Technical Efficiency in Cashew Nut Production in Kilifi County, Kenya

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Abstract

The agricultural sector continues to be an important pillar of the coastal economy in Kenya. Cashew nuts together with coconuts are the principal cash crops grown in Kilifi County. Even though efforts have been made to improve productivity in the smallholder cashew sector, not much has been realized and productivity continues to stagnate. It seems that production technologies generated in research institutions have had minimal impact on efficiency and resource productivity. This study was therefore carried out with the main aim of analyzing the economic factors that influence production of cashewnut in Kilifi County. This was done by measuring the technical efficiency of cashew nut production and isolating the determinants of these efficiencies. The study used ordinary least squares (OLS) and maximum likelihood estimates (MLE) procedures to estimate parameters of identified input variables. The model also estimated technical efficiencies of individual farmers. Results showed that land area under cashew and extension service were significant determinants of output at five one per cent level of significance respectively while labour was significant at ten per cent

Key words: *technical efficiency, extension access, cashew nut farmers*

1. Introduction

Kilifi County covers an area of 12,609.7 km^2 and is located in the coast region in Kenya. 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 is the mainstay of the majority of the people in the County. The main food crop produced is maize while cash crops grown include coconuts, cashew nuts, citrus fruits and mangoes (GOK, 2009) and (NEMA, 2009). These crops are grown in smallholder farms which average 5.4ha. The growth of agriculture sector is faced with many challenges which include unfavourable land tenure, crop diseases, post harvest losses and low acreage. There is to low use of modern farming methods and low and irregular rainfall which cause drought resulting in perennial food shortages. (GOK, 2009).

Cashew nut, therefore, plays a vital role in the rural economy of the area. Cashews are grown commercially for their kernels. It also has a valuable by-product, the cashew nut shell liquid (CNSL) which is mainly used in a number of industrial products, including paints, plastics and brake lining. 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 does not tolerate waterlogged soils and coral areas.

Cashew farming faces several challenges among them pests and diseases. The common cashew diseases are powdery mildew and anthracnose (Ojiambo 2006, Waithaka 2002). The main pests are cored bug; cashew nut bugs, cashew bark borer, and cashew stem girdler. However, although efforts have been made to improve productivity in the smallholder cashew sector, not much has been realised and productivity continues to stagnate. The average yield per tree per year is 3.2 kg against a potential of 10kg per tree per year (Waithaka, 2002). This suggests that production technologies generated in research institutions have had no impact on efficiency and resource productivity.

2. Theoretical background

Producers behave like neoclassical firms who control the transformation of inputs into valuable outputs in order to maximize profits (Varian, 1992); (Jehle and Reny, 1998) and (Mas-Collel et al., 1995). Various approaches can be used to analyze producer's behavior. These include profit function approach, production function approach, cost function approach, or through mathematical optimization and dynamic programming. Given price taking, profit maximizing and a model of the physical production process, it is possible to derive a model of producer output and input decisions. Varian, (1992) posits that an economic agent's welfare can be maximized by maximizing their production functions. The welfare maximization problem facing the producer is:

$$\max W(u_1(x_1),\ldots,u_n(x_n))$$
$$such\,that\ T\left(X^1,\ldots,X^k\right)=0$$

where $X^g = \sum_{i=1}^{n} x_i^g \quad for\ g = 1,\ldots,k$.

3. Data

The study used 2013 cropping data from cashew nut farmers in Kilifi County. The data was collected from targeted farmers by way of researcher administered questionnaires and interviews. Data collected included socio-economic characteristics such as age of the farmer, education, gender, and familiy size. The economic data collected included cost of inputs, land under cashew nut production, output levels, and producer prices amongst others.

4. Data Analysis

Stochastic frontier analysis was used to test for technical efficiency. The functional form of the production function tested was a Cobb-Douglas production function which in its simplest version generally takes the form;

$$Y = AK^{\alpha} L^{1-\alpha} e^{\varepsilon}$$

Where Y = cashew nut output per unit of land measured in bags

K = capital employed

L = labour used in man days

A = scale of production

α = production elasticity

the above model was logarhtmically transformed into a linear form, thus:

$$\ln Y = \ln A + \alpha \ln K + (1-\alpha) \ln L + \varepsilon$$

The transformed production function was subjected to Ordinary least Squares regression. The purpose was to determine parameter estimates which are significant in cashew nut production and for use in stochastic frontier analysis.

The stochastic production function as used by Puran et al., (2011) is defined by:

$$Y_{it} = f(X_i;\beta)\exp e_i \qquad e_i = v_i - u_i \quad for\ i = 1,2,\ldots N$$

Where; Y_{it} = output level at any one given time

X_i = input vector

i = individual producer

e = error term

$f(x_i;\beta)$ = suitable production function

Technical efficiency of an individual firm is defined in terms of the ratio of the observed output to the corresponding frontier output, conditioned on the level of inputs used by the firm. Technical inefficiency is therefore defined as the amount by which the level of production by the firm is less than the frontier output.

$$T\hat{E}_i = {Y_i}/{Y_i^*}, where Y_i^* = f(x_i;\beta)$$

Y_i^* is the highest predicted value of the i[th] farm.

The production function was estimated using frontier 4.1 software package.

5. Results and Discussions

As the table shows (table 1), land area cultivated and extension are statistically significant at 5 per cent and 1 per cent level of significance respectively. Labour is also significant at 10 per cent. The log-likelihood (λ) obtained was -23.0993 while the one-sided error likelihood ratio (LR) test is 0.5860.

Table 1: Maximum Likelihood Estimates for Cobb-Douglas Stochastic Frontier Analysis

Variables	Coefficients	SE	t-ratio
Constant	6.3890	1.0610	6.0219
Land area	0.1977**	0.0803	2.464
Labour	0.1505*	0.0858	1.7536
Fertilizer	0.0106	0.0282	0.376
Age of crop	0.1077	0.1384	0.7782
Extension	0.5265***	0.1309	4.0233
Sigma squared	0.1978**	0.0833	2.3745
Gamma	0.6059*	0.3452	1.7553

Diagnostic statistics			
Sigma-squared	0.1978**	0.0833	2.3745
gamma	0.6059*	0.3451	1.7553
Log-likelihood function	-0.2310		
LR test	0.5860		

The parameter, sigma squared (δ^2), is the sum of error components μ and ν $\left(\delta_{\mu}^{2}+\delta_{\nu}^{2}\right)$ while gamma (γ) s the ratio of the variance of μ and ν $\left(\delta_{\mu}^{2}/\delta_{\nu}^{2}\right)$. Gamma was the only significant estimate at 5 per cent level. The value of gamma is 0.6059 which implies that about 61 per cent of the total variation in cashew nut output can be attributed to technical inefficiency. The fact that gamma is significantly different from zero means that variation in cashew nut output can be attributed to the effects of technical inefficiency.

The estimated coeeficient for land area allocation was 0.1977. This is the elasticity of cashew nut production with respect to land allocation. It represents the marginal impact of an extra unit of land allocation which is equivalent to an increase of 19.77 per cent in cashew nut output for a one-unit increase in land allocation. Cashew tree is a big plant with extensive root system, thus to acquire enough nutrients, and water, spacing should be optimal. There is a positive relationship between production and acreage. If land is taken as capital, then increases in acreage represent an increase in capitalisation.

Policies aimed at expanding acreage under cashew nut need to be encouraged so as to increase efficiency. This can be done by coming up with strategies aimed at giving incentives to farmers to allocate more of their land to cashew nut production. Obare et al. (2010) in a study of small holder farmers in Nyandarua North District found that land was a limiting resource in irish potato production.

The elasticity of output with respect to extension service provision is 0.5265. Ceteris paripus, this suggests that, an increase equivalent to 52.65 per cent in output can be achieved through increase in extension service. This implies that households with increased contacts with extension officers tend to be more efficient. This can be attributed to the fact that access to agricultural extension services may influence the adoption of better farming methods and practices. Farmers get to know of new production techniques and improved varieties. Knowledge gained from contact with extension officers positively influence cashew nut farmers in adopting modern technological and management practices. The findings are consistent with those of Xu and Jeffrey (1998), Nyagaka, et al (2010) and Nyanjong' and Lagat (2012) who found that increased farmers contact with extension officers tend to improve their managerial ability.

The positive effect of extension services implies that enhancing farmers' access to information will improve technical efficiency. Policy makers should therefore focus on effective and efficient methods of extension provision to farmers.

Labour had a coefficient of 0.1505 which is the marginal impact of one more unit of labour input on cashew production. With an additional unit of labour, cashew nut output increases by 0.15 per cent. This can be interpreted as shadow or dual price of labour. There is a direct relationship between cashew nut output and labour input. Cashew production is a labour intensive activity with very little mechanisation. Labour is thus a critical input component. This observation is consistent with Ogunniyi and Ajao (2011) and Amaza *et al.* (2006). Labour is required for weeding, pruning, and harvesting.

6. Conclusion and policy implications

The mean technical efficiency of cashew farmers is 77.5 per cent. This means that with current technologies, farmers can improve on their output by adopting a more efficient allocation of resources. Significant economic factors are cultivated land area under the crop, labour and extension services. Availing of more labour will increase the output of cashew nut. The policy implication here is that there is need to motivate labour into cashew nut production. Labour is normally motivated through increased payments. Cashew farmers therefore need to consider increased direct payment to labour on their farms or through bonuses. They have to make deliberate effort to put more labour into cashewnut production. Extension was another important economic factor affecting output of cashew nut. Of all economic factors this was found to have the highest shadow price. Availing of extension service to farmers will have the greatest impact on output. Extension staff provides farmers with information and skills with respect to control of pests and diseases, adoption of improved seeds and seedlings among others. adequate extension contact will enable the farmers to rehabilitate the cashew sector by improving its productivity

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