Original Research Article

Nexus between Technical Efficiency and Financial Sustainability: Evidence from Small Scale Sunflower Oil Processing Firms in Tanzania.

Abstract

Studies on technical efficiency and financial sustainability of firms respectively, have captured the attention of many scholars in both developed and developing economies over several decades. There are patchy empirical evidences however, that link technical efficiency and financial sustainability of small scale agro-processing firms in the context of developing economies like Tanzania. Sunflower Oil Processing Firms are of no exception as the sub-sector is dominated by small scale firms with no well documented relationship between technical efficiency and their financial sustainability. This study was set to determine the relationship between technical efficiency and financial sustainability while controlling for staff productivity. The study used firm level cross-sectional data collected from 219 sunflower oil processing firms randomly selected in Dodoma and Singida regions. A Multiple Linear Regression Model was used in analysing the data. Technical efficiency scores were estimated using Stochastic Frontier Analysis (SFA) model. It was found that there exists a relationship between technical efficiency and financial sustainability of sunflower oil processing firms in Tanzania. The higher the technical efficiency the more Sunflower Oil Processing Firms will be financially sustainable. The findings of this study imply that improving technical efficiency levels is a pre-requisite for financial sustainability of Sunflower oil processing firms in Tanzania.

Key words: Technical Efficiency, Financial sustainability, Sunflower Oil Processing Firms

1.0 Introduction

Sunflower oil processing firms are ones of emerging agro-processing industries in Tanzania with great potentials in providing nutritious and cholesterol free oil in both rural and urban areas, apart from creating jobs and income (Ekblom, 2016). These industries are predominant in the central agricultural corridor of Tanzania in Singida and Dodoma regions due to the large amount of sunflower seeds being produced (TEOSA, 2012). Sunflower oil is the most important and popular edible oil produced in Tanzania since colonial times when sunflower was introduced from Europe and America (RLDC, 2010).

Despite the predominance of sunflower oil processing firms in the area where sunflower seeds are largely grown, many of these firms are only of small scale (Ziliona, Mwatawala & Swai, 2013; Iringo, Elias & Majid, 2014). They produce low outputs whose standards are so low to compete in international markets and hence end up operating at low profit (Mpeta, 2015). It has been reported that, many agro-processing firms are established daily across the globe, but of about 85% fail after only few months of operations since their establishment (Woldie, Leighton & Adesua, 2008). This has been experienced even in developed countries like the USA, where approximately 50% of small-scale food processing firms fail within the first year of operation (Islam & Tedford, 2012). In China, many small processing firms have a lifespan of less than three years (Yanping and Huanwei, 2006),. An even more discouraging situation has been experienced in South Africa, where the rate of failure is much higher than others, in which, between 70% and 80% of the firms fail within their first few months of operation (Fatoki, 2011). One of the causes could be inefficiency in operations. This study was meant to determine the relationship between technical efficiency and financial sustainability of sunflower oil processing firms in Tanzania, the link which is scantly found in the literature.

The study has been grounded from the microfinance settings, particularly the study by Nyamsogoro (2010); Kipesha (2013); Marwa and Aziakpono (2015) which established the relationship between efficiency and financial sustainability in Microfinance empirical setting. This was done following the absence of empirical evidences on the established link for processing firms, particularly on the sunflower oil processing sub-sector in Tanzania context.

2.0 Literature Review

2.1 The Concept of Financial Sustainability

Theoretically, sustainability is a wide term and has been defined by many in several dimensions depending on user requirements. For instance, Filene (2011) defined sustainability as the ability of an entity to continue a defined behavior indefinitely. It further implies the ability of the firm to meet its goals over the long term. In the same vein, Nyamsogoro (2010) in the Microfinance sector defined sustainability to mean permanence or the ability to repeat performance through time. Other scholars in a business sector like Hubbard (2009) described sustainability as the ability of the firm to meet the need of its stakeholders without compromising its ability to meet their needs in the future. In other words, financial sustainability means the smooth operation of the firm with the necessary profitability, having adequate liquidity to overcome any challenges of bankruptcy. It is also considered as a necessary condition for institutional sustainability which is the most important requirement for any business. According to Doicui (2009) financial sustainability is a full cost recovery or profit making and is associated with the aim of building an institution that can last into the future without continual reliance on government subsidies or donor funds. It is the ability of an institution to meet its operational costs from income generated from services or products provided and have enough reserves for recapitalization (Thela, 2012). In this paper, the financial sustainability refers to the ability of sunflower oil processing firm to survive in the business and be able to meet its operational and financing expenses from its income generated thus has enough profit for recapitalization in a long run. Specifically, it is the ability of a sunflower oil processing firms to generate income that exceeds its total costs hence survival in business for long time. Profitability is therefore considered as a residual and a proxy measure of the firm financial sustainability.

2.2 . Measures of Financial Sustainability

Measurements of financial sustainabilityy in previous literature have been encored in two levels of indicators Operational Self-Sufficiency (OSS) and Financial Self-Ssufficiency (FSS) (Nyamsogoro, 2010; Kipesha, 2013; Marwa & Aziakpono, 2015). Operational Self-Sufficiency has been used to assess how far an institution has come in covering its operating expenses with its operating income regardless of the source while financial self-sufficiency measures the extent to which operating revenue can cover institution's direct and indirect costs from its income

generation (Thela, 2012). Moreover, Financial Self-Sufficiency is considered to be more appropriate measure of sustainability as it attempts to show the financial picture of the firm on unsubsidized basis (Nyamsogoro; 2010; Thela, 2012). It is defined as the ratio of adjusted financial revenue to total expenses. The ratio above 1 indicates sustainability while below 1 indicates the incapability of the firm to pay all of their expenses from their own generated income and therefore not financially sustainable

$$FSS = \frac{\textbf{\textit{Adusted Financial Revenue}}}{\textbf{\textit{Adjusted Operating Expenses}}} \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

In this paper, Financial Self- sufficiency (FSS) as a measure of the sunflower oil processing firms' financial sustainability is a ratio of total expenses to total revenue. From the profitability theory point of view profit is considered as the residual, calculated as an excess of income over expenditure to mean financial sustainability (Glautier & Underdown, 2001; Nyamsogoro, 2010). In other words, Marriott, Edwards and Mellett (2004) considered profits as what remain after costs of productions have been paid for. If profit is considered as a residual, then profitability can be used as a proxy measure of financial sustainability since it considers covering all costs incurred in earning plus any costs necessary to at least maintain the current level of operations (ibid).

2.3 The Concept of Technical Efficiency

Efficiency refers to reaching the desired output with the minimum input or means (Thela, 2012). It is the relationship between inputs and output that seeks to minimize resources costs. The conception of Technical efficiency is centred on input- output relationship. Technical efficiency is achieved when a minimum possible input is used to produce a given level of output or when a maximum possible output is produced given a certain level of input (Koopmans, 1951; Debreu; 1951) and (Farrell 1957; Kumbhakar & Lovell, 2000; Coelli et al. 2005; Charoenrat, 2012; and Ngeh, 2014).

2.4 . Measurement of Technical Efficiency

Technical efficiency levels/scores estimated from each specific firm have been used as a proxy measure of technical efficiency in sunflower oil processing firm as in previous studies (Charoenrat, 2012, Ngeh, 2014, Marwa and Aziakpono, 2015). Each firm score was obtained as continuous variable estimated by using the stochastic frontier model as the ratio of inputs to

outputs factors of production of the firm. This has been borrowed from the study by Njiku and Nyamsogoro (2018), which simultaneously estimated and studied the determinants of technical efficiency of small scale sunflower oil processing firms in Tanzania using one stage stochastic frontier Approach. Three inputs were involved in this relationship (capital, labour and material costs) and unit processed in litres as output (Ibid). It is a measure of effectiveness transformation of inputs into maximum outputs of the firms, which provides a more comprehensive measure of effective use of the firms' resources in maximising their output. Optimal output of the firm implies a high technical efficiency level attained and hence the financial sustainability of the firm (Marwa & Aziakpono, 2015).

2.5. Technical Efficiency and Financial Sustainability of the firm

Financial sustainability of the firm has been considered by previous scholars as a function of many different factors, both internal and external to firm operations depending on the research question(s) addressed and data availability. For instance, the study by Nyamsogoro (2010) and Thela (2012) respectively, analysed the relationship between efficiency and financial sustainability in the area of Microfinance by looking at various cost and revenue elements like liquidity ratio, operating expense ratio and staff productivity. They employed a traditional approach (financial ratios) and found that efficiency helps microfinance institutions to attain their financial sustainability. It is in this sense that efficiency of the firm reflects on whether existing resources have been used effectively as it involves cost minimisation and income maximisation at a given level of operation thus have an enduring impact on the financial sustainability of the firm **(**Essmui, Berma, Shahadan & Ramlee, 2013; Ngeh, 2014).

To add on that, the study by Marwa and Aziakpono (2015) used return on assets, technical efficiency levels /scores, loan size and deposit mobilization and cost per loan portfolio as explanatory variables in predicting financial sustainability of SACCOs in Tanzania. It has been reported that, efficiency is positively related to financial sustainability of the firm (Nyamsogoro, 2010). More efficient firms tend to have relatively lower expenditure and higher revenue generated per unit. This is to say that efficiency of the firm affects the financial sustainability either through cost reduction or revenue increase or both (ibid).

Though these studies provide a good background to the study at hand, they differ in terms of their nature of inputs and outputs thus their findings cannot be generalised across sectors and sub-sectors due to different contexts. The Microfinance Institutions deal with the provision of small-scale financial services to business firms and individuals while agro-processing firms, particularly sunflower oil processing firms deal with the extraction of oil and seedcakes from sunflower seeds.

2.5.1. Technical Efficiency Levels/scores

In this paper, technical efficiency was used as a measure of the effectiveness of transformation of a set of inputs resources given and technology into maximum outputs. It was computed from capital, labour and material costs as inputs originally measured in Tanzania Shillings (Tshs) as well as unit processed in liters as output but were all transformed into their natural logs. Each firm specific scores were computed as continuous variables for inclusion in the regression analysis.

2.5.2. Staff Productivity Ratio

Efficiency also depends on staff productivity. The staff productivity ratio captures the overall productivity of the firms' total human resources in maximizing out for improved financial sustainability. It is the ratio of the number of units produced by the number of staff involved. The ratio provides information on how efficiently the firm uses its personnel resources in maximizing their output. In the same vein, the ratio indicates how well the firm utilizes its staff in general in enhancing income and reducing the overall expenditure. It indicates how efficiently the firm is using its resources and the role played by the staff in managing its production, bringing about profitability and hence the financial sustainability of the firm. Studies in Microfinance Institutions revealed that the higher the number of units per staff would indicate the "firm's" high efficiency in utilizing its staff and hence high profitability of the firm for financial sustainability (Nyamsogoro, 2010; Thela 2012). This study used staff productivity to test the applicability of this finding in sunflower oil processing firms' empirical settings.

3.0. Methodology

This study combines both technical efficiency scores estimated from a Stochastic Frontier Analysis (SFA) model as the ratio of each firms 'inputs and output, which formed a column of

continuous variable and staff productivity ratio from the traditional ratio approach as a measure of efficiency in explaining the financial sustainability of sunflower oil processing firms. The inclusion of staff productivity ratio in the regression model was to determine the extent to which sunflower oil processing firms utilize their staff in maximizing their output for improved financial sustainability. This was done in an attempt to control for staff productivity differences, so that we could ensure the internal validity of the influence of technical efficiency levels on the financial sustainability of sunflower oil processing firms in Tanzania. This has been grounded following the assertion by Kuhn (1996) as quoted in Nyamsogoro (2010:61) that "*devising new approaches and methodologies may lead to the discovery of new knowledge"*.

3. 1. The Data

A set of primary cross-sectional firm-level data was collected from for 219 sunflower oil processing firms in Dodoma and Singida regions using both questionnaires and interviews. Dodoma and Singida regions were purposely selected as central agricultural corridor and processing potential of sunflower oil in Tanzania. The highest produced amount of sunflower seeds in this area has led to predominance of sunflower oil processing industries along Dar-es salaam to lake zones and Arusha highways.

The study used simple random sampling technique in selecting sunflower oil processing firms in the area where only firm owners were purposively selected as targeted respondents. This was due to the fact that sunflower oil processing firms are of small- scale in nature mainly owned and controlled by the individuals. The owners of the firms were purposely selected and interviewed as primary sources on important data particularly on the quantity produced on liters, price per liter, quantity of raw materials used and the price per bag, average daily wages for labour, other operating expenses incurred daily and the number of personnel in their respective firms.

3.2. Model Specification

Multiple Linear Regression Model was used to determine the influence of technical efficiency on the financial sustainability of sunflower oil processing firms. The model suits in this study due to

the nature of the dependent variable (Financial Sustainability) which was continuous and involved more than one explanatory variable in explaining the relationship.

3.2.1 Dependent Variable

Financial Sustainability was measured by Financial Self-Sufficiency (FSS) as the ratio of revenue to expenses for each specific sunflower oil processing firm under the study. The use of Financial Self-Sufficiency (FSS) as the proxy measure of financial sustainability in sunflower oil processing firms was due to the fact that, it measures the ability of the firm to cover its operating expenses from the income generated internally. Financial Self Sufficiency indicates the ability of the firm to sustain itself in the business from its generated income. The ratio is computed as: FSS = Total Revenue /Operating expenses.

The revenue was computed by considering the number of litres processed and sold in each sunflower oil processing firm and the price per litre in a year. Also, all expenses incurred by the firm for getting the revenue including material costs, labour costs, water and electricity costs, rent and taxes were considered in computing the FSS.

3.2.2 Independent Variables

Independent variables were technical efficiency and staff productivity. The technical efficiency was measured by technical efficiency levels/scores. Staff productivity was introduced to control for differences in staff productivity which could influence sustainability apart from technical efficiency. Both variables, technical efficiency levels and staff productivity ratio were estimated from each specific firm as continuous to measure the role of efficiency in explaining the financial sustainability of sunflower oil processing firms as in previous studies (Njiku & Nyamsogoro, 2018).

Dependent and independent variables involved were continuous and thus suit for Multiple Linear Regression Analysis (MLRA) model in studying the relationship, as expressed in the general linear regression operational equation below.

3.2.2. The Operational Model

$$E(Y)_i = \alpha + \beta_i X_i + \cdots + \beta_n X_n \quad \ldots\ldots (2)$$

Where, $E(Y_i)$ is the mean of the response variable which was Financial Self-Sufficiency (FSS) in this case, X_i are independent variables involved in the study, which are technical efficiency levels and staff productivity ratio from each specific firm, and β_i are their respective parameters.

3.3 Operationalization of the study variables and their expected effects on Financial Sustainability.

Measurements of variables involved in the study and their expected theoretical effect on the dependent variable are indicated in Table 1.

Table 1: Operationalization of the study variables

S/N	Technical Efficiency Indicators.	Definition and measurement	Expected effect on FSS	Comments
1	Technical Efficiency levels	A continuous variable estimated from SFA as a ratio of output to input factors of production for each firm.	+	Maximum output increases the profit and hence financial sustainability of the firm.
2	Staff Productivity Ratio	Continuous variable, measured as the ratio of unit produced per staff.	+	More units produced per staff means efficiency utilisation of staff for higher profitability.
3	Financial Self Sufficient (FSS)	Continuous variable and a measure of financial sustainability as the ratio of Revenue/Expenses.	(dependent variable)	Ratio >1means Financially sustainable Ratio <1 means not financially sustainable.

4. 0 Results

4.1: Descriptive Results

The descriptive statistics explaining the overall distribution of the variables included in the model as is indicated in Table 2

Table 2: Descriptive Statistics

Variables	Mean	Std. Deviation	N
Financial Self Sufficiency	0.942	0.155	219
Technical Efficiency levels	0.529	0.149	219
Staff Productivity ratio	9700.278	10631.365	219

The results in Table 2 indicate that on average, sunflower oil processing firms under the study are not financially self-sufficient as their overall ratio is below 1 (0.94). This implies that most of sunflower oil processing firms are not able to cover their operating expense from internally generated income, though they are nearly break-evening, to mean that they are just retaining their operating capital. Thus any improvement on the significant variables would mean profitability and hence financial sustainability of the firms. Likewise, the results in Table 2 depicts that on average sunflower oil processing firms operate at a mean technical efficiency level of 53% implying that there is an opportunity for more improvement by 47% under a better use of inputs and technology. Besides, the descriptive results also revealed that each staff can produce 9700 units of output on average for maximum profit. However, standard deviation on both financial self-sufficiency and on technical efficiency scores was of about 15.5% and 14.9% respectively indicating that there is variability in the performance among sunflower oil processing firms. There are huge variability on staff productivity among firms under study as indicated by the standard deviation.

The analysis in Table 2 of descriptive statistics was extended in Table 3 to disclose the distribution of firms under the study according to their Financial self-sufficiency performance ratio as either they are not financially sustaible (operate at loss), operate at a break-even point or at a profit to imply they are financial sustainabity as indicated in Table 3.

Table 3: Distribution of firms according to FSS performance ratio

FSS ratio	n	%
Below 1	118	53.8
1	10	4.6
Above 1	91	41.6
Total	**219**	**100.0**

The results in Table 3 indicate that 53.8 % (n=118) of sunflower oil processing firms under the study operate at a loss since their ratio is below 1. This implies that expenses of the firms are higher than revenue generated and thus the firms are unable to cover their operating expenses from their income generated and therefore could be financially unsustainable. Also 4.6% (n =10) of the firms under the study are operating at the break-even point since their FSS ratio is 1 indicating that the revenue generated is equal to expenses incurred and thus the firms are neither

making profit nor loss. Their generated revenue is enough to cover expenses without any surplus, thus are retaining their operating capital. Moreover 41.6% (n = 91) of sunflower oil processing firms under the study are operating at a profit since their FSS ratio is above 1 indicating that the firm's revenue are higher than expenses incurred and thus could be financially sustainable.

4.2. Empirical Results

This paper aimed to determine the influence of technical efficiency on financial sustainability of sunflower oil processing firms in Tanzania, using a combined measure of efficiency (technical efficiency levels and staff productivity, the contribution which is scantly found in previous studies. This paper therefore fills this knowledge gap by using Multiple Linear Regression as indicated in Table 4 of model summary.

Table 4: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate	Durbin-Watson
1	.871[a]	.758	.756	.07675	1.826

a. Predictors: (Constant), Staff Productivity ratio, Technical Efficiency (TE) levels

b. Dependent Variable: Financial Self- Sufficiency (FSS)

The results of the overall linear regression model summary indicate R^2 value of 0.758 to imply that 75.8% of the variation in the dependent variable (FSS) was explained by the independent variables included in the model. Also, the regression coefficients Table 5 indicate the joint and individual effect of the technical efficiency levels and staff productivity ratio (independent variables) to the financial sustainability (dependent variable) of sunflower oil processing firms in Tanzania, respectively.

Table 5: Regression Coefficients of Technical efficiency level and staff productivity to FSS

Model	**Unstandardized Coefficients**		**Standard. Coeff.**	**t**	**Sig.**	**Collinearity Statistics**	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.417	.022		18.657	.000**		
TE levels	1.048	.049	1.006	21.478	.000**	.509	1.963
Staff Prod. Ratio	-3.108E-006	.000	-.213	-4.537	.000**	.509	1.963

**Significant at 5%

The results in Table 5 revealed that both technical efficiency levels and staff productivity ratios, jointly predict the financial sustainability of sunflower oil processing firms in Tanzania due to a significant F-statistic. Both variables are highly statistically significant determinants of the financial sustainability of sunflower oil processing firms in Tanzania at 5% level of significance with ($p = 0.0001$) though with different directions. Technical efficiency level relates positively to the financial sustainability of the firm while staff productivity ratio relates negatively to the financial sustainability of the firms under the study.

The positive coefficients for technical efficiency levels with financial sustainability implies that when technical efficiency level of the firm increases the financial sustainability of sunflower oil processing firms also increases. Thus, the higher the technical efficiency levels the better indication for high financial sustainability of the firms. This further means that input resources transformed to the optimal output in terms of quantity of oil in litres produced and sold lead to high revenue and hence the financial sustainability of the firm.

However, a negative beta coefficient of staff productivity with the financial sustainability of the firms under the study implies that any increase in a number of units produces per staff affect negatively the financial sustainability of sunflower oil processing firms in Tanzania. Theoretically, it would be expected that high staff productivity ratio would lead to efficient utilisation in maximising output and hence a high level of financial sustainability, but the empirical evidence suggests otherwise. The negative relationship between staff productivity and financial sustainability in this study implies that the more numbers of units produced by a staff the less financially sustainable the firm is. This implies a prevalent state where there is a big difference between units produced as a result of staff productivity and units actually sold as a result of market response. Moreover, sunflower oil processing firms are basically machine intensive and not labour intensive. This is due to the fact that the main driver and catalyst of the production in sunflower oil processing firms are machines (technology) and not human capital (staff) as compared to other sub-sectors of manufacturing. This was also revealed by high elasticity of capital input (measured by cost of machines) as it relates positively to the output of the firms measured in litres of oil processed (Njiku & Nyamsogoro, 2018).

Moreover, technical efficiency levels were computed from the input-output relationship of capital, labour and material to the (quantity) litres of oil processed as output. In this capital and materials contribute significantly to the output, though with different directions, positively with capital while negatively related to materials of production. The negative relation with material implies that the output of the firm declines with an increase in materials. This is due to the low quality of raw materials used in the production, purchased during harvest season without quality compromise to avoid shortage during off- season due to the seasonality nature of the sunflower seeds. The seeds are not available to processors throughout the year and if available, are sold through the middlemen at high cost regardless of their quality. Capital comprised of the initial cost of processing machines which are available to all firms, thus contributed positively with high elasticity to imply that, it is the most contributing input factor of production to sunflower oil processing firms' production capacity (Njiku & Nyamsogoro, 2018). The findings are in line with the study by Essmui et al. (2013) and Ngeh (2014) respectively, which also found that technical efficiency influence the financial sustainability of the manufacturing firms. A negative relationship between staff productivity and financial sustainability of the firms was also observed in the study by Nyamsogoro (2010) on the financial sustainability of Rural Microfinance in Tanzania.

Therefore, by using a combined measure of efficiency as determinants of financial sustainability of sunflower oil processing firm, it was observed that technical efficiency levels from a transformed set of inputs, particularly capital and materials under a given technology matters a lot in explaining the financial sustainability of sunflower oil processing firms in Tanzania. Also, though staff utilization efficiency is negatively related to the financial sustainability of the firm, their role should not be ignored completely. Firms need to put up strategies to ensure that there is sufficient market for output produced at profit marking prices.

5.0 Conclusion and Policy Implications.

Based on empirical findings, we conclude that technical efficiency and financial sustainability of small scale sunflower oil processing firms in Tanzania are positively related. A strong and highly statistically significant relationship revealed between technical efficiency levels and the financial

sustainability of firms mean that technical efficiency matters a lot for the financial sustainability of sunflower oil processing firms in Tanzania. Any increase in the technical efficiency level in sunflower oil processing firms, increases the profitability of the firm and hence financial sustainability. Moreover, the role of human capital (staff) in sunflower oil processing firms, particularly in handily support to processing machines and in packaging of oil is important for improved financial sustainability. These findings imply the need for government and other agencies in the sector to create an enabling environment for sunflower oil processing firms to have access to improved machines (technology) and quality materials for enhanced technical efficiency and reliable markets. These are prerequisites for financial sustainability of small scale sunflower oil processing firms in Tanzania.

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