Factors Influencing Technical Efficiency in Cashew Nut Production in Kilifi County, Kenya.

Koech R.K[1*], Nyangweso P.M[2] and Mwakubo S.M[3]

[1]Department of Business Management and Economics, Pwani University
P.O Box 195-80108, Kilifi , Kenya

[2]Department of Agricultural Economics and Resource Management, Moi University

P.O Box 3900, Eldoret, Kenya. Email: philoe2000@gmail.com

[3]Department of Crops Science, Pwani University

P.O Box 195-80108, Kilifi , Kenya. Email: samuelmwakubo@yahoo.com

[*]Corresponding Author.
Email: olchungenkoech@yahoo.com. Cell +254772633101

Abstract

The agricultural sector is an important pillar of the coastal economy. Cashew nuts production is widely practiced in Kilifi County. Cashew farming faces several challenges among them pests and diseases. Given a set of inputs, an economic agent will either be efficient or inefficient. There are several factors, both internal and external that may determine the level of operation by a farmer. To determine the factors influencing the technical efficiency level of a farmer a two-stage stochastic frontier analysis was done. The first stage generated efficiency scores for each famer which were then regressed against famers characteristics in the second stage. The results of the second stage regression are presented in this paper. The size of the household, gender and availability of extension services were found to positively influence the technical efficiency of a

farmer. Gender sensitive policies should therefore be formulated and implemented as a way of assisting farmers attain higher level of efficiency. Intensification of extension service will also see an improvement in farmers' level of efficiency.

Key words: *technical efficiency, extension access, gender*

1.1 Introduction

Kilifi County covers an area of 12,609.7 km^2 and is located in the coast region. It borders Kwale County to the south west, Taita Taveta County to the west, Tana River County to the north, Mombasa County to the south and Indian Ocean to the east (GOK 2013). Agriculture, both food and non-food at subsistence and commercial levels, constitutes 5 per cent of the coastal economic activity at the Kenyan coastal region (GOK, 2009). The average farm-size is 6-8 ha. Tree crops such as cashew nuts, coconuts, citrus and mangoes occupy about 50 per cent of the arable land. The cashew tree is suited to the coast and does well even in poor soils (Waithaka, 2002). The crop performs well in well-drained sandy-loam soils, and altitude of up to 600m above sea level (GOK, 2005).

Cashew farming faces several challenges among them pests and diseases. The common cashew diseases are powdery mildew and anthracnose (Ojiambo, 2006) and (Waithaka, 2002). The main pests are cored bug; cashew nut bugs, cashew bark borer, and cashew stem girdler. Cashew nut production in Kenya has been declining over the years from an average of 27,000 tonnes per year in 1975-79 to a low of 16,340 tonnes per year in the 2006/11

1.1.1 Theoretical background

Given a set of inputs, an economic agent will either be efficient, operating at the margin or inefficient; operating within the production possibility curve. There are several factors, both internal and external that may determine the level of operation by a farmer; efficient or inefficient.

It is conceptualized that farmers can behave in a certain way once they possess some predetermining characteristics. Following (Greene and Ng'ong'ola, 1993; Adeogun at al., 2008; Hadi et al., 2010) this scenario can be conceptualized as follows:

$$Y_i = g(I_i) \quad (1)$$

Where Y_i is the observed efficiency level for the ith farmer.

I_i is an underlying farmer characteristic for the ith farmer.

g is a functional relationship between efficiency level (Y_i) and farmer characteristic (I_i)

1.2 Data analysis

A stochastic frontier production function using the explicit Cobb-Douglas production function as shown below was used:

$$Y = \alpha \prod_{i=1}^{k} X_i^{bi} \exp(\varepsilon) \quad (2)$$

Where Y is the frontier output, X's the physical inputs, b is the elasticity of Y with respect to X, α is the scale factor and ε = υ – u is a composed error term. This model can be transformed into logarithmic form as:

$$LnY = Ln\alpha + b_i \sum_{i=1}^{k} LnX_i + \upsilon_i - u_i \qquad (3)$$

The technical efficiency according to (Coelli et.al, 1998) is estimated as:

$$Technical\ efficiency\ (TE) = \frac{Y_i}{\exp(X;\beta + \varepsilon_i)} = \exp(-u_i) \qquad (4)$$

In translog form this can be stated as:

$$\ln y_i = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ln x_{ki} + \frac{1}{2} \sum_{k=1}^{n} \sum_{j=1}^{n} \alpha_{kj} \ln x_{ki} \ln x_{ji} + \varepsilon_i \qquad (5)$$

Where; ln = natural logarithms

Y = yield/output

X_{ij} = input variables namely cultivated area under cashew measured in acres, labour size, amounts of fertilizer in kilograms used per year and farm gate price measured in KES per kilogram.

α_i= parameters to be estimated

the inefficiency model is given by the following equation;

$$\mu_i = \delta_0 + \sum_{m=1}^{t} \delta_m z_i \qquad (6)$$

Equation 5 can be fully expressed as:

$$\mu_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 \qquad (7)$$

The hypothesized relationships for the production and inefficiency functions were as shown in table 1 below.

Table 1. Description of the inefficiency variables (Zs) and expected signs.

Variable (Zs)	Units of Measure	Expected sign to TE
Technical inefficiency (μ)	0-1	
Gender	Male=1 and Female=0	+/-
Age	Years	+/-
Education	None=0, primary=1, post primary=2	+/-
Household size	Persons	+/-
Cashew age	Number of years	+/-
Extension frequency	Number	+
Credit amount used	Kshs	-

1.3 Results

Table 2. Comparison of technical efficiency scores to selected socioeconomic characteristics

Variable	Description	TE (%)
Gender	Male	74.5
	Female	70.4
Age (years)	35 and below	75.9
	36 – 50	70.4
	>50	74.5
Education	No formal education	68.3
	Primary	73.0
	Post primary	76.5
Extension	Yes	72.8
	No	73.2
Age of crop (years)	30 and below	79.0

	31-50	70.7
	>50	73.2

The two genders had different mean technical efficiencies with females at 70.4 per cent and males at 74.5 per cent. Males were more efficient than females in resource utilization. The results were against the findings by (Oladeebo and Fajuyigbe, 2007; Dadzie and Dasmani, 2010), who found that women are more efficient resources users and managers than men. This scenario could be attributable to the findings by Nyanjong' and Lagat (2012) that, rural women are disadvantaged in terms of access to education, land, credit and extension services.

The different age categories of farmers performed differently in terms of TE. The younger category of 35 years and below was the best performers at a mean score of 75.9 per cent. Those over 50 years came second at 74.5 per cent. Those between 36 and 50 years came last at 70.4 per cent. Education was also found to influence TE levels. Respondents with post primary level education were the best performing at 76.5 per cent followed by those with primary level education at 73 per cent. Respondents with no formal education were the least performing at 68.3 per cent. There was a difference in technical efficiency between those who had access to extension services and those who did not at 72.8 and 73.2 per cent respectively. The age of the cashew plant was found to correlate positively with output. The younger the crop the more productive it is. From the results it was found that a younger crop of 30 years and below had a performance of 79 per cent while the older crop of between 31 and 50 years had a mean performance of 70.7 per cent.

Table 3. Inefficiency model results

Variable	Coefficient	Std. error
Household size	-0.0024	0.0028
Gender	-0.0426	0.0439
Education	0.0516	0.0377
Extension	-0.0416	0.0424
Age(household head)	0.0026	0.0020
Age(cashew crop)	0.0023	0.0016
Constant	0.0380	0.1436

Age of the farmer had a negative influence on technical efficiency. From the results (table 2) it can be seen that if a farmer attained a higher age category, TE would decrease by 0.26. These findings were consistent with those of Nchare (2007) in coffee and Richman (2010) in cocoa who found out that age influenced technical efficiency negatively. However, these results were

inconsistent with the findings of Karani (2013), who in a study of passion fruit management found age to positively influence TE.

Education was positively related to inefficiency score which means that improvement in education does not lead to higher efficiency score. This particular finding was surprising. Theory has it that education is a way of improving human capital and therefore this is supposed to be reflected in higher outputs. The results were inconsistent with the findings of Nchare (2007) in Arabica coffee study in Cameroon, Msuya *et al*. (2008) in small holder maize productivity research in Tanzania, Nyagaka *et al*. (2010) in the study of technical efficiency in resource use among Irish potato farmers in Nyandarua-Kenya and, Khai and Yabe (2011) in rice production study in Vietnam, who all found that education positively contributes to higher TE scores. However, Njeru (2010) in wheat study in Uasin Gishu District Kenya and Sibiko (2012) in common bean productivity study in Uganda found that education not to have any significant influence in TE determination.

Access to extension service was found to have a positive relationship to technical efficiency. Kuria *et al*. (2003), Amaza *et al*. (2006) and Sibiko (2012) used similar approach and found a significant positive relationship between access to extension and technical efficiency. Croppenstedt (2005) while undertaking a study on technical efficiency measure of wheat in Egypt found that a higher frequency of extension visits of at least two influenced technical efficiency negatively.

The age of the cashew tree had a positive inefficiency coefficient. This implies that the older the tree the less the production, ceteris paribus. Since the age was measured in years, the results show that beyond optimal production age, any one additional year contributes and equivalent of

2.3 per cent to inefficiency. Thus older trees were less productive than the younger ones. Farmers should therefore be advised to replace old stock with young ones.

Conclusion

Extension, household size and gender had positive effects on technical efficiencies. Gender is a very important issue in agriculture since women constitute about half the population and majority of small scale farmers are women. Most of the day to day farming activities are done by women. Gender roles in agriculture are determined by socio-cultural factors as well as the current economic environment. Extension plays an important role in advancing rural communities through the improvement of their agricultural development activities. Availing of extension service to farmers will have the greatest impact on output. It is therefore incumbent on the government and other stakeholders to up the ante in provision of extension services.

References

Adeogun O.A., A.M. Ajana, O.A. Ayinla, M.T. Yarhere and M.O. Adeogun 2008. Application of Logit Model in Adoption Decision: A Study of Hybrid Clarias in Lagos State, Nigeria. *American-Eurasian J. Agric. & Environ. Sci., 4 (4): 468-472, 2008*

Amaza P.S., Bila, Y., Iheanacho A.C. (2006): Identification of Factors that Influence Technical Efficiency of Food Crop Production in West Africa: Empirical Evidence from Borno State, Nigeria. Journal of Agriculture and Rural Development in the Tropics and Subtropics, 107 (2): 139–147

Croppenstedt, A. (2005). Measuring Technical Efficiency of Wheat farmers in Egypt,

ESA Working Paper No. 05-06, Food and Agriculture Organization

Dadzie, S. and Dasmani, I. (2010). Gender Difference and Farm Level Efficiency: Metafrontier Production Function Approach, *Journal of Development and Agricultural Economics* 2(12): 441-451.

GOK (2013). Agricultural Sector Development Support Programme (ASDSP), Nairobi.

GOK (2009). Kilifi District Development Plan 2008-2012. Government Printer, Nairobi.

GOK (2005). National Development of the Cashew Nut Crop. Ministry of Agriculture, Nairobi.

Greene, D.A.G and Ng'ong'ola, D.H. 1993. Factors affecting fertilizer adoption in less developed countries: An application of multivariate logistic analysis in Malawi. *Journal of agricultural economics Vol 44, No.1*

Hadi, F., Silong, D and S.K. Sarkar 2010. Application of Logit Model in Innovation Adoption: A Study on Biotechnology Academic Researchers in Malaysia. *American-Eurasian J. Agric. & Environ. Sci., 9 (3): 282-287, 2010*

Karani, C. G. (2013). Assessment of Purple Passion Fruit Orchard Management and Farmers' Technical Efficiency in Embu, Meru and Uasin-Gishu Counties, Kenya

Khai, H. and Yabe, M. (2011). Technical Efficiency Analysis of Rice Production In

Vietnam. *J. ISSAAS 17(1):135-146*. Retrieved on 2rd April 2012 from http://www.issaas.org/journal/v17/01/journal-issaas-v17n1-15-khai_yabe.pdf

Kuria, J., Ommeh, H., Kabuage, L., Mbogo, S. and Mutero, C. (2003). Technical Efficiency of Rice Producers in Mwea Irrigation Scheme. *African Crop Science Conference Proceedings,* 6: 668-673.

Msuya, E., Hisano, S. and Nariu, T. (2008). Explaining Productivity Variation among Smallholder Maize Farmers in Tanzania. *XII World Congress of Rural Sociology of the International Rural Sociology Association*. Goyang, Korea.

Nchare, A. (2007). Analysis of Factors Affecting the Technical Efficiency of Arabica Coffee Producers in Cameroon. *African Economic Research Consortium* , AERC Research paper163.

Njeru, J. (2010). Factors Influencing Technical Efficiencies among Selected Wheat Farmers in Uasin Gishu District, Kenya. *Journal of Economics and International Finance 3(4): 211 – 216*

Nyagaka, D.O., Obare, G.A. & Nguyo, W.N(2010) Economic Efficiency of Smallholder Irish Potato Producers in Nyandarua North District,Kenya, *African Journal of Agricultural Research*,Vol.5, No.11, pp.1179-1186.

Nyanjong',O.J and Lagat, J (2012). Analysis of Efficiency in Sugarcane Production: The Case of Men and Women Headed Households in SONY Sugar Out-Grower Zone, Rongo and Trans-Mara Districts, Kenya

Ojiambo,E., 2006. Can The Poor Influence Policy? Lessons from the Cashew Nut Revitalization Campaign in Kenya Coast. Research and Policy in Development, Case Study Puran, M., Oladeebo, J. and Fajuyigbe, A. (2007). Technical Efficiency of Men and Women Upland Rice Farmers in Osun State, Nigeria, *Journal of Human Ecology* 22(2): 93-100.

Richman, D. (2010). *What drives efficiency on the Ghanaian cocoa farm*? Ghana Institute of Management and Public Administration, Ghana.

Sibiko, K. (2012). Determinants of Common Bean Productivity and Efficiency: A Case of Smallholder Farmers in Eastern Uganda. Unpublished MSc Thesis, Egerton University

Waithaka,J.H.G., 2002. Assessment of the Situation and Development Prospects for the Cashew Nut Sector, Kenya.