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ECONOMIC ANALYSIS OF WATERMELON BASED PRODUCTION SYSTEM IN OYO STATE, NIGERIA

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ABSTRACT

The study examined the economic analysis of watermelon based production system in Oyo State, Nigeria. A multistage random sampling technique was adopted in the selection of ninety farmers from the chosen local governments. Well-structured questionnaire was used to obtain information on socio-economic characteristics and other relevant variables. The study data were analyzed by descriptive statistics, budgetary and stochastic frontier production function. The results showed that 94.9% of watermelon farmer in the study area were male and 96.6% of them were married. Watermelon was predominantly grown as sole crop by 52.8% while 47.2% of farmers engaged in intercropping. Budgetary analysis revealed that watermelon intercropping with cassava had higher gross margin (₦258, 367.02/ha) than sole watermelon (₦ 232, 918.06/ha). The benefit/ cost ratio (BCR) of sole watermelon (2.35:1) was greater than watermelon cassava intercropping system (2.13:1). Yield level was positive and significantly influenced by labour input. The level of education was significant and found to contribute positively to technical efficiency while farming experience was found to reduce technical efficiency. Inadequate credit facilities (78%), pest and disease (76.3%), inadequate fertilizer ((69.5%) and high transportation cost ((54.2%) were the prominent constraints to watermelon production in the study area.

Keywords: watermelon based farm, budgetary analysis, stochastic production function.

INTRODUCTION

Watermelon (*Citrullus lanatus*) is one of the most widely cultivated crops in the world at large and the global production in 2002 reached 89.9 million mega grams (FAO, 2003, Huh *et al*., 2008). China was reported to be leading country in production of watermelon followed by Turkey, United States, Iran and Republic of Korea (Huh *et al*., 2008; Wehner and Maynard, 2003). There are over 1,200 varieties of watermelon worldwide and quite a number of these varieties are also cultivated in Africa (Zohary and Hopf, 2000). The global consumption of the crop is greater than that of any other cucurbit. According to Adeoye *et al*., (2007) and Oguntola, (2006), watermelon is the most preferred among five other exotic vegetables examined in Ibadan Metropolis of Oyo State, Nigeria.

Recent report indicated that exotic vegetables production generate higher profit, provided more employment and income to the farmers than those of indigenous vegetables, Knowledge of availability of aggregated farm level resources and differences in their productivities are essential in order to enhance productive capacity of the smallholder farmers (Ajewole and Folayan, 2008). This will indicate the direction of resource use adjustment and allocation (Ogundari and Ojo, 2005). Efficiency measurement is very important because it leads to resource savings, efficiency gains are also important since efficient farms are more likely to generate higher income and thus stand a better chance of surviving (Bravo-Uretar and Rieger, 1991).

Against this background, it is necessary to evaluate the performance of this crop in sole and mixtures, and the factors affecting the productivity in order to determine the profitability of the production. Therefore, this study was undertaken to determine economic efficiency of water melon based system in Oyo State. The study specifically examined socio economic characteristics of the farmers, compare costs and returns structure across the cropping systems, determine the factor affecting production level and technical efficiency of resource use, and identify the constraints faced by watermelon farmers in the study area. This study will serve as a guide to prospective investors on watermelon production investment decisions.

METHODOLOGY

Study area

The study was carried out in Oyo State, which lies within the tropical zone in the rain forest region of southwestern part of Nigeria. It is located between latitude 8.0°N and Longitude 4.0°E of Greenwich meridian of equator. Ibarapa Central and Ibarapa East local Government areas of Oyo State were purposively selected for the study. The areas are peculiar for horticultural crop production and a large percentage of the inhabitants are farmers. The population Figure of Ibarapa central and East are 102,979 and 118,226 respectively (NBC, 2006).

Sampling technique

A multistage sampling technique was used in selecting the respondents. Based on *apriori* information, two local Government areas with highest density of watermelon farmers were selected using purposive sampling technique. The second stage was the random selection of thirty per cent of producers from each local government areas based on the total number of watermelon farmers. In all a total number of ninety

respondents were selected for the interview in which 89 questionnaires were processed for the analysis.

Data collection

Data were collected using structured questionnaire on farmers output, production input variables (farm size, labour used, fertilizer, cost of seed, chemicals, transportation cost, harvesting cost, depreciation and rent). Also included in the data collection were the socioeconomic characteristics of the farmers (age, education, farming experience, household size, credit availability, gender and marital status). All data on resource use, production cost and outputs were converted to per hectare equivalent.

Method of data analysis

Data were analyzed using descriptive and quantitative statistical techniques. Farm budget analysis was constructed to estimate the production cost, revenue and gross margin accruable to the farmers. The equation used in estimating the various parameters were defined below:

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

$$TC = TFC + TVC \quad (2)$$

$$NP = TR - TC \quad (3)$$

Where:

TC = total cost, TFC = total fixed cost, TVC= total variable cost
GM = Gross margin, TR = Total revenue, NP = Net profit
Depreciation on tools was calculated by the straight line method as follows:

Depreciation = (cost of purchase - salvage value)/useful life.

Stochastic frontier

The model was employed to examine factors influencing output of watermelon among farmers in the study area and the technical efficiency of resources employed. The main strength of the model is that it deals with stochastic noise and permits statistical test of hypothesis pertaining to production structure and degree of efficiency. Efficient transformation of inputs into output is characterized by the production function, which shows the maximum output obtainable from various input vectors. The stochastic production function is defined as:

$$Q = f(X_i\beta) \exp(V_I - U_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:

Q = Quantity of Watermelon output
X_I = Vector of input quantities
β = vector of parameters to be estimated
Exp = exponential function
V_i = random variables
U_i= non negative random variables which are account for technical inefficiency in production.

The random errors, Vi, are assumed to be independently and identically distributed and independent of Ui's. V capture variations in output due to factors outside the control of the farmer like fluctuations in input prices, farm size. The U's are also assumed to be independently and identically distributed ((Meeusen and van den Broeck, 1977, Aigner *et al*., 1977). U's are factors under farmers control, it follows half normal distribution and it is a non negative random variable called technical inefficiency effect associated with the technical efficiency of watermelon production. It captures the variation in output due to age, household size, farming experience, extension visit and level of education.

Technical efficiency (TE) of an individual farmer is defined as the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by the farmer. Thus the technical efficiency of farmer i in the context of the stochastic frontier production function (1) is:

$$TEi = Yi/Yi^* = f(X_i; \beta) \exp(V_I - U_i)/f(X_i\beta) \exp(V_I) \ldots (5)$$

$$TE = \exp(-U_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where Yi is the actual output and Yi* is the frontier output (potential output). The value of the technical efficiency lies between zero and one. The most efficient farmer will have value one, whereas the less efficient farmers will have their efficiencies lying between zero and one.

RESULTS AND DISCUSSIONS

Socioeconomics characteristics of respondents

The result of the analysis (Table-1) showed that most of the respondents were male (94.5%) while only 5.5% were female. This indicates dominance of male folk in watermelon production. Seventy one percent of respondents were less than 50 years old revealing presence of young and middle aged individuals who are known to be active and innovative. They are also likely to be opened to new ideas. Furthermore, majority of the farmers (96.7%) were married and are therefore expected to be stable and settled career wise. About seventeen percent of the respondents did not have any formal education, 23.6% attended primary school, and 27.0% had secondary school education while 32.5% had tertiary education. This shows high level of literacy in the study area. The result also indicated that 47.2% of the respondents had been in the practice of watermelon production for more than 5 years, 40.4% of them had grown water melon between 6-10 years while 12.4% had grown water melon between 11-15 years. The mean years of water melon production experience was 6 years. This further shows that water melon production is a newly introduced profession of the people in the study area. The mean household size was 6. This indicates that the household size of respondents were relatively large.

Credit facilities were not enjoyed by 64.0% of respondents. This may be due to the absence of micro

financial institution in the area. Agricultural extension services reached 79.8% of the farmers in the study area. This will enable the farmers to have access to improved technologies involved in production of the crop.

Table-1. Socioeconomic characteristics of respondents.

Personal characteristics	Categories	Percentage
Sex	Male	94.5
	Female	5.5
Age	Below 30	3.4
	30-40	36.0
	41-50	32.6
	51-60	25.8
	Above 60	2.2
Marital status	Single	2.2
	Married	96.7
	Separated	1.1
Educational qualification	No formal education	16.9
	Primary	23.6
	Secondary	27.0
	Tertiary education	32.5
Experience	1-5 years	47.2
	6-10 years	40.4
	11-15 years	12.4
Household size	1-3	16.9
	4-6	46.1
	7-9	27.0
	Above 10	10.0
Access to loan	Yes	36.0
	No	64.0
Extension visit	Yes	79.8
	No	20.2

Cropping practices employed by farmers

Watermelon was predominantly grown as sole crop by (52.8%) while 47.2% of farmers engaged in intercropping. Watermelon was intercropped with cassava, maize, tomato and pepper in the study area. About 73.8% intercropped with cassava, 14.3% with maize, 7.1% with pepper and 4.8% with tomato. The reasons given for intercropping watermelon with other crops were improved income (62%), increased fertility (19%), prevention against crop failure (14%) and for maximum use of land (5%) (Table-2). Although sugar baby and kaolack were the most grown varieties of watermelon in the area. Majority, (96%) preferred variety Sugar baby (Table-2). This was attributed to the following: marketability, sweetness, size and storability. With respect to the method of seed planting, it was discovered that direct seeding method was the most popular technique adopted by most of the sampled farmers.

About 39.3% of the farmers had between 1-2ha, 37.1% had less than 1 ha and only 3.4% had more than 6 hectares. This shows that most of the farmers operated small scale enterprise. The Table also shows that majority of the respondents relied on hired labour (50.8%) for their farm operation while 35.6% depend on self and hired labour. Majority of the farmers carried out an average of two weedings in water melon production. This is because watermelon suppresses weed growth after full establishment. Moreover, more than 79.8% percent of the farmers did their weeding manually while about 13.5% combined chemical weeding with manual weeding (Table-2).

Table-2. Cropping practices adopted by farmers.

Characteristics	Categories	Percentage
Cropping system	Sole watermelon	52.8
	Watermelon intercrop	47.2
Intercrop System	Water melon - cassava	73.8
	Watermelon - maize	14.3
	Watermelon-pepper	7.1
	Watermelon-tomato	4.8
Reasons for intercropping	Improved income	62.0
	Increased fertility	19.0
	Prevention against crop failure	14.0
	Maximum use of land	5.0
Watermelon variety	Sugarbaby	96.0
	Kaolack	4.0
	Charlton gray	-
Method of seed planting	Direct seeding	97.8
	Transplanting	2.2
Farm size	Below 1 ha	37.1
	1-2 ha	39.3
	3-4 ha	13.5
	5-6 ha	6.7
	Above 6 ha	3.4

Costs and returns structure

The estimates of the budgetary analysis for sole and watermelon intercrop are presented in Table-3. The average gross margin generated by sole watermelon farms was ₦ 232, 918.06 per hectare which was lower than ₦ 258, 367.02 per hectare recorded on farms that intercropped watermelon with cassava. Also, the net margin was higher by about ₦ 25, 448.96 per hectare for farms that intercropped watermelon with cassava. Similar trends (higher income with intercropping) were also observed by Aihonsu (2002) and this may probably be the reason why watermelon-cassava intercrop was popular with the farmers. However, the benefit to cost ratio of sole watermelon (2.35) was higher than that of the intercropping system (2.13).

In term of the cost structure, hired labour accounted for almost 90 percent of total variable cost for both sole watermelon and intercrop enterprises, while seed, fertilizer and chemical accounted for the rest. This probably indicates high labour requirement of agricultural practices. Watermelon production is profitable based on the fact that an average farm in the area investigated recorded over 100 percent returns on investment.

Table-3. Average cost and profitability per hectare of watermelon production.

Variables	Sole watermelon farm		Watermelon - cassava farm	
	Amount ₦ /ha	% of VC/TVC	Amount ₦ /ha	% of VC/TVC
Revenue				
Value of watermelon output	400,000.00	100	350,000	73.0
Value of other crops	-	-	130,108.69	27.0
Total Revenue (TR)	400,000.00	100	480,108.69	100
Variable cost				
Seed	6,000	3.6	14,628.63	6.6
Fertilizer	10,000	6.0	10,000	4.5
Chemicals	1,200.00	0.72	1,200.00	0.54
Hired labour	149,881.94	89.71	195,913.04	88.4
Total variable cost	167,081.94	100	221,741.67	100
Gross margin/ha	232,918.06		258,367.02	
Fixed cost				
Rent on land	2,000		2,000	
Depreciation	1,333		1,333	
Total fixed cost	3,333		3,333	
Total cost (TC)	170,414.94		225,074.67	
Net margin/ha	229,585.06		255,034.02	
B/C ratio	1: 2.35		1: 2.13	

Source: Computed from survey data 2009.

Factors that influences output and technical efficiency of watermelon farmers

The result of the estimated production frontier and technical efficiencies were presented in Table-4. The result showed that estimated coefficient of labour input was positive and significant at 1% level. This means that the output will increase as the level of these independent variables increases. This conforms to the findings of Adebayo (2006), Ajibefun and Abdulkadri (2004), Ajibefun *et al*., (2002), and Ogundele and Okoruwa (2006). They showed that hired labor contributed positively to farm productivity in the dry savannah and humid forest agro-ecological zones of Nigeria.

For technical inefficiency effect, the coefficient of household size variable showed a positive relationship and was not significant. This suggests that increase in household size may increase technical inefficiency in the study area. The coefficient of education showed a negative relationship with the predicted technical inefficiency effect and was significant at 5% level. This implies that increase in years of schooling reduces technical inefficiency or improves efficiency. This agrees with the findings of Adetiba (2005) and Ajibefun and Abdulkadri (2004) and Kehinde (2005). They confirmed that education was key to enhanced productivity among farming households in the humid forest, dry savannah and moist savannah agro-ecological zones of Nigeria.

The positive coefficient of experience which was significant at 10% level indicates that any increase in years of experience increases inefficiency. This indicates that more experienced farmers tend to be less efficient in watermelon production in the study area. This conforms to the findings of Ajewole and Folayan (2008). They reported similar trend in dry season leaf vegetable production among small holders in Ekiti State, Nigeria. The coefficient of extension visit was also negative though not statistically significant. This implies that farmers that received more extension visit tend to be more efficient. The positive coefficient of age also indicates that older farmers tend to be less efficient in the production of water melon. Table-5 summarized the TE distribution of the studied farmers. There were variation in the level of efficiency among the farmers ranging from a very low 27.56% to 59.1% with a mean efficiency of 34%. However, 14.4% of farmers had TE of 40% and above.

Table-4. Estimate of the stochastic production function.

Variable	Parameter	Coefficient	t-value
Frontier production function			
Constant	β_o	0.33	4.54**
Ln seed quantity	β_1	-0.61	-4.02
Ln chemical quantity	β_2	-0.14	-1.1
Ln Fertilizer quantity	β_3	-0.29	-9.74
Ln farm size	β_4	0.44	6.22
Ln Labour input	β_5	0.10	4.99***
Technical inefficiency function			
Constant	$б_o$	0.31	7.7**
Age	$б_1$	0.11	1.40
Household size	$б_2$	0.11	0.08
Farming experience	$б_3$	0.15	1.66*
Extension visit	$б_4$	-0.16	-1.03
Level of education	$б_5$	-0.84	2.22**
Variance parameters			
Sigma square	$б^2$	0.73	5.57
Gamma	Γ	0.41	-3.10
Log likelihood	Lif	-0.66	

***, **,* Significant at 1%, 5% and 10% **significant at 0.01

Table-5. Distribution of technical efficiencies.

Efficiency	No. of farmers	Percentage
20 - 29.99	24	26.7
30 - 39.99	53	58.9
40 - 49.99	10	11.1
50 - 59.99	3	3.3
Total	90	
Mean	34	
Minimum	27.56	
Maximum	59.1	

Constraints to watermelon production

Constraints to watermelon production in the study area are shown in Table-6. Inadequate credit ranked first among the constraints. This is closely followed by pest and disease problem. There are also problems of inadequate supply of inputs like fertilizer and seed among other constraints faced in the study areas.

Table-6. Constraints to watermelon production.

Constraints	Percentage
Inadequate credit	78
Pest and disease problem	76.3
Inadequate fertilizer	69.5
Labour shortage	67.8
Inadequate transportation	54.2
Seed Procurement	44.1
Marketing problem	39
Pilfering	33.9
Inadequate technical know how	23.7

CONCLUSIONS AND RECOMMENDATIONS

The study has shown that watermelon production is profitable in the study area. The study further revealed that the production level was significantly influenced by labour input while level of education was identified as significantly contributing towards increased farmer's efficiency. Based on the findings from the study, the following recommendations are made:

- More research on watermelon should be encouraged especially in the areas of disease and pest control. This will solve the problem of infestation during the growing period; and
- Farmers should organize themselves into groups through which they can get access to production inputs.

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