Tropentag 2010
ETH Zurich, September 14 - 16, 2010
Conference on International Research on Food Security, Natural Resource Management and Rural Development

Resource-use Efficiency in Tomato Production in the Dangme West District, Ghana

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Keywords: Dangme West District, efficiency, Production function, Resource use, Tomato

Introduction

Tomato forms a very important component of food consumed in Ghana and this is evident in the fact that many Ghanaian dishes have tomatoes as a component ingredient. Tomato 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 tomato farming, the resources required include the seeds, land, labour, capital and fertilizer. 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.

Study Objectives

This study seeks to describe the socio-economic characteristics of tomato farmers in the district, estimate the farm production function of tomato with a view of deriving the marginal factor productivity so as to estimate how efficiently the tomato farmers in the district are using their resources.

Study area and data collection

The Dangme West district is forms about 41.5% of the landmass of the Greater Accra Region of Ghana and is an important center where crop production is done for both the domestic market and also for export. A wide variety of crops are grown there because of the suitable climatic conditions. The crops produced there include fruits (e.g. pineapple, watermelon and mango), vegetables (e.g. tomatoes, pepper and cabbage) and staples like cassava and maize.

Primary data was collected with the aid of a well structured questionnaire. The data were collected using multi-stage sampling technique. The three towns in the Dangme West District, Dodowa, Kpong Bawaleshie and Ayikumah were purposeful selected based on intensive tomato cultivation in these areas. The second stage involved simple random selection of 20 respondents from each of the towns. Baseline information on socio-economic characteristics such as age, family size, and marital status, source of finance for the farm, farm size, and extension contact were obtained. Also, data on input use and output levels as well as their unit prices were collected. Data collected was for the 2007 farming season.

Analytical techniques

Descriptive statistics using percentage and frequency tables were used in the analysis of the socio-economic characteristics of the farmers.

Ordinary Least Squares (OLS) was used to obtain the farm production function. The Cobb Douglas production function was employed in this study as it gave the best fit compared to the linear, exponential and semi-log functional forms.

The linear stochastic form of the specified Cobb – Douglas function is given as;

$$lnY = lnA + b_1 lnX_1 + b_2 lnX_2 + b_3 lnX_3 + b_4 lnX_4 + b_5 lnX_5 + \mu$$

Where:

Y=Tomato output (kg) X_1=Farm size (ha), X_2=Quantity of seed (kg),
X_3=Pesticide (litre), X_4=Family labour (man-days), X_5=Hired labour (man-days),
X_6= Quantity of fertilizer (kg) A=the intercept parameter, b_1-b_6 = Regression coefficients,
μ = random error term

The coefficients are the marginal productivities of the corresponding inputs with respect to output. To ensure maximum profit and efficiency of resource, a 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). The efficiency of a resource was 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 is given as;

$$r = MVP / MFC$$

r = Efficiency coefficient MVP=Marginal Value Product
MFC=Marginal Factor Cost of inputs

MFC = P_{xi} where P_{xi}=Unit price of input X_i

MVP is obtained from the expression, $MVP = MPP \times P_y$

Where MPP=Marginal Physical Product and P_y =Unit Price of Output

The MPP is obtained from the estimated regression coefficients which are the elasticities of production (E).

$$MPP_x = \partial y / \partial x \quad \text{but} \quad E_x = \frac{\partial y}{\partial x} \cdot \frac{x}{y}$$

Hence $E_x \cdot \frac{y}{x} = \frac{\partial y}{\partial x} = MPP_x$; Therefore, $MVP_x = E_x \cdot \frac{y}{x} \cdot P_y$

y = mean value of output, x = mean value of input x

MVP for each in input was therefore obtained by multiplying the regression coefficient of that input with the ratio of the mean value of output and that input and with the unit price of output.

MFC of each input was however obtained from data collected on the unit market prices of the various inputs during the 2007 production season.
The decision rule for the efficiency analysis is if:
r = 1; resource is been used efficiently
r >1; resource is under utilization and increased utilization will increase output.
r <1; resource is over utilized and reduction in its usage would lead to maximization of profit.

Results and Discussion

The results from the study indicate that most of the farmers were literate and were within an age range of 30 – 39 years with a mean age of 42. The tomato farmers were mainly smallholder farmers who cultivate between 3 to 4 acres with an average farm size of 2.5acres. Also, majority of the farmers (87%) were in contact with extension agents. There are also more men (88%) than women having tomato farms at the study area. Only 24% of the farmers have access to credit for farming and it is mainly obtained from relatives which are of small amount
The result for the production function analysis is shown below in table I.

Table I: Estimated Cobb-Douglas production function for tomato production

Dependent Variable: **LOG(OUTPUT)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(SEED)	0.091643	0.070642	1.297297	0.2004
LOG(LAND)	0.328145	0.084417	3.887218	**0.0003*** **
LOG(PESTICIDE)	0.128016	0.053976	2.371694	**0.0215** **
LOG(HIRED_LABOUR)	0.043624	0.018499	2.358245	**0.0222** **
LOG(FERTILIZER)	0.033103	0.037784	0.876091	0.3851
LOG(FAMILY_LABOUR)	-0.001540	0.020546	-0.074937	0.9406
C	6.583790	0.192585	34.18634	0.0000
R-squared	**0.739061**	**F-statistic**		**24.0746**
Adjusted R-squared	**0.708362**	**Prob(F-statistic)**		**0.0000**

** **(5% Significance level)** *** **(1% Significance level)** Source: Field survey, 2008

From the regression results, hired labour, pesticide and farm size were observed to affect tomato output significantly and hence are the determinants of tomato production in the study area. Farm size was significant at 1% whereas pesticide and hired labour were significant at 5%. The Adjusted R^2 value for the regression is 70.8% and this means that 70.8% of the variations in the tomato 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. 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 (farm size) under cultivation is increased by 1%, the yield of tomato would increase by 32.8%. If quantity of seed, fertilizer, hired labour and increase by 1%, yield of tomato would increase by 9.2%, 3.3% and 4.4% respectively. Family labour however had a negative coefficient indicating than an increase in family 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 and reported an inverse relationship between family labour and output.

From the result of resource-use efficiency estimation shown in table II, the use of family labour was found to have a negative efficiency coefficient. This indicates an extreme use of family labour by the farmers which in turn leads to reduction in profit obtained. On the other hand, seed, land, hired labour, fertilizer and pesticide were the inputs being underutilized as their

efficiency coefficient is greater than one. To increase output, there is the need for the farmers to increase the utilization of seed, land, hired labour, fertilizer and pesticide.

Table II: Efficiency of resource – use in tomato production

Resource / Input	Coefficient	MVP (GH¢)	MFC (GH¢)	r
Seed	0.091643	73.31	6.0	12.22
Land	0.328145	262.52	30.0	8.75
Fertilizer	0.033103	26.48	7.0	3.78
Pesticide	0.128016	102.41	8.0	12.80
Family labour	-0.001540	-1.23	5.0	-0.25
Hired labour	0.043624	34.90	5.0	6.98

Source: Field survey, 2008

Conclusion

Findings from the study indicate that most of the farmers are in contact on a regular basis with extension agents. Tomato farming in the district is a male dominant activity with the men making up 88% of the respondents sampled. The farmers do not receive financial assistance in form of credit from formal sources. They depend mostly on their personal savings.

Hired labour, pesticide and farm size (land) were observed to affect tomato output significantly. Farm size was significant at 1% whereas pesticide and hired labour were significant at 5%. Furthermore, the farmers were inefficient in the use of resources. Seed, land, hired labour, fertilizer and pesticide were underutilized. Enough potential therefore exist for increased production of tomato in the study area.

The findings of the study implies that financial institutions in the area should consider making loans available and accessible to the farmers so that they can afford to increase the use of the inputs that are currently being underutilized. Also, there is the need for extension officers in the study area to educate the farmers to increase the use of land, hired labour and seed and also the right quantities of pesticide and fertilizer in order to boost profitability of the business.

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