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A Comparative Economic Analysis of Tobacco and Groundnut Farming in Urambo District, Tabora Region, Tanzania

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Abstract

Using 2007/2008 cropping season survey, data on 121 randomly selected smallholder farmers from three villages, this study provides a comparative economic analysis for tobacco and groundnut farming systems. Cross-sectional research design was adopted and was completed by household interviews based on a structured questionnaire. Purposive, multistage and random samplings were carried out. A Random sampling procedure was used to obtain a sample size of 121 respondents of which 60 were tobacco farmers and 61 groundnut farmers. Cobb-Douglas production function, gross margin analysis and descriptive statistics; and independent samples t-test statistics were used as analytical tools. Results revealed that a gross margin per acre for groundnut was lower than that of tobacco by 569 231.90 TZS equivalent to $ 497.62. However, result revealed no significance difference in profitability yielded by the two farming while a comparison of household income contribution by tobacco and groundnut enterprises gave a significance difference with p-value <0.000 in terms of income generated by the two crops. In this study, an increasing return to scale exists in both farming systems. Therefore, an increase in all inputs by one percent increases tobacco and groundnut by more than one percent. However, by comparing the two cropping enterprises, if all factor inputs are varied by the same proportion, the percentage by which output will increase in tobacco was larger than that of groundnut. The study concluded that tobacco farming activity was more profitable enterprise than groundnut farming. It also contributed more income to farmer than what groundnut farming it does. In tobacco farming hired labour revealed the negative relationship with the output; however this had a positive relationship in groundnut farming. Contrary to tobacco, groundnut seed varieties had the negative response in groundnut output.

Key Words: Income, Profitability analysis, Cobb-Douglas production function

1. Introduction

Similar to other traditional cash crops, tobacco was introduced in the country during the colonial period in the 1930s. The crop has gone through several phases- a reflection of the political and economic orientation of the country during the process of development. It is the main source of income to 72,000 smallholders and offer employment opportunities in both farms and tobacco processing factories. However, there is no doubt that tobacco production is a highly contentious issue in which critics hold sway, often on health, world price fluctuations and environmental grounds (Rweyemamu 2001). On the other hand, groundnuts in Tanzania are grown by smallholder farmers and are one of the major raw materials for edible vegetable oils in the country. It is one of several oilseeds produced in the country. The crop is consumed in various forms and is considered to be one of the protein sources for the rural people. Major utilization of groundnut is for domestic consumption including seeds and for oil extraction (Okumu 2007). Apart from the economic and dietary benefits, groundnut is a good fixer of atmospheric nitrogen to the soil when inoculated with the right species of rhizobia (Waddington & Johannes 1998).

In Urambo district, tobacco has been the most important traditional cash crop since 1960s. However, between 1995/96 to 1999/2000 the production of tobacco in the district declined from 13,027,000 tones to 4,675,400 tones, respectively (Masudi et al. 2001 & Kalamata 2000). At the same time, the world market price of tobacco has been fluctuating (MAFS 2005). Apart from declined production, tobacco farming worldwide as been criticised. For instance, the WHO Framework Convention on Tobacco Control of May 2003 aims at involving all member countries in a comprehensive and multi-sectoral control and restriction of accessibly and promotion of tobacco products, with the aim of reducing consumption and concomitant morbidity and mortality associated with tobacco use (WHO 2003).

In view of the above facts concerning tobacco farming, the government and development partners have taken some measures to mitigate the problems. Different initiatives are taken by different stakeholders to develop high-yielding varieties and promote groundnut production, as a substitute of tobacco, which is environmental friendly. Despite these efforts, little is known about the contribution of groundnut production to the income of smallholder farmers' vis-à-vis other cash crops grown in Tabora region. Therefore, this study was an attempt to undertake a comparative economic analysis of tobacco and groundnut farming and their contribution to farmers' income.

2. Research Methodology

2.1 Description of the Study Area

The study was conducted in Urambo district of Tabora region in Tanzania. The district receives an annual rainfall ranging from 900mm – 1200mm. It has an annual mean temperature of 30 ^{0}C and mean minimum temperature of 16.4 ^{0}C. It has a well drain medium-textured soil. The topsoil is loamy sand or sand loam while the sub soil texture is sandy clay loam. The upland vegetation in the district is miombo woodland mixed up with wetland vegetation of mbuga wooded grassland and mbuga grassland. The predominant economic activities in the district are agriculture and livestock keeping. Other economic activities taking place in the district include beekeeping and fishing. The district was purposively selected for this study due to its long experience in flue cured tobacco production. Furthermore, it was among of the areas deemed suitable for groundnut production after the British survey which was conducted soon after the Second World War.

2.2 Sampling Procedures

Purposive, multistage and random samplings were carried out. In the first stage, purposive and multistage area samplings were used to obtain divisions, wards and villages which cultivate tobacco and groundnut. A random sampling technique was employed to select three villages which grow tobacco and groundnut in Kaliua ward. The villages sampled were Kaliua, Kasungu and Kasisi. The sample frame of this study consisted of all groundnut and/or tobacco growers in the study area. A Random sampling procedure was further used to obtain a sample size of 121 respondents of which 60 were tobacco farmers and 61 groundnut farmers.

2.3 Data Collection and Analysis

Primary data was collected from 121 tobacco and/or groundnut growers. Structured questionnaires was designed in such a way that it was able to capture both qualitative and quantitative data on household identification variables, farm activities, labour use and other purchased inputs, output and marketing of tobacco and groundnut. Secondary data was obtained from District Agricultural and Livestock Development Officer (DALDO) office-Urambo district, Tumbi Agricultural Research and Training Institute, Sokoine National Agricultural Library (SNAL) and from the Internet. Analysis of quantitative and qualitative data collected from the survey was done by using Cobb-Douglas production function, gross margin analysis, descriptive statistics and independent-samples t-test statistics.

2.4 Analytical Techniques

2.4.1 Gross margin analysis

Gross margin analysis was crucial to establish whether the two crops provide the same economic benefits. The following empirical model was used.

$$GM = TR - TVC \quad (1)$$

Where; GM = Gross Margin for each crop (TZS/ha), TR = Total Revenue from sale of each crop (TZS/ha). This is given by multiplying quantity produced by unit price, TVC = Total Variable Costs spent on production of each crop (These include labour, inputs). This is given by multiplying quantity of resources by their corresponding unit price.

2.4.2 Cobb-Douglas production function

Partial coefficients for each of the inputs were estimated using the Cobb-Douglas production function. According to microeconomic theory, a production function is a model that is used to formalize the relationship between inputs and outputs as specified in the general form illustrated below.

$$Y_i = f(x_i) \quad (2)$$

Where; Y_i = Represents the output, x_i = Represents variable inputs, and $f(.)$ = functional form

To estimate the parameters different production functional forms such as Cobb-Douglas, translog and the constant elasticity of supply (CES) can be used. In this study a Cobb-Douglas production function was used. Before considering the Cobb-Douglas production function, an examination of the condition for profit maximization was described:

Given the output price (P_y), the marginal value product (MVP) of Y_i can be computed as shown in equation (3) below;

$$MVP = MPP * P_y \quad (3)$$

Where; MPP = Represents marginal physical product, MVP = Represents marginal value product

From the production function (2), a profit function (π) can be generated as shown in the following equation (4)

$$\pi = TVP - TVC \quad (4)$$

Where; π = Represents profit, TVP = Represents total value product, TVC = represents total variable cost

Applying the first order condition (FOC) to equation (4) we get equation (5).

$$\partial\pi / \partial x_i = MVP - MFC = 0 \quad (5)$$

Where; MVP = Represents marginal value of product, MFC = Represent marginal factor cost.

Thus, profit maximization is achieved when MVP equals to the MFC as shown in equation (6). This point represents the optimum use of inputs.

$$MVP = (MPP * P_y) = MVC = P_x \quad (6)$$

Having discussed the conditions for profit maximization, Cobb-Douglas production function is discussed. Analysis of Cobb-Douglas production function was used to examine the influence of factor inputs to tobacco and groundnut farming. The empirical models for tobacco and groundnut enterprises were specified as follows:

In the case of tobacco the empirical model was specified as follows:

$$InQ_i = \alpha_0 + \alpha_1 InA_1 + \sum_{i=1}^{n=3} \alpha_2 InL_i + \sum_{i=1}^{n=3} \alpha_5 InK_i + \varepsilon \quad (7)$$

Where: Q_i is the total output of tobacco of the i^{th} farm (Kg), α_0 is the constant term of the regression, $\alpha_0, \alpha_1, ..., \alpha_6$ are unknown parameters to be estimated, A_1 is the size of land cultivated for tobacco(acres), L_1 is the hired labour used in the tobacco production (man-days), L_2 is the contract labour used in the tobacco production (man-days), L_3 is the family labour used in the tobacco production (man-days), K_1 is the amount of fertilizers used in tobacco production process (bags), K_2 is the amount of tobacco seeds used in the production (gm), K_3 is the amount of pesticides used in tobacco production (Litres), ε is the error term

For groundnut the model was specified as follows:

$$In\ Q_{2=}\ \beta_0 + \beta_1 InA_1 + \sum_{i=1}^{n=2} \beta_2 InL_1 + \beta_4 InK_1 + \varepsilon \quad (8)$$

Where: Q_2 is the total output of groundnut of the i^{th} farm (Kg), $\beta_0, \beta_1, ..., \beta_4$ are unknown parameters to be estimated, A_1 is the size of land cultivated (acres), L_1 is the family labour used in the groundnut production (man-days), L_2 is the hired labour used in the groundnut production (man-days), K_1 is the amount of seeds used in groundnut production process (kg), ε is the error term

3. Results and Discussion

3.1 Profitability Analysis for Tobacco and Groundnut Farming

The profitability analysis was conducted by comparing the two gross margins (i.e. Gross margin of tobacco and groundnut). Independent-samples t-test was used to test the significant difference in the two gross margins at 95% confidence interval. Calculating the difference between total revenues obtained in the previous cropping season (2007/2008) and total variable costs incurred in production and marketing processes was done to get the two gross margins. For tobacco, variable costs incurred were land preparation, farm husbandry, fertilizers, chemicals, transport, burning, curing of tobacco and storage costs. For groundnuts, these involved land preparation, farm husbandry, fertilizers, transport and storage. Results in Table 1 show that a gross margin per acre for groundnut was lower than that of tobacco by 569,231.90 TZS equivalent to $ 497.62.

Furthermore, the independent sample t –test was conducted to compare the two gross margins to evaluate whether there is no significance difference in profitability yielded by tobacco and groundnut farmers. From the analysis (Table 2) in which the hypothesis that tobacco and groundnut farmers do not differ in their profitability, the t statistic under the assumption of unequal variance has a value of 2.756 and the degree of freedom has a value of 76.698 with an associated significance level of 0.007.

This suggests that there is enough evidence to reject the null hypothesis in favour of the alternative hypothesis, that is, there is a significance difference between the two profitability from tobacco and groundnut farmers with the P-value <0.007. However, the low groundnut gross margin can be attributed to usage of local groundnut seeds which are low yielding and more susceptible to pests and diseases as well as low usage of fertilizers and pesticides. Results also show that the market of groundnut was unreliable due to the fact that farmers sold their produce at lower price which did not reflect the production cost.

3.2 Cobb-Douglas Production Function of Tobacco and Groundnut

3.2.1 Input elasticity

Determination of the elasticity's was crucial for the sake of estimating responsiveness of output to inputs. Most of the inputs on the Cob-Douglas model are statistically significant and have the expected signs. Evaluated at the sample mean, the output elasticities with respect to the inputs which included family labour, hired labour, contract labour, fertilizer, size of the land, pesticides and seeds for the Cobb-Douglas production functional form were estimated. The results of Cobb-Douglas production function for tobacco and groundnuts which was analysed using OLS regression method are summarized in Table 3 and 4.

Result revealed that the constant value of groundnut is larger than that of tobacco. Traditional theory of production stipulates that the larger the value of the constant term the more technically efficient the farmers are. However, results also indicate that in groundnut, 1% increase in land size input is associated with 75.7% increase in output while in tobacco it is associated with 39.1% increase in output. This means that land size input in groundnut had more influence in production than in tobacco. The results also indicate that in groundnut, 1% increase in hired labour input it is associated with 39.2% increase in output while in tobacco it is associated with a decrease of 2.1% in output. This means that hired labour input in groundnut had more influence in production than in tobacco. Therefore farmers could be advised to allocate more hired labour in groundnut production than in tobacco production. Other factor inputs such as fertilizer, pesticides and seed have shown a positive influence on tobacco output. Contrary to tobacco production, a 1% increase in seed input in groundnut is associated with a decrease of 13.8% in output. This could be attributed to the fact that most groundnut farmers use local seed varieties, which have shown to have doubtful performance. Generally, the study shows that tobacco yield has the highest responsiveness to seed, followed by land size, fertilizer, family labour, pesticides and contract labour. Compared to groundnut, the yield has the highest responsive similar to land size, followed by hired labour and family labour.

The summation of the partial coefficients of production with respect to every input for homogenous function (all resources varying in the same proportion) is 1.332 for tobacco and 1.055 for groundnut. This represents the returns-to-scale coefficient, also known as function coefficient or total output elasticity. If all factor inputs are varied by the same proportion, the function coefficient indicates the percentage by which output will be increased. In this case, the production function can be used to estimate the magnitude of returns to scale. Constant return to scale holds if the sum of all partial coefficients is equal to one. If this sum is less than one, the function has decreasing return to scale and if the sum is more than one the function has an increasing return to scale. In this study, an increasing return to scale exists in both farming systems, therefore, an increase in all inputs by one percent increases tobacco and groundnut outputs by more than one percent. However, by comparing the two cropping enterprises, if all factor inputs are varied by the same proportion, the percentage by which output will increase in tobacco is larger than that of groundnut.

3.2.2 Marginal value product

Furthermore, in order to assess the condition of producers' profit maximization, Marginal Physical Product (MPP), Marginal Value Product (MVP) and input prices were also estimated. Table 5 and 6 show MPP, MVP and factor price of tobacco and groundnut production, respectively

For profit maximization, the MVP is supposed to equal with the respective unit factor prices. If that condition is satisfied any additional use of input factor which is equal to its MVP will be irrational and will lead to losses.

The result in the above table does not satisfy this condition. Instead, for fertilizer, pesticides and seed the MVP are greater than their respective unit factor prices. This indicates that tobacco production has not reached the optimal use of inputs and could probably benefit by increasing the amount of fertilizer, pesticides and seeds used in production. On the other hand, MVP for labour is smaller than its respective unit price factor, indicating that more labour has been used in tobacco production which is not leading to any profit. This is also supported by results in Table 7 Input elasticity of hired labour has a negative influence on the tobacco output. A 1% increase in hired labour input in tobacco is associated with a decrease of 2.1% in the output of tobacco.

For groundnut, the MVP for labour is greater than the factor price, an indication that groundnut production has not reached the optimal use of labour input. Therefore, groundnut farmers can benefit by employing more labour in their enterprise. This study also shows that farmers have incurred big losses by using local seed varieties. This dictates the need for farmers to use improved and high yielding groundnut seed varieties for increased yield and income.

By comparing the two marginal value products of tobacco and groundnut, there is a larger potential for improving farmers incomes and hence profit maximization through increasing groundnut production that is yet to be exploited. This is due to the fact that only one factor of production in groundnut is not yet used to its optimal, while in tobacco farming three of them have not yet been used efficiently to realise maximum profit. However, this must be used in conjunction with increased access to improved groundnut varieties (with better disease resistance, yield performance and market acceptability) under improved crop husbandry techniques.

3.3 Income Differences between the Two Crops Farming

The independent sample t-test was used to compare the two incomes from tobacco and groundnut farming to evaluate whether there is no difference in income generated. Descriptive statistics given in Table 7 show that income from tobacco farming has a mean income of 2 135 988.33 (TZS) ($ 1 867.26) while for groundnut farming a mean income of 358 648.36 (TZS) ($ 313.53) was recorded. This means that income generated from tobacco was 1 777 339.97 (TZS) ($ 1 553.73) higher compared to groundnut.

According to the test and the pre-specified level of significance there is evidence to reject the null hypothesis in favour of the alternative hypothesis, that is, there is a significance difference between income generated from tobacco and that of from groundnut farming with the P-value <0.000 (Table 8). Other studies done by Mkanta & Chimtembo (2000) have found out that the average net income from tobacco farming was $ 564 per household for the year 1999, (lowest earnings were $ 51, and while highest were $ 2,809). On the other hand, contribution of groundnut produced in dry and wetter areas found an average contribution of TZS 2 113 ($ 2.64) and 3 621 ($ 4.53) respectively (Yanda et al. 2000). These figures have similar implication of income contribution on households by the two crops, whereby tobacco still remains the greater income contribution compared to groundnuts.

4. Conclusion and Recommendation

Based on the results from this study, the null hypothesis of no significant different in profitability received by farmers from the two farming enterprises was rejected in the favour of alternative hypothesis. In other words, the study found that tobacco farming is a more profitable enterprise compared to groundnut farming in the study area.

Following the independent-samples t-test at a significance level of 0.05, there was enough evidence to reject the null hypothesis in the favour of the alternative hypothesis which stated that there is a significant difference between income generated from tobacco and that of groundnut farming with the P-value < 0.000. This implies that income generated from tobacco was higher compared to income generated from groundnut. Furthermore, this study showed that some of the production inputs have negative relationship with the output of tobacco and groundnut. In tobacco farming, hired labour revealed a negative relationship with output although it had a positive relationship in groundnut farming. Therefore, this study suggests that farmers could accrue more profit from hired labour in groundnut farming. But due to the use of local groundnut seed varieties which have questionable yield, farmers have been making losses. This was reflected in the study by the negative response of seed in groundnut output. Therefore there is a need to make sure that improved groundnut seed varieties are available in the study area. Hence, the null hypothesis was rejected in favour of the alternative hypothesis which stated that there is a significant responsive to production inputs on tobacco and groundnut outputs. This study also observed that the absence of organized groundnut marketing through the marketing boards or local

cooperative unions left farmers without assured market outlets and prices. For the time being, the domestic market is not big enough to meet the supply of groundnut though its production is still low.

Despite, the observed performance of tobacco and groundnuts, climate change has been noted as the main constraint for their anticipated yield. Therefore, the study suggests further research works on climate change, mitigation strategies adopted by farmers to counteract its effects in their faming systems and their impact on farm level output.

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Table 1. Gross margins of tobacco and groundnuts

Parameters	**Tobacco**	**Groundnuts**
Total Revenue (TR)	2 143 488.00	340 507.40
Total Variable Costs (TVC)	1 343 502.00	109 753.30
Gross Margins (GM)	799 986	230 754.10

Source: Field Survey data, 2008

Table 2. Independent Samples test for gross margins of tobacco and groundnut farmer

t-test for Equality of Means	**t-value**	**df**	**Sign (2-tailed)**	**Mean Difference**	**Std error difference**	**95% confidence interval of the difference**	
						Lower	Upper
Equal variances not assumed	2.756	76.698	0.007	618753.8798	224528.48138	171632.42496	1065875.33461

Table 3. Cobb-Douglas production function for tobacco

Variables	Coefficients	Std. error	t-sign
α_0 (Constant)	4.355	0.715	0.000
α_1 (Land size)	0.391	0.140	0.007
α_2 (Family labour)	0.124	0.142	0.388
α_3 (Hired labour)	-0.021	0.067	0.762
α_4 (Contract labour)	0.004	0.140	0.976
α_5 (Fertilizer)	0.196	0.099	0.052
α_6 (Pesticides)	0.10	0.105	0.343
α_7 (Seeds)	0.538	0.154	0.001

R square = 65.7%; Total partial coefficient = 1.332; Source: Field Survey data, 2008

Table 4. Cobb-Douglas production function for groundnut

Variables	Coefficients	Std. error	t-sign
β_0 (Constant)	4.577	1.179	0.000
β_1 (Land size)	0.757	0.301	0.015
β_2 (Family labour)	0.044	0.206	0.830
β_3 (Hired labour)	0.392	0.178	0.032
β_4 (Seed)	-0.138	0.184	0.456

R square =62.9%; Total partial coefficients = 1.055; Source: Field Survey data, 2008

Table 5. Marginal value products and unit factor prices for tobacco

Variables	APP (kg/acre)	Input elasticity	MPP (kg/acre)	MVP (TZS)	Unit factor price (TZS)
Labour	5.57	0.143	0.8	1 236.07	2 500.00
Fertilizers	93.93	0.196	18.42	28 574.31	25 000.00
Pesticides	633.01	0.1	63.44	98 392.92	15 000.00
Seeds	141.85	0.538	76.32	118 367.30	*

* Tobacco seeds are given to farmers free of charge; Source: Field Survey data, 2008

Table 6. Marginal value products and unit factor prices for groundnut

Variables	APP (kg/acre)	Input elasticity	MPP (kg/acre)	MVP (TZS)	Unit factor price (TZS)
Labour	10.7	0.436	4.67	2 482.50	1 500.00
Seeds	17.34	-0.138	-2.39	-1 273.00	500.00

Source: Field Survey data, 2008

Table 7. T-test income for tobacco and groundnuts farmers

Variable	Farming enterprises	N	Mean	Std. deviation	Std. error mean
Annual income	Tobacco	60	2 135 988.33	2 056 884.75	265 542.67934
	Groundnuts	61	358 648.36	653 638.77	83 689.86811

Source: Field Survey data, 2008.

Table 8. Independent Samples test for income contribution from tobacco and groundnut

t-test for Equality of Means	**t-value**	**df**	**Sign (2-tailed)**	**Mean Difference**	**Std error difference**	**95% confidence interval of the difference**	
						Lower	Upper
Equal variances not assumed	6.384	70.618	0.000	1777339.9727	278418.58518	1222137.01373	2332542.93162