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INVESTMENT APPRAISAL OF OIL PALM PRODUCTION IN THE NIGER DELTA REGION, NIGERIA

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Abstract

This paper examines how entrepreneurial activities can Oil palm is an important crop in Nigeria and the main products are palm oil and palm kernel. These are used for food and nonfood purposes. The older trees are aging and new ones are not springing up commensurably, thereby creating a supply gap in the industry. Farmers are risk-averse and tend to prefer short gestation crops. There is the need to stimulate local production and substitute for hard currency payments for the imports. This study is aimed at establishing that despite the long gestation period of oil palm, investments in the enterprise was viable and profitable. The objective of the study was to carry out an investment analysis of oil palm production in Niger Delta Region of Nigeria. The questions guiding the study were whether oil palm 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 estimated for oil palm enterprise positive? (b) Is the Internal Rate of Return estimated for oil palm production greater than the opportunity cost of capital? (c) Is the Benefit Cost Ratio computed for oil palm production enterprise greater than unity? (d) How robust are the estimated decision ratios and what effect did fluctuations on yield and prices' level have on the production process? Knowledge of the economic indicators of oil palm production will enable prospective entrepreneurs rank oil palm production properly among other candidate enterprises (for selection) for investment as a means of livelihood. The research design for this study is quantitatively descriptive research design following the investment analysis of the firm. The data used in this study was secondary data which were primarily collected during the Commodity and Enterprise Analysis Survey of the Niger Delta Region, Nigeria. The data was

collated and analysed using Microsoft Excel. It was found out that the base Internal Rate of Return was 35%, and the base Net Present Value was estimated at ₦5,815,473 and the Benefit Cost Ratio was estimated at 3.4. Since the Internal Rate of Return was greater than the hurdle rate of 14%, and the Net Present Value greater than unity, it was concluded that oil palm production in the Niger Delta Region of Nigeria is profitable because it could pay back any loan and leave some surplus for the farmer. The estimated Internal Rate of Return was relatively stable and almost insensitive to small changes in yield, output price, total benefits, investment cost and operating costs. It is worthy to note that the annual incremental revenue without the oil palm enterprise was only ₦ 20,960 per annum but with the oil palm enterprise the

annual incremental revenue was ₦ 2,227,640. This reaffirms the conclusion that oil palm production in the Niger Delta Region of Nigeria is profitably viable. The oil palm farmers in the Niger Delta were constrained by the high cost, adulteration non availability of farm inputs especially fertilizers and agrochemicals. Similarly, agricultural loans were not readily available to farmers because commercial banks were risk averse and require expensive collaterals which the farmers could not afford. It is recommended that the government should assist the farmers by enacting policies that would ensure timely provision of unadulterated inputs including land, fertilizers and agrochemicals to the oil palm farmers at affordable prices.

Background

The oil palm (*Elaeis guineensis*) is an ancient plant with its origins in the tropical rainforest regions of West Africa. The oil extracted from its fruits has been a valuable resource used for both culinary and medicinal purposes. Oil palm was a staple crop in the subsistence agriculture of Nigerian communities especially in the rain forest zones. During the colonial period, the British government recognized the economic potential of oil palm and encouraged oil palm production for producing palm oil which was a valuable commodity for export. The trees planted during the colonial era are aging and oil palm production is declining. According to Department for International Development (DFID, 2025) oil palm production in Nigeria has experienced decline from the 1960's when the country was producing 45% of the global output to a current output that represents 1.7% of the global palm oil output. Local production of palm oil has stagnated at a little less than a million metric tons since 2012. The youth are risk-averse concerning establishing tree crop farms and plantations. They prefer crops with short gestation periods and associated with short pay back periods. The governments of Nigeria, in collaboration with various stakeholders, implemented initiatives to promote sustainable oil palm cultivation, increase production, and improve the value chain. This

study intends to show that despite the long gestation period of oil palm, the farm and plantation enterprises are viable and profitable investments. Based on the estimated Return On Investment (ROI) oil palm 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

Oil palm is an important crop in Nigeria whose main products (oil and kernel) are used for food and nonfood purposes. As the older trees and plantations are aging, new trees and plantations are not springing up commensurably, thereby creating a supply gap in the industry. Present day farmers are risk-averse and tend to prefer short gestation crops associated with short pay back periods to establishing tree crop farms and plantations with longer gestation periods. Currently, the supply for palm oil and other oil palm products like palm kernel cake and palm kernel oil, for culinary and industrial use, lag behind the demand. The shortfall in local supply is met by imports thereby reducing the nation's limited foreign reserve considerably. There is the need to stimulate local production and substitute for hard currency payments for the imports. This study is geared at showing that despite the long gestation period of oil palm, the farm and plantation enterprises are

viable and profitable investments. The questions guiding the study are whether oil palm production enterprise in the Niger Delta Region of Nigeria provide a viable means of livelihood for the farmers specifically: (a) Is the Net Present Value (NPV) estimated for oil palm enterprise positive? (b) Is the Internal Rate of Return (IRR) estimated for oil palm production greater than the opportunity cost of capital? (c) Is the Benefit Cost Ratio (BCR) computed for oil palm production enterprise greater than unity? (d) How robust are the estimated decision ratios of NPV and IRR? and What implications fluctuations on yield and prices' level have on the production process?

Objectives of the Study

The main objective of the study was to carry out an economic analysis of oil palm production in Niger Delta Region of Nigeria. Specifically, to determine whether oil palm production generated:

- a) A positive Net Present Value (NPV);
- b) An Internal Rate of Return (IRR) which was greater than the opportunity cost of capital?
- c) A Benefit Cost Ratio (BCR) which was 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 the study is limited to the investment analysis of oil palm 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 study is limited to the Niger Delta Region of Nigeria and the investment analysis of oil palm production in 2017. The resources of time and funds available for the study were inadequate.

Significance of the Study

Knowledge of the economic indicators of oil palm production will enable prospective entrepreneurs rank oil palm production properly among other candidate enterprises (for selection) for investment as a means of livelihood. This will enable oil palm production gain its lost glory in the food basket of the country and conserve the scarce foreign exchange. It will also undoubtedly, go a long way in ameliorating the scourge of unemployment, which is one of the underlying causes of insecurity, robbery, kidnapping, prostitution, and other vices bedeviling the Nigerian economy.

Literature Review

A legion of studies has been carried out on oil palm production in the Niger Delta Region of Nigeria and elsewhere. Notable among them include: Adeleke, A. O., and Falola, A. (2021), Akpan, U. S., and Udofia, E. P. (2019), Yusuf, M. O. L., and Ayanlade, A. (2015) and Akinniran T. N., et. al. (2013). Generally, the studies employed multistage sampling technique to select a sample of farmers from a population of oil palm tree farmers. The

selected sample size ranged between 100 and 125 respondents. They collected primary data using structured questionnaires, collated the data with micro-soft spread sheet Excel and applied descriptive and inferential statistics in the data analysis.

The descriptive statistical tools included: the mean, frequency distribution, table, percentages. These were used to describe the socio-economic characteristics of the respondents. They used; budgetary analysis and regression analysis to measure the profitability of oil palm production and dependence of oil palm output on various inputs used respectively. Their methodology, survey instrument, test statistics, sampling, sample size and analytical procedures were quite sound but they did not appraise investment in the oil palm industry by projecting the production over several years to estimate the internal rate of return, the net present value and the benefit cost ratio.

They found out that majority of oil palm producers were married males that had only primary education. Their farm sizes ranged between 4 to 8 hectares. Majority of them did not belong to any farmers association and they used obsolete technology. The problems included low investment level and late arrival of inputs. The results of the studies showed that oil palm production was profitable and that majority of the farmers still operate their production on a small scale. Akinniran T. N., et. al, (2013), indicated that oil palm farmers obtained funds from their previous savings, and utilized hired labour and that all farmers in Surulere utilized chemical, obtained seedlings from government, though about half of the population did not belong to any farmers association. He asserted that before independence oil palm played major role in Nigerian export business and will continue to grow and develop the economy of

the country if adequately considered a major economy builder by the agricultural sector, a huge employer of labour and a catalyst in the manufacturing industries' development.

Overall, the pathway of oil palm production in Nigeria from 1980 to 2023 reflects a dynamic industry. The Department for International Development (DFID, 2025), stated that the Nigerian palm oil industry is highly fragmented, which limits its ability to coherently respond to emerging opportunities from time to time. Smallholder farmers (SHF) dominate local production and account for approximately 80% of local production of palm oil while established plantations account for less than 20% of the total market. The Niger Delta region of the country accounts for 54% of local production by SHF involving an estimated one million value chain actors – farmers, processors and traders.

The dominance of SHF in the palm oil market has resulted in low output production systems, reducing Nigeria's actual production compared to the country's potential considering low Fresh Fruit Bunches (FFBs) and Crude Palm Oil (CPO) yields per hectare of land. It asserted that limited supply of seedlings and absence of Seed/Seedlings certification has encouraged proliferation of counterfeit and poor-quality seedlings. Nigerian Institute for Oil Palm Research (NIFOR) has been the major source of Oil palm seeds/seedlings to small holders in the Niger Delta. While the large plantations rely mostly on imported seeds to ensure quality and guaranteed returns on investment, small holders on the other hand can only access NIFOR seeds/seedlings. Molokwu C, C, and A. Coker, (2017), indicated that the leading states in oil palm production in the Niger Delta were Abia, Edo, Rivers and cross river states.

The incubation period was 0.8 years and the gestation period was 3.1 years. On

enterprise selection criterion in the oil palm value chain, the gross margins in all the oil palm value chain nodes (production, processing and marketing) were quite profitable because their revenues were greater than their variable costs. The value chain node with the highest gross margin was oil palm processing with gross margin of ₦ 2,007,706. It was followed by oil palm marketing with a gross margin of ₦ 1,370,568. The third in ranking was oil palm production with a gross margin of ₦ 172,549. The critical input of the investor in selecting a value chain node in the Niger Delta Region was funding. Investment fund was the scarcest input faced by the entrepreneurs. The return on investment (ROI) was therefore considered the selection criterion for investing in the oil palm value chain nodes.

It was apparent that oil palm marketing with a return on investment of 1.72 was the best investment in the nodes, followed by oil palm processing with ROI of 0.88. and oil palm production with ROI of 0.15. According to DFID (2025), counterfeiting of Oil palm seedlings has been possible for quack operators due to the absence of strong legislation to protect seed supply, as NIFOR itself has no distribution channels making adulteration easy. It is recommended that oil palm seed/seedling policy be established to drive Supply of Quality and Certified Seeds/Seedlings to the industry.

This study appreciated the methodology of the authors but noted that they did not address the analysis of investment over time in the oil palm industry neither did they address the fluctuations in yield and prices consequently they did not estimate the internal rate of return (IRR),

the net present value (NPV) and the benefit cost ratio (BCR) nor access the impact of fluctuations in yield and prices on these decision ratios. This study will bridge the gap by projecting oil palm production over several years, estimate the IRR, NPV and BCR and conduct sensitivity analysis as well as apply Monte Carlo Simulation and Risk Analysis on the estimates to determine the impact of fluctuations in yield and prices on the decision ratios. This will enable adequate conclusions on the viability and profitability of the enterprise.

Analytical Framework

The analytical framework for this study is the theory of the firm, specifically, farm investment analysis. Several scholars including: Henderson and Quandt (2010) and Hirshleifer (2005) discussed the theory of the firm. Farm investment analysis determines the attractiveness of additional investment to the farm using the following performance criteria namely: Net Benefit Ratio (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), Net Benefit Investment Ratio (NBIR) and Net Benefit Increase (NBI). 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

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 NPV; the BCR and the IRR for oil palm production in the Niger Delta Region of Nigeria. It will apply these ratios to test the viability and profitability 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 pointed out that: Sensitivity analysis is a financial

that of the outflows (i.e., those which have a positive net present value) are selected. Those with negative 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 or Benefit Cost Ratio (BCR) of an enterprise is computed as the present value of future net cash flows over the initial cash outlay

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 in 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 results (IRR and NPV)
- d) taking decisions

The authors indicated that adequate consideration be taken 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. We usually present switching values in terms of the percentage change in the value of variable needed to turn the project's NPV equal to zero. The authors noted the main shortcomings of Sensitivity Analysis as: (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. 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 ENPV and EIRR estimates and to establish their respective probability distribution; and estimating the probability of the weighted ENPV and EIRR.

If distributions are unknown, the simplest and most popular distributions used in empirical risk analysis are 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 more reliable expected values of the EIRR and the ENPV. This study will apply the Monte Carlo Simulation and Risk Analysis.

Methodology

The research design for this study is quantitatively descriptive research design following the investment analysis of the firm. The data used in this study was secondary data which were primarily collected during the Commodity and Enterprise Analysis Survey of the Niger Delta Region, Nigeria (Molokwu and Coker, 2017). The data was collated and analysed using Microsoft excel following the principles of budgeting and investment analysis. These were both quantitative and descriptive. 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 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.

Christopher and Coker Alexander (2017). LIFE enterprise was projected to 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 oil palm seedlings as well as maize cultivation. Oil palm started yielding palm fruits from the fourth year and maize cultivation was discontinued as the palm fronds shielded maize from sunlight. The oil palm yielded palm fruits at the rate of 2033.0 kg/ha. Only ten percent of the palm fruits were used on the farm for consumption or gifts to friends, similarly thirty percent of produced maize were consumed or served other on-farm purposes. The rest palm fruits and maize were sold for cash unprocessed. It was noted that land as a resource is scarce in the study area. Although farmers in the baseline survey owned their farms, it was difficult to acquire a farm land in the Niger Delta Region of Nigeria.

Analysis of the Oil Palm Cropping Pattern

The first aspect of the oil palm cropping enterprise that was analyzed was the cropping pattern. The cropping pattern showed how oil palm was introduced to a hectare of farm that was previously used for cultivation of maize traditionally. The data used in the analysis were derived from the Pre-LIFE project baseline survey conducted by Messrs. Molokwu C.

		Table 1 : Cropping Pattern							
Year	Pattern	Unit	Without			With			
			1-15 YR	YR. 1	YR. 2	YR. 3	YR. 4	YR. 5	YR. 6
Yield	Oil palm	ha	0	1	0	0	0	1	1
	Maize	ha	0.8	0.8	0.8	0.8	0.8	0	0
Production	Oil palm	kg/ha	0.0	0.0	0.0	0.0	1500.0	2033.0	2033
	Maize	kg/ha	1800.0	1500.0	1500.0	1500.0	1500.0	0.0	0
Farm use	Oil palm	kg	0	0	0	0	0	2,033	2,033
	Maize	kg	1,440	1,200	1,200	1,200	1,200	0	0
Sales	Oil palm	kg	0	0	0	0	0	203	203
	Maize	kg	432	360	360	360	360	0	0
	Oil palm	kg	0	0	0	0	0	1830	1830
	Maize	kg	864	720	720	720	720	0	0
			Source: Study data analysis						

Analysis of Operating Inputs, Investment and Operating Cost

Table 2 analyzed the operating inputs, investment and operating cost. The additional inputs required for the oil palm enterprise on the traditional maize cultivation included: oil palm seedlings, compound fertilizers, pesticide, hired labor, packaging containers and manure.

The investment is made up of the loan (₦ 3,552,449) including the cost of tools and equipment.

The prices attached to the inputs are market prices obtained from the market survey. The oil palm farmers in the survey were constrained by scarcity of land, high cost and adulteration of

Oil palm seeds/seedlings. They were also constrained by non-availability and late arrival of farm inputs especially fertilizers and agrochemicals and pleaded that government should assist them in making

available unadulterated fertilizers and agrochemicals timely and at affordable prices.

Similarly, agricultural loans were not readily available to farmers because commercial banks were risk averse and required expensive collaterals which the oil palm farmers could not afford.

Table 2: Operating Inputs, Investment and Operating Costs									
Year	Unit	Price	Without			With			
			1-10	1	2	3	4	5	6
Cash Inputs									
Seedlings	NOS	1000	0	500	0	0	0	0	0
Maize seed	kg	200	20	20	30	30	30	0	0
Fertilizers	kg	20200	2	2	6	6	6	4	4
Pesticide	Naira	21000	2	2	5	5	5	3	3
Hired labor	WDs	1000	30	30	40	40	40	50	50
Containers	Naira	1000	100	100	150	150	150	200	200
Manure	kg	5	80	80	100	100	100	100	100
Costs									
Seedlings	NOS	1000	0	500000	0	0	0	0	0
Maiz seed	kg	200	3200	3200	4800	4800	4800	0	0
Fertilizers	kg	20200	32320	32320	96960	96960	96960	80800	80800
Pesticide	Naira	21000	33600	33600	84000	84000	84000	63000	63000
Hire labor	WDs	1000	24000	24000	32000	32000	32000	50000	50000
Containers	Naira	1000	80000	80000	120000	120000	120000	200000	200000
Manure	kg	5	320	320	400	400	400	500	500
Operating Cost			173440	673440	338160	338160	338160	394300	394300
Source: Study Data Analysis									

Source: Study Data Analysis

Estimation and testing of the IRR, NPV and BCR.

The project format presented in table 3, detailed the computation of the IRR, NPV and the BCR. The production sold made 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. If financial inflows and outflow were incorporated in the analysis then it 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 of debt service and transfers to the 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 subtracting from cash flow before financing the cash flow without the oil palm enterprise (which would have accrued if there was no oil palm enterprise in the farm). The cash flow without the oil palm enterprise was estimated as farm benefits that used to accrue annually during the steady state situation before the oil palm enterprise. With the Incremental benefits before financing, one may estimate internal rate of return (IRR) and net present value (NPV). Since the farm benefitted from oil palm loan which it also repaid, the estimation of IRR and NPV were delayed until the impact of the oil palm loan and its repayment was incorporated into the analysis to derive the incremental benefits after financing (AF). It is worthy

to note that the cash flow streams used were benefit or cost streams that were projected to the twenty fifth year of the oil palm enterprise life. Applying the incremental benefits after financing (AF) the base IRR was estimated at 35%, and the base NPV was estimated at ₦5,815,473 and the BCR was estimated at 3.4. Since the IRR was greater than the hurdle rate of 14%, it was concluded that oil palm production in the Niger Delta Region of Nigeria was 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 also greater than unity, it was concluded that oil palm production in the Niger Delta Region of Nigeria was profitably viable. It is worthy to note that the annual incremental revenue without the oil palm enterprise was only ₦ 20,960 per annum but with the oil palm enterprise the annual incremental revenue was ₦ 2,227,640. This reaffirmed the conclusion that oil palm production in the Niger Delta Region of Nigeria was profitably viable.

Table 3: Cash Flow or Project Format								
Unit	Price	Without					With	
		1-15 YRS	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6
Production sold :								
Palm fruits	1300	0	0	0	0	0	2378610	2378610
Maize	150	129600	108000	108000	108000	108000	0	0
Net		129600	108000	108000	108000	108000	2378610	2378610
Farm use								
Palm fruits	1300	0	0	0	0	0	264290	264290
Maize	150	64800	54000	54000	54000	54000	0	0
On Farm Use		64800	54000	54000	54000	54000	264290	264290
Total Production		194400	162000	162000	162000	162000	2642900	2642900
Production costs:								
Total Investment Cost		0	3552449	0	0	0	0	0
Total Operating Cost		173440	673440	338160	338160	338160	394300	394300
Total Taxes		0	0	0	0	0	0	0
TOTAL OUTFLOWS		173440	4225889	338160	338160	338160	394300	394300
Cash flow before financing		20960	-4063889	-176160	-176160	-176160	2248600	2248600
Financial inflows:								
Disbursements from project loan:								
Oil palm loan			3552449					
Transfer from previous period			673440	338160	338160	338160	394300	394300
Contribution from own savings								
Sub-total financial inflows:			4225889	338160	338160	338160	394300	394300
Financial outflows:								
Debt Service								
Oil palm loan				1184150	1184150	1184150	0	0
Transfer to next period			338160	338160	338160	394300	394300	394300
Sub-Total Financial Outflows:			338160	1522310	1522310	1578450	394300	394300
Net Financing	0		3887729	-1184150	-1184150	-1240290	0	0
Cash flow AF		20960	-176160	-1360310	-1360310	-1416450	2248600	2248600
Farm benefits AF		20960	-176160	-1360310	-1360310	-1416450	2248600	2248600
Incremental benefits (BF)			-4084849	-197120	-197120	-197120	2227640	2227640
NPV (14%)		4835066		BCR	3.3648			
IRR (25 years)		0.237404						
Incremental benefits (AF)			-197120	-1381270	-1381270	-1437410	2227640	2227640
NPV (14%) in Naira		5815473						

IRR (25 years)	0.352047
NPV (14%)	5815473
Source: Study data analysis	

Sensitivity Analysis

This study discretionally evaluated the impact of 10 percent fall in the yield of oil palm, 10 percent fall in the output price,

10 percent fall in total benefit, 10 percent rise in investment cost and 10 percent rise in operating cost on

the Internal Rate of Returns (IRR) of oil palm production to determine how sensitive the estimated IRR was to changes in these variables. The results were presented in table 4. It was evident from the table, that in the

cases of 10 percent fall in the yield of oil palm, 10 percent fall in the output price of palm fruits, 10 percent fall in total benefit from oil palm, there was only 9 percent fall in the IRR in each of the cases and when the investment cost was raised by 10 percent there was only 6 percent fall in the IRR and also when the operating cost was increased by 10 percent, the IRR fell by only 3 percent. It was concluded that the estimated IRR was

The table showed that 60 percent fall in yield caused the estimated IRR to fall from 35 percent to 12 percent; 55 percent decrease in the price of output resulted in the estimated IRR falling from 35 percent to 14 percent; 60 percent fall in total benefit caused the estimated IRR to fall from 35 percent to 14 percent; a rise in the investment cost

by 340 percent made the estimated IRR to fall from 35 percent to 14 percent and a rise in the operating costs by 550 percent caused the estimated IRR to fall from 35 percent to 13 percent. It was concluded that the estimated IRR was relatively stable and

relatively stable and almost insensitive to small changes in yield, output price, total benefits, investment cost and operating costs.

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

Table 4: Result of the Sensitivity Analysis			
Change in variable	Base IRR	Estimated IRR	Percent change
Yield fall by 10%	35%	32	9%
Output Price fall by 10%	35%	32	9%
Benefit fall 10%	35%	32	9%
Investment cost rise by 10%	35%	33	6%
Operating cost rise by 10%	35%	34	3%
Source: Study data analysis			

Table 5: Switching Values at 14 % Discount Rate				
Variable	Percent Change	Base IRR	Estimated IRR	Percent change
Yield fall	-60%	35%	12%	66%
Output price fall	-55%	35%	14%	60%
Total benefit	-60%	35%	14%	60%
Investment rise	340%	35%	14%	60%
Operating cost rise	550%	35%	13%	63%
Source: Analysis from the Study				

almost insensitive to small changes in yield, output price, total benefits, investment cost and operating costs.

Monte Carlo Simulation and Risk Analysis

The three major limitations of sensitivity analysis are: (i) it does not consider the

probabilities of occurrence of the events; (ii) it does not consider the correlations among the variables and (iii) 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. There is no justification for the practice of changing the value of one variable at a time while keeping the values of the other variables constant when the variables are correlated. This practice can only be justified if the other variables concerned are not correlated with the one being changed. Otherwise, the values of the related variables must be changed jointly. See Pedro Belli et al., (2001). Simulation and risk analysis mitigates the shortcomings of sensitivity analysis; however, the process is fraught with the difficult task of assigning probability distributions to project component variables and specifying correlations. As a resolution, according to ADB, (2017), if the distributions are unknown, project analysts can 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. Concerning price search in Niger Delta markets, it follows a process of optimum optimum. This implies that on getting to a market, there

is a section of the market which has the highest concentration of a particular commodity and that commodity's price will be cheaper in that section than any other section of the market. Within that section there will be a trader who sells the particular commodity cheaper than other sellers and getting to that seller one haggles the price of the commodity until a satisfactory bargain is attained. Consequently, there is no specified mean or standard deviation of the price of any given commodity. The price depends on one's ability to search and haggle. Therefore, the price distribution of any commodity is hardly known. Monte Carlo Simulation in this study applied the distributions that were apparent from the NDDC baseline survey and assigned normal distribution to yields and triangular distribution to the input and output prices. The base (without simulation) NPV and IRR were Five Million, Eight Hundred and Fifteen Thousand, Four Hundred and Seventy-Three Naira (₦ 5,815,473) only and 35 percent respectively.

Simulated Expected Internal Rate of Return (EIRR)

In simulating the IRR, NPV and the BCR (2000 iterations), the descriptive statistics results of the NDDC baseline study were adapted as follows: the yield of oil palm was normally distributed with a mean of 2033 kg/ha and a standard deviation of 50 kg/ha.

The yield of maize also was normally distributed with a mean of 1500 kg/ha and a standard

deviation of 40 kg/ha. The prices followed triangular distribution with the prices used in this study taken as the modal prices. The minimum prices were set at 90

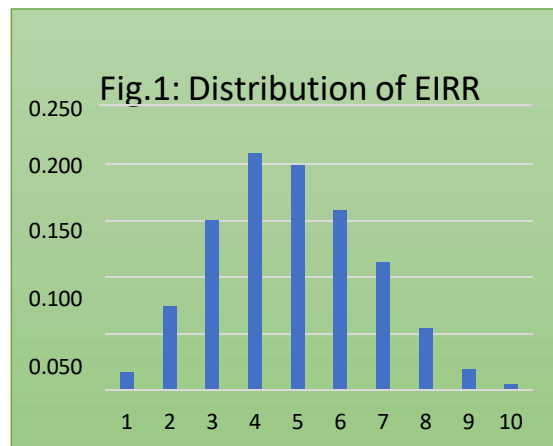
percent of the prices used in this study and the maximum prices were set at 120 percent of the prices used in this study for the respective variables. The simulated EIRR was 36 percent with a mean of 36 percent, a minimum of 31 percent and a maximum of 41 percent. This was distributed into 10 classes with a range of 0.009 or 1 percent. The result was presented in table 6. The distribution was presented as column graph in figure 1. In the column graph the figures in the row represent the class of the expected internal rate of return interval as in

Table 6: Distribution of EIRR			
	From	To	Result
1	0.316	0.326	0.016
2	0.326	0.335	0.074
3	0.335	0.345	0.151
4	0.345	0.354	0.210
5	0.354	0.364	0.200
6	0.364	0.373	0.160
7	0.373	0.383	0.114
8	0.383	0.392	0.054
9	0.392	0.401	0.018
10	0.401	0.411	0.005

Source; Study Data Analysis.

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. The simulation provided us with the expected internal rate of return and the frequency distribution which was an approximation of the probability distribution which would have obtained had the number of estimations of the IRR using sample the size as in the NDDC baseline survey study been repeated for an infinite number of times. Since the EIRR (36%), and the estimated expected minimum value (EIRR=31%) was above the hurdle rate, it was concluded that the simulation of the IRR reinforced our confidence that investment in the oil palm production enterprise is notably profitable.



Simulated Expected Net Present Value (ENPV)

In simulating the ENPV (2000 iterations), the same assumptions made about the distribution of the yields and the prices in simulating the EIRR were also adopted. The simulated Expected Net Present Value (ENPV) was Six Million, One Hundred and Sixty Thousand, Nine Hundred and Twenty Six Naira (₦ 6,160,926) only, with a mean of Six Million, Thirty Two Thousand, Five Hundred and Forty Four Naira (₦ 6,032,544.9) only; a minimum of Four Million, Five Hundred and Fifty Four Thousand, One Hundred-and Thirty Naira, Seventy Seven Kobo (₦ 4,554,130.77) only, and a maximum of Seven Million Seven Hundred and Forty Eight Thousand, Five Hundred and Seventy Eight Naira, Seventy Six Kobo (₦ 7,748,578.76) only. This was distributed into 10 classes with a class interval of

Table 7: Distribution of ENPV			
	From	To	Results
1	4662820	4987653	0.014
2	4987653	5312486	0.083
3	5312486	5637319	0.167
4	5637319	5962152	0.215
5	5962152	6286985	0.198
6	6286985	6611818	0.164
7	6611818	6936651	0.095
8	6936651	7261484	0.045
9	7261484	7586317	0.015
10	7586317	7911150	0.005

Source; Study Data Analysis.

Three Hundred and Nineteen Thousand, Four Hundred-and Forty- Four Naira Eight Kobo (₦ 319,444.8) only. The result was presented in table 7. The distribution was presented as column graph in figure 2. In the column graph, the figures in the row represent the mid-class of the expected net present values 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 base NPV and IRR provided the net present amount that would accrue and the associated internal rate of return if the sample cross-sectional data of inputs, yields and prices collected during the NDDC baseline study survey were used to estimate a single-shot NPV and IRR. However, simulation provided us with the expected net present value and expected internal rate of return as well as their frequency distributions which were approximations of their probability distributions which would have been realized had the number of estimations of these parameters using sample size as in the NDDC baseline survey study extended for an infinite number of times. Since the ENPV (6,160,926), EIRR (36%), the BCR (3.4) and their estimated expected minimum values (minimum ENPV= ₦ 4554130.8; and minimum EIRR=31%) were all well above the hurdle rates, the simulation reinforced our confidence that investment in the oil palm production enterprise is worthy and profitable.

Summary, Conclusions, Recommendations

Oil palm is an important crop in Nigeria, producing palm oil and palm kernel for both food and industrial uses. The aging

of plantations without adequate replacement has led to a significant supply gap. This study was aimed at showing that despite the long gestation period of oil palm, investments in the enterprise was viable and profitable. This study examined the economic viability of oil palm production in the Niger Delta Region through an investment analysis, estimating Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio (BCR).

Knowledge of the economic indicators will enable prospective entrepreneurs rank oil palm production properly among other candidate enterprises for investment as a means of livelihood. It will encourage the youths and other farmers to take up oil palm production as a means of livelihood thereby ameliorating the scourge of unemployment, which is one of the underlying causes of insecurity, robbery, kidnapping, prostitution, and other vices bedeviling the Nigerian economy. The study found that oil palm production is profitable, with a base IRR of 35%, NPV of ₦5,815,473, and BCR of 3.4.

The IRR exceeded the hurdle rate of 14% therefore indicating that oil palm production was profitable and could pay back any loan and leave some surplus for the farmer. The annual incremental revenue without the oil palm enterprise was only ₦ 20,960 per annum but with the oil palm enterprise the annual incremental revenue was ₦ 2,227,640. This reaffirms the conclusion that oil palm production in the Niger Delta Region of Nigeria is profitably viable. The oil palm farmers in the Niger Delta were constrained by the high cost and adulteration of farm inputs especially oil

palm seeds/seedlings, fertilizers and agrochemicals. Agricultural loans were not available to farmers because banks required expensive collaterals which the farmers could not afford. It is recommended that:

- i. government should assist the farmers by enacting policies that would ensure the provision of unadulterated inputs including fertilizers and agrochemicals to the oil palm farmers at affordable prices.
- ii. oil palm seed/seedling policy be established to drive Supply of Quality and Certified Seeds/Seedlings to the Industry.
- iii. Government should facilitate the provision of farm lands from communities without too much strains.
- iv. Government should ensure the provision of loans by banks without demanding prohibitive collaterals.
- v. Simulation and risk analysis should be applied in appraising agricultural investments especially oil palm production.

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