technical efficiency decline, resulting in a mismatch between production and consumption [18].

Mpeta et al. [19] compared technical efficiency among Kongwa district small scale sunflower producers in the central agricultural zone. The study used the propensity score method to reduce bias from farmer characteristics. According to the study, sunflower farmers who contract farms are 7.4% more technically efficient than those who do not. Farmland size, input loans, age, off-farm income, schooling, labor, and fertilizer were examined. Only two variables were significant at 5%. Hence, the study advised farmers to participate in extension programs, farm management training, and input credit systems to improve technical efficiency and production. However, Mwalupaso et al. [15] found that using mobile phones to acquire agricultural information maximized technical efficiency. The report also suggests using mobile phones and providing technology in agriculture since it boosts production and provides information for rural farmers.

Ngaisset and Jia [20] examined Lobaye's palm oil processors' technological efficiency. Descriptive and stochastic frontier analyses were used to analyze 159 randomly chosen palm oil processors. The study found 81% technical efficiency, meaning processors can enhance efficiency by 19% to reach their full capacity. Yet, producer education in the production area considerably affects palm oil processor productivity. So, the study advises measures to improve and train producers to increase knowledge, productivity, and efficiency. Attipoe et al. [21] examined how rural and community banks affect cocoa production technical efficiency. A cross-sectional survey of 500 cocoa growers was analyzed using stochastic frontier analysis and Heckman's model. The study found that rural and community banks' financial support improved cocoa growers' technical efficiency. The rural and community banks' credit availability is governed by many circumstances, yet farmers' technical efficiency averaged 81%, indicating that no farmer attained the cocoa production efficiency requirement of 100%.

Kea et al. [14] examined Cambodia's rice production's technical efficiency and important parameters. From 2012 to 2015, panel data was collected from 25 Cambodian provinces. The stochastic frontier analysis showed that capital investment (i.e., agricultural machinery), land, and fertilizer application affect output. The survey also found that rice production was only 78.4% technically efficient. Additionally, Ismiasih [22] used secondary data from the 2013 agricultural survey of 1229 palm farmers in Western Kalimantan to assess palm oil production efficiency. The stochastic frontier analysis showed that the farmers analyzed are technically inefficient. The study also found that plant age, number of productive trees, fertilizers, labor, and pesticides affected palm oil production efficiency. However, the report suggested that farmers participate in plasma programs and become more involved in cooperatives to learn more about palm oil farming. Sarker et al. [23] evaluated Bangladeshi watermelon growers' technical efficiency, efficiency factors, and dangers. The stochastic frontier analysis of 180 farmers identified a mean technical efficiency level of 86%, indicating that Bangladeshi watermelon producers can improve by 14%.

This study examined the technical efficiency of sunflower oil production in the case of the Singida region. specifically, the study determined the level of technical efficiency among producers of sunflower oil as well as analyzed the socio-economic factors affecting the technical efficiency in the production of sunflower oil among the small-scale producers. The study aims to determine the level of technical efficiency in the production of sunflower oil among small-scale producers and analyze the socio-economic factors affecting the technical efficiency in the production of sunflower oil among small-scale producers

2. METHODOLOGY

2.1 Study Models

Methodology Study Models Coelli, Prasada Rao, O'Donnell, and Battese [24] recommended stochastic frontier analysis (SFA) as the best measure of technical efficiency estimation in agriculture studies rather than the deterministic approach and data envelope analysis (DEA), because data from agriculture are highly influenced by measurement errors and the effects of pests, weather, diseases, etc. This study adopted the stochastic production frontier because it is the most precise technique used in technical efficiency estimation.

The SFA split up the error term (deviation) into two parts to accommodate factors beyond firms' control. Thus, one is a technical inefficiency portion for a firm, and another part includes random shocks, also known as white noise, like bad weather or climate, measurement errors, and the exclusion of variables that could be included in the model. [25]. Subsequently, this study determines the factors that influence or affect technical efficiency and estimates the technical efficiency of sunflower oil small-scale producers in Singida, Tanzania, using the SFA model.

The study model is expressed

$$lnYi = \beta_o + \sum\beta_i lnX_{ij} + exp^{ei}$$

Where by:
ln = represent the natural logarithm
i= represent the i^{th} Sunflower oil producer
Yi= represents liters of sunflower oil of the i^th^ sunflower oil producer
X_{ij} = denotes the production inputs i^{th} sunflower oil producer
$e_i = v_i - u_i$ represents the residual random term composed of two elements v_i and u_i.

The vi captures random deviation in output caused by factors like climatic condition, variables exclusion, and other exogenous shocks, while ui denote the technical inefficiency.

The Cobb Douglas functional form was used in this study to estimate the relationship between inputs of production and outputs produced. This functional form is preferred because the model of this study has more than three independent variables and is simple in specification and production frontier estimation in the literature reviewed. Additionally, the parameter approximation using the econometric technique is very simple in terms of analysis and explanation (interpretation) because of its logarithmic production function nature.

The Cobb-Douglas functional form of stochastic frontier production expressed as follows:

$$lnY_i = \beta_o + \sum_{j=1}^{4} \beta_j lnX_{ij} + v_i - u_i$$

Where:
β_o = Constant
Y = Liters of Sunflower oil produced
X_{ij} = Independent variables
v_i = Random error
u_i = Inefficiency effect, which is non-negative

Therefore, the inefficiency model defined as follows:

$$u_i = \delta_0 + \delta_{ij} Z_{iji}$$

u_i = Technical Inefficiency
δ_1-δ_5 = Parameters to be estimated
Z_1-Z_5 = Independent variable coefficient

2.2 Sampling Methods

Basing on the Cochran sample calculating formula, this analysis selected a total of 176 survey respondents using a simple random and cluster sampling technique to represent the overall population of 322 small scale producers of sunflower oil that are located in the Singida region. The population studied in the area of study was thus subdivided into numerous clusters. In this case, the seven regional districts are: Iramba, Singida urban, Manyoni, Mkalama, Ikungi, Singida rural, and Itigi. Additionally, these districts were further subdivided into wards present in the respective districts by means of cluster sampling techniques. In this case, the five districts (clusters) were selected using the simple random technique so as to ensure uniformity in the sampling process. Finally, the respondents to be analyzed in this particular analysis from the specified wards were also selected using the simple random technique of sampling.

3. RESULTS AND DISCUSSION

The presentations of findings are mainly based on the designed objectives of the study that govern the study analysis. Therefore, the findings displayed are a result of the descriptive statistical analysis performed in the study as well as the inferential statistical analysis performed on the data collected. Such analysis and presentation of the findings were done to precisely achieve the study objectives and answer the research objectives that specifically intended to determine the level of technical efficiency in the production of sunflower oil. As well as analyzing the socio-economic factors affecting the technical efficiency of the production process.

3.1 Descriptive Statistics for Continuous Variables

From the study analysis, the specified continuous variables were about seven i.e., liters of sunflower oil produced, capital injected in the firm, amount of labor employed in the production process, amount of electricity used on daily basis, education of the producer (owner), experience in the production process and age of the producer. Therefore, the statistical analysis was basically based on the mean averages, standard deviations and the min and max ranges were presented.

The variable liters were researched in Table 1 above to establish the number of liters sunflower oil produced in the study area among the studied respondents. Furthermore, the variable was investigated as the foundation for establishing the study's technical efficiency. According to the data, 176 observations were made in the study region, and the mean or average number of liters produced on a daily basis was 39.47 liters. The small scale producers generated the most liters per day, 60 liters, and the least amount, 5 liters, of sunflower oil per day. Moreover, variable capital, determined by company investment, was specified for 176 small scale firms. The researched small scale producers injected a maximum of Tsh. 2850000/= and a minimum of Tsh. 855000/=. The statistics also showed that the average capital invested was Tsh. 8869006/=, with small scale producers diverging by Tsh. 7045075/=.

Yet, variable labor was explored as a crucial production determinant that affected small scale producers' technical efficiency. The findings showed that among the 176 small scale producers surveyed, the largest number of labors required in the production process was 30 and the lowest was one, meaning a range of 29 laborer. The average labor was 9, while small manufacturers deviated from the norm by 7.4 (standard deviation). Variable electricity was also explored as a key production factor. To simplify production, electricity costs were analyzed. The lowest daily power or energy resource expenditure among the 176 analyzed producers was Tsh. 2000/=, while the highest was Tsh. 14200/=. The average daily electricity or energy expenditure was Tsh. 6427.8/=, and producers varied from the norm by Tsh. 3053.7/=.

Among the 176 producers evaluated, education was measured in years of schooling. The maximum number of years spent in school was 19, indicating masters' holders, while the lowest was 2, indicating primary school class 1. The average number of years spent at school was 12.7, which represents form leavers, while the producers' education years (schooling years) differed from the mean by 3.7, or 4 schooling years. Since more experienced producers are predicted to be technically efficient, experience was explored as a fundamental driver of producer technical efficiency. The most experienced producer had 18 years of producing experience, while the least experienced had 2. The average experience was 6.98 years, or 7 years of production, while the average variance was 4.13 years (standard deviation).

Next, all 176 producers were examined by age, with the oldest being 62 and the youngest 27. The average sunflower oil producer was 41.58 years old, and the producers surveyed were 9.9 years older.

3.2 Empirical Results of the Stochastic Frontier Model

Stochastic frontier method was used to do the analysis and it only required a single step to complete the entire process. The method relied on statistical estimates of the Cobb Douglas function, where inputs of production determine the amount of output produced, and estimate inefficiency factors, or factors that prevent producers in the examined area from maximizing their technical efficiency in sunflower oil production. The linear regression model of the technical efficiency levels established for each producer and the inefficiency causes was also highlighted by the empirical data.

Table 1. Descriptive statistics for continuous variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Liters	176	39.47159	10.18174	5	60
Capital	176	8869006	7045075	855000	2.85e+07
Labor	176	9.386364	7.405684	1	30
Electricity	176	6427.841	3053.741	2000	14200
Education	176	12.77841	3.714341	2	19
Experience	176	6.982955	4.135525	2	18
Age	176	41.58523	9.902589	27	62

Source: Field Survey, (2023)

Table 2. Level of technical efficiency of the sunflower producers

Variable	Observation	Mean	Std. Dev.	Min	Max
Technical efficiency	176	0.6991336	0.1849744	0.089621	0.9919784

Source: Field Survey, (2023) (2023)

Table 3. Empirical Results of the Stochastic Frontier Model

Variables	Coefficients	Standard Error	P>|z|
Frontier			
Labor	-.0884616*	.000273	0.000
Seeds	.0921063*	.0006081	0.000
Capital	.0763461*	.0001326	0.000
Land size	-3.15e-07	.0000411	0.994
Electricity	-.1283844*	.0002018	0.000
Constant	3.675365	.	.
Inefficiency model			
Age	-.0410882*	.00227	0.000
Experience	.0002097	.0041827	0.960
Training	.0487744*	.0241856	0.044
Location	.0217225	.0252988	0.391
Constant	1.9721	.0867432	0.000
Usigma			
cons	-4.104623	.1171153	0.000
Vsigma			
cons	-24.10556	13.82894	0.081
sigma_u	.1284377	.007521	0.000
sigma_v	5.83e-06	.0000403	0.885
lambda	22036.77	.0075209	0.000
Number of observations = 176 Wald chi2(5) = 6.62e+06 Prob > chi2 = 0.0000 Loglikelihood=183.8355			

Source: Field Survey, (2023) (2023)
Note: Dependent variable is Sunflower oil in Liters
*P-values with *, ** and *** imply significance level at 10 percent, 5 percent, and percent respectively*

Technical efficiency averaged 0.699, or 69.9%, according to Table 2. The sampled population's average technical efficiency is 69.9%, or 70%. Hence, small scale sunflower oil producers in the analyzed region are 30% less efficient and may improve by 30% to attain their full potential. The data also shows that sunflower producers in the region have a minimum technical efficiency of 0.0896, which is 8.96% efficient and 91.04% below their potential. The most technically efficient corporation received a 0.9919 efficiency rating, or 99.19% technical efficiency. Producer efficiency was 0.185, 18.5% below average.

In Table 2, all independent variables affecting the deterministic phase of the analysis, the Cobb Douglas model, are significant at 5% except land size. At 5% significance, the land size variable did not affect sunflower productivity among the examined producers in the region. Such findings concur to those of Mpeta [26] that signified that land was the least significant variable among the others in the production process. Such that whenever other factors are significantly well efficient in the production process, a smaller land is needed in the overall process of production. Moreover, two socio-economic aspects which are Age and training were statistically significant and crucial to the production process, whereas others had little impact.

However, for the significant variables impacting sunflower oil production, the results show that if all other variables are maintained constant, a 1% increase in labor size (number of workers) decreases productivity by 0.08%. In a similar situation, the variable seed intake was supposed to monitor production seed processing. While other conditions are fixed, increasing seed intake by 1% increases sunflower oil output by 0.09%.

The variable capital introduced to the business increased sunflower oil production by 0.07% when other factors were held constant. While other variables are held constant, an increase in land size by 1% corresponds to a 0.000000315% rise in productivity, which is not significant at 5%. Finally, a 1% increase in electricity usage increases sunflower oil production by 0.1% when other conditions are maintained equal.

In the inefficiency section of the model, increasing age by one year increases sunflower oil production efficiency by 0.4%, decreasing inefficiency among the investigated small scale producers. While all things are held constant, a year of small scale producer experience decreases efficiency by 0.0002%. Variable experience is not statistically significant. Sunflower growers with training were 0.2% more efficient than those without. Finally, urban producers may be less efficient.

Significant variables include daily labor, seed intake, capital in shillings, machinery cost, and electricity use in production. Variable labor hurt output. This implies that a corporation will be technically efficient if it produces more with fewer labor. Yet, electricity spending reduces output and efficiency, while capital was found to increase production and producer efficiency. Lastly, the number of sunflower seeds used as source material had a favorable significant effect. So, the more kilogrammes of seeds processed, the more sunflower oil produced and the more technically efficient the manufacturer. These findings agree with Ngaisset and Jia [20] and Ismiasih [22] that variable capital and raw material are the most important variables in production and efficiency.

On the side of inefficiency part, Variable experience, training, and location favorably increase technical inefficiency, according to stochastic frontier model study. Experience, training, and location all lower the study's technical efficiency. The variable affected technical efficiency and inefficiency differently. Age was found to negatively affect technical inefficiency and positively affect technical efficiency. Technical efficiency may rise with producer age. These findings contradict most underlying assumptions and specifically Sarker et al. [23], who also reported a positive relationship between age and productivity.

There are a variety of ways in which the technical efficiency might be triggered by the societal and economic context. Thus, a linear regression model is further done with regard to the technical efficiency levels derived from the stochastic frontier model to prove the effect of such factors on the level of technical efficiency. The OLS assumption that the model is built on makes it strictly linear.

Table 4 demonstrates that the model was statistically significant at the 5%, 1%, and 10% levels of significance, with an F-Statistic of 38.26 and a probability of F of 0.000 out of a total of 176 observations. This was the case at all three levels of significance. In addition, the model had an R-squared value of 0.5760, which indicates that the inefficiency factors evaluated (age, gender, experience, training, location, and education level) account for 57.6% of the variation in technical efficiencies. These factors include: age, gender, experience, training, location, and education level. It was demonstrated that age was a significant influence for all of the variables that were investigated at all three levels of significance (1%, 5%, and 10%).

The study also used precise producer technical efficiencies to create a linear regression model to determine the socio-economic determinants affecting sunflower oil production technical efficiency. The work employed stochastic frontier analysis to determine the linear regression model based on Ordinal Least Square model linear assumptions. Technical efficiencies were regressed to socioeconomic parameters such age, gender, experience, training, location, and

Table 4. Regression model of the socio-economic factors affecting the level of technical efficiency

Variables	Coefficient	Standard Error	P>|t|
Age	.0083645*	.0007123	0.000
Gender	.0047088	.0168619	0.780
Experience	-.0039877*	.0017364	0.023
Training	.026474**	.013564	0.053
Location	-.0456363*	.0125964	0.000
Education	.0044728*	.0015295	0.004
cons	.4577687	.0422507	0.000
Number of obs	176		
F (6, 169)	38.26		
Prob > F	0.0000		
R-squared	0.5760		
Adj R-squared	0.5609		
Root MSE	0.07179		

Source: Field Survey, (2023) (2023)
Note: Dependent variable is Sunflower oil in Liters
*P-values with *, ** and *** imply significance level at 10 percent, 5 percent, and percent respectively*

education. The data showed that producer technical efficiency increased with age. So, older producers are more productive. Such data also suggest that elderly producers are more efficient than younger ones. Yet, such studies on age can also imply the capital-imposed gap, where the senior group tends to impose a huge capital due to financial stability, which can increase production efficiency. Sarker et al. [23] discovered a favorable relationship between age and productivity.

Male producers are 0.4% more technically efficient than female producers. The proposed model shows that women are less likely than males to produce sunflower oil in Singida. These data support Kaijage (2016)'s claim that men farmers are more technically proficient than female farmers.

Literature suggests that variable experience boosts production and efficiency [21,20,19]. This study found that producer experience negatively impacted technical efficiency. Those data suggest that experienced producers become less efficient. Most people get sluggish and less focused over time, which is true for most sunflower oil manufacturers in Singida. Attipoe et al. [21] found that most cocoa producers are technically proficient.

According to the literature, trained staff performs better than unskilled staff. The study found that varied training did not affect technical efficiency. Nonetheless, the variable was positive. Trained workers were 0.2% more technically efficient than unskilled ones. Njiku [16] and Kaijage (2016) also found that the more a producer is trained, the more efficient they will be.

In the variable location, urban-based producers especially in Singida town and adjacent township centers—were less technically efficient than rural-based producers. Nevertheless, urban producers produce more but also use more labor than rural producers, which adds to inefficiency. Ismiasih [22] also found that rural firms are more likely to produce because they are closer to raw materials.

Technical efficiency increased significantly with schooling. So, better educated producers are more efficient. Kaijage (2016), Surker et al. [23], and Attipoe et al. [21] found a positive correlation between education and production efficiency [27].

3.3 Policy Implication

Therefore, the study recommends that for the producers to be technically efficient they should invest more on the capital inputs of the production process since the variable capital was found to be very significant at affecting the efficiency and the overall level of production. Furthermore, in a connection to the capital imposed, the producers should focus on employing more efficient and latest tech machines for the processing of sunflower oil. It was noted that majority of the small producers were using the oldest technologies in the processing and therefore not being quite effective enough. In similar concept of expanding the capital inputs, the study recommends that the producers should focus on acquiring loans and credits so as to broaden their capital base.

Through acquiring loan, the producers will have enough funds to buy the high-tech machines that are quite efficient and less electricity consuming.

On the other hand, since the technical efficiency of the producer of sunflower oil decreases with an increase in number of labors employed in the production process. Therefore, owners can observe a minimal number of effective employees in sunflower oil processing firms for improved output as well as improve their overall level of technical efficiencies. A large number of workers working on a similar task result in wasted time, difficulty in management, and higher labor costs. Furthermore, the producers can take initiatives of conducting training activities to their labor so as to promote the effective working capabilities.

Furthermore, the study discovered that male producers are more efficient than female producers, and those in rural areas are more efficient than those in urban ones. As a result, the government and other agriculture stakeholders should increase women's access to more and better production facilities and resources, as well as financial assistance. Furthermore, urban producers should be assisted in obtaining raw materials such as sunflower seeds on time and at a minimum cost comparable to that incurred by rural farmers [28].

4. CONCLUSION

The small scale producers in Singida region are not fully technically efficient whereby on average their level of technical efficiency was around 69.9%, Therefore, it demonstrates that majority of the producers are in the decline and subsequently in the second and third stage of production, which yield a relative lower return in comparison to inputs used. thus, the study concludes that majority of the producers are not technically efficient due to a negative effect and inefficiency of some variables such as labor. Furthermore, factors such as land was found to be insignificant for the production process, since it was revealed that most producers don't highly depend on large part of land for production. In precise it was revealed that the actual land used for production was small and most part of the land remaining was used for storage of sunflower as well as for the inspection and sorting of the sunflower seeds to be processed. Lastly, basing on the findings it can also be concluded that male producers are more technically efficient than the female and also the producers that are based on rural areas are more technically efficient than those in urban.

Furthermore, it was revealed that the variables cost capital introduced in the business and the amount of seeds used per day were the most significant factors in the production. This demonstrates that employing of quality input factors could yield a chance for an increased output as well as improving the overall efficiency of the production process.

Nevertheless, study also examined the concepts of education level as well as the training among the producers. Therefore, given the level of education and training being quite low, the government through Small Industries Development Organisation, Tanzania Food and Drugs Aauthority and other governing institutions such as Centrol Zone Sunflower Oil Processors Association can also consider improving the capacity and skills of producers through providing occasional seminars as well as special industrial training on the overall production process of sunflower oil. This is because it was revealed in the study analysis that the technical efficiency of the producers tends to improves as number of years of schooling increases.

Moreover, it was also revealed that the trained producers are more technically efficient than the untrained producers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Debru G. The coefficient of resource utilisation. Econometrica. 1951;19(3):273-292
2. Farrell MJ. The measurement of productive efficiency. Journal of the Royal Statistical Society. 1957;253-290.
3. Charoenrat T, Harvie C. Technical efficiency of thai manufacturing SMEs: A comparative study of north-eastern provinces, economics working paper university of Wollongong; 2012.
4. Rahman SA, Ajayi FA, Gabriel J. Technical efficiency in sorghum based cropping systems in soba area of kaduna state

Nigeria. Journal of Research in Science and Management. 2005;3(1):100-1

5. Organisation for economic co-operation and development – OECD. Agriculture in Sub-Saharan Africa: Prospects and challenges for the next decade; 2016. Available:https://doi.org/10.1787/agr_outlook-2016-5-en
6. Bachewe F, Berhane G, Minten B, Taffesse A. Agricultural transformation in Africa? Assessing the evidence in Ethiopia. Journal of World Development. 2018;105(20):286-298. Available:https://doi.org/10.1016/j.worlddev.2017.05.041
7. Jayne T, Snapp S, Place F, Sitko N. Sustainable agricultural intensification in an era of rural transformation in Africa. Global Food Security Journal. 2019;30(25):105-113. Available:https://doi.org/10.1016/j.gfs.2019.01.008
8. Mzali S. Agriculture in Africa 2019: The special report. Oxford Business Group. SAGE publications. London; 2019. Available:https://oxfordbusinessgroup.com/blog/souhir-mzali/focus-reports/agriculture-africa-2019-special-report
9. United Republic of Tanzania- [URT]. The Economic Survey 2018. Ministry of Finance and Planning. Dar es Salaam. Government printers; 2019. Available:https://www.mof.go.tz/uploads/documents/en-1646218922-KITABU%20CHA%20HALI%20YA%20UCHUMI%20WA%20TAIFA%20KATIKA%20MWAKA%202018_compressed.pdf
10. United Republic of Tanzania- [URT]. Singida socio-economic profile, 2015. National Bureau of Statistics. Ministry of Finance, Dar es Salaam. Government printers; 2017. Available:https://singida.go.tz/storage/app/uploads/public/59a/431/dc1/59a431dc167e2754571355.pdf
11. Iringo R. Sunflower subsector. Collaboration between Sunflower Oil Processors and RLDC for Improved Sunflower Sector in Tanzania. A Power Point presentation. 2013;12.
12. Rural Livelihood Development Company-RLDP. Rural livelihood transformations and local development in Cameroon, Ghana and Tanzania. International Institute for Environment and Development; 2016. Retrieved on 10th January, 2020. Available:https://pubs.iied.org/pdfs/1026811IIED.pdf
13. Ekblom M. Challenges facing food processing MSEs in Tanzania: Qualitative case study of the sunflower oil industry in babati, manyara. Doctoral dissertation, Södertörn University; 2016. Available:https://urn.kb.se/resolve?urn=urn:nbn:se:sh:diva-30289
14. Kea S, Li H, Pich L. Technical efficiency and its determinants of rice production in Cambodia. Journal of Economies. 2015;4(4)1-17. Available:https://doi.org/10.3390/economies4040022
15. Mwalupaso GE, Wang S, Rahman S, Alavo EJ, Tian X. Agricultural Informatization and Technical Efficiency in Maize Production in Zambia. Journal of Sustainability. 2019;11(8):1-17. Available:https://doi.org/10.3390/su11082451
16. Njiku AR. Determinants of technical efficiency and financial sustainability of small scales sunflower oil processing firms in Tanzania. PhD Dissertation, Mzumbe University, Tanzania; 2019. Available:http://hdl.handle.net/11192/2824
17. Tisimia VK. The growth of Small Agro-processing firms and their influence on employment creation in Tanzania. PhD thesis, Sokoine University of Agriculture, Morogoro, Tanzania; 2014. Available:https://www.suaire.sua.ac.tz/handle/123456789/610
18. Mushi CW. Cost efficiency of small scale sunflower processors in Dodoma region in Tanzania. Doctoral dissertation, Sokoine University of Agriculture, Tanzania; 2016. Available:https://www.suaire.sua.ac.tz/handle/123456789/1475
19. Mpeta D, Kuzilwa JA, Sebyiga B. Analysis of contract farming effects on efficiency and productivity of small scale sunflower farmers In Tanzania – A propensity score method approach. Journal of ActaScientiarumPolonorum, Oeconomia. 2018;17(1):75-84. DOI: 10.22630/ASPE.2018.17.1.9
20. Ngaisset F, Jia X. Analysis on technical efficiency in the process of exploitation palm oil in lobaye locality, central Africa republic. Journal of Social Sciences. 2020;8(5):474-488. DOI: 10.4236/jss.2020.85032
21. Attipoe SG, Jianmin C, Opoku-Kwanowaa Y, Ohene-Sefa F. The determinants of

technical efficiency of cocoa production in Ghana: An analysis of the role of rural and community banks. Journal of Sustainable Production and Consumption. 2020;23: 11-20.
Available:https://doi.org/10.1016/j.spc.2020.04.001

22. Ismiasih I. Technical efficiency of palm oil production in west kalimantan. Habitat. 2017;28(3):91–98.
Available:https://doi.org/10.21776/ub.habitat.2017.028.3.13
23. Sarker B, Majumder S, Khatun A. Technical efficiency, determinants and risks of watermelon production in Bangladesh. Journal of Economics and Finance. 2017; 8(2): 51-59.
DOI:10.9790/5933-0802045159
24. Coelli TJ, Rao DSP, O'Donnell CJ, Battese GE. An introduction to efficiency and productivity analysis. 2nd Edition. Springer publishers, New York, USA; 2005.
Available:https://doi.org/10.1007/b136381
25. Lovell C. Production frontiers and productivity efficiency. The Measurement of Productive Efficiency: Techniques and Applications; 1993.
26. Mpeta DF. Effects of contract farming on production and income of sunflower farmers in kongwa district in central agricultural zone of Tanzania. PhD Thesis, Mzumbe University, Morogoro, Tanzania; 2015.
Available:http://hdl.handle.net/11192/2247
27. Kumar R. Research methodology: A step-by-step guide for beginners. 5th Edition. SAGE publications. London; 2018.
Available:https://doi.org/10.1080/15348431.2019.1661251
28. Rural Livelihood Development Company-RLDP. Sunflower Sector; Market Development Strategy, an initiative by Rural Livelihood Development Company; 2010. Retrieved on 31stDecember, 2020.
Available:http://www.rldc.co.tz/docs/sunflower.pdf

APPENDIX

Table A1. Description and measurement of variables

Variable	Description	Measurement
Amount produced	Amount of sunflower oil produced per day	Liters
Capital	Amount of money invested in machinery for the production process	Tanzania shillings
Labor	Number of labors employed in the production process	Number of workers employed
Electricity	Amount of money spent in electricity	Tanzania shillings
Seeds	Number of seeds used in the production process	Kilograms
Land size	Area of land occupied in the production process	Square meters
Technical efficiency	Effectiveness with which a given set of inputs is used to produce an output	Derived from a stochastic frontier model
Age	Age of the producer	Number of years
Gender	Male or female	A dummy variable
Experience	Number of years since first involved in the production process	Number of years
Training	Trained or not trained	A dummy variable
Location	Urban or rural	A dummy variable
Education	Number of years spent in school	Number of years

Source: Field Survey, (2023)

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