Determinants of Financial Sustainability of Small Holder Sugarcane Farming Systems in Tanzania

Ally S. Mushi[5] and Deus D. Ngaruko[6]

Abstract

The study investigated the impact of farming systems on determinants of smallholder sugarcane farmers (SSFs) financial sustainability (FS) between Block Farming (BF) and Traditional Farming (TF) systems. FS was analyzed by assessing profitability of the farming system. Semi structured questionnaires were administered to a random sample of SSFs and officials of block farms within Kilombero valley in Morogoro region in the south eastern Tanzania. 1040 observations from 394 respondents for SSFs' FS have been analyzed at significance level of $p = 0.05$. Two sample t-Tests, one way ANOVA and Tobit regression analysis performed revealed that effects of the two farming systems on the hypothesized factors differs significantly. Yield, price and cost have been found to have significant effects on financial sustainability, whereas the effect of land size and sucrose were not significant.BF has been found to be significantly more effective than TF system in ensuring profitability of the farmers. Profitability through BF is 0.56 (56%) as compared to 0.39 (39%) through TF.

Key words: smallholder farmers, block farming, traditional farming, financial sustainability and profitability, Tanzania

[5] Kilombero Sugar Company, Morogoro-Tanzania. Email: allymushi@gmail.com

[6]Associate Professor- Centre for Economics and Community Economic Development, Open University of Tanzania Email: deus.ngaruko@out.ac.tz

1.0 Introduction

An effective farming system is expected to generate sustainable financial gain through profitable operations among the smallholder sugarcane farmers (SSFs) and ensure betterment of their welfare. In the bid to improve the efficiency of SSFs in Tanzania, Block Farming system was introduced in 2006 through a European Union grant amounting to €562,000 aiming to improve the productivity of smallholder sugarcane farmers in five areas namely, Kilombero and Mtibwa in Morogoro region, Kagera in Kagera region, Mahonda in Zanzibar and TPC in Kilimanjaro region,(European Commission, 2006). However, the first block farms in the country were formed in the Kilombero valley within the Morogoro region.

The introduction of block farming aims to replace or complements the Traditional Farming system which is considered to be inefficient. The introduced smallholder farming system is expected to improve the profitability of the SSFs by taking rewards of economies of scale through collective management of various inputs and by overcoming the impediments of fixed cost per unit infrastructure investment. This study attempted, through comparative analysis between BF and TF systems, to assess the impact of farming systems on determinants of financial sustainability among SSFs in Tanzania.

The Block Farming system is defined as a contiguous farming area operated under shared ownership that allows small, otherwise economically inefficient farmers to take advantage of economies of scale via the collective management of various inputs, and via overcoming the obstacles of fixed costs per unit of necessary infrastructure investments (Rugaimukamu et.al, 2007). This strategy has resulted into a significant increase of sugarcane production when compared to the Traditional (indivualized) Farming system, (Mushi, 2012). Since Block Farming is potentially more effective than Traditional Farming into augmenting sugarcane throughput, smallholder sugarcane farming becomes financially sustainable through enhanced profitability.

However, some smallholder farmers have had opinion that production costs in block farms is high and it affects the profitability of farmers. This group of farmers think that despite higher yields obtained in block farms, individualized Traditional Farming system is better than Block Farming system in terms of profitability. Banks and other microfinance institutions, on the other side, are struggling to recover loans from some smallholder sugarcane farmers who are delaying or default their loan repayment. It is therefore, imperative to critically and scientifically study the financial sustainability of the smallholder sugarcane farming systems in Tanzania through comparative analysis between Block Farming and the Traditional Farming systems.

The general objective of this study is to assess the effectiveness of the smallholder Farming Systems on the financial sustainability of sugarcane farmers in Tanzania. The study intends to specifically:examine determinants of financial sustainability of smallholder sugarcane farming through Block Farming in comparison to Traditional Farming system; and determine profitability attained through block farming and traditional farming systems.

1.1 Sugarcane block farming and profitability

Block Farming is a system which comprises of contiguos farming areas joined together to form one homogeneneos farming area managed collectively, but with each farmer retain the ownership of his/her area, to take advantage of economies of scale via collective management of various inputs, and via overcoming the obsatacles of fixed cost of necessary infrastucture investments, (Rugaimukamu *et.al.* 2007; Basimwaki *et al*. 2007). According to (Mushi, 2012), Traditional Farming system is a dominant farming system practiced in Tanzania whereby smallholder farmers own and manage small pieces of land, mostly between 1 and 5 acres (0.4 to 2.02 hectare).The farmer have all decisions about his farm and normaly tend to adopt methods which are cheap thus ending up sacrificing proper crop husbandry which results into low production.

Business will not persist in the long run without being profitable. Profitabilty is thus the principal objective of all business venture. Profitabilty can be understood as a ratio which states the rate of profit amount benchmarked against some point of reference, usually percentage. Profitability ratios can be used as decision tools applied to measure financial wellbeing of a business. A bussiness that is not profitable can not survive. Equally a business that is highly profitable has the ability to recompense its owners with large return on their investment. In other words a business that is profitable in the long run is financially sustainable. In the current study on the financial sustainability of the smallholder sugarcane farming systems in Tanzania, both variable costs and fixed costs have been looked into.

Basically the land preparation costs and costs of infrastructures form the fixed cost element whereas other operational costs like seedcane, planting, weeding, fertilizing, and herbiciding forms variable cost element. The total production cost comprising of fixed costs and variable costs have been used in the examination of the determinants of the profitability of the two farming systems. Transport cost, cess, contributions, fees, supervissions costs have been charged as operating expenses and used in the calculation of the operating profit or earning before interest and tax (EBIT).

Horngren *et al.,* (2009) wrote that profit margin is the amount of income earned on every dollar of sales. It is a component of Return On Investment(ROI). In the study on the financial sustainability of smallholder sugarcane farming systems through comparison analysis between Block Farming and Traditional Farming systems, profitability (equation 1) is looked at as an indicator of financial sustainability. Here profitability of the smallholder sugarcane farmers will be explained by the operating profit margin. Arnold (2008), mentioned that operating profit also known as EBIT is found on the company's income statement. EBIT is a Company's earnings (profits) before interest and tax are deducted. The operating profit margin looks at earnings before interest and tax (EBIT) as a percentage of sales as shown in equations (1) and (2**):**

$$\text{Profitability} = \text{Operating profit margin} = \frac{\text{EBIT}}{\text{Net sales revenue}} \quad (1)$$

Whereas,

$$\text{EBIT} = \ (\text{Gross profit} - \text{operating expenses}) \quad (2)$$

Operating profit margin is a rough measure of the operating leverage a company can achieve in the conduct of the operational part of its business. It indicates how much EBIT (its calculation is shown in equation 2) is generated per shilling of sales. High operating profits can mean the company has effective control of costs, or that sales are increasing faster than operating costs. Gross profit (gross margin) is net sale minus the cost of goods sold. Merchandisers strive to increase the gross profit percentage, which is computed as follows:

$$\text{Gross profit percentage} = \frac{\text{Gross profit}}{\text{Net sales revenue}} \quad (3)$$

The gross profit percentage (equation 3) is one of the most carefully watched measures of profitability. A small increase may signal an important rise in income. Conversely, a small decrease may signal trouble, (Horngren et al, 2009).

Masuku (2011) investigated the determinants of profitability for smallholder sugarcane farmers in Swaziland and provided considerable insights regarding the factors affecting the performance of smallholder farmers in the sugar industry. The study was based on data collected from 124 smallholder sugarcane farmers who supply sugarcane to three sugar mills in Swaziland and with a maximum land size of 100 hectare/farmer. The study used purposive sampling and data were analysed by using least squares regression analysis to estimate performance of farmers based in gross margin per hectare. The results revealed that profitability of the sugarcane farmers was affected by the yield per hectare, the farmer's experience, sucrose content in the sugarcane, the change in the production quota of the farmers and the distance between the farm and the mill. The study suggested that smallholder farmers need to be trained and motivated in order to be commercially oriented and improve yield.

In the study by Waswa *et al*. (2011) to establish the relationship between contract sugarcane farming, poverty and environmental management in the Lake Victoria basin, social survey design was adopted. Primary data were collected using questionnaires from 37, 40 and 40 household heads representing sugarcane farmers from Lurambi, Koyonzo and Chemelil respectively. Data on farmer incomes were obtained from individual farmer payment statements. Descriptive statistics focussing on frequency distributions and step-wise backward regression were used to derive income models as platforms for future decision-making in sugarcane agri-business. Results from Lurambi, Koyonzo and Chemelil showed that on average farmers retained only 32, 31 and 34% respectively of the gross income from contract sugarcane farming. The study suggested that to profit from contract sugarcane farming, farmers need to at least double their current mean yields per unit area, assuming that available land devoted to sugarcane excluding land for subsistence farming is at least 5 acres.
The remainder of this study is organized as follows. While section 2 gives Conceptual framework, section 3, spells out methodology. Section 4 estimates and reports the results. Section 5 discusses the findings. Section 6 provides concluding remarks and recommendations.

2.0 Conceptual framework

Block Farming is viewed as a voluntary formation of one homogeneous farm by combining adjacent farms with different soil characteristics with an intention to improve productivity and shares the proceedings proportionately with an ultimate goal to advance the welfare of the members through the enhanced productivity of sugarcane production. The revelation by Malonga et al. (2009) of the fact that miller cum planters and commercial sugarcane farmers use blocks of about 20 to 30 hectares all over the world testify how uneconomical is to grow this crop in small and fragmented plots and thus justify the introduction of block farming system. Unlike block farming, traditional farming is a dominant farming system practiced by smallholder farmers in Tanzania and elsewhere in Africa and world at large whereby the farmers own and manage fragmented small pieces of land mostly between 1 to 5 acres. These farmers normally tend to adopt methods which are cheap thus ending up sacrificing proper crop husbandry which results in low production.

Smallholder sugarcane farming profitability depends on various factors but more so on the farming systems used. The farming systems which are independent variables are assessed to determine their effects on factors of financial sustainability and on profitability. In the context of small farms, the current theory of farm management is best articulated as the cohesive contemplation of two complementary theoretical frameworks derived from Morden management theory, (Kast & Rosenzweig, 1974). The first of these frameworks is farm system with conceptualization of the farm purposeful system whereas the second framework concerns management by objectives with the aim of maximizing economic profit subject to relevant constrictions has been the traditional conjectural approach to viable farm management, (Jensen, 1977, Nix, 1979).

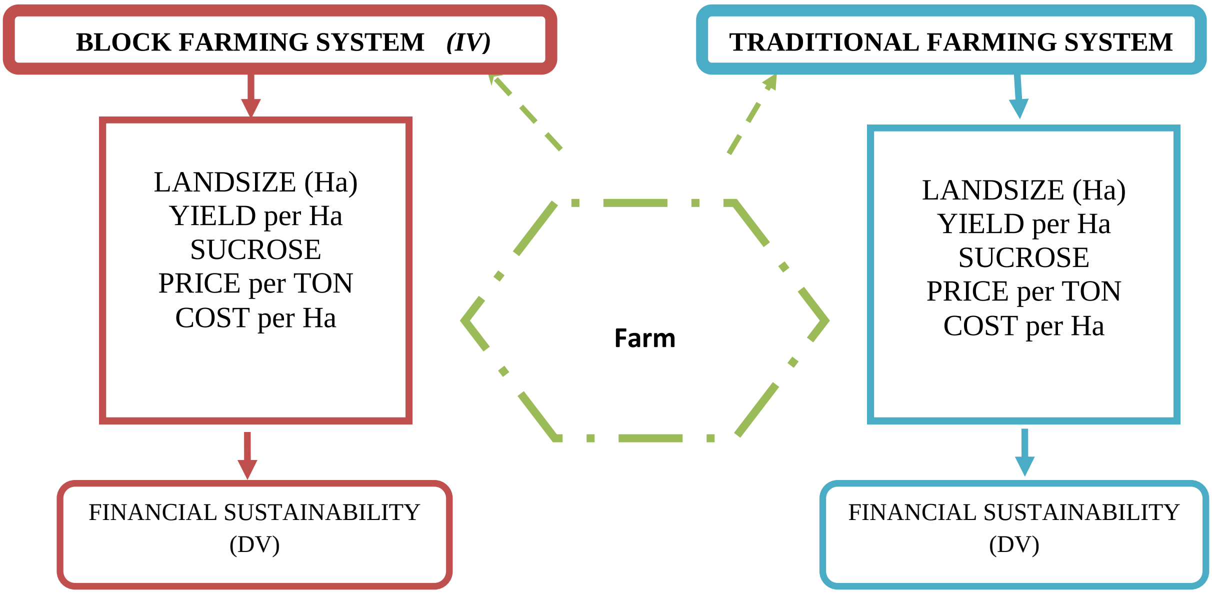

Figure 1: Conceptual framework

3.0 Methodology

The study adopted the survey strategy associated with deductive approach. Primary data required for this study have been collected from 394 smallholder sugarcane farmers and officials of block farms through self-completed questionnaires administered to a random sample. Secondary data were requested from Kilombero Sugar Company and sugarcane farmers associations. These smallholder farmers were those selling their sugarcane to two sugar processing companies located in the region namely Kilombero Sugar Company who own two sugar processing factories one in Kilosa and another in Kilombero district, and Mtibwa Sugar Estate located in the Mvomero district.

However, since there are more than ten well developed block farms in the Kilombero area as compared to only two underdeveloped block farms in Mtibwa, the study focused on the smallholder farmers in the Kilombero valley. The study population comprised of more than 8,000 contract smallholder sugarcane farmers practicing Block Farming and Traditional Farming systems located in the Kilombero valley sugarcane zone within Kilombero and Kilosa districts, and officials of selected financial intermediaries in the study area. Shapiro Wilk test for non-normality of data and appropriate transformations were done to each of the data sets to allow for parametric test.

The financial sustainability was assessed through examination of factors of profitability, namely land size, yield, sucrose, price and cost. Effects of the farming system for each of the factors have been analysed. The profitability from each of the farming system was determined. ANOVA, t-test, Tobit regression analysis and Spearman's rank correlation test each at significance level of $p = 0.05$ were used in the study.

4.0 Empirical Results

4.1 Profitability between Block Farming and Traditional Farming

Financially sustainable smallholder sugarcane farming depends on the profits attained from the farming operations through an applicable farming system. The results shown in Table 1 of an examination of profitability of the farming systems revealed a significant difference between Block Farming ($M = 0.56$, $SD = 0.22$) and Traditional Farming ($M = 0.39$, $SD = 0.23$), $t\,(36.57) = 4.23$, $p = 0.0001$.

Table 1: Profitability by farming systems

			t-Test – Profitability by Farming Systems		
Group	Mean	Std. Dev.	df	t	p value
Block Farming	0.5551	0.2236			
Traditional Farming	0.3924	0.2256			
Difference	0.1627		36.5734	4.2322	0.0001

4.2 Effect of Farming Systems on Financial Sustainability

Effectiveness of the farming systems into ensuring financially sustainable smallholder sugarcane farming was assessed by comparing profitability by farming systems. Results of the one way ANOVA test in Table 2, revealed that there is a significant effect of the farming systems on the financial sustainability (measured by profitability), $F\,(1, 1038) = 20.02$, $p < 0.0001$.

Table 2: Effects of farming systems on profitability

One-way Analysis of Variance for profitabil~y: PROFITABILITY					
				Number of obs =	1040
				R-squared =	0.0189
Source	SS	df	MS	F	Prob > F
Between farming_sy~m	0.94361023	1	0.94361023	20.02	0.0000
Within farming_sy~m	48.936389	1038	0.04714488		
Total	49.879999	1039	0.0480077		
	Intraclass Correlation	S.E.		Asy. [95% Conf. Interval]	
	0.21942	0.25508		0.00000	0.71938
Estimated SD of farming_sy~m effect					0.1151202
Estimated SD within farming_sy~m					0.2171287
Est. reliability of a farming_sy~m mean (evaluated at n=67.64)					0.95004

4.3 Effectiveness of the Farming Systems on Profitability

The financial sustainability of the smallholder sugarcane farming systems was assessed by analyzing the profitability of the two farming systems. The hypothesis that Block Farming System (BFS) is not more effective than Traditional Farming System (TFS) into ensuring the profitability of the smallholder sugarcane farmers was tested. The results does not support the null hypothesis as it was revealed that there is a significant difference on the effectiveness of the farming systems on the profitability of smallholder sugarcane farmers whereby profitability resulting from Block Farming (M = 0.56, SD = 0.22) is significantly higher than profitability attained through Traditional Farming (M = 0.39, SD = 0.22). Consequently, it is inferred that BFS is more effective than TFS into ensuring the profitability of the smallholder sugarcane farmers.

Essentially, these results suggest that BFS is more effective than TFS into ensuring the financial sustainability of the smallholder sugarcane farming by bringing comparatively higher profits. Waswa et al., (2011) showed that contract sugarcane farmers in Lurambi, Koyonzo and Chemelil retained 32, 31 and 34% respectively, of gross income. The farmers in those three areas are traditional farmers and their gross profit is slightly less than the 0.39 (39%) realized by traditional farmers in the Kilombero valley as found in the current study. The 0.56 (56%) profitability attained through Block Farming System introduced in Tanzania suggest that the farming system is potential into assisting the smallholder farmers to uplift their economic and financial wellbeing. There are possibilities to improve further the profitability of smallholder sugarcane farmers practicing Block Farming through improved management controls and supervisions to ensure optimization of returns through cost reductions and yield improvement.

4.4 Determinants of financial sustainability of Farming Systems

Land size, yield, cost, sucrose content in sugarcane and price offered by the sugar processing factories are some of factors considered to have effects on the profitability and subsequently on the financial sustainability of the smallholder sugarcane farming. An independent t-Test has been applied to assess the difference on these factors between the two smallholder farming systems. Spearman’s rank correlation test has been used to analyse the effects of the hypothesized factors on profitability of the farming systems. The causality of the hypothesized factors on the profitability was assessed by deploying the Tobit regression analysis. Table 3 and Table 4 give summary statistics of the means and variances of hypothesized factors for BFS and TFS respectively.

Table 3: Summary statistics - Block Farming System

> farming_system = BLOCK FARMING

Variable	Obs	Mean	Std. Dev.	Min	Max
Landsizeha	35	24.0734	1.7973	20.23	26.3
Yieldha	35	56.698	9.3010	36.47	76.21
Sucrose	35	10.0457	0.8390	8.57	11.57
Price	35	61274.6	7446.152	40359	70208
Costha	35	1507257	640876.7	342387.5	2911175
profitabil~y	35	0.5551	0.2236	-0.06	0.86

Table 4: Summary statistics - Traditional Farming
-> farming_system = TRADITIONAL FARMING

Variable	Obs	Mean	Std. Dev.	Min	Max
Landsizeha	1005	1.7347	1.5802	0.20	8.09
Yieldha	1005	55.7696	13.5611	17.88	133.44
Sucrose	1005	9.7906	1.0963	6.30	13.63
Price	1005	48283.67	12606.48	14274	81761.41
profitabil~y	1005	0.3924	0.224	-0.15	0.88

Results and discussions on these tests are presented in the succeeding sections. The order of these presentations starts with the results on the Tobit regression analysis and of the first order partial derivatives of the coefficients of the resulting Tobit models. This will be followed by the presentations of the results on differences of the factors hypothesized to affect the financial sustainability between the farming systems. Then, results of the Spearman's rank correlation test deployed to analyses the association of each of the factors to the profitability by farming system will then ensue. Finally discussion of these findings will be conducted.

4.5 Causality of Land Size, Yield, Sucrose, Price and Cost on Financial Sustainability
Tobit regression analysis was performed to assess the causal effects of the hypothesized factors on financial sustainability of the farming systems. Two Tobit models, one for Block Farming System (BFS) and another for Traditional Farming System (TFS) were developed. In each of the two models the variables hypothesized to have causal effect on profitability (PROFIT) measured as a ratio of earnings before interest and tax (EBIT) to revenue, are land size (LAND) measured in hectare (ha), Sugarcane yield (YIELD) measured in tonnes per hectare (tch), sucrose content (SUCROSE) measured in percentage, price of one tonne of sugarcane (PRICE) in Tanzania Shillings (TZS) and total cost per hectare (COST) measured in TZS. The examination of the causality of the hypothesized factors on the financial sustainability of Block Farming System revealed that there is a significant causal effect of the predictor variables on profitability, $F(5, 30) = 201.38$, $p < 0.0001$, as shown in Table 5.

Table 5: Tobit regression analysis on BFS

Model	β	SE	t	Sig.(p)
land size(rsqrt)	-0.138308	0.4698848	- 0.29	0.771
Yield (sqrt)	0.1709008	0.0003857	11.96	0.000
sucrose (sqr)	-0.0001423	0.0003857	- 0.37	0.715
price (log)	0.6163947	0.0537301	11.47	0.000
cost (log)	- 0.5263025	0.0249881	- 21.06	0.000
constant	- 0.0311753	0.7157457	- 0.04	0.966

Notes:
Obs. summary: 2 left-censored observations 32 uncensored observations 1 right-censored observation.
F (5, 30) = 201.38; Prob>F = 0.0000; Pseudo R^2 is 25.5124;
Log pseudolikelihood = 65.866805

Using these figures on Equation 4, the values of first-order derivatives for each of the variables were worked out and the outcome is as presented in Table 6.

$$\frac{\delta Ey}{\delta Xi} = \beta i \times \left[1 - \left(z \times \frac{f(z)}{F(z)}\right) - \frac{f(z)^2}{F(Z)^2}\right] \quad (4)$$

Table 6: First order partial derivative of Tobit model on BFS

Predictor variable	Transformation	printed β	β after back transformation	δEy/δXi
Landsize	Reciprocal of square root	$- 0.14 \times 10^{-1}$	5.23×10^{1}	3.85×10^{1}
Yield	Square root	1.71×10^{-1}	2.92×10^{-2}	2.15×10^{-2}
Price	Natural logarithm	6.16×10^{-1}	1.85×10^{0}	1.36×10^{0}
Sucrose	Square root	-1.42×10^{-4}	2.02×10^{-8}	1.49×10^{-8}
Costha	Natural logarithm	-5.26×10^{-1}	$- 5.91 \times 10^{-1}$	4.35×10^{-1}

Likewise, as shown in Table 7, Tobit regression analysis on the causal effects of the predictor variables on the financial sustainability of the Traditional Farming System have revealed that there is a significant effect of the variables on profitability, $F (5, 1000) = 1782.89$, $p < 0.0001$.

Table 7: Tobit regression analysis on TFS

Model	β	SE	t	Sig.(p)
landsizeha	-0.0199	0.0044471	-2.45	0.014
yieldha	0.149543	0.0024741	60.29	0.000
sucrose	-0.0000507	0.0000758	- 0.67	0.504
price	0.5531943	0.0078827	70.18	0.000
costha	-0.5363791	0.0060744	- 88.30	0.000
constant	0.9582515	0.0662766	14.46	0.000

Notes:

Obs. summary: 61 left-censored observations 926 uncensored observations 18 right-censored observations.

$F(5, 1000) = 1782.89$

Prob>F = .0000

Pseudo R^2 = 21.7057

Based on Amemiya, (1979) assertion on the effects of the coefficients of Tobit model, the first-order partial derivative of equation 5 presented by Mc Donald & Moffitt, (1980) was applied to deduce the causal effects of the hypothesized factors on the financial sustainability of the TFS. For the case of Traditional Farming 926 observations out of 1015 are uncensored which gives a ratio of 0.92. Therefore the required F(z) value for TFS is about 0.92. Because the value of F(z) is greater than 0.5, the required area in the normal graph is obtained by subtracting 0.5 from the F(z) value which gives an area of about 0.42. This area gives a 'z' value of 1.41 and hence this gives the corresponding f(z) = 0.15. Using these figures on Equation 5, the values of first-order partial derivatives for each of the predictor variables is worked out and the outcome is as presented in Table 8

Table 8: First order partial derivatives for predictor variables through TFS

Predictor variable	Transformation	printed β	β after back transformation	δEy/δXi
Land size	Recip. of sq. root	-1.09×10^{-2}	8.43×10^{1}	6.31×10^{1}
Yield	Square root	1.49×10^{-1}	2.22×10^{-2}	1.67×10^{-2}
Price	Natural logarithm	5.53×10^{-1}	1.74×10^{0}	1.30×10^{0}
Sucrose	Square root	-5.1×10^{-5}	2.57×10^{-9}	1.92×10^{-9}
Costha	Natural logarithm	-5.36×10^{-1}	-1.71×10^{0}	1.28×10^{0}

5.0 Discussion of Findings

This study attempted to assess the financial sustainability of the smallholder sugarcane farming systems through comparative analysis between BFS and TFS. One way analysis of variance (ANOVA), two sample t-Test, Spearman's rank correlation test and Tobit regression analysis, all at the significance level of 0.05, have been applied to assess effects, differences, associations and causal effects of the hypothesized factors namely land size, yield, sucrose, price and cost, on the financial sustainability of the smallholder farming systems. The association between financial sustainability and loan repayment performance has also been examined to determine if there is any significant effect of the financial sustainability of the farming systems on loan repayments.

Effects of the farming systems on financial sustainability (FS) were found to be significant. There is also a significant difference of the FS of the two farming systems. The FS has been measured by the profitability attained in each of the two farming systems. Profitability was calculated as the ratio of the operating income (EBIT) to the total revenue earned by the smallholder sugarcane farmers. Financial sustainability of the BFS as measured by profitability (M = 0.56, SD = 0.22) is significantly higher than the financial sustainability of TFS (M = 0.39, SD = 0.23). The findings suggest that BFS is significantly more effective than TFS into ensuring the higher financial sustainability. The financial sustainability was explained by the profitability attained through the two smallholder farming systems.

The effect of land size on the financial sustainability was found to have a non-significant small size on BFS, whereas the effect size was significant and moderate on the TFS. There is a significant difference on landsize between BFS (*M* = 24.07 ha) and TFS (*M* = 1.74 ha). The causal effect of land size on the financial sustainability on BFS was found to be negative and non-significant while it was negative and significant on the TFS. The implication of this finding is that for smallholder farming systems to be financially sustainable, the land used should have an optimum size. A small increase of land size above the optimum size used in BFS will result into a negative effect on the financial sustainability. On the other hand, a small increase on land in the case of TFS that does not bring the farm to an optimum land size will cause a significant negative effect on the financial sustainability. It is therefore concluded that use of an optimum land size is a key driver of financial sustainability of the smallholder farming systems.

It is also concluded that crop yield is a key determinant of financial sustainability of the farming systems. Effect size of yield on profitability was found to be significant and moderate on BFS while it was significant and small on TFS. Causal effect of yield on the financial sustainability was found to be significant on the two farming systems. Every unit increase on yield per hectare on BFS and TFS have significant positive effect on the financial sustainability. Smallholder farmers and other stakeholders should therefore focus into improving crop yields to sustain their profitability and consequently financial sustainability.

Quality of crops, in the context of this study sugarcane sucrose, is an important determinant of the financial sustainability of the farming systems. Sucrose is a measure of the amount of sugar in a volume of extracted sugarcane juice. Sugarcane with high sucrose content attracts high sugarcane price per tonne. Sucrose content attained on BFS (*M* = 10.05 percent) was found to be significantly higher than sucrose content realized on TFS (*M* = 9.98 percent). However, there was a non-significant low effect size of sucrose on the financial sustainability of the two farming systems. Causal effect of a unit increase of sucrose on the financial sustainability was found to be non-significant and decreasing on both BFS and TFS. This result was unexpected and calls for further studies on how sucrose content is determined and linked to the sugarcane price per tonne by the millers.

Price of one tonne of sugarcane basing on the sugarcane quality measured by the percentage of sucrose content in sugarcane has proved to be among the key determinants of the financial sustainability of the smallholder sugarcane farming systems. Price of sugarcane attained through BFS (M = TZS 61,274.60) was found to be significantly higher than price attained through TFS (M = TZS 48,269.23). This difference is attributed by the difference on sucrose content which was also found to be significantly higher on BFS. The relationship between price and financial sustainability of the farming systems was also found to be significant on both BFS and TFS. However, the effect size of this relationship was moderate on BFS while it was low on TFS. Causality of price on the financial sustainability was also found to be slightly higher per unit increase on BFS (1.36) than on TFS (1.30).

Cost has significant negative effect on the financial sustainability of the smallholder sugarcane farming systems. However, there is no significant difference between the cost per hectare on BFS (M = TZS 1,507,257) and TFS (M = TZS 1,545,989). The effect size of the correlation between cost and the financial sustainability was found to be high on the BFS and moderate on TFS. Causality of cost on the financial sustainability was found to be significant on the BFS with small decrease in profitability (0.44) per unit increase in cost. On the TFS every unit increase on cost reduces the profitability by about 1.28 units. These results suggest that a unit increase in cost on the TFS has a higher negative effect on the financial sustainability than on BFS. It can therefore be deduced that BFS offers a higher financial sustainability than TFS owing to the significantly lower causal effect of any unit increase on cost.

6.0 Conclusion and Recommendations

Although financial sustainability of Block Farming System has been found to be on the higher side as compared to the financial sustainability of the Traditional Farming System it is worth to consider the following points in order to enhance and optimize return among smallholder sugarcane farmers:

- Optimum size of block farm should be determined to optimize returns to members.
- Management of block farms should be improved to ensure effective use of resources so as to guarantee smooth and cost effective operations.
- Reason for the drop of yield in block farms should be investigated.
- Irrigation schemes and high yield sugarcane varieties should be introduced to smallholder sugarcane farmers.
- A more appropriate mechanism to measure sucrose content in sugarcane must be introduced and must be managed by a third party to ensure fairness.
- Smallholder sugarcane farmers should be encouraged and assisted to form more block farms as they have proved to be more effective into ensuring financial sustainability.

Following the promising outcome of the effectiveness of Block Farming System as compared to Traditional Farming System into ensuring the financial sustainability of the smallholder sugarcane farmers, it is recommended that various relevant National policies be reviewed and amended accordingly in order to enhance the efficiencies and productivity of smallholder farmers in all industries of crop subsectors as defined in the Agriculture and Livestock policy (1977). The following subsections presents and discusses these recommendations.

6.1 Tanzania Agricultural Loan Act and Farm Services Agency

It was found that the National Agriculture and Livestock Policy and the National Microfinance Policy do not provide frameworks or provisions that will assist smallholder farmers in case of natural disasters capable of ruining farmers' financial and economic wellbeing. It is therefore recommended that the Government, through its machineries, should formulate and enact a new Tanzania Agricultural Loan Act (TALA) which should provide a framework to initiate loan guarantee schemes for smallholder farmers and agricultural co-operatives. Farmers can use these loans to establish and develop farms while agricultural co-operatives may access loans to process farm products for value additions, distributions or marketing of the farming products. The proposed TALA should make provisions for the introduction of Tanzania Farm Service Agency (TFSA) which will be tasked to facilitate government guarantee to lenders repayment of up to 95% of net loss on eligible loans issued in case of natural disasters like flood, drought or quarantine as well as subsidy to smallholder farmers/traders. TALA and TFSA should be among the policy instruments of the Agriculture and Livestock Policy.

6.2 Review of National Agricultural Policy

It also recommended that the Tanzania Agricultural and Livestock Policy (URT, 1997) be reviewed to ensure emphasis is put on introduction of joint farming societies like block farming. The policy should also broaden the role of the government in the improvement of smallholder farming because this is the area which employs majority of Tanzanians, and if taken seriously will have tremendous effect into the improvement of the livelihoods and welfare of the citizens and the nation at large. To ensure farmers are motivated to form the joint farming societies, the policy should emphasis on smallholder farmers training and introduces special incentives that will encourage farmers to participate in these joint farming/block farming societies with an aim to commercialize agriculture in the crop subsector. The policy, (URT, 1997), should also set a framework for formulation and enacting of a new National Agricultural Fair Pricing Act (NAFPA) which will ensure farmers are compensated fairly through appropriate pricing of their produces basing on farm products quality. This will stimulate productivity and efficient production among smallholder farmers and ensure financial sustainability of the farming societies.

6.3 Recommended Farm Systems Financial Sustainability Model – (FSFS-M)

A generic model presented in Figure 2 has been developed in the course of this study and is recommended for future analyses of financial sustainability or financial profitability of smallholder and corporate farming systems.

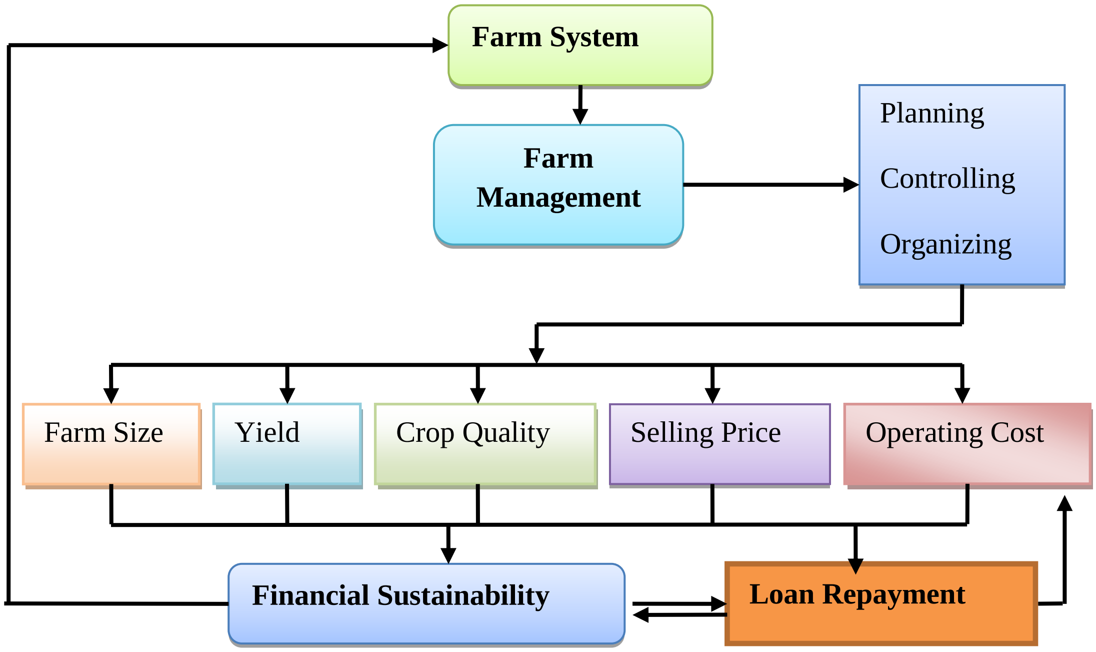

Figure 2: Farm systems financial sustainability model (FSFS-M)

Smallholder farming financial sustainability depends on various factors but more so on the farming systems used. The farming systems which are independent variables are assessed to determine their effects on factors of profitability. The analysis can be conducted to compare two or more farming systems. The model can also be used to analyse the financial sustainability of a single farming system. Farm management plays an important role on the financial sustainability of farming systems by aiming to maximize financial profitability. An applicable farming system is expected to facilitate effective management of the farm activities through the traditional management roles of planning, controlling and organising. In the context of small farms, the current theory of farm management is best articulated as the cohesive contemplation of two complementary theoretical frameworks derived from contemporary management theory, (Kast & Rosenzweig, 1974). The first of these frameworks is farm system with conceptualization of the farm purposeful system, and the second framework that concerns management by objectives with the aim of maximizing economic profit subject to relevant constrictions has been the traditional conjectural approach to viable farm management, (Jensen, 1977, Nix, 1979). Five key factors, namely farm-size, crop-yield, crop-quality, selling-price and total operating-cost make an important integral part of the recommended model. Correlation and causal effects of these factors on the profitability should be analysed to examine their correlation and causal effects on the financial sustainability of the respective farming system. Farm size plays an important role into enhancing financial sustainability among farmers. Through an effective farm system an optimum farm size can be set up and managed appropriately to take advantages of economies of scale.

High crop yield is expected to bring in more revenue given a particular selling price. Consequently, the achieved high revenue is expected to bring in high profitability which if sustainable will result into a financially sustainable farming operation. An effective farming system is perceived as a key driver of high crop yields. However, other factors like variety, weather and agronomic factors can also affect crop yield. Crop quality is a key determinant of achieving financial sustainability of smallholder farmers. A better quality farm produce is expected to attract a superior selling price and hence higher profit as compared to inferior quality crop. It therefore seems reasonable to include crop quality as one of key determinant of financial sustainability of farming systems.

Broadly, sustainability refers to the ability to contain an organization over a long term. Commercial farms are organizations in their own rights. Financial sustainability refers to the ability to maintain financial capacity over a long time. Financial sustainability is achieved when a business like commercial farm is able to produce and deliver a product to the market at a price that covers their expenses and generate a profit (Bowman, 2011). Loan repayment refers to reimbursements of loans acquired by farms or individual farmers to finance various farm operations or purchase of capital goods. It is expected that a financially sustainable farming will facilitate an effective loan repayment among farmers. The FSFS-M model can as well be utilized to assess the correlation between loan repayment rate and financial sustainability of a single farming system or comparing two or more farm systems.

6.4 Recommended Analytical Models for Future Studies

The two limits Tobit model has found an extensive use in the analysis of categorical data, (Long, 1997). In this study of the financial sustainability of smallholder sugarcane farming systems, the two limit Tobit model was found to be very efficient and useful in the analysis of continuous ratio data. The financial sustainability of the smallholder commercial farmers was explained by the profitability attained by the farmers through either of the two smallholder sugarcane farming systems in use, namely BFS and TFS. Profitability ratio was calculated by dividing the operating profit (earnings before interest and tax) to the revenue. The Tobit model was censored between 0 and 0.8 basing on arbitrary assumption that smallholder farmers will spend not less than 20% of their revenue to finance both pre- harvest and post-harvest costs per hectare. The lower limit was chosen basing on an arbitrary assumption that the revenue received equals the total cost expended. These assumptions were centred on the major limitation of the study viz. lack of accurate data on pre-harvest cost from some farmers due to poor record keeping. Post-harvest costs were accurately calculated from sugarcane sales payment vouchers issued to farmers by the Sugar Processing Company.

The same approach, however with some modifications basing on crop involved and limitations of a particular study, is recommended for future studies of financial sustainability. Though, as suggested by (Amemiya , 1979) and (Long , 1997) it is emphasized here that interpretation of the coefficients of the Tobit model must involve the manipulation of the partial derivatives of the model coefficients by applying Equation 28 (Chapter three) developed by Mc Donald & Moffitt, (1980) which might be cumbersome to those with little or no mathematical background. To Counteract the requirement of the partial derivative manipulations prior to interpretation of the effect of the regression coefficients of the Tobit model, future studies can as well involve the conversion of continuous ratio data, like the profitability ratio, to categorical data and thus enable the application of multinomial binary logistic regression analysis like Probit model to be performed. The Probit model has been explained in detail by (Amemiya, 1979) and (Long, 1997) and initially presented in Chapter two. The model equations are re-presented here as Equations 5, 6, 7 and 8.

$$P_r(Y = 1/X) = \Phi(X\beta) \quad (5)$$

Where P_r denotes probability and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution. The parameters β are typically estimated by maximum likelihood. The Probit model can also be motivated as a latent variable model. Suppose that there exists an auxiliary random variable:

$$Y^{*}A = X^{1}\beta + \varepsilon \qquad (6)$$

Where, $\varepsilon \sim N(0, 1)$.

Then Y can be viewed as an indicator for whether this latent variable, (Amemiya, 1985) is positive:

$$Y = \begin{cases} 1 \; if \;\; Y^{*} > 0 & i.e. -\varepsilon < X^{1}\beta \\ 0 & otherwise \end{cases} \qquad (7)$$

The Probit model can be constructed by choosing functions of Xβ that ranges from 0 to 1. Cumulative distribution functions (cdf) have this property and readily provide a number of examples, (Long, 1997). The cdf for the standard normal distribution results in the probit model shown in Equation 8:

$$P_r\,(Y = 1|X) = \int_{-\infty}^{x\beta} \frac{1}{\sqrt{2\pi}} \exp(-\frac{t^2}{2})\, dt = \varphi(x) \qquad (8)$$

We finally recommend that the impact of farming systems on financial sustainability of smallholder farmers deserves further detailed analysis. A study to assess how sucrose is measured and how it is related to the determination and setting of sugarcane prices is recommended following the unexpected result on the effect of sucrose content on the profitability of the smallholder sugarcane farmers. The study should also focus on how and to what extent the current procedure has affected the financial sustainability of the smallholder sugarcane farmers.

REFERENCES

Amemiya, T. (1979). The estimation of a Simultaneous-Equation Tobit Model. *International Economic Review*, 20(No. 1), 169 – 181

Arnold, G. (2008). Corporate Financial Management (fourth ed.). Essex, England: Prentice Hall.

Basimwaki,S., Issae,A., Kurczak, K., Munisi, J., Stubbings, T. (2007, June). Draft Final Report Component B. Block Farming. Tanzania: Unpublished.

Bowman, W. (2011). Financial capacity and sustainability of ordinary non-profits. *Non-profits management and leadership, 20*(11), 55-65.

European Commission. (2006). Tanzania - EC Multi - Annual Adaptation Strategy for the Period from 2006 - 2013 Under the Accompanying Measures for Sugar Protocal Countries.: European Commission.

Horngren, C. T., Harrison Jr., W. T., & Oliver, M. S. (2009). Accounting (8th ed.). New jersey: Prentice Hall.

Jensen, H.R. (1977). Farm Management and Production Economics, 1946 – 70. A Survey of Agricultural Economics: Literature University of Minnesota Press, Minneapolis, vol.1: 1- 90.

Kast, F.E., Rosenzweig, J.E. (1974). Organization and Management: A system approach. New York: Mc Graw Hill.

Long, S. (1997). Regression Models for Categorical and Limited Dependent Variables. Thou and Oaks, CA: Sage Publication.

Malonga, M., Rugaimukamu, J. and Sheiza, J. (2009, June). Technical assistance to facilitate sensitization training for establishment of block farming to outgrowers association management in five areas of Kilombero, Ruembe, Mtibwa,Kagera and Zanzibar. Final report - sensitization of block farming training .: Unpublished.

Masuku, M. (2011). Determinant of Sugarcane Profitability: The case of Smallholder Growers in Swaziland. Asia.n Journal of Agricultural Sciences, 3(3), 210 - 214.

McDonald, J., & Moffit, R. (1980). The Use of Tobit analysis. Review of Econometrics and Statistics , Vol 62, 318 - 321.

Mushi, A. S. (2012). Performance of Block Farming on Sugarcane Production from 2007 to 2011 - A Case of Kilombero. Dissertation Submitted for the Partial Fulfillment of the Degree of Master of Business Administration of the Open University of Tanzani.

Nix J. (1979). Farm management: The state of the art (or science): Journal of Agricultural Economics 30: 277 - 92

Rugaimukamu, J. F., Mongi, J., Baddeley, M. (2007). Establishment of Block Farming in Outgrower areas in Kilombero Valley. Paper Presented at TSSCT conference at Kibaha : Unpublished.

Waswa, F., Mcharo, M., & Gwei, J. P. (2011). Contract Sugarcane Farimng and Farmers' Incomes in the Lake victoria basin, Kenya. Published online at www.m.elewa.org.