Agris on-line Papers in Economics and Informatics

Volume IV Number 2, 2012

Resource-use Efficiency in Cashew Production in Wenchi Municipality, Ghana

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Abstract

The study considered the determinants of cashew production with special reference to cashew production in Wenchi Municipality of Brong-Ahafo Region of Ghana. Data collection was through well structured questionnaire administered on 140 respondents selected through random sampling technique. The methods of analysis used were descriptive statistics and production function analysis using the Ordinary Least Square (OLS) criterion. Results showed that majority of the farmers were ageing and there was high level of illiteracy as about 61.4% of total respondents had no formal education. Results further showed that farm size, capital, fertilizer and pesticides are positively related to cashew output while labour is inversely related. Also, the farmers were inefficient in the use of resources. Land, fertilizer and pesticide were underutilized while labour and capital were over utilized. Farmers should be encouraged to increase the use of land, fertilizers and pesticides so as to increase productivity.

Key words

Production function, Cobb-Douglas, Resource-use, Cashew.

Introduction

Agriculture is the predominant sector in Ghana's economy. In 2008, agricultural activities contributed to 33.6% of Gross Domestic Product (GDP), employed about 60% of the labour force, and accounted for 54% of foreign exchange earnings. The sector itself is composed of five subsectors, namely crops other than cocoa, livestock, fisheries and forestry. However, non-traditional crops, such as pineapple, mango and cashew nuts, are increasingly of importance to the Ghanaian economy (MOFA, 2007).

Cashew is one of the non-traditional export crops being given the necessary boost by the government of Ghana. Cashew has a long history as a useful plant but only in the present century has it become an important tropical tree crop. The earliest reports of cashew are from Brazil (Mitchell and Mori, 1987). Cashew (Anacardium occidentale linn) is one of the important tree-nut crops, ranking third in international trade after hard nuts and almonds (MOFA, 2007).

The first ever recorded exports of cashew nuts from Ghana was in 1991, amounting to 15 metric tonnes. In 1997, export volumes rose to 3,571 metric tonnes. According to the Ghana Export Promotion Council, in 2002, the country exported 3,893 metric tonnes of cashew valued at $1,450,306. This export figure increased by 79.15% in 2003 to 6,338 metric tonnes, which was valued at $1,598,636. Annual export of raw nuts reached 47,000 metric tonnes in 2006, contributing approximately US$ 23 million in foreign exchange earnings. This figure is considered very small when compared with world excess demand of 430,000 metric tonnes of raw nuts, valued at US$270 Million, and growing at a rate of 5-8% per annum. It is therefore obvious that demand continuous to exceed supply; meanwhile there are many cashew farmers in Ghana and their productivity is on the lower side (MOFA, 2007).

Cashew production in Ghana is mainly a smallholder activity and provides income to farmers and all other agents involved in its production and marketing. Resources used in any production activity are regarded as the inputs that drive the production process. In cashew farming, the resources required include the seeds, land, labour, capital, fertilizer

and pesticides. The main technology applied is the traditional cutlass and hoe technology which has been blamed for the low output levels of farmers. A resource or input is said to be efficiently utilized when it is put to the best use possible and at minimum cost allowable. In a bid to help farmers increase productivity, the focus is usually on whether farmers are using better and improved technologies. It is however necessary to investigate whether these farmers are even making maximum use of what is available to them in terms of inputs so that the stakeholders involved in agriculture will be convinced that the new technologies they intend to introduce to farmers will be used efficiently and cost effectively to boost output. Farmers might use resources rationally but not at the economic optimal level. As the aim of every agribusiness firm is to maximize profit whiles minimizing cost, it is pertinent to determine the efficiency of resource-use (Tambo and Gbemu, 2010).

Materials and methods

Study area and Data Collection

The study was carried out in Wenchi Municipality in Brong-Ahafo Region of Ghana as it is the major cashew production zone in Ghana. The study area lies between latitudes 7°27N and 8°30N and longitudes 1°30N and 2°36W. Wenchi Municipality occupies an area of 7,619.7 square kilometres and a population density of 5-20 persons per square kilometre. The study used both primary and secondary data. Primary data was mainly cross-sectional. It was collected from 140 cashew farmers randomly selected from lists of cashew farmers in the following farming communities: Akrobi, Awisa, Nkonsia and Abotareye, for the 2009-2010 production season. The communities were purposively selected based on the level of cashew production. In each community 35 cashew farmers were randomly selected. Variables included in the questionnaire were: initial capital outlay or establishment cost, area of land under cashew cultivation, labour input in land preparation, planting, weeding, fertilizer, pesticide application and harvesting, the quantities of pesticides and fertilizer used in cashew cultivation. Others include farmer's age, farmers' educational level, gender, household size, farmers contact with extension workers, economic part of cashew sold, farming experience and sources of finance. Also the study made use of secondary data obtained from the internet, academic journals, Libraries and the Ministry of Food and Agriculture (MOFA).

Conceptual framework

Determinants of Cashew output

The economic model commonly used to determine the relationship between the various factors and the output in agriculture is production function model. The production function of any farmer is determined by resource availability of the farmer. In agriculture, the production inputs consist of land, labour and capital as the basic factors of production. The expected relationship between output and land is that as more land is brought under production, output is increased (Malassis 1975). The simplified form of production function is given by:

$$Q=f(L_d,K,L) \quad (1)$$

Where Q is the production output, which is a function of land (L_d), the capital (K) and the labour force (L) used for the production of the same output. A production function may be defined as a mathematical equation showing the maximum amount of output that can be realized from a given set of inputs. The mathematical form of the Cobb-Douglas production function is given by:

$$Q=AL^{\alpha} K^{\beta} \quad (2)$$

Where Q is the output, A is the technology used in the production of output, L is labour input, K is capital input and α and β are elasticity. Alternatively, a production function can show the minimum amount of inputs that can be utilized to achieve a given level of output (Malassis 1975). To find out the impact of these factors on farm level production of cashew on small-scale farmers in Wenchi Municipality, the functional relationship is specified.

$$OUTPUT=f\,(FAMS, LAB, CAP, FERT, PEST, u) \quad (3)$$

Where,

OUTPUT = Cashew nut output (in kilogrammes of cashew nut)

FAMS = Farm size (in acres)

LAB = Labour quantity (in man-days)

CAP = Physical capital (in Ghana cedis (Gh¢) spent on equipments)

FERT = Liquid Fertilizer used (in litres)

PEST = Pesticides used (in litres)

u = stochastic error term.

Among the various functional forms for analyzing production functions, double-log gives the best fit and is the best (Eze et al, 2010 and Goni et al, 2007). The econometric model is specified using the double-log Cobb-Douglas production function as follows:

$$\ln OUTPUT = \ln\beta_0 + \ln\beta_1 FAMS + \ln\beta_2 LAB + \ln\beta_3 CAP + \ln\beta_4 FERT + \ln\beta_5 PEST + u \quad (4)$$

Using Ordinary Least Squares (OLS) technique, the coefficients of the above variables were estimated. For the study to estimate with OLS, the Cobb-Douglas production function had to be a transformed model, to satisfy the Classical Linear Regression Model (CLRM), so as to come up with the usual assumption of Best Linear Unbiased Estimator (BLUE).

Efficiency of resources use in cashew production

To ensure maximum profit and efficiency of resources, a cashew farmer must utilize resources at the level where their marginal value product (MVP) is equal to their marginal factor cost (MFC) under perfect competition (Kabir Miah et al, 2006; Tambo and Gbemu, 2010). The efficiency of a resource would be determined by the ratio of MVP of inputs (based on the estimated regression coefficients) and the MFC. Following Goni et al. (2007), Fasasi (2006) and Stephen et al (2004), the efficiency of resource use is given as;

$$r = \frac{MVP}{MFC} \quad (5)$$

r = Efficiency coefficient

MVP = Marginal Value Product

MFC = Marginal Factor Cost of inputs

$$MFC = P_x \quad (6)$$

Where

P_{xi} = Unit price of input, say X.

$$MVP = MPP_x . P_y \quad (7)$$

Where

MPP = Marginal Physical Product

P_y = Unit Price of cashew output

From equation 4,

$$\beta_i = \frac{\partial Y}{\partial X} \cdot \frac{X}{Y} \quad (8)$$

$$MPP_x = \frac{\partial Y}{\partial X} = \beta_x \frac{Y}{X} \quad (9)$$

MPP_x = Marginal Physical Product of input X and is a measure of technical efficiency of input X.

β_x = Elasticity of production with respect to Input X = Regression coefficient of input X

Therefore

$$MPP_x = \frac{\partial Y}{\partial X} = \beta_x \frac{Y}{X} \quad (10)$$

Y = mean value of output,

X = mean value of input X

MVP for each input is therefore obtained by multiplying the regression coefficient of that input with the ratio of the mean value of output and that of input and with the unit price of output. MFC of each input will however be obtained from the data collected on the unit market prices of the various inputs. The decision rule for the efficiency analysis is if:

r = 1; resource is been used efficiently

r >1; resource is underutilized and increased utilization will increase output.

r <1; resource is over utilized and reduction in its usage would lead to maximization of profit.

(Eze, 2003; Mbanasor, 2002; Olayide and Heady, 1982; Okon, 2005).

Returns to scale is estimate by the sum of the elasticity of the various inputs. The decision rule for the return to scale is that if:

$\sum\beta_i$ = 1, implies constant returns to scale

$\sum\beta_i$ <1, implies decreasing returns to scale

$\sum\beta_i$ >1, implies increasing returns to scale

Results and discussions

Descriptive Analysis

Evidence from the descriptive analysis of socioeconomic characteristics of respondents in the study area in Table 1 shows that 61.4% of the sampled cashew farmers were males and 38.6% were females. The results show that more men are involved in cashew production in the Wenchi Municipality than women. This is consistent with the results of CASCA (2002) which revealed that most cashew trees or farms are owned by men (60%) while the other 40% are divided amongst women (10%), the family as a whole (15%) and grandparents (15%). It also shows that both men and women can take cashew production as a business and a source of employment.

The results of the study show that most cashew farmers in Wenchi Municipality are ageing since a greater percentage of the cashew farmers interviewed (74.3%) were above forty (40) years and none of the respondents was below twenty (20) years. Very few cashew farmers in the municipality (25.7%) were between the ages of twenty-one (21) and forty (40) years. Farmers in this age group constitute the very energetic youth and are likely to work effectively to increase their yields. The few number of youth involved in cashew production (25.7%) could indicate that the future of the cashew industry, especially in the Wenchi Municipality is bleak. The youth are the future growers of the cashew crop and if cashew nut supply is to be sustained, there is the need for the youth to be encouraged to go into cashew production.

From the study, it was realised that a higher percentage of cashew farmers in Wenchi Municipality (61.4%) are illiterates. Such farmers did not receive formal education. About 17.1% of cashew farmers in the Wenchi Municipality ended in the primary school while 10.7% of them were educated up to the Middle or Junior Secondary School level. Some cashew farmers

Characteristic	Frequency	Percentage (%)	Characteristic	Frequency	Percentage (%)
Gender			*Household Size*		
Male	86	61.4	1 - 5	81	57.9
Female	54	38.6	6 - 10	40	28.6
Total	140	100.0	>10	19	13.5
Age			Total	140	100.0
≤20	0	0.0	*Farming Experience (Years)*		
21 - 40	36	25.7	≤5	78	55.7
41 - 60	68	48.6	6 - 10	34	24.3
61 - 80	36	25.7	11 - 15	20	14.3
Total	140 characteristic	100.0	>15	8	5.7
Education			Total	140	100.0
Illiterate	86	61.4	*Source of finaces*		
Primary	24	17.1	Personal Saving	91	65.0
Middle School/JSS	15	10.7	Friends	10	7.1
SSS/Vocational/Technical	10	7.1	Relatives	9	6.4
Post Secondary/Tertiary	5	3.7	Cooperatives	12	8.6
Total	140	100.0	Bank Loans	18	12.9
Pruning			Total	140	100.0
Do pruning	74	52.9	*Contact with Extension Officers*		
Do not do pruning	66	47.1	Contact	42	30.0
Total	140	100.0	No Contact	98	70.0
Cashew Varieties			*Economic part of cashew sold*		
Improved	44	31.4	Apple	0	0.0
Local	96	68.6	Nut	140	100.0
Total	140	100.0	Total	140	100.0

Source: Field Survey data 2010

Table 1. Socioeconomic Characteristics of Cashew Farmers.

in the municipality (7.1%) had Senior Secondary School education while very few of them (3.7%) got to the Post Secondary and Tertiary level. The higher percentage of illiterate farmers could have negative impact on the adoption of new production technologies.

The results of the study revealed that a greater percentage of cashew farmers in the Wenchi Municipality (52.9%) pruned their cashew trees while 47.1% did not do pruning. The results show that most cashew farmers in Wenchi Municipality probably saw pruning as a very important cultural practice in cashew production. There is however the need for increased awareness of the importance of pruning in cashew production since 47.1% of the respondents did not do pruning at all.

The results showed that only 31.4% of cashew farmers in the Wenchi Municipality used improved varieties of cashew while the rest (68.6%) used local varieties. The results of the study showed that cashew nut is the main product of the cashew crop of economic importance in Wenchi Municipality. Also, a greater proportion of cashew farmers in the Municipality (65%) financed their production through personal savings. The distribution of the household size indicated that most cashew farmers in the Municipality (57.9%) had a household size that ranged from 1 to 5 while the average farm size was found to be 3.33 acres. The study also revealed poor extension visits to cashew farmers since 70% of farmers sampled had no extension contact. Finally, most cashew farmers sampled had less than five (5) years of experience in cashew production. This could have a negative impact on output.

Cashew production function analysis

From the regression results in Table 2, farm size, labour, capital, fertilizer and pesticide were observed to affect cashew output significantly and hence are the determinants of cashew production in the study area. Farm size, labour and pesticides were significant at 1% whereas capital and fertilizer were significant at 5%. The R2 value for the regression is 0.840912 and this means that 84.1% of the variations in cashew output are explained by the factor inputs. Also from the F-statistic it can be concluded that the overall regression is significant at 1% significance level which means that at least one of the explanatory variables significantly affects the output of cashew. The values of the coefficients indicate the elasticity of the various inputs to the output. Considering farm size, the elasticity value indicates that if land under cultivation is increased by 1%, the yield of cashew would increase by 92.4%. If quantity of capital, fertilizer and pesticides increase by 1%, yield of cashew would increase by 4.3%, 8.7% and 4.3% respectively because they are positively related to cashew output. This is in line with the results of Goni et al (2007) who conducted a study into the analysis of resource-use efficiency in rice production in the lake Chad area of Borno state, Nigeria and found out that a unit increase in the level of seed, farm size, and fertilizer will lead to 12.6, 127.2, and 20.5 percent changes in rice output respectively. Imoudu (1992) also showed that farm size is a significant determinant of maize output and profitability in Ondo-State. The results of the study are also in consonance with those of Ohajianya (2006) in Imo State, Nigeria, and Onyenweaku et al (1996). Labour however had a negative coefficient

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.106303	0.739814	6.902142	0.0000
lnFAMS	0.923613	0.188644***	4.896063	0.0000
lnLAB	-0.022457	0.185277***	0.121206	0.0007
lnCAP	0.043158	0.189123**	2.456227	0.0289
lnFERT	0.087111	0.024699**	3.526886	0.0226
lnPEST	0.042582	0.018065***	2.357151	0.0099
R-squared	0.840912	Mean dependent var	6.442207	
		F-statistic	98.92029	
		Prob (F-statistic)	0.000000	

Note: (***) Indicates significance at the 1% level. (**) indicates significance at the 5% level.
Source: Field Survey data 2010

Table 2. Estimates of the Production function analysis.
Dependent Variable: lnOUTPUT

indicating that an increase in labour will lead to a decrease in yield and this corroborates Stephen et al (2004), who studied on resource-use efficiency in cowpea production in North East Zone of Adamawa State, Nigeria and reported an inverse relationship between labour and output.

Return to scale was calculated as the sum of individual production inputs elasticities. The sum of elasticities resulted to a value of 1.074, which shows increasing returns to scale. This suggests that cashew farmers in the study area can increase their cashew output by employing more of these five resources (i.e land, labour, capital, fertilizer and pesticide). This is in line with the results of Goni et al (2007) who found out that rice farmers in the study area could increase their rice output by employing more of seed, farm size, fertilizer and labour. The result of increasing return to scale is also in line with the findings of Ajibefun (2002) and Uchegbu (2001) but contrary to the finding of Obasi (2007).

The values of the Marginal Physical Product (MPP) show that the farmers were more efficient in the use of land than the other resources. This suggests that if additional acres were available, it would lead to an increase in cashew production/yield by 299.72 kg among the farmers. This implies that the farmers are more technically efficient in the use of land. Of all the resources used, labour had the least MPP (0.017 kg). This shows inefficiency in the use of available labour. These results also corroborate those of Goni et al (2007).

Given the level of technology and prices of both inputs and outputs, efficiency of resource use was further ascertained by equating the Marginal Value Product (MVP) to the productive Marginal Factor Costs (MFC) of resources. A resource is said to be optimally allocated if there is no significant difference between the MVP and MFC i.e. if the ratio of MVP to MFC =1 (unit). Table 3 further reveals that the ratios of the MVP to the MFC were greater than unity (1) for all the inputs except labour and capital which implies that within the limits of statistical error, none of the inputs was efficiently allocated by the cashew farmers. This implies that farm size, fertilizer and pesticide were under-utilized, while labour and capital were over utilized (less than one). This means that cashew output was likely to increase and hence revenue if more of such inputs (land, fertilizer and pesticide) had been utilized. The efficiency results of land, labour and capital agree with those of Eze et al (2010) who studied the Resource Use Efficiency in Arable Crop Production among Smallholder Farmers in Owerri Agricultural Zone of Imo State, Nigeria but that of fertilizer disagrees. The adjustment in the MVPs for optimal resource use (% divergence) in Table 4 indicates that for optimum allocation of resources more than 92% increase in farm size was required, while approximately 28% increase in fertilizer was

Resource	Mean	Elasticity	MPP	MVP	MFC	r
Farm Size	3.34	0.923613	299.72	125.88	8.91	14.13
Labour	1469.54	-0.022457	-0.017	-0.0071	3.00	-0.0024
Capital	18.34	0.043158	2.55	1.071	18.34	0.058
Fertilizer	2.20	0.087111	42.92	18.03	13.05	1.38
Pesticide	0.65	0.042582	71.00	29.82	12.71	2.35

Mean of Cashew output = 1083.86 Price of cashew nut = 0.42 $\sum\beta_i$=1.074

Source: Field Survey data 2010

Table 3. Values of estimates of efficiency parametersDependent Variable: lnOUTPUT.

Resource	Efficiency Gap	% Divergence
Farm Size	117.00	92.92
Labour	3.01	41,766.67
Capital	17.28	1,624.14
Fertilizer	4.96	27.54
Pesticide	17.16	57.45

Source: Field Survey data 2010

Table 4. Adjustments in MVPs for optimal resource use (% divergence).

needed. Similarly, over 57% increase in pesticide was needed. Labour and capital were over utilized and required approximately 41,766.67% and 1,624.14% respectively reduction for optimal use in cashew production. Eze et al (2010) obtained similar results for land, labour and capital but that of fertilizer disagreed.

Conclusion

Findings from the study indicate that cashew farming in the municipality is a male dominant activity with the men making up 61.4% of the respondents sampled. Most of the cashew farmers in the study area (70%) have no contact on a regular basis with extension agents. Also, a greater proportion of cashew farmers in the Municipality (65%) financed their production through personal savings. That is most farmers do not receive financial assistance in the form of credit from formal sources. The results also showed that majority of the farmers were ageing and quite inexperienced in cashew production. Also, the level of illiteracy was very high among the respondents as about 61.4% of total respondents had no formal education while 17.1%, 10.7%, 7.1 and 3.7% had primary, Middle School/ JSS, secondary/Vocational and tertiary education respectively. Respondents are majorly small-scale farmers with a mean farm size of 3.33 acres. Results further showed that variables such as farm size, capital, fertilizer and pesticides are positively related to cashew output while labour is inversely related. Also, the farmers were inefficient in the use of resources. Land, fertilizer and pesticide were underutilized while labour and capital were over utilized. Farmers should be encouraged to increase the use of land, fertilizers and pesticides so as to increase productivity. Enough potential therefore exist for increased production of cashew in the study area. Among other things, farmers should have more access to extension services in order to improve their knowledge of farm management. Also, the government should introduce the farmers to formal education through adult literacy education, evening classes and establishment of demonstration farms.

Acknowledgement

The authors are especially indebted to the staff of the Ministry of Food and Agriculture (Wenchi) for the information they provided about the cashew crop. They are also grateful to the respondent farmers without whose co-operation the study could not have taken place.

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