

ECONOMIC ANALYSIS OF PLANTAIN PRODUCTION IN THE NIGER DELTA REGION, NIGERIA

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ABSTRACT

This study conducted the economic analysis of plantain production in the Niger Delta region of Nigeria to understand the production process and ensure increased production to satisfy the domestic and export demand and also generate foreign exchange for the country. The objectives of the study were to determine whether plantain production generated a positive Net Present Value; an Internal Rate of Return which is greater than the opportunity cost of capital and a Benefit Cost Ratio which is greater than unity. It tested the sensitivity of the estimated decision ratios to changing values of the yield of plantain and the components of costs and benefits. It also determined the switching values and applied Monte Carlo Simulation to determine the Expected Net Present Value and the Expected Internal Rate of Return in plantain production. The study used secondary data which were primarily collected during the Commodity and Enterprise Analysis Survey of the Niger Delta Region of Nigeria (Molokwu and Coker, 2017). The consumption of plantain has risen tremendously in Nigeria in recent years because of the rapidly increasing urbanization and the great demand for easy and convenient foods by the non-farming urban populations. The yield rate for plantain was estimated at 7842.0 kg/ha. Only one percent of produced plantain and 3 percent of produced maize were consumed or served other on-farm purposes. The rest was sold for cash. Probability distribution was applied to obtain the prices that generated the costs. It was evident that apart from 10% fall in yield of plantain which changed the IRR by as much as 46 percent, there were small percentage changes with variations in the other variables. It is concluded that although the estimated IRR was relatively stable to changes in output price, investment cost and operating costs it is very sensitive to changes in the yield of plantain. The switching value for the yield of plantain was a fall of 13 percent, that of output price was a fall of 40 percent, that of investment cost was a rise by 450 percent and that of operating costs was a rise by 550 percent. The base (without simulation) NPV and IRR were ₦ 3,901,047 only and 37 percent respectively. The simulated ENPV was ₦ 4,039,888 only, with a mean of ₦ 4,000,790 only; a minimum of ₦ 3,300,705.25 only, and a maximum of ₦ 4,804,852.29 only. The simulated EIRR was 39 percent with a mean of 37 percent, a minimum of 34 percent and a maximum of 41 percent. Firstly, it was recommended that the government should increase its spending on building good roads and other infrastructure. Secondly, Plantain production enterprise should ensure adequate monitoring of the yield rate of plantain and ensure that it does not fall below 10 percent through proper application of agrochemicals, fertilizers, other inputs

and labor. Thirdly, The Switching value analysis and Monte Carlo Simulation and Risk Analysis should be applied in analyzing agricultural production specifically plantain production.

Key words: *Plantain, Net Present Value, Internal Rate Return, Sensitivity Analysis, Simulation*

Background

The Federal Government of Nigeria is committed to the attainment of self-sustaining growth in all the sub-sectors of agriculture and the structural transformation necessary for the overall socio-economic development of the country as well as the improvement in the quality of life of Nigerians. To this end it introduced the following agricultural programs namely: the Agricultural Transformation Agenda (ATA); Growth Enhancement Support Scheme (GESS); Anchor Borrowers' Programme (ABP); Youth Empowerment in Agriculture Programme (YEAP); Livelihood Improvement Family Enterprises (LIFE) Programme; National Agricultural Seeds Council (NASC); and the Commercial Agriculture Credit Scheme (CACS). The baseline for LIFE Programme was termed Rapid Commodity and Enterprise Analysis Survey and was conducted between February and March 2017 by Messrs. Molokwu C. Christopher and Coker Alexander. They were guided by the terms of reference (TOR), the Country Project Officer (CPO) and the Regional Economist (WCA) of the International Fund for Agricultural Development (IFAD) in the design of the survey instrument and the implementation of the entire survey. The goal of LIFE was to realize a transformed rural economy in which the rural population can derive prosperity and equal benefits. It is geared at increasing income and empowerment for rural youth and women. Plantain (*Musa spp.*) occupies a strategic position for rapid food production in Nigeria. It is ranked third among starchy staples. The country's output doubled in the last 20 years.

Following Akinyemi et al (2010), Plantains (*Musa spp.*, AAB genome) are plants producing fruits that remain starchy at maturity and need processing before consumption. Production, which is concentrated in the Southern part of the country, still remains largely in the hands of small-scale farmers who, over the years, have ingeniously integrated it into various cropping systems. Based on the estimated Return On Investment (ROI) plantain production was a candidate crop studied in the baseline survey and the data collected during the baseline survey was employed in this study.

Research Problem

The need for availability of affordable staple food within the reach of the exploding population of Nigerians requires that research efforts should be geared at the production mechanisms of the staple foods in the country to understand and improve their technologies to meet the food needs of the burgeoning population. Currently, there exists inadequate knowledge of improved cultural practices of plantain production by the farmers coupled to an inefficient system of extension services and research, consequently, the yield potential of plantain is still low in the country. If the current situation of poor research on the production of plantain in the rainforest belt of Nigeria is allowed to linger on, hunger and unemployment will exacerbate the precarious food situation and food importation will deplete the scarce foreign exchange of the country. This study is geared at the economic analysis of plantain production in the Niger Delta region of Nigeria to adequately

understand the production process and involve the necessary measures that will ensure increased production to satisfy the domestic demand, meet export demand and generate the needed foreign exchange for the country. The questions guiding the study were whether plantain production enterprise in the Niger Delta Region of Nigeria provided a viable means of livelihood for the farmers specifically: (a) Is the Net Present Value (NPV) estimated for plantain enterprise positive?

(b) Is the Internal Rate of Return (IRR) estimated for plantain production greater than the opportunity cost of capital? (c) Is the Benefit Cost Ratio (BCR) computed for plantain production enterprise greater than unity? (d) How robust are the estimated decision ratios of NPV and IRR? and What implications do fluctuating prices and yield have on the production process?

Objectives of the Study

The main objective of the study was to conduct an economic analysis of plantain production in Niger Delta Region of Nigeria. The specific objectives were to determine whether plantain production generated:

- a) A positive Net Present Value (NPV);
- b) An Internal Rate of Return (IRR) which is greater than the opportunity cost of capital?
- c) A Benefit Cost Ratio (BCR) which is greater than unity?
- d) Sensitive decision ratios (NPV and IRR); and
- e) Determine with Monte Carlo Simulation expected (ENPV and EIRR)

Scope of the study

The scope of this study is limited to the economic analysis of plantain production in the Niger Delta Region of

Nigeria. It estimated the following performance indicators for the enterprise namely: the NPV, IRR, and BCR. It tested the sensitivity of the estimated decision ratios to changing values of the yield and the components of costs and benefits and determined the switching values. It used the Monte Carlo Simulation technique to determine the expected values of the NPV and IRR under situations of varying distributions of yield, input and output prices.

Limitations of the study

The data employed in the study were collected in March 2017 by Messrs. Molokwu C. Christopher and Coker Alexander without bearing this study in mind. The resources of time and funds available for the study were inadequate.

Relevance of the Study

Knowledge of the economic indicators of plantain production will enable prospective entrepreneurs rank the enterprise properly among other candidate enterprises (for selection) for investment as a means of livelihood. This will undoubtedly, go a long way in ameliorating the scourge of unemployment, which is one of the underlying cause of insecurity, robbery, kidnapping, prostitution, and other vices bedeviling the Nigerian economy.

Literature Review

This study reviewed several literatures concerning plantain production in the Niger Delta Region of Nigeria and elsewhere. It also reviewed relevant economic theory and statistical tools applied in this work. The latter included the theory of the firm; sensitivity analysis and Monte Carlo Simulation and Risk Analysis.

Federal Government of Nigeria (FGN) and other government policies, acts and initiatives in plantain production system in Nigeria

The Federal Government of Nigeria (FGN) and the FAO (2006,2022), and other agencies including Faturoti, B.O., et al (2007) and Ayanwale A.B, et al. (2016), recognized that plantain was among the most important staple food crops in humid forest zone of West and Central Africa. Nigeria is one of the largest plantain producing countries in the world (FAO, 2006). They have encouraged policies which has developed many technologies aimed at improving the production of plantain and removing constraints posed by pest and diseases, marketing opportunities and perishability. Seven gaps of critical implications to production and commercialization of plantain were identified as government non-intervention, marketing and constraints to production, weak fragile links among stakeholders, research-farmers dichotomy, project sustainability, lack of documentation and funding. Linkages among stakeholders were generally weak and without cohesion; objectives were at variance and unhealthy. They concluded that stakeholder's cohesion and coordination of efforts were needed for increased production and commercialization.

Governmental intervention was needed in the areas of policy initiatives and acts that will go beyond the ad-hoc response which are usually triggered by natural disasters such as pest and diseases as was the case with black Sigatoka outbreak in mid-80's which was the only period government really intervened in plantain production in Nigeria.

Plantain Production and the Value Chain in The Niger Delta Region of Nigeria and Elsewhere

A lot of studies have been carried out on plantain production in the Niger Delta Region of Nigeria and elsewhere. Many of them dwelt on the inputs and outputs structures, combinations and quantities employed in the industry. Notable ones included: Akinyemi, S.O.S et al, (2010), Salami,

M. F. et al, (2023), Oyedele O.O., et al (2022), Kayode, R. M. O., et al, (2013), Adeoye, I. B.,(2013). Adeoye, I. B., et al. (2013). They employed multi-stage sample surveys to collect data and analyzed the data using descriptive statistics. These authors noted that plantain production was male dominated, while women handled marketing. Contributions of plantain to the income of rural households in major producing areas in Nigeria continued to increase tremendously in the last few years. Unlike some other starchy staples whose demand tend to fall with rising income, demand for plantain increases with increasing income. With the potential for industrial processing of plantain, which has recently been adopted, and the increased interest in production by small- and large-scale farms in the country, it is believed that Nigeria will continue to be one of the world's largest producers of plantain. The consumption of plantain has risen tremendously in Nigeria in recent years because of the rapidly increasing urbanization and the great demand for easy and convenient foods by the non-farming urban populations.

Marketing of plantain and its bye-products

Many researchers have conducted studies on the marketing of plantain and its bye-products. Notable among them included: Salami M.F.et al. (2023), Kayode, R. M. O., et al, (2013), Aina O.S., et al. (2012): They posited that it is insufficient for policymakers to focus

solely on resolving production issues without considering the marketing issues in order to secure food security. Salami M.F. et al. (2023), analyzed plantain marketing in the Ilorin metropolis of Kwara state, Nigeria. Specifically, they investigated the socioeconomic characteristics of plantain marketers in the study area, assessed the market margin and marketing efficiency of plantain marketers, identified the local plantain market structure, and looked at factors influencing price as well as those restricting the marketing of plantains in the area. They combined purposive and random sampling methods to gather information from 100 respondents. Their analysis used descriptive statistics, market margin, marketing efficiency analysis, Herfindahl index, and Likert-type scale. The result of the study indicated that women made up the vast majority (98%) of plantain marketers. It was determined that the market margin and marketing efficiency were 6,111.21 naira per week and 34.88%, respectively. The Herfindahl index for the plantain market was 0.0121, indicating a tendency toward perfect competition. While poor roads, bulkiness, high perishability, lack of storage facilities, and shortage of supply were the main factors restricting the marketing of plantains in the area, high transportation costs, size, and quantity were the significant factors determining plantain prices in the area. The researchers advised that the government increase its spending on building good roads and other infrastructure.

Application of plantain for medicinal purposes and in the pharmaceutical industry

On the application of plantain for medicinal purposes and in the pharmaceutical industry, it was noted that

plantain has long been considered by herbalists to be a useful remedy for cough, wounds, inflamed skin or dermatitis, and insect bites. Bruised or crushed leaves have been applied topically to treat insect bites and stings, eczema, and small wounds or cuts. A notable author in this area was Boris, N.T.J, et al, (2023), who dwelt on the vegetative cycle and medicinal applications of plantain. They indicated that the vegetative cycle of the plantain varied between 10-18 months depending on the variety, its consumption was 150 kg/inhabitant/year and has 35.5 g of carbohydrates; 1.3 g of proteins and 5.8 g of fibers. Regular consumption of plantain can be an effective way to fight against oxidative stress. It has medical and therapeutic value for diabetic patients, gallbladder disease and colon cancer. Gastrointestinal disorders like diarrhea and vomiting can be treated with plantain. It is processed in developing countries to formulate food products like cake, doughnut, pancake, jam and many others.

Apparently, a lot of studies have been carried out concerning acts and initiatives on plantain production system in Nigeria; plantain production and the Value Chain in The Niger Delta Region of Nigeria and elsewhere; marketing of plantain and its bye-products and application of plantain for medicinal purposes and in the pharmaceutical industry but none of the studies estimated the following performance indicators for the plantain enterprise namely: the NPV, IRR, and BCR. They also did neither test the sensitivity of these decision ratios to changing values of the yield and the components of costs and benefits nor determined the switching values. They did not also use Monte Carlo Simulation technique to determine the expected values of the ENPV and EIRR under situations of varying distributions of yield,

input and output prices. This study will bridge these gaps.

Theory of the firm

Several micro-economic text books including: Henderson and Quandt (2010) and Hirshleifer (2005) discussed the theory of the firm. The theory of the firm states that firms maximize profits. Profit was defined as total revenue minus total cost: $\pi = TR - TC$. Where (i) $\pi = \text{Profits}$; (ii)

$TR = \text{Total Revenue}$; (iii) $TC = \text{Total Cost}$. This measured economic profit, which included the opportunity cost, implicit or explicit of all resources employed. The main constraints of the firm were its technology; the prices of factors of production, and the demand for its product. Plantain production in Nigeria follows the theory of a perfectly competitive firm (enterprise) which is a

price-taker in both the inputs and outputs' markets. The firm maximizes profit by equating marginal revenue (unit price) to marginal cost. The investment decision is appraised using the discounting and the non-discounting techniques of appraisal. The discounting techniques include the net present value; the benefit cost ratio and the internal rate of return while the non-discounting methods include the urgency, the accounting rate of return and the payback period. The commonly applied techniques were the NPV; the BCR and the IRR. The Net Present Value is the sum of the present values of all the cash-flows; the positive as well as the negative flows expected to occur over the life of the enterprise. It takes into account the timing of cash flows as well as the time value of money. As noted by Horne J.V, (2001) the present value calculation can be generalized to cover any period, thus:

$$PV = \frac{A_t}{(1+r)^t}$$

Where: A_t is the amount of the future cash flows in the given period.

r is the interest (or discount) rate to be used.

t is the time lapse between now and the cash flow. It is apparent that the larger the discount rate (r) and the longer the time lapse(t), the smaller the PV becomes. The **decision rule** is that projects with the present value of the inflows exceeding

that of the outflows (i.e., those which have a positive net present value) are selected. Those with negative net present value (NPV) are rejected. Where there are competing projects, the one with the larger positive NPV will be chosen. Following Horne J.V, (2001) the profitability index (Benefit Cost Ratio) of an enterprise was computed as the present value of future net cash flows over the initial cash outlay i.e.:

$$BCR = \frac{\sum_{t=1}^n \frac{A_t}{(1+k)^t}}{A_0}$$

if BCR is greater than unity (1) the investment proposal is acceptable. In

computing the profitability index the net rather than the aggregate is computed. The

initial outlays are discretionary to the firm. Subsequent cash outlays are not discretionary. The Internal Rate of Return (yield) of an enterprise is the discount rate which makes the net present value of investment equal to zero, Horne J.V, (2001). It is closely related to the NPV. They are both based on the discounted cash flow technique (DCF). The decision rule with the IRR method is that all projects whose IRR exceeds the cost of capital should be undertaken. If all projects cannot be undertaken, the project with higher IRR is normally chosen. For a single project, accept or reject decision regarding a project, both NPV and IRR should give the same result. With IRR, projects should be accepted when they give a return in excess of the cost of funds. This study will estimate the Net Present Value; the Benefit Cost Ratio and the Internal Rate of Return for plantain production in the Niger Delta Region of Nigeria and will apply these ratios to test the viability of the production process.

Sensitivity Analysis and Switching Values

This study reviewed several studies on sensitivity analysis and switching values some of which were: ADB, (2017), Belli, P., and J.R. Anderson. (2013), IFAD, (2016), and FAO. (2007). These authors were well detailed on the subject and pointed out that: Sensitivity analysis is a financial model that determines how target variables (NPV and IRR) are affected by changes in inputs, outputs and yield variables. it is carried out to identify the key variables that may influence project cost and benefit streams. Sensitivity analysis involves recalculating the IRR or/and the NPV with varying values of the key variables. The variations in the key variables may be independent

or a combination. Four steps are involved in sensitivity analysis namely:

- a) selecting the inputs, outputs, yields and other variables to which the investment decision may be sensitive;
- b) determining the possible extent of variation of these variables from the base case;
- c) calculating the effect of different values of these variables on the projects results (IRR and NPV)
- d) taking decisions.

The authors indicated that the analyst must take adequate consideration of: (a) Aggregate costs and benefits. (b) Critical cost and benefit items. (c) The effects of different types of delays in project implementation. They explained the switching value of a variable as that value at which the project's NPV becomes zero or the IRR equals the discount rate.

Generally, the authors noted Shortcomings of Sensitivity Analysis Sensitivity analysis and the consequent three major limitations namely: (a) Failure take into account the probabilities of occurrence of the events. (b) Failure to consider the correlations among the variables. And (c) the associated arbitrariness in the sense that varying the values of sensitive variables by standard percentages does not necessarily bear any relation to the observed or likely variability of the underlying variables. These shortcomings necessitate the need for simulations.

Monte Carlo Simulation and Risk Analysis

According to Samik Raychaudhuri, (2008), Monte Carlo simulation is a type of simulation that relies on repeated random sampling and statistical analysis to

compute the results. This method of simulation is very closely related to random experiments. These are experiments for which the specific result is not known in advance. In this context, Monte Carlo simulation can be considered as a methodical way of doing so-called “what-if” analysis. Given the shortcomings of sensitivity analysis, Simulation is the simple and generally applicable technique for overcoming it and calculating the expected ENPV, EIRR and analyzing risk. Simulation involves three steps namely:

(a) Specifying the probability distribution of the important uncertain components (prices, yields and delays); (b) Specifying the correlations between the components; and (c) Combining this information to generate the expected ENPV and EIRR and the underlying probability distribution of project outcomes. Monte Carlo Simulation involves:

- i. identifying key determinant factors or variables of project costs and benefits;
- ii. establishing the probability distributions of these variables;
- iii. randomly selecting values of these variables from their probability distributions;
- iv. combining these selected values with base case values of all other variables and parameters to estimate an ENPV or EIRR;
- v. repeating steps (3) and (4) numerous times to provide a large number of NPV and IRR estimates and to establish their respective probability distribution; and estimating the probability of the weighted ENPV and EIRR.

If distributions are unknown, project analysts can also make simplifying assumptions about the probability distribution of variables. One of the simplest and most popular distributions used in empirical risk analysis is the triangular distribution. Three parameters completely describe this distribution: the most likely value (the mode), the lowest possible value, and the highest possible value. The expected value of a triangular distribution is one-third of the sum of the three parameters. Simulation has the advantages of overcoming the shortcomings of sensitivity analysis and estimating a more reliable expected values of the decision ratios including the EIRR and the ENPV. This study will apply the Monte Carlo Simulation and Risk Analysis.

Methodology

The study used secondary data which were primarily collected during the Commodity and Enterprise Analysis Survey of the Niger Delta Region, Nigeria (Molokwu and Coker, 2017).

The Niger Delta region of Nigeria is located in the southern part of Nigeria, bordered to the south by the Atlantic Ocean and to the East by the Republic of Cameroon. The region covers about 112,110 square kilometers, representing 12% of Nigeria’s total surface area. It has a population of about 30 million people, representing 18% of Nigeria’s population. It is located within the tropical rainforest climate zone on the northern regions and freshwater swamp and mangrove swamp forests in the southern regions, from Longitudes 4.15°N - 7.17°N and Latitudes 5.05°E - 8.68°N (Maduawuchi, 2018). It has the heaviest rainfall within West Africa, with an annual rainfall total of between 1,300 mm and 4,000 mm (Maduawuchi, 2018); The Region

comprises nine States, spread across the South-South (Akwa Ibom, Cross River, Edo, Delta and Rivers States), South East (Abia and Imo States) and South West (Ondo State) Zones of Nigeria. Bayelsa, Cross River and Rivers State have extensive coastlines; Ondo, Delta and Akwa Ibom have coastlines and agricultural lands, while Abia, Edo and Imo have no coastlines. More than 40 ethnic groups including the Ijaw, Ikwerre, Itsekiri, Isoko, Urhobo, Kalabari, Okrika, Ogoni, Oron, Efik, Ibibio, Igbo, Annang, Bini, Esan and

Analysis of the Plantain Cropping Pattern

The first aspect of the plantain cropping enterprise that was analyzed was the cropping pattern.

The data used in the analysis were derived from the Pre-LIFE project baseline survey conducted by Messrs. Molokwu C. Christopher and Coker Alexander (2017).

The enterprise LIFE was assessed at 25 years. Only the

first 5 years of the enterprise was shown in this and subsequent tables. This is because by the fifth year, the enterprise has attained a steady state in production and the remaining years were projections. In the years without the enterprise, the land was used for maize production. The first year was used for land preparation and planting the suckers as well as maize cultivation. Plantain started yielding from the third year from which maize cultivation was discontinued as the canopy of the plantain shielded maize from sunlight. The yield rate for plantain hired labor, packaging containers and manure. The investment is made up of the loan (₦524503) and cost of tools and equipment

Table 2: Operating Inputs, Investment and Operating Costs

Yoruba, inhabit the Niger Delta Region, speaking about 250 different dialects (FRN, undated). The Commodity and Enterprise Analysis Survey used multi-stage stratified sampling design and clusters of focus group discussion to collect data from 1,017 respondents. Although the survey did not have this study in mind, it collected data on production patterns, prices, investment and operating inputs which supported this study. Available data was collated and analyzed using Microsoft Excel spread sheet.

Table 1: Cropping Pattern

		WithoutProject			WithProject				
		Unit	1-10	1	2	3	4	5 - 25	
Yield	Plantain	ha	0	1	0	0.3	0.3	1	
	Maize	ha	0.8	0.8	0.8	0.8	0.8	0	
		ha	0.8	1.8	0.8	1.1	1.1	3	
Production	Plantain	kg/ha	5489.4	0.0	7842.0	7842.0	7842.0	7842.0	
	Maize	kg/ha	1500.0	1500.0	1800.0	2000.0	2100.0	2100.0	
Home use	Plantain	kg	0	0	0	2,353	2,353	7,842	
	Maize	kg	1,200	1,200	1,440	1,600	1,680	0	
Sale	Plantain	kg	0	0	0	235	235	784	
	Maize	kg	360	360	432	480	504	0	
	Plantain	kg	0	0	0	2117.34	2117.34	7057.8	
	Maize	kg	720	720	864	960	1008	0	

Source: Pre-LIFE Project Baseline Survey Data (2017)

was 7842.0 kg/ha. Only one percent of produced plantain and 3 percent of produced maize were consumed or served other on-farm purposes. The rest was sold for cash.

Analysis of Operating Inputs, Investment and Operating Cost

Table 2 analyzed the operating inputs, investment and operating cost. The additional inputs required for the plantain enterprise on the traditional maize cultivation included: suckers, compound fertilizers, pesticide, (₦800000). The prices attached to the inputs are the mean prices obtained from the baseline survey

and the probability distribution of the prices was used to derive the prices which multiplied the inputs to derive the operating costs. Probability distribution was applied to obtain the prices that generated the cost.

	Unit	Price	1-10	1	2	3	4	5 - 25
Suckers	kg	163	0.0	1445.0	0.0	0.0	0.0	0.0
Compound	kg	9500	5.0	5.0	5.0	5.0	5.0	5.0
Pesticide	Naira	3000	3.0	3.0	3.0	3.0	3.0	3.0
Hired labor	WDs	1000	88.0	88.0	88.0	88.0	88.0	88.0
Containers	Naira	50	78.0	78.0	78.0	78.0	78.0	78.0
Manure	kg	20	102.0	102.0	102.0	102.0	102.0	102.0
Startup Cost			0	1324503	0	0	0	0
Suckers		161.5	0	235535	0	0	0	0
Compound		9444.5	815	47500	47500	47500	47500	47500
Pesticide		3106.7	489	9000	9000	9000	9000	9000
Hired labor		1046.0	14344	88000	88000	88000	88000	88000
Containers		56.9	12714	3900	3900	3900	3900	3900
Manure		21.8	16626	2040	2040	2040	2040	2040
Total Operating inputs			44988	385975	150440	150440	150440	150440

Source: Pre-LIFE Project Baseline Survey (2017)

Estimation and testing of the IRR, NPV and BCR.

In table 3, the project format which detailed the computation of the IRR, NPV and the BCR was presented. The sales make up the net production. The total value of production was derived by adding consumption at home and gifts to the net production. The total investment cost was added to total operating cost and total taxes in order to obtain the total outflows. In the Niger Delta Region, agricultural production was not taxed consequently there were no values for taxes. Cash flow before financing was derived by subtracting the total outflows from the total value of production. This stage ended the financial aspect of the analysis. When Financial inflows and outflow were incorporated, the analysis is referred to as economic analysis. The financial inflows were made up of different types of loans, transfers from previous periods, and contribution from own savings. The financial outflows were made up debt service and transfers to next period. Net Financing was derived by subtracting total financial outflows from total financial inflows. Cash flow after financing was obtained by adding net financing to the cash flow before financing alternatively called farm benefits after financing. Incremental benefits before financing (BF)

were computed by removing cash flow before financing that would have accrued if there was no plantain enterprise in the farm. This was estimated as farm benefits that used to accrue annually during the steady state situation before the plantain enterprise. With the Incremental benefits before financing, one may estimate Internal rate of returns (IRR) and net present value (NPV). Since the farm benefitted from loan which it also repaid, the estimation of IRR and NPV were deferred till the impact of the loan and its repayment were incorporated to derive the Incremental benefits after financing (AF). It is noteworthy that these terms used were benefit or cost streams that were projected to the twenty fifth year of the enterprise life. Applying the Incremental benefits after financing (AF) the base IRR was estimated at 37%, and the base NPV was estimated at ₦3,901,047 and the BCR was estimated at 4.21. Since the IRR was greater than the hurdle rate of 14%, it was concluded that plantain production in the Niger Delta Region of Nigeria is profitable because it could pay back any loan and leave some surplus for the farmer. As the estimated NPV was greater than unity and estimated BCR was greater than unity, they reaffirmed the conclusion that plantain production in the Niger Delta Region of Nigeria is profitably viable.

Table 3: Cash Flow or Project Format								
Cash Flow		Without					With Plantain	
Year	Unit	Unit Price	1-10	1	2	3	4	5 - 25

Production sold:									
	Plantain	N/kg	209.0696671	0	0	0	442,672	442,672	1,475,572
	Maize	N/kg	46.92762009	33,788	33,788	40,545	45,051	47,303	0
NET VALUE OF PRODUCTION				33,788	33,788	40,545	487,722	489,975	1,475,572
On Farm Stock:									
	Maize		53.8258853	19,377	19,377	23,253	25,836	27,128	0
Sub-Total on Farm Use				19,377	19,377	23,253	25,836	27,128	0
Total Value of Production				53,165	53,165	63,798	513,559	517,103	1,475,572
Production costs:									
Total Investment Cost				0	1,324,503	0	0	0	0
Total Operating Cost				44,988	385,975	150,440	150,440	150,440	150,440
Total Taxes				0	0	0	0	0	0
TOTAL OUTFLOWS				44,988	1,710,478	150,440	150,440	150,440	150,440
Cash flow before financing				8,177	-1,657,313	-86,642	363,119	366,663	1,325,132
Financial inflows:									
Disbursements from project loan:									
Plantain revolving loan					250,000				
Transfer from previous period					0	0	0	0	0
Contribution from own savings									
Sub-total financial inflows:					250,000	0	0	0	0
Financial outflows:									
Debt Service									
Plantain revolving loan						83,333	83,333	83,333	
Transfer to next period					0	0	0	0	0
Sub-Total Financial Outflows:					0	83,333	83,333	83,333	0
Net Financing				0	250,000	-83,333	-83,333	-83,333	0
Cash flow after financing				8,177	-1,407,313	-169,975	279,785	283,330	1,325,132
Farm benefits after financing				8,177	-1,407,313	-169,975	279,785	283,330	1,325,132
Incremental benefits (BF)					-1,665,490	-94,819	354,941	358,486	1,316,955
NPV (14%)				4,132,018					
IRR (25 years)				37%					
Incremental benefits (AF)					-1,415,490	-178,152	271,608	275,152	1,316,955
NPV (14%) in 000 Naira				4,181,607					
IRR (25 years)				38%					

Sensitivity Analysis

This study discretionally evaluated the impact of 10 percent fall in the yield of plantain, 10 percent fall in the output price, 10 percent rise in investment cost and 10

percent rise in operating cost on the Internal Rate of Returns (IRR) of plantain production to determine how sensitive the estimated IRR was to changes in these variables. The results were presented in table 4. It was evident that apart from 10% fall in yield which changed the IRR by as much as 46 percent, there was small percentage changes with variation in the other variables. It was

percent rise in operating cost on the Internal Rate of Returns (IRR) of plantain production to determine how sensitive the estimated IRR was to changes in these variables. The results were

Table 4: Result of the Sensitivity Analysis

Change in variable	Base IRR	Estimated IRR	Percent change
Yield fall by 10%	37%	20	46%
Output Price fall by 10%	37%	32	14%
Investment cost rise by 10%	37%	35	5%
Operating cost rise by 10%	37%	36	3%

Source: Study data analysis

concluded that although the estimated IRR was relatively stable to changes in output price, investment cost and operating costs it was very sensitive to changes in the yield of plantain. The yield rate was therefore an instrumental variable to the viability of the plantain production enterprise.

Switching Values at 14 percent Hurdle Rate

According to Belli, P., and J.R. Anderson, (2013), the preferred approach to sensitivity

analysis uses switching values. The analysis of the switching value at 14 percent hurdle rate was carried out and the results were presented

in table 5. The table showed that 13 percent fall in yield will cause the estimated IRR to fall from 37 percent to 13 percent; 40 percent decrease in the price of output will result in the estimated IRR falling from 37 percent to 14 percent; a rise in the investment cost by 450 percent will make the estimated IRR to fall from 37 percent to 14 percent and a rise in the operating costs by 550 percent cause the estimated IRR to fall from 37 percent to 13 percent. Plantain production enterprise would ensure that the yield of plantain should not fall below 10 percent. This will involve adequate application of fertilizers, other inputs, agrochemicals and labor.

Monte Carlo Simulation and Risk Analysis

Sensitivity analysis has three major limitations; Firstly, it does not take into account the probabilities of occurrence of the events; Secondly, it does not take into account the correlations among the variables and thirdly, the practice of varying the values of sensitive variables by standard percentages does not necessarily bear any relation to the observed or likely variability of the underlying variables. The usual technique of changing the value of one variable at a time and keeping the values of the others constant is justified only if the variables concerned are uncorrelated. Otherwise, the values of the related variables must be changed jointly. Pedro Belli et al., (2001). Simulation and risk analysis mitigates the shortcomings of sensitivity analysis. In doing so the task of assigning probability distributions to project component variables and specifying correlations was the most difficult step. However, according to ADB,

Table 5: Switching Values at 14 % Discount Rate

Variable	Percent Change	Base IRR	Estimated IRR	Percent change
Yield fall	-13%	37%	13 %	65%
Output price fall	-40%	37%	14 %	62%
Investment cost rise	450%	37%	14 %	62%
Operating cost rise	550%	37%	13 %	65%

Source: Analysis from the Study

(2017), if the distributions are unknown, project analysts can also make simplifying assumptions about the probability distribution of variables by using the triangular distribution which is completely described by three parameters namely: (1) the most likely value (the mode), (2) the lowest possible value, and (3) the highest possible value. The expected value of a triangular distribution is one-third of the sum of the three parameters. Price search in Nigerian markets follow a process of optimum optimum. On getting to a market, there is a section with the highest concentration of a particular commodity and that commodity's price is cheaper there than any other part of the market. Within that section there will be a trader that sells the commodity cheaper than other sellers and getting to that seller one haggles the price of the commodity until a satisfactory bargain is struck. There exists neither mean nor standard deviation of price of any given commodity. It depends on one's ability to search and haggle. Consequently, the price distribution of any commodity is hardly known. Monte Carlo Simulation in this study applied the normal distribution for yield and triangular distribution for the input and output prices. The base (without simulation) NPV and IRR were Three Million, Nine Hundred and One Thousand, Forty-Seven Naira (₦ 3,901,047) only and 37 percent respectively.

Simulated Expected Internal Rate of Return (EIRR)

The simulated EIRR was 39 percent with a mean of 37 percent, a minimum of 34 percent and a maximum of 41 percent. This was distributed into

12 classes with a class interval of 6.8 percent. The result was presented in table 6. The distribution was presented as bar graph in figure 1, and as a line graph in figure 2. In the bar graph and line graph the figures in the row represent the class of the expected internal rate of return interval as in column 1 of table 6. The available space was limited to accommodate the class range. The figures in the column show the frequency or percentage of the iterations that fall within the class.

Table 6: Distribution of EIRR

	From	To	Result
0	0.0000	0.0068	0.0000
1	0.3354	0.3422	0.0005
2	0.3422	0.3490	0.0250
3	0.3490	0.3559	0.0770
4	0.3559	0.3627	0.1180
5	0.3627	0.3695	0.1695
6	0.3695	0.3763	0.1775
7	0.3763	0.3831	0.1535
8	0.3831	0.3899	0.1160
9	0.3899	0.3967	0.0870
10	0.3967	0.4035	0.0615
11	0.4035	0.4103	0.0150
12	0.4103	0.4171	0.0005

Source; Study analysis.

Fig. 1: Distribution of the EIRR presented in bar chart

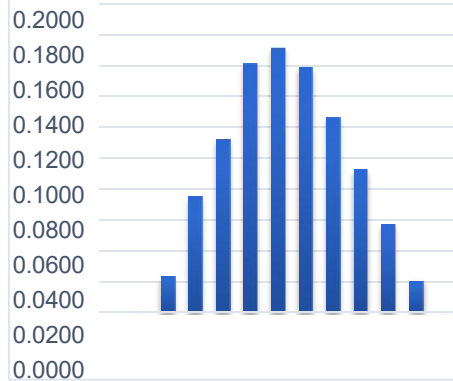
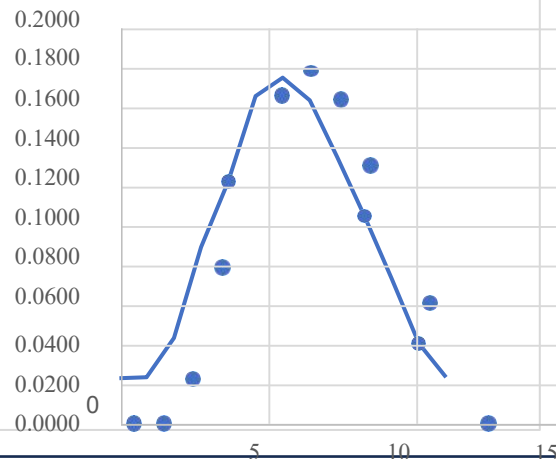


Fig. 2: Distribution of the EIRR presented in line graph



Simulated Expected Net Present Value (ENPV)

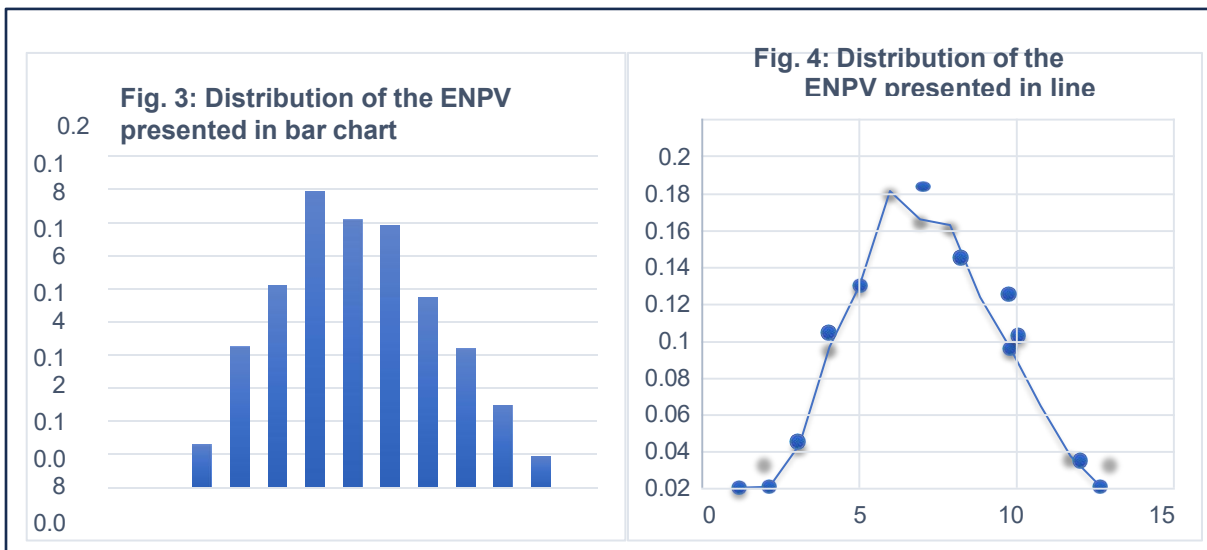
The simulated Expected Net Present Value (ENPV) was Four million, Thirty-Nine Thousand, Eight Hundred and Eighty-Eight Naira (₦ 4,039,888) only, with a mean of Four million, Seven Hundred and Ninety naira (₦ 4,000,790) only; a minimum of Three million Three Hundred Thousand, Seven Hundred-and Five-naira, Twenty-Five Kobo (₦ 3,300,705.25) only, and a maximum of Four million Eight Hundred and Four Thousand, Eight Hundred and Fifty Two naira Twenty nine Kobo (₦ 4,804,852.29) only. This was distributed into 12 classes with a class interval of One Hundred and Fifty Thousand, Four Hundred-and Fourteen-naira Seven Kobo (₦

Table 7: Distribution of ENPV

	From	To	Result
0	0	150414.7	0
1	3150290.5	3300705.3	0.001
2	3300705.3	3451120	0.026
3	3451120	3601534.7	0.085
4	3601534.7	3751949.4	0.122
5	3751949.4	3902364.1	0.179
6	3902364.1	4052778.8	0.162
7	4052778.8	4203193.5	0.159
8	4203193.5	4353608.2	0.115
9	4353608.2	4504022.9	0.084
10	4504022.9	4654437.6	0.050
11	4654437.6	4804852.3	0.019
12	4804852.3	4955267	0.001

Source; Study analysis.

150,414.70) only. The result was presented in table 7. The distribution was presented as bar graph in figure 3 and as a line graph in figure 4. In the bar chart and line graph, the figures in the row represent the mid-class of the expected net present value as in column 1 of table 7. The available space was limited to accommodate the class range. The figures in the column show the frequency or percentage of the iterations that fall within the class.



The estimation of the EIRR and ENPV was simulated 2000 times to produce the results in tables 6 and 7; and figures 1 to 4. The simulated Expected Net Present Value (ENPV) was Four million, Thirty-Nine Thousand, Eight Hundred and Eighty-Eight Naira (₦ 4,039,888) only, with a mean of Four million, Seven Hundred and Ninety naira (₦ 4,000,790) only; a minimum of Three million Three Hundred Thousand, Seven Hundred-and-Five-naira, Twenty-Five Kobo (₦ 3,300,705.25) only, and a maximum of Four million Eight Hundred and Four Thousand, Eight Hundred and Fifty Two naira Twenty nine Kobo (₦ 4,804,852.29) only. The simulated EIRR was 39 percent with a mean of 37 percent, a minimum of 34 percent and a maximum of 41 percent. These were distributed into 12 classes and the percentage entries (probabilities) of each class estimated. The annual incremental benefit was One Million Two Hundred and Eighty-Three Thousand, Seven Hundred and Fifty-Two Naira

(₦1,283,752) only. Considering the facts of a high simulated ENPV values with an average of ₦ 4,000,790 and minimum of ₦ 3,300,705.25 concomitant with an annual incremental benefit of ₦1,283,752 only, certainly, plantain farming is a low risk, high return on investment plant even at fluctuating output prices. It also suggests that youths should consider taking up plantain production for livelihood and growing the economy.

Summary and Conclusions

This study conducted the economic analysis of plantain production in the in the Niger Delta Region of Nigeria to adequately understand the production process and involve the necessary measures that will ensure increased production to satisfy not only the domestic demand but also meet export demand and generate the needed foreign exchange for the country. The objectives of the study were to determine whether plantain production generated: a positive Net Present Value; an Internal Rate of Return

which was greater than the opportunity cost of capital? and a Benefit Cost Ratio which was greater than unity? It tested the sensitivity of the estimated decision ratios to changing values of the yield and the components of costs and benefits and determined the switching values and applied Monte Carlo Simulation to determine the expected ENPV and EIRR.

The consumption of plantain has risen tremendously in Nigeria in recent years because of the rapidly increasing urbanization and the great demand for easy and convenient foods by the non-farming urban populations. The study used secondary data which were primarily collected during the Commodity and Enterprise Analysis Survey of the Niger Delta Region, Nigeria (Molokwu and Coker, 2017). The yield rate for plantain was 7842.0 kg/ha. Only one percent of produced plantain and 3 percent of produced maize were consumed or served other on-farm purposes. The rest was sold for cash. Probability distribution was applied to obtain the prices that generated the cost. It was evident that apart from 10% fall in yield which changed the IRR by as much as 46 percent, there was small percentage changes with variation in the other variables. It is concluded that although the estimated IRR was relatively stable to changes in output price, investment cost and operating costs it is very sensitive to changes in the yield of plantain. A 13 percent fall in yield will cause the estimated IRR to fall from 37 percent to 13 percent; 40 percent decrease in the price of output will result in the estimated IRR falling from 37 percent to 14 percent; a rise in the investment cost by 450 percent will make the estimated IRR to fall from 37 percent to 14 percent and a rise in the operating costs by 550 percent cause the estimated IRR to fall from 37 percent to 13 percent. The base (without

simulation) NPV and IRR were Three Million, Nine Hundred and One Thousand, Forty-Seven Naira (₦ 3,901,047) only and 37 percent respectively. The simulated Expected Net Present Value (ENPV) was Four million, Thirty-Nine Thousand, Eight Hundred and Eighty-Eight Naira (₦ 4,039,888) only, with a mean of Four million, Seven Hundred and Ninety naira (₦ 4,000,790) only; a minimum of Three million Three Hundred Thousand, Seven Hundred-and Five-naira, Twenty-Five Kobo (₦ 3,300,705.25) only, and a maximum of Four million Eight Hundred and Four Thousand, Eight Hundred and Fifty Two naira Twenty nine Kobo (₦ 4,804,852.29) only. The simulated EIRR was 39 percent with a mean of 37 percent, a minimum of 34 percent and a maximum of 41 percent. The annual incremental benefit was One Million Two Hundred and Eighty-Three Thousand, Seven Hundred and Fifty-Two Naira (₦1,283,752) only. Certainly, plantain farming is a low risk, high return on investment plant even with fluctuating prices and youths should take-up plantain production for livelihood and grow the economy.

Recommendations

The recommendations arising from this study included:

- i. Government should increase extension service delivery on plantain production to increase yield through dissemination of improved plantain suckers, demonstration farms and farmer field business schools.
- ii. Youths should take-up plantain production as a means of livelihood and growing the economy.
- iii. Plantain production enterprise should ensure adequate monitoring of yield rate of plantain and ensure

that it does not fall below 10 percent. This could be achieved by proper application of agrochemicals, fertilizers, other inputs and labor.

- iv. The Switching value analysis, Monte Carlo Simulation and Risk Analysis should be applied in analyzing agricultural production specifically plantain production.

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