Technical Efficiency of Cocoa Production through Contract Farming: Empirical Evidence from Kilombero and Kyela Districts

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Abstract- This study centred on assessing the effect of key determinants of technical efficiency in cocoa production through contract farming drawing experience of Kilombero and Kyela districts. Primary data were collected using structured questionnaires. Probability sampling design was used to obtain respondents from smallholder farmers. Whereby cross-sectional data were collected using structured questionnaire from the sample size of 271 respondents in Kyela and Kilombero Districts. The stochastic production frontier function was estimated by using maximum likelihood estimation (MLE), data was analysed by using NLOGIT software version 5. Overall results show that 41 percent (n=111) of smallholder farmers had a mean technical efficiency below 50 percent and thus are considered to be technically inefficient while 59 percent (n=160) of them were technically efficient by more than 50 percent. These smallholder farmers were technically efficient in terms of number of hours spent in farms, labour training, experience, distance and size of labourer. Moreover, results show that smallholder farmers agreed that being in contract had increased access of training (89.3% (n=242)), credits (80.8% (n=219)), production quantity (73.1% (n=198)), production acreage (71.7% (n=194)), timely purchase (92.9% (n=252)) and timely payment (95.2% (n=258)). Whereas, the results show that 67.47% (n=183) of respondents said, contract farming had no impact on timely inputs and 74.9% (n=203) of respondent disagreed that contract farming helped to introduce new technology. Thus, the study concluded that there is great possibility for technical efficiency to increase agricultural productivity in contract farming.

Index Terms- Contract Farming, Technical Efficiency, Smallholders

I. Background Information

Tanzania is endowed with high potential base for agriculture development, yet it is among the poorest in developing countries (one of the last 20 in the rank) (United Nation Development Programme (UNDP), 2004). Agriculture (including crop production, livestock and natural resources) is one of the leading sectors of the economy. Apart from providing food, it remains to be the country's main source of income for the rural population, which forms 80 percent of the total population and employs 70 percent of the active labour forces (Ministry of Agriculture and Food Supply (MAFS), 2005). The agricultural sector in Tanzania is facing a lot of problems like low price, low incentives, low output, unreliable market lack of skills in crop husbandry, low chemical fertilizers, delay payments violated by crop buyers (Ministry of Agriculture, Food and Cooperative (MAFC), 2006). Because of those problems stakeholders and non-government organization started to make arrangement with smallholder farmers through contract farming in order to provide services in production and marketing of the products. Contract farming refers to contractual arrangements between farmers and other firms, whether oral or written, in which non-transferable contracts specify one or more conditions of marketing and production (Glover and Kusterer, 1990).

Literatures suggests that, through contract farming smallholder farmers get various assistances such as introduction of higher-value seeds, information, technology, reduction of production risk for farmers, monitoring and labour incentives, timely inputs and production markets, credit and financial intermediation, reduction in the risk of price fluctuations, increased incomes and market access (Eaton and Shepherd, 2001; Glover and Kusterer, 1990; Key and Runsten, 1999; Holloway et al. 2000; Warning and Key, 2002; Patrick 2004; Birthal et al. 2005a; and Ramaswami et al. 2006). In Tanzania, cocoa is among the crop which is produced under contract farming. Other crops which are under contract farming include sugar cane, tobacco, tea, pyrethrum, cotton, cashew nut, coffee, citrus fruits, and sisal (MAFC, 2006). The study aimed at assessing the effect of key determinants of technical efficiency (i.e., accessibility of new technology, timely purchase, timely inputs, timely payment, better price, access to credit and labour training) within contract farming in Cocoa production.

II. Theoretical Framework

Different forms of functions can be used to estimate the general production function, among them, most commonly used are the Cobb-Douglas and the translog production functions. The Cobb-Douglas production function has been widely used in agricultural studies because of its simplicity and ease of estimation from agricultural data (Derbetin, 1992). The Cobb-Douglas production function, in its stochastic form, was presented in equation 1.

$$y_i = \beta_0 \prod x_{ij}^{\beta_j} . e_i^{\varepsilon_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . Equation\ (1)$$

Where; $y_i =$ Output for i=1, 2, 3…….,n; β_0 = Constant; $\Pi =$ A steady multiplicative symbol; $x_{ij} =$ i^{th} input, for the j^{th} respondent for i=1,2,3,.....,n and j=1,2,3...…..,n, $e =$ Natural logarithm; $\beta_i =$ A vector of parameter; for i = 0, 1, 2,3, … N; and $\varepsilon_i =$ The error term

The loglinear transformation of equation 1 expression gives equation 2 which can be used for parameter estimation using regression analysis (Kumbhakar et al.1991).

$$\ln Y_i = \ln \beta_0 + \sum_{j=1}^{k} \ln \beta_i \ln X_{ij} + \varepsilon_i$$ ....
..........................Equation (2)

The error term (ε_i) has two components u_i and v_i which form equation 3

$$\varepsilon_i = v_i - u_i$$ ....
..................................Equation (3)

Where; $v_i =$ is a random error associated with random factors which are out of the control of the producers (Aigner et al. 1977; and Meeusen and Broeck, 1977) such as bad weather (drought, flood, volcanoes), diseases, wild animals, which can lead to the production below the frontier.

It has a zero mean and variance equal to δ_v^2 such that its distribution is given as $N\left(0,\ \delta_v^2\right)$.

$u_i =$ is a non-negative truncated half normal random variable (at zero) with a distribution given as , $N\left(0,\ \delta_u^2\right)$. However, u_i can also have other distributions such as gamma and exponential. It is associated with farm-specific factors. The mean values of u_i are determined by equation 4.

$$u_i = \omega_i \pi_i$$ ....
.............Equation (4)

Where; $\pi_i =$ Represents inefficiency variable for; i=1,2,3 …,n; $\omega_i =$ Parameter estimates; for i=1,2,3…,n; δ_v^2 and δ_u^2 are the variances of v_i and u_i respectively. The inefficiency variable is represented by farm characteristics such as age of smallholder farmers, level of education of smallholder farmers, family labour, hired labour, training, distances, access to credit, time (man day hours) and experience in cocoa production.

The maximum likelihood estimation of equation 2 yields parameter estimates; β_i and λ. Given the production frontier and inefficiency effect models represented in equation 5, technical efficiency can be obtained from the conditional expectation of u_i given ε_i as shown in equation 5 (Zaibet and Dharmapala, 1999).

$$E[-u_i|\varepsilon_i] = \frac{\delta_u \delta_v}{\delta}\left[\frac{f^*(\lambda \varepsilon_i/\delta)}{1-F^*(\lambda\,\varepsilon_i/\delta)} - \frac{\varepsilon_i \lambda}{\delta}\right]$$
....Equation (5)

Where; $E[-u_i|\varepsilon_i] =$ A conditional mean of u_i given ε_i; $\delta_v^2 =$ is the variance of v_i ; $\delta_u^2 =$ Is the variance of u_i; $\delta^2 = \delta_u^2 + \delta_v^2$ sample variance; $\lambda = \delta_u/\delta_v$ ratio of variance; $f^* =$ value of a standard normal distribution function; and $F^* =$ value of distribution function. Both functions are being evaluated at $\frac{\lambda \varepsilon_i}{\delta}$. Since technical efficiency of a production can be estimated under conditional expectation of u_i given ε_i.

The individual farmer's level of technical inefficiency was calculated from the expected value of equation 4 as re-written in equation 5 and later TE was compared with the return of cocoa output per kilograms per acre per year per household as showed in equation 6.

$$TE_i = \exp\left(E\left[-u_i\ \ |\varepsilon_i\right]\right)$$ ....
..................Equation (6)

Such that $0 \le TE \le 1$. Otherwise $TE_i < 1$ provides a measure of short fall of observed output from maximum feasible output that characterized by a stochastic elements that varies across producers (Kumbhakar and Lovell, 2000).

2.2 Empirical Model

The model in equation 7 representing stochastic frontier was estimated in two step process. First step; cocoa production through contract farming over one year output (Y) was regressed against the independent variables, including area under production (acres/land), labour (family labour plus hired labour), cocoa plants per acre and cost of technology used in production. The log linear production function is represented by equation 7.

$$LnY = \ln \beta_o + \beta_1 \ln X_{1ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + v_{ij} - u_{ji} \text{.................}Equation.(7)$$

Where; LnY = Output of cocoa products per kgs/acre/years/household; X_1 = Area under cocoa production (land); X_2 = number of cocoa plants per acre; X_3= Labour (man day/acre including family labour plus hired labour); X_4= Cost of technology used in production; v_i = Random errors; u_i = Technical inefficiency effects; and ln= natural logarithms.
Then in the second step; the error term (u_i) was regressed against selected socio-economic characteristics of the farm as shown in equation 8.

$$u_i = \omega_0 + \omega_1\pi_1 + \omega_2\pi_2 + \omega_3\pi_3 + \omega_4\pi_4 + \omega_5\pi_5 + \omega_6\pi_6 + \omega_7\pi_7 + \omega_8\pi_8 + \omega_9\pi_9$$
......Eqn(8)

Where; $\omega_0, \omega_1, \omega_2 \ldots\ldots \omega_9 =$ parameter estimates; $\pi_1 =$ age of smallholder farmers (years); $\pi_2 =$Level of education of smallholder farmers; $\pi_3 =$ Distance from home to the field, $\pi_4 =$Training, $\pi_5 =$Experience in cocoa production; $\pi_6 =$Credit; $\pi_7 =$Family labour, $\pi_8 =$ Hired labour; and $\pi_9 =$Time used in production (man hours per day).

III. Methodology

This study was conducted in Kilombero and Kyela Districts which are among the area producing cocoa beans in Tanzania, Kyela being the leading district in the production of cocoa beans. The primary data for this study were collected on March-April 2013. The sampling unit of the study was limited only to the areas producing cocoa, predominantly those within contract farming. In this study purposive sampling was employed to obtain wards and villages which produced cocoa beans. The sample of smallholder farmers was obtained from four wards and ten villages in both districts. Probability sampling method was employed to obtain 271 respondents from smallholder farmers producing cocoa. Cross-sectional data was collected using structured questionnaire from each district.

IV. Result and Discussion

4.2 Descriptive Statistics

Table 1 shows that majority of the male cocoa producers obtained mean output in kilogram 486.55 (55.8%) under mean acre cultivated was 1.33 (56.6%), mean of family labour used 1.99 (58.4%) and mean of hired labour used 0.86 (52.2%). The mean output of kilogram of cocoa obtained by female 385.18 (44.2%), under mean acre 1.02 (43.6%) cultivated; mean of family labour used 1.44 (41.6%); and mean of hired labour used 0.67 (47.8%). Based on the background variables data shows that males were very efficient in the production of cocoa than females; as theory suggests that males are more productive than females; the results from field support this theory because males were leading in the production of cocoa. There is a need to encourage females to participate fully in the production of cocoa.

Unmarried producers obtained the mean of cocoa output per kilogram per acre per year was 107.50 (12.3%); mean of acre cultivated was 0.29 (12.2%); the mean of family labour used was 0.43 (12.4%); and mean of hired labour used was 0.12 (8.1%). Married cocoa producers obtained the mean of cocoa output per kilogram per acre per year was 674.62 (77.4%); mean of acres cultivated was 1.84 (77.3%); the mean of family labour used was 2.72 (78.6%); and the mean of hired labour used was 1.20 (81.1%). Divorced cocoa producers obtained the mean of cocoa output per kilograms per acre per year was 89.61 (10.3%); the mean of acres cultivated 0.25 (10.5%); the family labour used 0.31 (8.9%); and the mean of hired labour used 0.16 (10.8%). Principally, married producers are more productive compared to single producers and divorced producers. The findings showed that married were leading in the production of cocoa because married producers had large labour force used in the production.

The mean output of cocoa in kilograms per acre/year produced by young groups aged below 40 years was 238.94 (27.4%); mean of acre cultivated was 0.70 (30.3%); mean of family labour used was 0.97 (28.4%); and the mean of hired labour used was 0.57 (37.3%). The mean output of cocoa in kilogram per acre/year obtained by old producer aged 40 years and above was 632.78 (72.6%); the mean of acre cultivated was 1.61 (69.7%); the mean of family labour used was 2.44 (71.6%); and mean of hired labour used was 0.96 (62.7%). In principle young producers are more efficiency than old producers in agricultural sector. In the study area the results are inversely to this notion and show that aged farmers obtained more kilograms of cocoa output compared to the young farmers who are strong in the production. This caused by the nature of the cocoa crop itself which discouraged the youth to engage in its production. The cocoa plant takes 3 to 4 years from planting to harvesting hence the young people may not be tolerant to invest in production and wait for 4 years in anticipation of harvesting as the findings this study indicated.

The mean of cocoa output per kilograms/acre/year obtained by smallholder farmers having primary level of education was 362.59 (41.6%); mean acre cultivated was 0.98 (40.3%); the mean of family labour used was 1.44 (47.8%); and mean of hired labour used was 0.64 (41.0%). The mean of cocoa output per kilograms obtained by smallholder farmers having secondary level of education was 297.74 (34.1%); the mean of acres cultivated was 0.78 (32.1%); the mean of family labour used was 0.76 (25.2%); and the mean of hired labour used was 0.51 (32.7%). The mean of cocoa output in kilograms per year produced by farmers having university level was 211.73 (24.3%); the mean acres cultivated were 0.67 (27.6%); the mean of family labour was 0.81 (26.9%); and the mean of hired labour used was 0.41 (26.3%). Logically, educated producers are the ones who can produce more compared to uneducated producers. Contrary to this notion, this study showed that smallholder farmers with lower level of education produced more efficient compared to those with higher levels of education. Thus, there is a need to encourage educated farmers to participate fully in production because educated people can easily adapt to the change of technology.

Table 1 Background Variables and Mean of (Kilograms, Acres, f/Labour, and h/Labour)

Variables	Freq	%	Mean of Kgs	Mean of acre	Mean of family labour	Mean of hired labour
Sex						
Male	155	57.2	486.55	1.33	1.99	0.86
Females	116	42.8	385.18	1.02	1.42	0.67
Marital status						
Not married	33	12.2	107.50	0.29	0.43	0.12
Married	212	78.2	674.62	1.84	2.72	1.20
Divorced	26	9.6	89.61	0.25	0.31	0.16
Age						
Young <40yrs	71	26.8	238.94	0.70	0.97	0.57
Old ≥ 40	200	73.2	632.78	1.61	2.44	0.96

Level of education						
Primary level	117	43.9	362.59	0.98	1.44	0.64
Secondary level	94	34.7	297.74	0.78	0.76	0.51
University level	59	21.8	211.73	0.67	0.81	0.41

Source: Field Data Survey, 2013.

4.3 Contribution of contract farming on cocoa production

Table 2 below indicates contribution of contract farming on cocoa production. The investigation of production quantity among the smallholder farmers within contract farming shows that 73.1% (n=198) of respondents agreed that contract farming led to increased productivity and others denied. Also result shows that 95.2% (n=258) of smallholder producers on contract farming said that contract helped them to sell their products on time while others disagreed. Findings showed that 92.9% (n=252) of smallholder farmers agreed that contract farming enabled timely purchase of their produces. Furthermore, result shows that majority (89.3% (n=242)) of respondents agreed that contract farming provides access of training to smallholder farmers. Moreover, result of production acreage shows that more than two third (71.7% (n=194)) of smallholder farmers increased the area of production being in contract farming and others disagreed. Eighty one percent (80.8% (n=219)) of respondents agreed that contract farming had made them access of obtaining credits. Whereas result indicates that majority of respondents 67.47% (n=183) disagreed that contract farming helped to obtaining input on time and 74.9% (n=203) of respondents disagreed that contract farming increased access of using new technology.

These results show that contract farming on cocoa production contributed a lot to smallholder farmers in terms of access of training, credits, increased production quantity, increased production acreage, timely purchase, and timely payment as Table 2 indicates.

Table 2 Opportunities within Contract Farming

Variable	% of Agree	% of Disagree
Production quantity	73.1 (n=198)	26.9% (n=73)
Timely purchase	95.2% (n=258	4.8% (n=13)
Timely payment	92.9 (n=252)	7.1% (N=19)
Timely inputs	32.53% (n=88)	67.47% (n=183)
Access of training	89.3% (n=242)	10.7% (n=29)
Production acreage	71.7% (n=194)	28.3% (n=77)
Availability of technology	25.1% (n=68)	74.9% (n=203)
Access of credit	80.8% (n=219)	19.2% (n=52)

Source: Field Data Survey, 2013

4.4 Trend of Price of Cocoa

Contract farming has constructive elements towards smallholder farmers; price stability is among the element within contractual arrangement. It is asserted that the situation is inversely proportional to the expectation of smallholder farmers of cocoa production. Table 3 shows the trend of price of cocoa products being fluctuating from 2010 to 2013, the mean price of cocoa in kilogram from 2010/2011, 2011/2012 and 2012/2013 was 2425.09, 2463.84 and 2024.72 respectively. The result shows the mean price of cocoa in 2010/2011 was low, in 2011/2012 increased and 2012/2013 the mean price decreased compared to the previous years. The price of cocoa has been fluctuating yearly thus discouraging the smallholder farmers to engage in production of cocoa. In turn, some of the farmers in Mbingu ward started to withdraw in cocoa production and burnt their cocoa farms.

Table 3 Trend of Price of Cocoa

	N	Min	Max	Mean	Std. Error	Std. De
Price 2010/11	271	1500	4000	2425.09	35.058	577.124
Price 2011/12	271	1500	3000	2463.84	16.235	267.261
Price 2012/13	271	1400	3000	2024.72	11.081	182.415

Source: Field Data Survey, 2013

4.5 Estimation Model

Table 4 presents results of the stochastic frontier production function; results estimated using maximum-likelihood method. As it can be seen from the table 4, the coefficient of amount of cocoa plants per acre was positive but not statistically significant. The expected signs for variables such as cost of technology used in production and labour were negatives while the coefficients of land were positive and statistically significant.

The coefficient of land 0.07376 (p-value 0.0577) under cocoa production was statistically significant at 10% level. This indicates when smallholder farmers increase area of production the output increases by 7% after three to four years. Labour (family labour plus hired labour) is a parameter used in production of cocoa its coefficient 0.04831 (p-value 0.0862) implies that a unit increases in labour could lead to an output rise by 4% statistically significant at 10% level. This result fall in line with findings of Kebede (2001) who suggested that hand hoes (technology used) were inputs in the production. Technology used in production was tested to find their effect in the cocoa production. The result showed that the coefficient of technology used was 0.01804 (p-value 0.0000), the variable being positive and statistically significant at 1% level. Smallholder farmers who applied new technology in their production increased their output by 1% in the next season ceteris paribus.

Table 4 Maximum-likelihood Estimates for Parameters of the Stochastic Frontier Production

Parameter	Proxy variable	Coefficient	Std.Error	p-Value
Stochastic Frontier				
Constant	β_o	11.5779***	.77339	0.0000
lnLand	β_1	0.07376*	.03886	0.0577
lnLabour	β_2	-0.04831*	.02816	0.0862
LnPlants	β_3	0 .02310	.02732	0.3977
lnTools (hand hoe)	β_4	-0.01804***	.00147	0.0000

Source: Field Data Survey, 2013 **Note:** ***,**,* ==>Significance at 1%,5%,10% level

4.5 Input Elasticity from Model Estimation

The elasticity's of output for land, labour, and technology used in production are return to scale of the Cobb-Douglas stochastic frontier model as shown on Table 5. Determination of elasticity's is necessary for the estimation of responsiveness of output to factor inputs of production. Most of the inputs on the stochastic frontier were statistically significant at different levels. Summation of all the partial elasticity of production with respect to every input was 0.14. For Cobb-Douglas model this figure represents the returns-to-scale coefficient, also called the function coefficient or total output elasticity. When all factors were varied by the same proportion, the function coefficient indicated the percentage by which output increased. In this case, it means if all of the variables were to be increased by 1%, output would increase by 14% representing increasing return to scale.

Table 5 Input Elasticity

Variable inputs	Elasticity
Labour	0.05
Land	0.07
Technology used (Hand hoes)	0.02

Source: Field Data Survey, 2013

Table 5 shows that land and labour had high responsiveness in the production of cocoa, followed by technology used in production such as hand hoes. This implies that hand hoes had little response in the production of cocoa.

4.6 Marginal Value Product and Factor Inputs

In order to assess the condition of a producer's profit level a number of variable such as marginal physical product (MPP)[1], marginal value product (MVP)[2] and input prices were also estimated.

[1] MPP= APP*input elasticity

[2] MVP=MPP*output price

Table 6 Marginal Value Product and Factor Inputs

Variable	APP kgs per Acre	Elasticity	MPP kgs per Acre	MVP Tshs	Average Unit Price Tshs
Land	370.95	0.07	25.97	2,337,300	90,000
Labour	157.35	0.05	7.87	314,800	40,000
Technology used	0.12	0.02	0.0024	16.8	7,000

Source: Field Data Survey, 2013

Table 6 shows the condition requirement for profit maximization is that the Marginal Variable Product (MVP) must be equal to the average unit price of inputs. When the unit use of labour and land in production per acre is greater than the average unit of price this implies that the unit increase in the variables cocoa farm will lead to negative return in production. Therefore, the marginal value product of tools of production (technology used/ hand hoes) was lower than the average unit price. From this result the smallholder farmers would benefit by increasing the tools of production especially hand hoes in the production of cocoa rather than increasing labour and land.

4.7 Range of Frequency Distribution of Technical Efficiency

Table 7 shows the range of technical efficiency. About 41% of smallholder farmers had a mean below 50%, this represent the total number (n=111) smallholder farmers who were technically inefficiency in the production of cocoa. Furthermore, 59% (n=160) of smallholder farmers within contract farming were technically efficient in the production of cocoa had a mean Technical Efficiency above 50%.

Table 7 Percentage Technical Efficiency

Efficiency scores	Sample (N)	%
<40	1	0.4%
40-49	110	40.6%
50-59	94	34.7%
60-69	45	16.6%
≥70	21	7.7%
Total	271	100%

Source: Field Data Survey, 2013

Table 8 shows the results of socio-economic factors that influenced technical efficiency or inefficiency. A negative sign on a parameter efficiency means that the variable increases technical efficiency, while a positive sign reduces technical efficiency. It is important to note that these coefficients should not be directly interpreted (Battese and Coelli, 1993). Table 8 shows that age, education level, hired labour and credits were statistically insignificant. This indicates that they cannot explain any anything in the production of cocoa. Although prior, it was expected that availability of credit and hired labour in the production could increase output per kilograms per acre per household.

Training is a parameter which was used to capture the effect of training on technical efficiency of production of cocoa. The smallholder farmers who attained training in the production of cocoa had access to produce at high efficiency than non-trained farmers. The expectation was that smallholder farmers within contract farming had access to get training which enabled them to produce many products at high quality and increase their technical efficiency. The coefficient obtained was 0.12518 and p-value 0.0000 was statistically significant at 1% level. This indicates that the smallholder farmers who underwent training increased their products of cocoa beans. The results agree with Kibirige's (2008) who found that farmers who received training increased their maize productivity. Similarly, Sentumbwe (2007) found that farmers who got training in better agronomic practices were technically more efficient than farmers who lacked such training. Likewise Galawat and Yabe (2011) found that farmers who attended training were profit efficient, while farmers who did not have any training were inefficient and had low profit efficiency. Equally, Nikaido (2004) found that the participation of the small scale producers in trainings increased efficiency for small scale industry. This explains that smallholder farmers who undergo training become technically efficient in the production of cocoa. Inefficient farmers can be in technical efficiency if and only if they undergo training frequently in the production of cocoa.

Distance is a variable that is aimed to measure the effect of distance on technical efficiency. It was expected that smallholder farmers who were close to the farm increase technical efficiency compared to smallholder farmers who are far away from the field. The coefficient of distance was negative -0.01379 with the p-value 0.0658 as shown in Table 8. In accordance with this expectation the coefficient is negative and statistically significant at 5% level. The smallholder farmers who stayed far away from the field their output will decrease while those close to their farms increased their outputs. This suggests that the smallholder farmers who were close to their plot had access to increased production of cocoa within contract because of using less kilometre/metre in field. This finding is related with the findings of Kebede (2001) who found that the closer the farm the less the distance used and the greater the rice production technical efficiency.

Time is input which measured in man hours working in the cocoa farm. The standard hour for man days is six hours per day. The coefficient of man hours per day is -0.01379 and p-value 0.0128 which is statistically significant at 5% level. This indicates that smallholder farmers who used standard hours in the cocoa production their output are expected to increase while those who use less hour per day their output will decrease.

Family size is a variable which was measured to capture the effect of family labour on technical efficiency of smallholder farmers. Prior expectation was that family with large number of workers in production of cocoa is expected to be technically efficiency compared to smallholder farmers' with few members. The coefficient found was 0.10818 and p-value 0.0193 was statistically significant at 5% level. This indicates that family which had many labourers in the production of cocoa per day per acre were technically efficient. This result is similar to findings of Kibirige (2008) who reported that increasing number of labour in maize made farmers become technically efficient. Moreover, Kebede (2001) found that the increase of labour in production the output of rice was increased too. Also findings of Kibaara (2005) suggested that the increase of labour probably led to increase of maize yield.

The coefficient of experience of smallholder farmers in cocoa growing was negative 0.08899 with the p-value 0.0001 which was significant at 1% level, indicating that more experienced farmers tended to be more efficient in cocoa production. The experienced farmers were expected to be positively correlated for adoption of new technology and techniques of production. Smallholder farmers who had experience in production of cocoa their output per acre per year increase. The result was consistent with the findings of Oleke (2008) who found that experienced egg producers were the one who were technically efficient. Furthermore, Sesabo (2007) showed that fishermen who had many years of experience in fishing increased their productivity. Also, Kebede (2001) found that farming experience and education were both significant for improving technical efficiency. As well, Kibirige (2008) found that the maize producers who had many years in production increased their output. This suggests that the farmers who had experience in production of cocoa had technical efficiency because it enabled them to adopt new technology in production. New producers can be technically inefficient in a short run and technically efficient in the long run of production of cocoa.

Table 8 Determinants of Technical Inefficiency

Parameter	Proxy variable	Coefficient	Std.Error	p-Value
Inefficiency Model				
Constant	ω_0	6.80692***	0.35352	0.0000
Age of farmers (years)	π_1	0.01495	0.08556	0.8613
Level of education	π_2	0.02230	0.03875	0.5651
Training	π_3	0.12518***	0.02783	0.0000
Distance (home to field)	π_4	-0.01379*	0.00750	0.0658
Time (hour per day)	π_5	-0.01379**	0.05129	0.0128
Family labour (man days)	π_6	0.10818**	0.04623	0.0193
Hired labour (man days)	π_7	-0.00281	0.04076	0.9450
Experience (in cocoa prod)	π_8	-0.08899***	0.02308	0.0001
Credit	π_9	-0.02734	0.06353	0.6670
Variance Parameters for Compound Error				
Lambda $(\sigma u/\sigma v)$	λ	2.97549***	0.44977	0.0000
Sigma	σ	0 .67748***	0.00197	0. 0000
Sigma-squared (u)	$\sigma_u 2$	0.41240		
Sigma-squared (v)	$\sigma_v 2$	0.04658		
Gamma $\delta_u^2/(\delta_u^2+\delta_v^2)$	γ	0.89851		
Log likelihood function		-152.57567		
Mean technical efficiency		59%		

Source: Field data, 2013. **Note*****,**,* ==>Significance at 1%,5%,10% levels

V. Conclusion

Basing on the findings, it can be concluded that contract farming contributes much to smallholder farmers especially in terms of timely purchase of their products, timely payment, increased productivity, labour training and access to credit. On the other hand timely input and new technology are areas which contract farming seems to have no impact as the findings indicated in descriptive statistics. In the estimation models smallholder farmers within contract farming are technically efficient in the production of cocoa beans, although there are few smallholder farmers who are technically inefficient. Positive outcome obtained by smallholder farmers being in contract farming indicate that contract farming is good for supporting the smallholder farmers in the agricultural production. This calls for the government of Tanzania and NGOs to encourage contract farming in different crops in agriculture sector. The incentives available within contract farming enable smallholder farmers to increase production.

5.1 Policy Implication

The potential policy implication is transparency within contract, the institution making contract farming should be clear in case of crop fails and what happens if the contractors do not provide input on time. The contract is said to be silent in case of years when smallholder farmers failed to harvest crops. Also measures to be taken when the contractors do provide inputs timely to smallholder farmers should be stated. The contract must be transparent and both sides must agree on it.

Government intervention; The government must be involved in contract farming in order for the two parties to be efficient. The government institution must be involved when two parties sign the contract. The involvement of the government on contract farming will help to arrange price floor and legal enforcement on contract farming.

At the moment, smallholder farmers are faced with price instability of cocoa beans. This calls for international investors to come and build manufacturing industry in order to produce the final products of cocoa beans here in Tanzania, because the market of final products of cocoa beans is large rather than exporting raw products to the World market.

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References

[1] Aigner, D., C. A. K. Lovell, and P. Schmidt. (1977). Formulation and Estimation of stochasti Frontier Production Function Models. Journal of Econometrics 6: 21–37.

[2] Battese, G. E. and Coelli, T. J. (1993). A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. Empirical Economics 20, 325-332.

[3] Birthal, P.S., P.K. Joshi, and A. Gulati. (2005a). Vertical Coordination in High-Value Food Commodities: Implications for Smallholders. Markets, Trade, and Institutions Division Discussion Paper No. 85. Washington, D.C. International Food Policy Research Institute.

[4] Derbetin, L. D. 1989. Agricultural Production Economics. New York: Macmillan Publishing Company.

[5] Eaton, C. S., and Andrew W. Shepherd (2001). Contract Farming - Partnerships for Growth.AGS Bulletin No. 145. Rome: Food and Agriculture Organization (FAO).

[6] Galawat, F and Yabe, M (2011). Profit Efficiency in Rice Production in Brunei Darussalam, Department of Agriculture and Resource Economics, Faculty of Agriculture Kyushu University, 6-10-1, Hakozaki, Higashi-Ku, Fukuoka City, Japan

[7] Glover, D. and Kusterer, K. (1990) Small Farmers, Big Business: Contract Farming and Rural Development, London: Macmillan.

[8] Holloway, G., C. Nicholson, C. Delgado, S. Staal, and S. Ehui (2000). Agro industrialization through institutional innovations: Transaction Costs, Cooperatives and Milk Market development in the East African highlands. Agricultural Economics 23: 279-288.

[9] Ian Patrick report, (2004). Contract Farming in Indonesia: Smallholders and Agribusiness University of New England (UNE). in Pakistani Agriculture"America Journal of Agricultural Economics 77:657-685.

[10] Kebede T.A (2001). Farm Household Technical Efficiency: A Stochastic Frontier Analysis, a Study of Rice Producers in Mardi Watershed in Western Development Region of Nepal. Thesis/ dissertation, The University of Bergen.

[11] Key, N., and D. Runsten. (1999). Contract Farming, Smallholders and Rural Development in Latin America: The Organization of Agro-Processing Firms and Scale of Out-grower production. World Development 27: 381-401.

[12] Kibaara, B. W (2005). Technical Efficiency in Kenyan's Maize Production: An Application of the Stochastic Frontier Approach, Thesis submitted Department of Agricultural and Resource Economics in partial Fulfilment of the Requirements for the Degree of Master of Science Colorado State University Fort Collins, Colorado

[13] Kibirige, D. (2008). The Impact of the Agricultural Productivity Enhancement Program on the Technical Efficiency of Maize Farmers in Masindi District; A Thesis Submitted for to the School of Graduates in Partial Fulfilment of the Requirement for Award of A Master of science in Agricultural and Applied Economics of Makerere University Kampala.

[14] Kumbhakar SC, Ghosh S, Guckin M (1991). A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in US. Dairy Farms. J. Bus. Econ. Stat., 9: 279- 286.

[15] Kumbhakar, S. C., and C. A. K. Lovell. (2000). Stochastic Frontier Analysis. Cambridge: Cambridge University Press.

[16] MAFS, (2005). Budget Speech for the year 2005/2006 Presented at the National Assembly by the Minister for Agriculture and Food Security. July 2005, Dodoma –Tanzania.

[17] Meeusen, W., and J. van den Broeck. 1977. Efficiency Estimation from Cobb–Douglas Production Functions with Composed Error. International Economic Review 18:435–444.

[18] Mekong Private Sector Development Facility (MPDF). 2004. Lao PDR SME Agribusiness

[19] Ministry of Agriculture and Food Security in Tanzania (2006), Report on Contract Farming Status and Prospects for Tanzania.

[20] Ministry of Agriculture, Food and Cooperation (MAFC) report, (2006), Participatory Agricultural Development and Empowerment Project (PADEP), Conducted by Match Maker Associates Limited (MMA)

[21] Nikaido, Y (2004). Technical Efficiency of Small-scale Industry in India, Application of Stochastic Production Frontier Model. Research Project: Institutions, Networks, and Force of Changes in Contemporary South Asia, Under Japanese Ministry of Education, Science, Sports and Culture Grant-in-Aid for Scientific Research on Priority Areas Programme.

[22] Oleke, J.M (2008), Poultry Egg Production Technical Efficiency in Ilala and Kibaha District; A Dissertation Submitted in Partial Fulfilment of Requirements of Masters of science in Agricultural Economics at Sokoine university of Agriculture (SUA), Morogoro Tanzania.

[23] Patrick, I. (2004), Contract farming in Indonesia: Smallholders and Agribusiness Working

[24] Together. ACIAR Technical Report No. 54. Canberra: Australian Centre for International Agricultural Research.

[25] Ramaswami, B., P.S. Birthal, and P.K. Joshi. (2006). Efficiency and Distribution in Contract Farming: The Case of Indian Poultry Growers. MTID Discussion Paper 91. Washington, D.C.: International Food Policy Research Institute. In Poverty Reduction Strategies: the Case of Organic Rice Contract Farming in Thailand.

[26] Sentumbwe. S. (2007). Intra-House Labour Allocation and Technical Efficiency Among Groundnuts Producers in Eastern Uganda. MSc. Thesis, Makerere University Kampala Uganda.

[27] Sesabo J.K (2007). Marine Resources Conservation and Poverty Reduction Strategies in Tanzania; International Max Planck Research School for Mantime Affairs at the University of Hamburg Springer Berlin Heidelberg New York

[28] UNDP (2004). Human Development Report United Nation Development Report Programme, the case of Tanzania: Pathways to Human Development. Macmillan, New York.

[29] United Republic of Tanzania (URT) (2009). Progress in Millennium Development Goals: Mid Way Assessment, December. Dar es Salaam, Tanzania, p. 121.

[30] Warning, M. and N. Key (2002). "The Social Performance and Distributional Consequences of Contract Farming: An Equilibrium Analysis of the Arachide de Bouche Program in Senegal." World Development 30(2):255-263.

[31] Zaibet, L. and P.S. Dharmapala (1999). Efficiency of Government Supported horticulture: The Case of Oman, Agricultural Systems. 62: 159-168.

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