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Economic Analysis of Plantain Production in Derived Savannah Zone of Osun State, Nigeria

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Abstract: The study was conducted to examine the economics of plantain production in Iwo and Osogbo zones in the derived savannah zone of Osun State, in Nigeria. The objectives were to identify the characteristics of plantain farms, forecast the trend in farm size and analyze the costs and returns to production of plantains in order to determine its performance and how it can be improved. A multistage sampling technique involving purposive and random sampling was used in the study. Primary data collected with the aid of a structured questionnaire in 2009 on production inputs and output were analyzed using descriptive statistics, Markov chain process and budgetary technique. Descriptive analysis showed that all farms in the study area grew more than one variety of plantain, a majority (72%) of the farms adopted the recommended spacing of $3m^2$, all the farms were small scale and more than half of them followed the recommended desuckering policy of 4-5 plantain suckers per stool. Markov chain analysis showed an upward trend in the sizes of plantain farms in the area of study until the year 2027 when equilibrium would be attained with mean farm size of about 1960.5 plantain stands. Budgetary analysis results revealed that plantain production was profitable in the zone. The results further showed that the net return accruing to an average plantain farmer was N65, 781.67 per ha per annum. In order to improve production of plantain, farmers require to access finance in order to acquire farm inputs, hire labour, and acquire suitable farmland.

Key words: Derived savannah, economics analysis, markov chain, plantain production, profitability

INTRODUCTION

Banana and plantain (*Musa* spp) are important food crops in sub-Sahara Africa, providing more than 25% of the carbohydrate and 10% of the calorie for approximately 70 million people in the region (Swennen, 1990). Plantain is cultivated along the Coast of West and Central Africa stretching from Guinea to the Democratic Republic of Congo and Central Africa Republic (Swennen, 1990). The major producing countries with an annual output exceeding a million tonnes include Nigeria, Ghana, Cote d'Ivoire and Cameroon. Table 1 shows the Production and consumption figures and the importance of plantain relative to other starch staples. Food and Agricultural Organization, FAO (1997) indicates that Nigeria is one of the major producers of plantain in West and Central Africa, but the per capita consumption for Nigeria is the lowest in the region, implying the existence of market potential for increased production in the country.

The importance of plantain and banana cannot be over emphasized. Benjamin *et al*. (1995) showed that both rural and urban populace consume food prepared from plantain in many different forms in Ghana. Plantain and their products are in high demand, and this is reflected by the relatively high price of plantain compared with other starch staple crops with the exception of yam in Nigeria.

The production of plantain is relatively static despite this high demand partly as a consequence of the increased incidence of black sigatoka disease, which has a strong influence on yield, and the green leaves, and other diseases and pests (Ramsey *et al*., 1990). Declining soil fertility has also been implicated (IITA, 1997) as a cause for low production of plantain.

Swennen and Vuylsteke (1991) observed that Africa contributes about 50% of world production of plantain. The gross value of production of this crop ranks first among food crops in sub-Sahara Africa. The demand for plantain is increasing in West and Central Africa (Wilson, 1987). However, its cultivation is threatened by black sigatoka. This disease was accidentally introduced into Africa and first observed in Zambia in 1973 (Raemaekers, 1975). In 1979, black sigatoka spread in Gabon and

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Table 1: Production of some staple food crops in West and Central Africa and per capita consumption of plantain

	Production (1000 Tonn)					
Country	Plantain	Cassava	Yam	Rice	Maize	Consumption of plantain (kg)
DR Congo	2,400	16,800	300	400	1,100	40
Ghana	1,800	7,100	2,200	200	1,000	92
Nigeria	1,700	31,400	23,200	3,100	5,700	15
Cote d'ivoire	1,400	1,600	2,900	800	600	83
Cameroon	1,000	1,700	100	50	750	72
Guinea	400	600	90	700	80	49
Gabon	300	200	140	01	30	153

FAO Production Statistics (1997)

spread towards Cameroon and Congo in 1984 and to Nigeria and other West African countries in 1986 (Wilson and Buddenhagen, 1986). Black sigatoka destroys plantain leaves, which results in reduced yield. The disease is a major constraint to plantain cultivars collected from West and Central Africa, America and the Philippines. IITA started a genetic improvement programme in 1987, targeting the incorporation of durable host-plant resistance to black sigatoka in plantain and banana. Several black sigatoka resistant tetraploid hybrids (TMPx) were produced by crossing triploid plantain cultivars with wild and cultivated diploid bananas (Vuylsteke *et al*., 1993a). The selected tetraploid TMPx germ plasm with black sigatoka resistance has higher bunch weight, shorter plant stature and earlier maturity than their plantain parent (Vuylsteke *et al*., 1993).

Olufokunbi (1978), while working on market potentials of plantain sucker observed that Nigerian farmers do not buy plantain suckers. They obtain them from their own planting or from neighbours. This makes farmers to plant whatever materials they get with resultant variability in yield, and quality. The realization of this disadvantage and the fact that increased yields cannot be obtained without the use of certified and high yield seeds stimulated the development of a rapid plantain sucker multiplication tissue culture technique at the University of Ife. The plantain suckers multiplied through this technique are selected for high yield and for disease resistance. If Nigerian farmers would plant these suckers, there would be an improvement in farmers' productivity, income, and profit level, *Ceteris paribus.* In commercial enterprises, profit is a major motivating factor. The profit and profitability levels of farm enterprises may be influenced by the farm size. This is because it is assumed that with larger farm size the cost of production is spread across the number of hectares and as such profitability is increased (Adesina, 1981). Thus, it is necessary to examine the trend in size of farms to determine their inter-temporal performance. Markov chain procedure has been used to make estimates of the number and distribution of firms by size (farm size) for a number of industries, including segments of agriculture (Agbadudu, 1984; Onyenwaku and Alarms, 1988; Oguntola, 1991). Alimi *et al.* (2007) also used Markov chain process to determine the trend in plantain farm size in the rain forest zone of Osun State, Nigeria.

One of the advantages of plantain cultivation is that it does not require the use of heavy and costly farm machinery. Ndubizu (1985) noted that the other advantages of plantain crop production are its gestation period of between 14-20 months that can be considered extremely low when compared with other permanent crops; cost is incurred only once and as a perennial, several harvests can be made from one planting; unlike other annual crops, harvesting costs and on farm processing costs are minimal; income per hectare from plantain is higher than what is obtained in other carbohydrate food staples (Ndubizu, 1985). Marriot and Lancaster (1993) claimed that the cost of production of plantain in terms of cost per hectare per tonne and per unit of food energy is the lowest compared with other crops grown in traditional agricultural system. Since one of the main goals of an entrepreneur is profit maximization, any crop that has a relatively average to low cost of production is worth examining for possibility of profit enhancement.

It was also noted that plantain is produced mainly in bush fallows, home gardens, and backyard and as intercrop with cocoa and coffee where it serves as shade for young seedlings rather than on commercial basis. In this situation, production was basically for family consumption. Nowadays, plantain is produced for the market and inputs for its production are obtained from the market. Compared to Alimi *et al*. (2007), this present study, although use Markov chain process for plantain farm size trend, but in a different agro climatic zone (derived savannah). It also looks at the profitability of plantain production as a commercial agricultural enterprise in derived savannah zone of Osun State, Nigeria.

MATERIALS AND METHODS

Study area and sampling procedure: The study was conducted in Iwo and Osogbo zones in the derived savannah zone of Osun State. Data were collected in December 2009. The primary occupation in the area is farming. The tropical climate in the area favours the

growth of some varieties of annual crops, which include yam, cassava, maize, rice, cowpea, and perennial crops such as cocoa, kolanuts, plantain, and palm produce. Multistage sampling technique was used in selecting plantain farmers in the area. The first stage consisted of selecting five local Government Areas (LGAs) using purposive sampling technique based on popularity in plantain production (OSSADEP, 1997). The second stage involved a random selection of four villages from each LGA and the third stage involved a random selection of five plantain farmers from each village. An individual was considered to be a plantain farmer if plantain was one of the crop enterprises engaged in. In all a total of one hundred plantain farmers were interviewed. Primary data for the study were collected by administering a structured questionnaire that covered characteristics of farms, quantity and prices of inputs and output.

Analytical technique: The data collected were analysed using descriptive statistics (frequency distribution, median, and percentages) for characteristics of the farms, Markov chain process to predict the inter-temporal trend in mean and median farm sizes of plantain farms and budgetary technique to determine the profitability of plantain production. Revenue of the farm was computed as monetary value of the total farm output either consumed by the farmers' household or given out as gifts or reserved for other purposes. The total revenue is equal to the quantity of output multiplied by the price per unit of the produce. Cost of inputs associated with output was considered based on the principle of opportunity cost. The cost of using owned resources such inherited farmlands, owned labour, owned capital etc. were considered. The cost components to be considered include hired labour, rent on land, depreciation on purchased tools or equipment, hired cost of implements, cost of harvesting operations, handling and transportation, purchased modern consumable inputs such as fertilizers, herbicides, pesticides and planting materials (suckers). A cost (imputed cost) was assigned to factors of production that the farmers neither hired nor purchased because they already owned them. This included family labour, family land, owned capital and suckers separated from their mother plant, Depreciation, which is the part of the costs of the fixed assets consumed during a given period, was charged using the straight line method. Profit was computed as the difference between revenue and the cost of production. Gross margin was estimated using the expression:

$$GM = p_i q_i - r_i x_i \quad (1)$$

where,

GM = gross margin (N)

i = i-th farm in the sample

P_i = average price of plantain and sucker (N)

q_i = average quantity of plantain bunches and suckers produced

r_i = average price of variable inputs (N)

x_i = average quantity of variable inputs used(kg)

Subsequently, a net return was obtained from gross margin.

$$\text{Net returns} = GM - TFC \quad (2)$$

where, TFC = Total fixed cost

Various ratios were computed to ascertain the extent of the profitability of plantain enterprise namely:

- Operating expense ratio = Total Variable Cost/Gross Revenue
- Return Per Naira outlay = NFI/TC
- Benefit Cost Ratio (BCR) = Total Revenue (TR)/Total Cost (TC)
- Labour efficiency measure = Value of total output/ Total wage bill

A project is viable, if its benefit cost ratio is equal to or greater than 1 and at the particular discount rate. The higher the BCR, the more viable is the investment. Labour efficiency method was employed to show whether labour was efficiently managed in the zone.

RESULTS AND DISCUSSION

Farm characteristics: One hundred copies of questionnaire were administered. Fifteen copies that contained insufficient information needed for the analysis were dropped, leaving only data from eighty-five respondents for processing and analysis which were considered adequate. Table 2 presents the frequency distribution of plantain farmers by farm sizes for 2008 and 2009 in derived savannah zone. The results revealed that more than half (56 and 51% for 2008 and 2009, respectively) of the respondents cultivated between 1-1000 stands in the two years, respectively. The mean farm size in 2008 was 1120.6 stands and 1200.5 stands in 2009 (Table 2). The median farm size class was 1001-2000 stands in each of the two years. The results show that all the farms were small-scale. The method of land acquisition identified inthe study area includes purchase, leasehold, inheritance or gift (Table 2 and 3). Land is acquired mainly through purchase (40%), while each of inheritance and leasehold carries equal proportion (30%). Although, land was a constraint in some communities, inadequate finance for the acquisition of farm inputs and payment of hired labour was the major constraint

Table 2:Farm size of plantain farms in derived savannah zone

Farm size	Distribution (%) 2008	2009
Farm sizes (Stands) categories		
1-1000	56	51
1001-2000	30	32
2001-3000	10	13
3001-4000	04	04
Mean	1120.6	1200.5

Table 3: Farm characteristics of plantain farms in derived savannah zone

Characteristics	Distribution (%) in 2009
Land acquisition	
Purchase	40
Leasehold	30
Inheritance/Gift	30
Spacing adopted	
2.0-2.9	02
3.0-3.9	72
4.0-4.9	24
5.0-5.9	02
Mean 3.1	
Varieties grown	
Traditional Plantain	17.1
Koloko	11.1
Asogba	21.1
Akunlebe	12.7
Ayesomeji	23.5
Hybrid	14.2
No of plants per stand	
2-3	27.3
4-5	61.6
6-7	11.1
Mean	3.2
Soil conservation practices adopted	
Mixed cropping	32.8
Fertilizer	53.4
Manuring	6.9
Bush Fallowing	6.9
Agricultural system practiced	
Sole cropping	39.0
Inter cropping	61.0

Field survey (2009)

militating against increased plantain production in most communities where land was not a limiting factor.

The study further revealed that 72% of the respondents used the spacing bracket of 3.0-3.9 m^2, with a mean of 3.1 m^2 suggesting that farmers in the zone adopted recommended spacing and are expected to obtain high output of plantain per unit area. About 61.6% of the respondents had 4-5 plantain suckers left behind per stool. This is in line with literature, which states that to improve yield, the number of plants per stand must be controlled, as much as possible after the first harvest to eliminate competition (Ogazi, 1982). The average number of plantain suckers left behind per stool is 3.2 stands. The study showed that all the respondents grew more than one variety of plantain. About 17.2% of the respondents grew traditional plantain called "Agbagba", 23.5% of the farmers cultivated the new cultivar called "Ayesomeji" (double headed). About 14.2% planted hybrid; which may have positive impact on the farmers' profitability because the gestation period of hybrid cultivar is shorter and it attracts higher prices compared to other varieties. Various soil conservation practices under different categories of farming systems have evolved over time (Olayide *et al.*, 1981). These include mulching, bush fallow, mixed cropping, fertilizer, manuring etc. None of the farmers used mulching as a type of soil conservation practice; the reason may be because mulching is labour intensive and may require extra hands for biomass production. In the zone, out of 58 farmers that carried out one form of soil conservation method or the other, 53.4% of the respondents applied fertilizer to maintain soil productivity over a time. Not less than 32.8% of the respondents used mixed cropping methods of conserving soil nutrient. Further investigation showed that among the crops intercropped with plantain are yam, cocoyam and groundnut. These have short life cycle and do not compete with plantain. Maize is not included because it delays plantain harvest for two months due to the falling of its pollen grains on plantain leaves at tasseling stage. Kola-nut and cocoyam are said to be good intercrop. In this study, the majority (61%) adopted intercropping system.

Markov chain analysis results for farm size: The movement of plantain farmers from one farm size category to another between the two periods (2008 and 2009) is presented in Table 4. The farm size cultivated by the plantain farmers was grouped into four according to crop stands. 1- 1000, 1001-2000, 2001-3000, and 3001-4000 stands categories. The first cell on the first row (S_1S_1) contains the number of plantain farmers (42) that cultivated between 1 and 1000 stands in the first period (2008) and still remained in the same category in the second period (2009). The figure in the second cell of the first row (S_1S_2) represents the number of plantain farmers (8) in the farm size category 1-1000 stands in the first period, but had moved to 1001-2000 stands farm size category in the second period. The entry (0) in the third cell of the first row (S_1S_3) implies that there was no farmer in the 1-1000 stands farm size category in 2008 that had moved to 2001-3000 stands in the second period (2009). The same applies for the entries in the fourth cell and for other rows of the transition matrix. The transition probability matrix corresponding to the transition matrix of Table 4 is shown in Table 5. The entries in the cells on the principal diagonal of Table 5 indicate the tendency for the farmers to remain within a given category of farm size. These entries show that there was a strong tendency (0.84, 0.72, 0.74 and 0.50) for those cultivating farm size (between 1-1000, 1001-2001, 2001-3000 and 3001- 4000 stands) respectively to remain there. It means that for a proportion of 0.84 in the first cell of the principal diagonal (S_1S_1) for example, as many as 84% of the farmers remained in that category in the second period (2009). The proportion in the second cell of the principal diagonal

Table 4: Transition matrix for farm size (stands) categories

	2009				
Farm size (Stands) categories 2008	S_1 1-1000	S_2 1001 -2000	S_3 2001-3000	S_4 3001-4000	Total 2008
S_1 1-1000	42	8	0	0	50
S_2 1001-2000	4	18	3	0	25
S_3 2001-3000	0	1	6	1	8
S_4 3001-4000	0	0	1	1	2
Total 2009	46	27	10	2	85

Field survey (2009)

Table 5: Transition probability matrix for farm size

	2009			
Farm size (Stands) categories 2008	S_1 1-1000	S_2 1001-2000	S_3 2001-3000	S_4 3001-4000
$S_1$1-1000	0.84	0.16	0.00	0.00
$S_2$1001-2000	0.16	0.72	0.12	0.00
$S_3$2001-3000	0.00	0.13	0.74	0.13
$S_4$3001-4000	0.00	0.00	0.50	0.50

Field survey (2009)

(S_2S_2) corresponding to farmers cultivating 1001-2000 stands is 0.72. This implies that 72% of the farmers that cultivated 1001-2000 stands in 2008 remained in this category in 2009. The proportions in the cells to the right of each of the cells in the principal diagonal indicate the chances of moving to higher categories than that of the principal diagonal cell. Similarly, the proportions in the cell to the left of each of the cells on the principal diagonal indicate the chances of moving to lower categories than that of the principal diagonal cell. For instance, the cells to the right of the first cell on the principal diagonal (S_1S_2, S_1S_3 and S_1S_4) contain 0.16 and two zeros for 1001-2000, 2001-3000, and 3001-4000 stands, respectively. This implies that the probability of farmers who cultivate 1-1000 stands in period one to move to 1001-2000 category and higher ones in period two is low. These low chances of moving to higher categories found among the farmers will not bring about the much - desired increase in plantain production, unless urgent steps are taken to reverse the trend by attending to constraints in production.

Equilibrium values, actual and projected pattern of change in farm size cultivated by plantain farmers: Projection of the structure, which the farm size of the plantain farmers would eventually assume if the trend observed on the field during the two periods (2008 and 2009) continues through time, shows that equilibrium will be attained in the year 2027 (Table 6). When the proportions of farmers in different farm size categories at the initial year were compared with that of the equilibrium year, each of the proportions of farmers in 1-1000 (0.56) and 1001-2000 (0.30) farm size categories will decline to 0.28. The proportion of those in the farm size categories of 2001-3000 and 3001-4000 would grow from 0.10 and 0.04 to 0.32 and 0.12, respectively. According to the results, the mean farm size among the plantain farmers overtime time shows an upward trend in farm size. At equilibrium, the mean farm size would be 1960.5 stands per farmer compared to 1180.5 stands per farmer at the initial or starting year (2008). The median for the farm size lies within 1001-2000 farm size category. This reveals that in the long run at least half of the farmers would cultivate between 1001-2000 farm sizes. The results further show that plantain farmers in the derived savannah are small-scale holders since the average farm size is less than 11,111 stands (10 ha) (Adesina, 1981).

Budgetary analysis results: The estimated costs and return of plantain growers cultivating 1.0 hectare on the average in the zone were N 57,023.19 and N122, 804.86 per annum, respectively (Table 7). Among the cost components, cost of labour had the largest share of the total cost (60.3%), followed by cost of consumable farm inputs (26.4%). Revenue from plantain had the highest share (91.4%) of total revenue, whereas the total revenue on the average was N 122,804.86, while the gross margin and net income or return to management were N67, 042.31 and N 65, 781.67, respectively. The profit margin percentage was 53.6%, while return per naira outlay was N 1.3 implies that for every N 1 invested in plantain production enterprise there is a return of N 1.3 to the enterprise and the operating cash expenses ratio was Table 45.4%, which connotes that 45.4 % of the gross revenue was used to cover the operating expenses. About 55% of gross revenue went to the farmer's equity and unpaid labour and management. The benefit cost ratio and labour efficiency analysis were 2.2 and 3.6, respectively. This shows that output earning per N 1 expenditure on labour was N 3.6 showing that labour was well managed. These measures of performance indicate that plantain production in the study area is viable and profitable.

Table 6: Actual and projected structure of farm size among plantain farmers

Year	1-1000	1001-2000	2001-3000	3001-4000	Total	Mean	Median
2008+	0.56	0.30	0.10	0.04	1.0	1180.5	1-1000
2009*	0.51	0.32	0.13	0.04	1.0	1260.5	,,
2010	0.47	0.33	0.16	0.05	1.0	1330.5	1001-
2011	0.44	0.33	0.18	0.06	1.0	1415.5	2000
2012	0.42	0.33	0.20	0.07	10	1455.5	,,
2013	0.40	0.33	0.21	0.06	10	1520.5	,,
2014	0.38	0.32	0.23	0.07	10	1595.5	,,
2015	0.37	0.32	0.24	0.07	10	1615.5	,,
2016	0.36	0.31	0.25	0.08	10	1670.5	,,
2017	0.35	0.31	0.26	0.08	10	1690.5	,,
2018	0.34	0.30	0.27	0.09	10	1745.5	,,
2019	0.33	0.30	0.28	0.09	10	1765.5	,,
2020	0.32	0.30	0.29	0.10	10	1835.5	,,
2021	0.31	0.29	0.29	0.10	10	1815.5	,,
2022	0.31	0.29	0.30	0.11	10	1890.5	,,
2023	0.30	0.29	0.30	0.11	10	1885.5	,,
2024	0.30	0.29	0.31	0.11	10	1910.5	,,
2025	0.29	0.28	0.31	0.11	10	1890.5	,,
2026	0.29	0.28	0.31	0.12	10	1940.5	,,
2027**	0.28	0.28	0.32	0.12	10	1960.5	,,
2028	0.28	0.28	0.32	0.12	10	1960.5	,,

Field Survey (2009); +: Actual year; *: Stating (initial) state probability; **: Equilibrium probability vector

Table 7: Average costs and returns (N) to plantain farmers in derived savannah zone for 2008/2009 cropping season

Item	Mean amount(N)	Percentage of Revenue/ Cost
Revenue		
Revenue From Plantain	112,354.40	91.4
Revenue From Suckers	10,450.46	8.5
Total Revenue (TR)	122,804.86	
Variable costs		
Rent On Land	1,005.22	1.8
Cost Of Labour	34,407.63	60.3
Consumable Farm Inputs	15,026.72	26.4
Transport Cost	5,322.98	9.3
Total Variable Costs (TVC)	55,762.55	97.8
Gross margin (GM) = TR-TVC	67,042.31	
Fixed cost		
Depreciation on tools	1,260.64	2.2
Total Fixed Cost (TFC)	1,260.64	2.2
Total costs (TC) = (TFC+TVC)	57,023.19	
Net Income (NI) = (GM-TFC)	65,781.67	
Profit Margin (%) = NI/TR		53.6
Return Per Naira Outlay (N) NI/TC		1.3
Operating Expense Ratio (%) = TVC/TR		45.4
Benefit Cost Ratio (BCR) = TR/TC		2.2
Labour Efficiency = TR/Labour Cost		3.6

Field Survey (2009)

CONCLUSION AND RECOMMENDATION

The study employed descriptive statistics, Markov chain process and budgetary technique to analyse the characteristics of plantain farms, forecast the trend in farm size and costs and returns to production. All respondents grew more than one varieties of plantain and the majority (72%) of the respondents adopted the spacing of 3.0-3.9 m^2 with a mean of 3.1 m^2. Budgetary analysis results show that plantain production in the area is viable and profitable with net return of N 65781.67. Plantain farmers in the study area have a great potential to boost local production through increase in the sizes of plantain farms until the year 2027 when equilibrium would be attained at about 1960.5 plantain stands. This could be achieved by use of improved suckers, provision of rural infrastructures such as road that will facilitate easy movement of inputs to the farm and output from the farm to markets.

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