African Journal of Agricultural Economics and Rural Development ISSN: 2141-5091 Vol. 2 (3), pp. 129-137, May, 2014. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Technical efficiency analysis of organic mango out-grower farm management types: The case of integrated tamale fruit company (ITFC) out-growers in Northern Region

Bunbom Edward Daadi[1*], Issahaku Gazali[2] and Joseph Amikuzuno[3]

[1] Department of Climate Change and Food Security, Faculty of Agribusiness and Communication Sciences, University for Development Studies, P. O. Box TL 1882, Tamale, Ghana.

[2]Department of Climate Change and Food Security, Faculty of Agribusiness and Communication Sciences, University for Development Studies, P. O. Box TL1882, Tamale, Ghana.

[3]Department of Climate Change and Food Security, Faculty of Agribusiness and Communication Sciences, University for Development Studies, Ghana.

Accepted 8 April, 2014

To improve farmers' income from production, farm inputs have to be applied efficiently. This study estimated and assessed difference in technical of two farm management types (group management and family management). Data was obtained from a random sample of 204 out-growers through the use of structured questionnaire. A transcendental logarithmic (translog) stochastic production frontier was employed using the maximum likelihood estimation method, from which farm-specific technical efficiency was calculated. The result shows that farmers under family farm management are about 42%, more technically efficient than those under group farm management. The group managed farms are less technically efficient due to lack of commitment to managing farms and too large groups for leaders to effectively control. Training of out-growers, aimed at addressing specific needs are required to improve technical efficiency, while frequent farm demonstrations, breaking large groups into smaller ones and strategic shift from group to family plantations are some ways to improving technical efficiency.

Key words: Integrated tamale fruit company, technical efficiency, farm management type, out-growers, Northern region.

INTRODUCTION

Mango production in the Northern Region has been recognized as a way of fighting poverty and has consequently gained attention of government as reflected in the strategies of Food and Agriculture Sector Development Policy (FASDEP). The policy identified mango as a crop to focus on in the Northern Region due to agro-ecological suitability. Responsibility for implementation of policy programs does not rest on government alone. Indeed, government is expected to play only facilitating and coordinating roles in this pursuit. Success will depend largely on multi-stakeholder efforts whereby private sector is suppose to play crucial roles, including making or financing investment in the sector and opening market channels for access by less privileged farmers (MoFA, 2007).

The Integrated Tamale Fruit Company (ITFC) is one organization that is actively playing the expected roles of the private sector in the Northern Region. This company is able to produce and export high quality grade mangoes from inaccessible areas. This means that further improvement in exportable output is possible if transportation network improve (USAID and TIPCEE, 2009).

ITFC has been assisting subsistence farmers to cultivate

*Corresponding author. E-mail: bedaadi@uds.edu.gh

mango since 2001 in the communities surrounding its nucleus farm, through an out-grower scheme. The company sees the out-grower scheme as a way of getting the required volumes of mangoes to enable it command a higher degree of market power in the organic mango export markets as well as accessing greater productive capacity and reducing average cost of operations.

While pursuing its corporate objectives, it also support the poverty reduction goal of the Government of Ghana by providing the local people with sustainable income generating livelihoods through the establishment of organic mango farms (UNDP, 2007). In an attempt to balance the need to contribute towards poverty reduction among rural farmers and meeting international market requirements, ITFC developed its out-grower mango production scheme. This scheme consists of two types of mongo farm management organization: the family managed and the group managed mango farms. Under the family management system farms of limited size (0.4 to 4 hectares) are owned by a single farming household whose head is registered by ITFC as a farmer and a farm business account is created in the name of the farmer. Group managed farms on the other hand, range from 2 to over 40 hectares and are owned by a number of farming households that form a group. The group has a leadership made up of a chairman, secretary and treasurer. The farm is divided among registered group members in 0.4 hectare lots. Like in the case of family farm management however, individual account is created by ITFC in the name of each member.

In collaboration with bilateral donors, ITFC has financed the establishment of farms under both types of management. Outputs from farms of both systems appear satisfactory and farmers have earned significant levels of income well over their previous earnings (UNDP, 2007). However, there remain some unanswered questions about the income earning potentials of the farmers under the out-grower scheme. These include whether maximum possible outputs are obtained with given levels of inputs and which farm management type is more efficient, thus contributes more towards the goal of improving incomes of rural people in Northern Region. ITFC cannot answer these questions from empirical evidence. It is against this background that the study seeks to quantify technical efficiency levels of farmers under each farm management system so as to estimate possible gains that can be attributed to socio-economic and management characteristics. The main objective of the study is to analyze the efficiency of organic mango out-grower farm management types that ITFC operates. The specific objectives are to:

- Estimate technical efficiency (TE) levels of out-growers under the two farm management types.
- Identify the socio-economic/management attributes of farm/farmers that influence technical efficiency of the out-growers.

Productivity and Efficiency

Production involves converting a given set of inputs into output(s). Therefore, the amount of output obtained at the end of any production process depends on the amount of inputs applied and how these inputs are combined. While the level of input set gives scale effect Coelli (2005), inputs coordination determines how effective input-to-output conversion will be, considering physical quantities, values or both (Han, 1991). The combined effects of input scale and coordination (quantities and values) on output is referred to as productivity. Some researchers defined it simply, as the ratio of output to input or input to output (Sartorius and Kirsten, 2004).

Furthermore, productivity which typically concerns profitability of decision-making units is a function of three elements: technical efficiency, scale efficiency and allocative efficiency, with (Livio and Massimo, 2002). Performance indicators that are often considered under productivity are cost per unit output, output per hour, and output per area (Ariyarathna J and Joseph M. M., 2011). In finance, measures of productivity include earnings per share (EPS), return on investment (ROI), economic value added (EVA) and cash flow return on investment (Ittner and Larcker, 1998 and Hashem et al., 2010).

A closely related and more specific concept to productivity in production analysis is the concept of efficiency, which does not only examine output from a given input(s),but further compares the output to what can be achieved with the given input set.

According to Heyne (2008), economists view efficiency as a relationship between ends and means and when they say a situation is inefficient, it implies they could achieve the desired ends with less means, or the means employed could produce more of the desired ends, whereby “less” and “more” necessarily refer to value. Meaning, economic efficiency is measured by the relationship between the value of the ends and the value of the means rather than physical quantities. In other words, efficient situation in production for instance is where the value of input(s) applied gives the maximum possible output also in terms of value. Efficiency is, therefore, a measure of how well the production or input transformation process is performing. It indicates how well an organization uses its resources to produce goods and services. Thus, it focuses on the rates at which inputs are used to produce or deliver the outputs (OAG, 2007). Stating efficiency this way seems to define it more empirically than just a relationship as Heyne (2008) does.

Farell (1957)’s work on the measurement of productivity efficiency which proposed three components of a firm’s efficiency resulted in better understanding of the concept of efficiency. These are technical, allocative and economic efficiencies.

Technical Efficiency

In terms of output, technical efficiency (*TE*) is measured as a ratio of realized output(*Y*) to the potential output(Y^*) from a given set of input(s). It is generally assumed that the potential output is obtained by following the best practice methods, given a technology (Karagiannis, 2009) which defines a production frontier. Generally, the production frontier is specified as below;

$Y_i = f(X_i\,;\beta).\exp\,(-u_i)$…………………….. (1)

where $u_i \geq 0$,and represents technical inefficiency of ith farm. It $(u_i \geq 0)$ becomes a condition that guarantees that,

$Y_i \leq f(X_i\,;\beta)$………………………………… (2)

This conforms with $Y_i = f(X_i;\beta)\cdot TE_i$

or $Y_i = f(X_i;\beta_i).\exp\,(-u_i)$.....(3)

where technical efficiency is expressed as

$$TE_i = \frac{f(X_i;\beta)\cdot\exp(-u_i)}{f(X_i;\beta)} = \exp(-u_i)\text{……} \quad (4)$$

The above specification is deterministic and does not suit empirical analysis since random errors affect practical situations. Aigner *et al*. (1977) and Meeusen and Van den Broeck (1977) therefore proposed stochastic production frontier approach which incorporates the error term (ε_i) as specified below;

$Y_i = f\,(X_i;\,\beta_i) + \varepsilon_i$…………………………… (5)

where ε_i is a combined error term, made up of v_i(random effect) and $-u_i$ inefficiency effect as defined earlier. This can be expressed further as;

$Y_i = f(X_i;\beta_i) + (v_i - u_i)$ or

$Y_i = f(X_i;\beta_i).\exp(v_i)\,.\exp\,(-u_i)$. ………… (6)

From which, technical efficiency is derived by;

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{f(X_i;\beta)\cdot\exp(v_i-u_i)}{f(X_i;\beta)\cdot\exp(v_i)} = \exp(-u_i) \quad (7)$$

where Y_i is the observed output of a farm and Y_i^* is the frontier (maximum output possible).

METHODOLOGY

Study Area

The study covered the operational area of ITFC which includes Savelugu-Nanton, Tolon-Kumbungu, West Mamprusi and Karaga districts of the Northern region.

Sampling Procedure and Size

The sample was drawn from a total population of 1400 organic mango out-growers with some owning infant plantations. A list of all the farmers obtained from the scheme management was used as the sampling frame to draw the sample. This was stratified into group managed and family managed farms after which, simple random sampling procedure was used to obtain a representative sample from group out-growers, whilst a census of the family out-growers was employed because their number was small (53 out-growers).A total sample of 204 farmers (made up of 151 group and 53 family out growers) was used for the study.

METHODS OF DATA ANALYSIS

Two main models were used in empirical analysis of the data. However, the single stage estimation approach makes the second objective of the study an integral part of the first. The computer soft-ware used (frontier 4.10) accommodates specification of this kind of empirical model; hence the models were estimated together. Statistical test of difference of means was used to ascertain difference between technical efficiency levels of group and family out-growers. Analytical methods used to achieve the objectives are presented below.

Empirical Technical Efficiency Model

The empirical specification of the production frontier:

$$lnY_i = \beta_0 + \beta_1 lnPlAge_i + \beta_2\, lnWexp_i + \beta_3 lnPeKg_i + .5\beta_{11}\ln\,(PlAge_i)^2 + .5\beta_{22}\ln\,(Wexp_i)^2 + .5\beta_{33}\ln\,(PeKg_i)^2 + \beta_{12}(lnPlAge_i * lnWexp_i + \beta_{13}(lnPlAge_i * lnPeKg_i) + \beta_{23}(lnWexp_i * lnPeKg_i) + v_i - u_i \quad \text{…………………} \ (8)$$

Where, Y_i is total output of mango (kg/ha), PlAge is age of plantation (years), Wexp is weeding expenditure (Ghc/ha), PeKg is quantity of organic pesticides (kg/ha), β_0 is constant and *β*'s represent the coefficients of inputs PlAge, Wexp, PeKg and their second order terms respectively.

It is assumed that v_i is independently and identically distributed N˜ (0, σ^2_v) and u_i is a one-sided error term independent of v_i with truncated normal distribution having a mean μ and constant variance σ_μ^2. With ε, γ and σ from maximum likelihood estimation of the frontier, estimates of v_i and u_i were obtained by applying conditional distribution of u_i . By subtracting v_i from both sides of the equation; the frontier function became;

$$lnY_i^* = \beta_0 + \beta_1 lnPlAge_i + \beta_2\, lnWexp_i + \beta_3 lnPeKg_i + .5\beta_{11}\ln\,(PlAge_i)^2 + .5\beta_{22}\ln\,(Wexp_i)^2 + .5\beta_{33}\ln\,(PeKg_i)^2 + \beta_{12}(lnPlAge_i * lnWexp_i + \beta_{13}(lnPlAge_i * lnPeKg_i) + \beta_{23}(lnWexp_i * lnPeKgi - ui \quad \text{……} \ (9)$$

$$\Rightarrow \quad Y_i^* = Y_i - v_i \quad \text{………} \ (10)$$

Table 1. Null Hypotheses Tested.

Null Hypothesis	Implication
$H_0 : \beta_{ij} = 0$	C-D form is appropriate
$H_0 : \gamma = \delta_0 = \delta_1 \ldots \ldots = \delta_{10} = 0$	inefficiency effects are absent
$H_0 : \gamma = 0$	Non-stochastic inefficiency effect
$LR = -2[\ln\{L(H_0)\} - \ln\{L(H_A)\}]$	Generalized likelihood-ratio test

Table 2. Discription of Variables in the Inefficiency Model.

Variable	Definition	Measurement
Z_1	Age of the farmer	Years
Z_2	Gender of farmer	Dummy:1 for male,0 otherwise
Z_3	Farmer's household size	Number of persons
Z_4	Educational status of farmer	Number of years in school
Z_5	Cash crop farming experience	Number of years
Z_6	Training demonstrations	Number of times attended
Z_7	Farm management type	Dummy variable: 1 for group

⇨ From this frontier, farm-specific technical efficiency (TE) is measured as;

⇨ $TE_i = \frac{Y_i}{Y_i^*} = \exp(-u_i)$ ………..........(11)

Where Y* is defined as the frontier output (Bravo-Ureta and Rieger 1991) of mango in kilograms. The hypotheses below are tested to statistically validate efficiency of the production function and other parameters of efficiency among the sampled organic mango out-growers.

Empirical Estimation of Determinants of Inefficiency

The relationship between technical inefficiency estimates and socio-economic characteristics of farmers/farms is specified as below;

$\mu_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7$ …… (12)

Where μ_i is farm-specific technical inefficiency, Z's are as defined (Table 2),

δ_0 is a constant and δ_1 to δ_7 are coefficients. These and others, except demonstrations and management types, are usually the explanatory variable included in the second stage analysis (Bravo–Ureta, 1997). Demonstrations and management types as socio-economic variables are specific to the objective of this study.

In order not to violate the initial assumption about u_i, the inefficiency term is specified as an explicit function of the socio-economic attributes and estimated using the single stage estimation procedure proposed by (Coelli *et al.,* 1995).

RESULT AND DISCUSSION

Summary Statistics

Table 3 reports the summary of socio-economic attributes, farm characteristics and levels of some inputs. The mean ages for the group and family out-growers are 43 and 44 years respectively. These are not statistically different, hence an average out-grower is middle aged. There is also no statistical difference between mean household sizes of out-growers for the two farm manage-

Table 3. Summary of Variables by Management Type.

Variable	Unit	Sample (N=204)	Group Out-growers (n=151)	Family Out-growers (n=53)	Z-value
	Socio-economic Attributes of Out-growers				
Gender	Dummy	0.93	0.91	1	-0.131
Age of Outgrower	No. of years	43	43	44	-1.034
Household size	No. of people	6	6	6	0
Education	No. of years	2	2	3	-2.201**
Farm Management	Dummy	0.74	1	0	0
Experience	No. of years	21	21	20	0.521
Demonstrations	No. of times	7	6	7	-2.379**
Farm Characteristics					
Farm Size	Hectares	4	4.8	2.8	3.502***
Plantation Age	Years	6	6	5	1.031
Input Variables					
Weeding Expenditure/ ha	Ghana Cedis	31	31	31	0
Organic Pesticide	Kgs/ha	3.5	3.5	3.75	0.793
Price of Pesticide	Ghana Cedis	1.5	1.4	1.6	-1.831*
Output Variable					
Yield/Acre	Kg/ha	146.725	105	281.25	-34.76***

Source: Field Survey, 2011

ment types. The average number of persons per household is 6 for both groups.

Level of formal education attained by out-growers is generally low depicting high illiteracy situation in rural Northern Region. An average group out-grower had only two years of formal schooling, one year statistically less than a family out-grower. Therefore, the highest level of formal education attained by an out-grower is lower primary school.

On the average, an organic mango out-grower under ITFC project has about two decades of experience in taking part in farm credit programs. However, farmers experience in mongo production is the same as the age of their plantations because they did not produce mongo until the beginning of ITFC's program in 2001.

ITFC organizes biannual farm demonstrations for all its out-growers. These practical training sessions are meant to improve out-growers' technical skills in carrying out their farm operations. However, there is significant difference between group and family out-growers in terms of attendance at the training sessions. The average family out-grower attends one more demonstration session than the average group out-grower. This is an indication that family out-growers are more committed to measures that will improve upon their farm output than group out-growers. This evidence, according to Aditya (2008), is contrary to expectation that group operations will be more effective because the group encourages its members to participate in activities that they may not do as individuals.

Group farms are generally larger than family farms (Table 3). Farms belonging to group out-growers are about twice the sizes of those belonging to family out-growers. It should be noted however, that farm size as a characteristic does not indicate scale of production for a group out-grower since each group out-grower is limited to 0.4 hectares. Rather, it suggests the size of the group managing the farm. This means that though group farms are larger, a group out-grower as a family does not enjoy scale efficiency. On the other hand, farm size indicates scale of production among family out-growers since a family out-grower owns 0.4 or more hectares; hence they may have scale efficiency.

The age of plantations is about the same across farm management types. All farms in the sample are within the first of three agronomic age groupings-developing bearers, stabilized bearers and aging bearers. This means that all farms are young and still growing; hence output is expected to increase each year, all other conditions remaining optimal.

Table 4. Results of Hypotheses Tested.

Null hypothesis	Test Statistics	Critical Value	Decision
$H_0 : \beta_{ij} = 0$	23.34	12.59	Rejected
$H_0 : \gamma = \delta_0 = \delta_1 \ldots \ldots = \delta_{10} = 0$	105.49***	37.01	Rejected
$H_0 : \gamma = 0$	39.07***	9.50	Rejected
$LR = -2[\ln\{L(H_0)\} - \ln\{L(H_A)\}]$	298.28***	37.12	Rejected

***implies significant at 0.01.

Table 5. Maximum Likelihood Estimates of the Stochastic Production Frontier.

Variable	Coefficient	Standard error
Constant	1.26***	0.057
lnPlAge	-0.018*	0.0099
lnWexp	0.017**	0.0083
lnPeKg	0.159**	0.078
$(\ln PlAge)^2$	2.88***	0.010
$(\ln Wexp)^2$	-0.004	0.36
$(\ln PeKg)^2$	-0.12*	0.071
lnPlAge*lnWexp	0.008	0.44
lnPlAge*lnPeKg	-0.011	0.008
lnWexp*lnPeKg	-0.056*	0.033
σ^2	0.84 ***	0.0025
γ	0.98 ***	0.002
Log likelihood	298.23	
N	204	

Note: *,** and *** means significant at 0.1, 0.05 and 0.01 levels respectively.
Source: Field survey data, 2011.

The mean mango output per hectare of family out-growers is about three times that of group out-growers. This huge difference can only be attributed to differing quality of management, because there is no difference in quantities of inputs (weeding expenditure and organic pesticides) used between the two out-grower types to justify the difference in output.

Technical Efficiency

Test of the null hypothesis (in Table1), which suggests that the coefficients of second order terms in the translog specification are zero is rejected. Therefore the translog form of the production function is appropriate for the sampled organic mango out-growers. Table 4 shows the test results of the model.

In Table 5 Gamma (γ) which is the ratio of the variance of u to the total variance (σ^2) is 0.98 and statistically different from zero at 1%. This ratio measures the effect of technical inefficiency in the variation of output. It means therefore that 98% of the total variation in farm output is due to technical inefficiency.

The technical efficiency estimates derived (Table 6), relative to the above production frontier, ranges from 24% to 98%, with a mean of 53% among group out-growers. Among family out-growers, it ranges from 34% to 100% with a mean of 91%.This means that if an average group out-grower were to achieve the technical efficiency level of the most efficient out-grower in the entire sample, then he or she can realize 47% [i.e 1-(53/100)] output increase without additional inputs. Similarly, an average family out-grower who may become equally efficient as the most efficient sample out-grower will be increasing his or her output by 9% [1-(91/100)].

These calculations show that the technical inefficiency level is higher among group out-growers than family out-

Table 6. Distribution of Technical Efficiency by Farm Management Types.

Efficiency Class (%)	Group Out-growers		Family Out-growers	
	Frequency	**% of n**	**Frequency**	**% of n**
<*30*	10	6.6	0	0
31-40	24	16	1	2
41-50	36	23.8	2	3.7
51-60	33	22	2	3.7
61-70	25	16.5	4	7.5
71-80	10	7	4	7.5
81-90	8	5.3	6	11.3
>90	5	3.3	34	64.25
Mean	53		91	
Minimum	24		84	
Maximum	98		100	
N	151		53	

Note: sample sizes (n) for the two out-grower categories are not the same; hence basis for any comparison is the percentages (%) of the two sub-samples and not the frequencies. The mean, minimum and maximum are technical efficiency measures. Pooled sample mean technical efficiency is 72% but its distribution and frequency are not shown in the Table.
Source: Field Survey Data, 2011.

growers. Therefore, more efficiency gains can be realized by improving management practices among group out-growers than among family out-growers. The mean technical efficiency of the pooled sampled out-growers is 72% which is the same as Amos (2007) found among small-holder cocoa farmers in Nigeria. It is however greater than 34% found among rice farmers in the Upper East Region (Al-hassan, 2012), but less than the 86% found among small-holder sweet orange producers in Nigeria (Muhammed Lawal, 2007).

The percentage distribution of technical efficiency estimates for both group and family out-growers is shown in Figure1 The figure indicates normal distribution of efficiency levels among group farms but that of family farms is skewed to the left hand side.

Comparison of Technical Efficiency of Group and Family Farms

As already indicated, the mean technical efficiency of group and family farms is 53% and 91% respectively. This difference of 38% is large and significant at 1% (Table 7). The average group out-growers will therefore have to improve their output by 42% [1-(53/91)] if they were to become as efficient as an average family out-grower.

This result is contrary to Aditya (2008) who argued that group decisions are more efficient than those of family. The situation could be attributed to less commitment on the part of group out-growers as it is evidenced by their attendance to training sessions (demonstrations).

Determinants of Technical Inefficiency

The hypotheses that the inefficiency effect is absent and non-stochastic were rejected (Table 4). This means that variation in output is partly due to inefficiency and this inefficiency is stochastic.

The study excluded some of the usual variables like extension contact, access to credit and contract relationship with input suppliers or produce buyers in that analysis because, such characteristics are constants with no variation among all out-growers under the ITFC project. However, the number of demonstration sessions an out-grower attended since the establishment of his or her farm was used in place of extension contact. The other variable which is specific to this study (and not usual in the literature) is the type of farm management an out-grower belongs to. The estimated inefficiency model is presented in Table 8.

The model shows that the age of the out-grower, education, household size and experience have no significant effect on inefficiency whilst gender of out-grower,

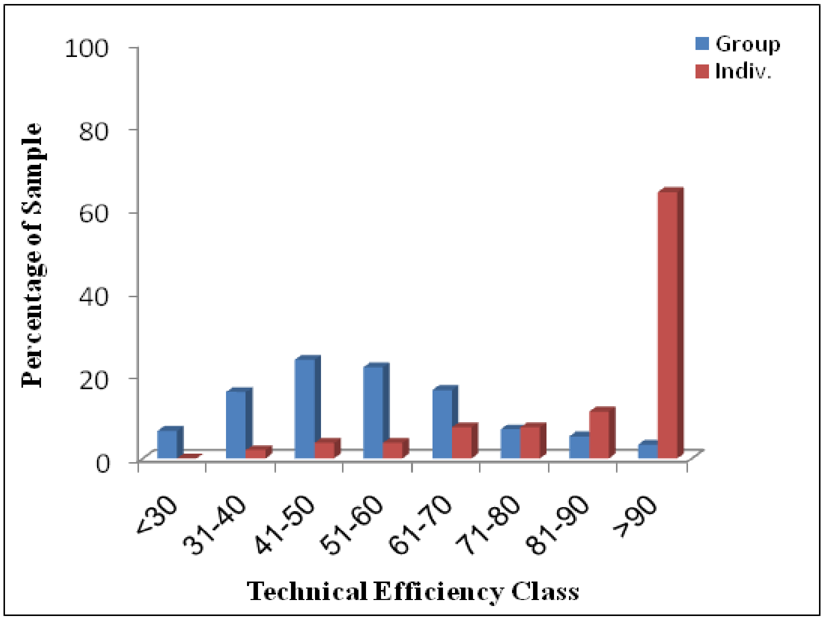

Figure 1. Distribution of Farm-Specific Technical Efficiency.

Table 7. Difference in Mean Technical Efficiency of Farm Management Types.

	Sample (N=204)	Group (n =151)	Family (n =53)	$X_G - X_f$	$\sigma_{X_G - X_f}$	$Z_{X_G - X_f}$	P-value
Mean	0.72	0.53	0.91	**-0.38*** **	0.0192	-47.79	0.0013
S^2	5.5046	0.046374	0.003679				
S^2/n	0.0269	0.0003	0.000069				

Note: S^2 = variance of farm-specific technical efficiency estimates, n = sample size of farm management types and ***= significant at 0.01.
Source: Field Survey, 2011.

demonstration visits and farm management type have significant effect on inefficiency. Gender, was measured as dummy with value of 1 for males, therefore a negative and significant relationship with technical inefficiency means that male out-growers are more technically efficient than their female counterparts. Traditionally, women in the Northern region do not have control over family labour. Also, farm operations like weeding and spraying are male dominated activities. Therefore, women who have mango farms are likely to use only hired labour for which they may pay more than their male counterpart and experience delays in farm operations; because hired labour may not be readily available at times they have to perform major farm operations like weeding.

Another socio-economic variable considered in the analysis is the number of technical training sessions (demonstrations) organized by ITFC that an out-grower attended. Its result also shows a negative and significant relationship. This implies out-growers who attended more sessions are less inefficient; hence the training helps to improve upon the technical efficiency levels of the out-growers. This is consistent with Al-hassan (2012) that through extension, farmers acquire skills in inputs mobilization, inputs use and crop disease control which enables them to reduce inefficiency.

Finally, the farm management type also shows positive relationship with inefficiency estimates. Farm management type was specified as a dummy variable with a value of 1 for group farms. Therefore, group out-

Table 8. Technical Inefficiency Model.

Variables	Coefficients	Standard error
Constant	1.0	0.714
Age	-0.01	0.010
Gender	-0.59**	0.263
Household size	0.005	0.006
Education	-1.04	1.65
Experience	-0.007	0.009
Demonstrations	-0.033***	0.015
Farm Mgt Type	1.047***	0.015

Note: The model is an explicit function of $-u_i$ which was specified as part of the frontier and was therefore, stimated together with the frontier using FRONTIER 4.1 (Battese and Coelli, 1995) single step procedure). *, ** and *** represent 10, 05 and 01 significant levels respectively.
Source: Field survey data, 2011.

growers are more technically inefficient than the family out-growers. As pointed out in section 1, farm sanitation and crop protection are poor on group farms because group members are not committed to carrying out farm operations as family out-growers do. Higher incidence of failure to weed, pest and disease infestation, bushfire destruction of plantation and farmer failure to attend farm management training sessions, as revealed by focus group discussions, are some of the reasons why group out-growers exhibit higher farm-specific technical inefficiency than their family counterparts.

CONCLUSIONS AND RECOMMENDATIONS

The results of the study show that sampled out-growers produce below frontier output, hence they are technically inefficient. Family out-growers are, however, more technically efficient than group out-growers. Mean technical efficiency difference of 38%, significant at 1% exists between the two farm management types. This is because women who are facing cultural setbacks in farm ownership and management are among the groups. Other factors include members of group out-growers fail to attend training demonstrations and many of the groups are too large for leaders to effectively manage them.

Therefore, the study concludes that family farm management is better than group farm management in terms of technical efficiency which is a necessary condition for economic efficiency; hence recommendations are tilted towards improving technical efficiency.

First, the few women among the group out-growers have been found to exhibit lower efficiency than their male counterparts and therefore, an affirmative action in the form of special training is needed to help them overcome the socio-cultural setbacks that prevent them from effectively managing their farms. Secondly, demonstrations on farm operations that are organized periodically by ITFC have significant positive effect on technical efficiency of out-growers and should be organized more frequently, especially for group out-growers.

Thirdly, scheme management needs to make conscious efforts to break up large groups into sub-groups with membership not exceeding five, having well-structured leadership to improve loyalty and commitment to farm management operations. In addition, out-growers, especially the families need to weed their farms more frequently. With improved farm sanitation, pest infestation and its associated need to spray are reduced, thus optimizing the investment they make in organic pesticide. Alternatively, farmers will also have to establish a trusty relationship with pesticide suppliers so that they can negotiate for lower prices in the long-run.

Finally, if the corporate objectives of ITFC are to be realized, the project's strategic plan should consider shifting support to establishment of more family managed farms, rather than groups.

REFERENCE

Aditya Sachdeva (2008). The Right Decision Every Time, Lotus Press, New Delhi, pp. 38-39.

Aigner DJ, Knot LCA, Schmidt P (1977) "Formulation and Estimation of Stochastic Frontier Production Function Models."*J. Econometrics* 6(1): 2–37.

Al-hassan Seidu (2012). “Technical Efficiency in Smallholder Paddy Farms in Ghana: an Analysis Based on Different Farming Systems and Gender”. J. Econ. Sustainable Dev. 3(5): 91-98.

Amos, TT (2007). An Analysis of Productivity and Technical Efficiency of Smallholder Cocoa Farmers in Nigeria Journal of Social Science 15, 2: 127-133.

Ariyarathna Jayamaha, Joseph M Mula (2011). “Productivity and Efficiency Measurement Techniques: Identifying the Efficacy of Techniques for Financial Institutions in Developing Countries” J. Emerg. Trends in Econ. Manag. Sci. (JETEMS) 2(5): 454-460.

Bravo-Ureta, Boris E, Laszlo Rieger (1991). “Dairy Farm Efficiency Measurement Using Stochastic Frontiers and Neoclassical Duality.”*Ame. J. Agric. Econs.* 73(2): 421–28.

Bravo-Ureta, Pinheiro (1997). “Technical, Economic and Allocative Efficiency in Peasant Farming: Evidence from the Dominican Republic”*The Developing Economies* 35(1): 48-67.

Coelli TJ (1995). “Recent Developments in Frontier Modeling and Efficiency Measurement”, *Australian J. Agric. Econs.* 39(3): 219-245.

Coelli TJ, Rao DSP, O'Donnell CJ, Battese GE (2005). An Introduction to Efficiency and Productivity Analysis, 2ed Springer: 41-61.

Farrell, Michael J (1957). “The Measurement of Production Efficiency.”*J.Royal Statistics Soc.*, Series A, 3:253–290.

HanKH (1991). “A productivity measurement of activities at the micro level”

Hashem N. Mahdi M, Mohammad M (2010). “Efficiency Measurement of Enterprises Using the Financial Variables of Performance Assessment and Data Envelopment Analysis” *Appl. Mathematical Sci.,* 4(37): 1843 – 1854.

Heyne Paul (2008). “Efficiency”. *The concise Encyclopedia of Economics* : 1157-1166.

Ittner CD, Larckner DF (1998). Innovations in Performance Measurement: Trends and Research Implications. *J. Manag. Acct. Res.* (10): 205-238.

Karagiannis Giannis, Vangelis Tzouvelekas (2009) “Measuring Technical Efficiency in the Stochastic Varying Coefficient Frontier Model”, *Agricultural Economics (40):389–396.*

Livio C, Massimo G (2002). “The Efficiency Measurement of Factories via Data Envelop Analysis” *Systems Analysis Modeling Simulation* 42(10): 1521-1536.

Manag. Acct. Res., 2(4): 249-261.

Meeusen Wim, Julien van den Broeck (1977). “Efficiency Estimation from Cobb-Douglas Production Function with Composed Error”. *Int. Econ. Rev.* 18(2): 435–444.

Ministry of Food and Agriculture (2007). Food and Agricultural Sector Development Policy II (FASDEP), *Government of Ghana Policy Document, pp. 24-29.*

Muhammed-Lawal A (2007). “Efficiency of Sweet Orange Production among Small Scale Farmers in Osun State”, *Afr. J. Gen. Agric.* 3(2): 127-132.

Office of the Auditor General of Canada (2007). “Understanding Efficiency”, *Auditing of efficiency*. http://www.oag-bvg.gc.ca, 07/11/2011.

Sartorius Kurt, Kirsten J (2004) “The Cost Efficiency of Small Farm Inclusion in Agribusiness Supply Chains” *South Afri. J. Acc. Res.* 18(1): 87-113.

United Nations Development Program (2007). “Case Study of Integrated Tamale Fruit Company: Organic Mangoes Improving Livelihoods for the Poor”, Bulletin-*Growing Inclusive Markets.* www.growinginclusivemarkets.org 28/09/2010.

USAID (2009), “Ghana Assessing Economic Benefits: The Case of Banana, Mango, and Rice” *USAID-Ghana Moongate Associates, portfolio Economics series (1): 24-31*. http://www.moongateassociates.com/Portfolio.html 26/03/2014.