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ECONOMIC APPRAISAL OF MANGO-GUAVA-CASHEW PLANTATION FARMING IN KOGI STATE NIGERIA

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ABSTRACT

This study conducted Economic Appraisal of Mango-Guava-Cashew Plantation enterprise in Kogi State Nigeria and determined whether the plantation enterprise generated a positive Net Present Value; an Internal Rate of Return which is greater than the opportunity cost of capital; a Benefit Cost Ratio which is greater than unity; conducted sensitivity analysis on Net Present Value and Internal Rate of Return; and determined with Monte Carlo Simulation technique the expected Net Present Value and Internal Rate of Return.This study reviewed publications on fruits, (mango, guava and cashew inclusive) and also studies on mango, guava and cashew individually. The data used in this study was secondary data obtained from Fadama III project Implementation Completion Studies carried out in Kogi state. Available data was collated and analyzed using Microsoft Excel spread sheet. The analysis was hinged on the theory of the firm, sensitivity analysis and Monte Carlo Simulation technique. The Internal Rate of Return was estimated at 36%; the Net Present Value was estimated at ₦8,131,328 and the Benefit Cost Ratio was estimated at 25.4. Since the Internal Rate of Return was greater than the hurdle rate of 12%, the estimated Net Present Value was greater than unity and estimated Benefit Cost Ratio was greater than unity, it was concluded that mango-guava-cashew plantation in the Kogi State of Nigeria was profitable and could pay back any loan and leave some surplus for the farmer. The constraints to plantation agriculture in the study area were pests and diseases, inadequate capital, high cost of inputs such as seeds, fertilizers and labour respectively, high cost of transportation and lack of access to market. It was recommended that practical steps should be taken to address the

problems of land fragmentation. Productivity enhancing support services such as fertilizers, herbicides and chemicals should also be readily available and at affordable prices to farmers. An effective and efficient agricultural extension service scheme should be put in place to avail farmers with the opportunity of managing their small farms more effectively for optimal productivity.

Key words: Appraisal, plantation farming, Net Present Value; an Internal Rate of Return, Benefit Cost Ratio, Simulation

Background

Whenever food is discussed in Nigeria attention is tilted to roots, tubers and grains, rarely were fruits and nuts given prominence, no wonder malnutrition was always present or incipient sapping vitality and endangering the health of the populace. The need to promote the production of fruits and nuts in plantations can never be overemphasized. Traditionally, fruit trees were planted as hedges around the compound, boundary demarcations for plots or grown in the wild and people take them seasonally as gifts or rewards of hunting expeditions. Commercial crops such as cocoa, rubber and oil-palm were researched into by international organizations including the International Institute for Tropical Agriculture (IITA) but rarely were attention focussed on developing plantations for fruits and nuts such as mango, guava and cashew for local consumption. Kogi state which is situated in the middle belt of Nigeria and endowed with vast land mass encompassing forests, shrubs and grasslands is well suited for plantation crops.

Statement of the Research Problem

Traditionally, small plots of land were devoted to planting roots, tubers, and grains. Rarely was attention given to fruits and nuts and this has led to scourge of endemic malnutrition. If the situation is not assuaged, food problem in the country will remain unsolved. To ameliorate the situation, it is advocated that plantation agriculture be developed to boost the production of fruits and nuts in such large quantities that will arrest the menace. In lending support to producing sufficient quantities of fruits and nuts to satisfy the burgeoning population, this study is geared at the Economic Appraisal of Mango-Guava-Cashew Plantation Farming in Kogi State, Nigeria. If the venture is profitable, with adequate provisions made for land and necessary input acquisition it is expected that the teeming population of unemployed youths will take up plantation agriculture as a means of livelihood. This will reduce the problems of youth unemployment, the menace of ingesting hard drugs, robberies, kidnappings and insecurity in the region.

Objectives of the Study

The aim of this study was to conduct Economic Appraisal of Mango-Guava-Cashew Plantation Farming in Kogi State Nigeria.Specifically, the objectives were to appraise the establishment of Mango-Guava-Cashew Plantation in Kogi State and determine whether the plantation farming generated:

a) A positive Net Present Value (NPV);

b) An Internal Rate of Return (IRR) which is greater than the opportunity cost of capital (12 percent)?

c) A Benefit Cost Ratio (BCR) which is greater than unity? conduct

d) Sensitivity analysis on 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 Economic Appraisal of Mango-Guava-Cashew Plantation Farming in Kogi State Nigeria. It estimated the following performance indicators for the enterprise namely: the NPV, IRR, and BCR. It tested the sensitivity of the estimated NPV and IRR to changing values of the yield and the components of costs (input prices) and benefits (output prices) and determined the switching values. It used the 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.

Limitations of the study

The data applied in the study were collected from Fadama III Project in Kogi State in 2022 however, without bearing this study in mind. The resources of time and funds available for the study were inadequate.

Significance of the Study

An analysis of the economics of production of Mango-Guava-Cashew Plantation in Kogi State will enable prospective entrepreneurs rank the enterprise properly among other candidate enterprises (for selection) for investment as a means of livelihood. This will assist in decision making for employment creation and eliminating some of the causes of insecurity, robbery, kidnapping, prostitution, and other vices bedeviling the Nigerian economy.

Literature Review Government policies

The Federal Government of Nigeria (FGN) is highly committed to developing agriculture to enable self-sufficiency in food production as well as supply raw materials to the growing industries in the country. To this end the FGN has several policies and initiatives aimed at boosting agricultural production, including those specifically focused on plantation agriculture. These policies emphasize a shift towards a more private sector-led, market-oriented approach, while also prioritizing food security, sustainability, and the modernization of agricultural practices. It established appropriate institutions and created administrative organs such as the Fadama III project which was implemented with the World Bank funding and FGN support to facilitate the integrated development and realization of the country's agricultural potentials (Oladunni,Olufemi Ajayi, 2021).

Kogi state government (KSG) and various organizations in the state are actively involved in promoting agricultural initiatives, including mango, guava and cashew cultivation, to enhance economic well-being and create jobs in the state. KSG's agricultural policies included providing farmers with improved seedlings, mechanization, and agrochemicals. The State has the potential for mango, guava and cashew production because of its favorable climate and landmass, as well as opportunities for both local consumption and export. This study reviewed publications on fruits, (mango, guava and cashew inclusive) and also studies on mango, guava and cashew individually.

Fruits and Vegetables

Several studies were conducted on fruits and vegetables, notable authors in this field included Cock and Voss, (2004); Gabre Madhin and Hagglade, (2003); Minot

and Ngigi, (2004); and Subramanian et al., (2000).They stated that fruits and vegetables play a very important role in the nutrition and health especially as they contain substances which regulate or stimulate digestion, act as laxatives or diuretics, pectins and phenoic compounds which play a part in regulating the pH of the intestines. They asserted that fruits and vegetables contributed to the income of both the rural and urban dwellers. The value of fruits and vegetables per unit area was significantly higher than the value of the cereal crops. Fruits and vegetables can generate higher profits than staple crops, especially when land is relatively scarce and labor is abundant.

Studies from the developing countries of Asia and Africa consistently show that farmers engaged in the production of fruits and vegetables earned higher net farm incomes than farmers engaged in cereal production alone (Abedullah et al., 2002; Cock and Voss, 2004; Francisco, 2004). Fruits and vegetables generated more jobs per hectare, on-farm and off-farm, than staple based agricultural enterprises (Ali et al., 2002). Improving access to vegetables and fruits in their diets reduces mortality and morbidity of infants and children under five years old, particularly in rural areas (Von Braun et al., 2004). Diabetes type 2, obesity and certain cardiovascular diseases and cancers can be significantly reduced via increased consumption of fruits and vegetables (WHO, 2003). Over two billion people suffer from micronutrient deficiencies through poor diets (UN/SCN, 2004).

Poor feeding habit predisposes people to infections and diseases such as typhoid fever, heart, liver and kidney diseases due to poor body defense mechanisms. Fruits and vegetables play a very important role in the nutrition and health (Hulme, 1971; Nagy and Shaw, 1980) especially as they contain substances which regulate or stimulate digestion, act as laxatives or diuretics, pectins and phenoic compounds which play a part in regulating the pH of the intestines. It was evident that fruits and vegetables including mango, guava and cashew improve maternal health**.** According to Von Braun et al., (2004), if food security was achieved during girlhood and diet rich in micronutrients were taken during conception, pregnancy and the first few months after childbirth maternal health will be highly improved. Diabetes type 2, obesity and certain cardiovascular diseases and cancers can be significantly reduced via increased consumption of fruits and vegetables including mango, guava and cashew (WHO, 2003).

On medical and pharmaceutical properties of fruits the authors deposed that fruits (including mango, guava and cashew) and vegetables have usually constituted the main repository of drugs and many have been known not to pose any threat to human life (Ayodele, 1996). Fruits and vegetables including mango, guava and cashew ensure environmental sustainability because perennial tree crops can conserve and protect the soil in hilly and high rainfall regions. The challenges and problems of fruits and vegetables were primarily, natural adversities like weather factors which are not within the control of agricultural producers; pest and diseases, and adverse fluctuations in both input and output prices as well as low application of fertilizers. Secondly, problems include, low access to agricultural credit due to problems with collateral and high interest rates; land tenure insecurity; low and unstable investment in agricultural research; inadequacy of necessary infrastructure such as water supplies, transport and marketing systems.

Thirdly, there is the problem of post-harvest losses caused by a wide variety of

factors, ranging from growing conditions to handling at retail level because fruits and vegetable consist of high percentage water; deteriorate in transit, storage, high temperature and humidity; packaging and bad containers. The following recommendation were made: (i) avoidance of post-harvest losses by following good production practices such as proper irrigation; and (ii) application of appropriate and adequate fertilizers; (iii) appropriate vocational training in agriculture; and (iv) the government needs to improve the infrastructural facilities such as good roads for transportation and electricity to maintain storage facilities in order to sustain the constant supply of fruits and vegetables. The authors did not project the production of fruits for several years or estimated their net present values or internal rate of returns to assess their viability. This study will close this gap.

Mango

Several scholars researched on mango crop. Some notable ones included; MOALF/SHEP PLUS, (2019), Ibukun E. O et al (2015); Rajkumar et al., (2007),and JBAH, (2015). They identified mango with the botanical name: Mangifera Indica in the family of Anarcadiaceae with the local name: mangoro and asserted that it is an abundant fruit in Nigeria and a high source of nutrients, mostly vitamins and can be properly utilized as mango concentrate in other to convert the highly perishable but prime fruit into a more stable form which can serve as a convenient source of instant fruit drink. They applied random sampling in a survey to collect a sample of farms which they studied. They used descriptive statistics to analyze the sample data. They asserted that mango fruit can be used as fresh fruit, juice, puree, jam, chutney, pickles, canned or dried. The fruit contains almost all known vitamins and many essential minerals including Thiamine, Niacin, Ca, Fe etc.

The common varieties recommended for production were: Alphonso, Zill, Julie, Palmer, Keitt, Lippens, Saigon, Edward, Haden, and Early gold. Generally, they mature 3– 4 years after transplanting or in-situ grafting. These varieties are available and can be obtained at. Nigeria Horticultural Research Institute (NIHORT). Mangoes are propagated using grafts raised through veneer grafting or other propagation technique as recommended by NIHORT. On medicinal and pharmaceutical uses, it was apparent that mango powder can be used as ingredients for health drinks, baby foods, sauces, marinades, confections, yogurt, ice cream, nutrition bars, baked goods and cereals and can be rehydrated into instant fruit drinks used as a refreshing drink. (Rajkumar et al., 2007). According to JBAH, (2015), boiling of mango leaves in Linn water and drinking the resultant solution was a cure for malaria. If the bark was soaked for 24 hours and the water extracted was used, for bathing 3 time a day, it will cure typhoid fever.

Guava

Some studies found that guava was more drought resistant than most of the fruit trees and can withstand extreme summer temperatures up to 46°C (Taiwo, 2005). The crop was adaptable to a wide range of soil and climatic conditions and grows satisfactorily in all parts of the country (Annon, 2005). Guava contains a large amount of citric, lactic, malic, oxalic, acetic acids and trace amount of formic acid (Alagumani, 2005). The ripe fruit of guava was usually eaten as dessert, it can also be processed into jellies, jam, paste, juice, baby food, puree, beverages, syrup, wine, and other value-added products (Basseto et al., 2005). According to Millins et al., (2000),

some parts of the guava tree have medicinal and commercial value; the bark and leaves are traditionally used to expel the placenta during childbirth; the leaves can be made into tea and astringent which can cure stomach aches, and serve as a vermifuge; also, when crushed or chewed help to relieve toothaches, while pounded leaves are applied to treat rheumatism locally. The plant is also useful in dyeing and tanning processes (Millins et al., (2000).

Several authors carried out research on guava. They included: Lawal, S.A. (2013). Byresh.S. (2007), Naphade S.A. et. al., (2008), and Okoye, B. C., et.al., (2009), They used a multi-stage sampling procedure to collect primary data with the aid of structured questionnaire. The statistical tools used to analyze the data were descriptive statistics which they applied to describe the socio-economic characteristics of guava and determined the profitability of guava production in the study areas. Lawal, S.A. (2013) determined net farm incomes, benefit cost ratio and applied the stochastic production frontier function model. In his study the quantity of guava seeds applied was 0.073kg/ha with an average market price of ₦5000 per kg the quantity of fertilizer was 567.90 kg/ha., and the quantity of agrochemical was 8.583 litres/ha. He estimated the total revenue (TR) at ₦266,926.8 while the total cost (TC) was ₦97,213.07 per hectare of guava farms. The net farm income was ₦169,749.73 per hectare of guava farms. The average rate of return on investment (return per naira invested) was ₦2.75, indicating that for every ₦1 invested in guava production in study area; a profit of ₦1.75 kobo was made. He indicated that the mean technical efficiency for the 126 sampled farmers in the study area was 0.82. The study revealed that constraints to guava production in the study area were pests and diseases, inadequate capital, high cost of inputs such as seeds, fertilizer and labour respectively, high cost of transportation and lack of access to market. It was recommended that farmers should form co- operative association through pooling of resources together for a better expansion, efficiency and effective management of resources and for profit-maximization.

Cashew

Cashew (Anacardium occidentale L.) is tropical nut tree crop, which is a source of food, income, industrial raw materials and foreign exchange for many countries of Africa, Asia and Latin America. Several authors in Kogi State and elsewhere have studied the cashew crop. Key contributions include: Kakwagh (2023), Jide P.J. et al. (2019), and Ogunwolu et al. (2020). In particular, Kakwagh (2023) examined the prospects and challenges of cashew production in Igala land of Kogi State located in North Central Nigeria. The study applied multistage sampling technique with a sample size of 300 respondents. Data were collected through the application of personal interviews, questionnaire and the trans–sect–walk observation. The study revealed that the area has rich soil with a favorable climatic condition and there was a ready market for cashew nuts. t indicated that cashew production was facing challenges such as fragmented land holdings, lack of extension services, and imposition of multiple taxes, inadequate government support and poor road network. It recommended that practical steps should be taken to address the problem of land fragmentation. Productivity enhancing support services such as fertilizers, herbicides and chemicals should also be readily available and at affordable prices to farmers. An effective and efficient agricultural extension service scheme should be put in place to

avail farmers with the opportunity of managing their small farms more effectively for optimal productivity. The average yield of cashew in Nigeria was estimated at 2,286 kg/ha. The increase in cashew production in Nigeria was attributed to increase in cultivated land area, rather than to increase in yield per hectare. Planting materials were unimproved open pollinated seed nuts that do not breed true to type. There is the need to step up research to produce cashew varieties with improved yields and quality as well as standardize effective propagation techniques to clone them. It was apparent from literature review that a lot of studies had been carried out on mango, guava and cashew in Kogi state, Nigeria and elsewhere concerning their production, propagation, marketing, medicinal values, pests and diseases and constraints but none of the authors projected the production of the crops over several years to estimate the net present values, internal rate of returns and cost benefit ratios. The authors while estimating monetary costs and benefits regarded the estimates as deterministic. They failed to incorporate the spatial and temporal fluctuations in yields, prices, incomes and outlays. This study on appraisal of mango-guava- cashew plantation will fill these gaps and it will apply Monte Carlo simulation and risk analysis to assess "what ifs" especially with fluctuations in yield and prices of inputs and outputs.

Analytical Framework

This study was hinged on the theory of the firm, specifically, farm investment analysis. Several micro-economic text books including: Henderson and Quandt (2010) and Hirshleifer (2005) discussed the theory of the firm. farm investment analysis checks 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). Mango-guava-cashew plantation in Kogi state follows the theory of a perfectly competitive firm (enterprise) which is a price-taker in both the inputs and outputs' markets. 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 (BCR)) 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 NPV; the BCR and the IRR for mango-guava-cashew plantation in Kogi State. It 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 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 in a combination. Four steps are involved in sensitivity analysis namely:

a) selecting the yields, inputs' prices, outputs' prices, 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 adequate consideration must 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 shortcomings of Sensitivity Analysis as: (a) Failure to 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 selecting the change in the key variables. The latter is because variation of the values of sensitive variables by standard percentages does not 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. The 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. Risk analysis differs from sensitivity analysis in that it estimates the expected (probability weighted) ENPV and EIRR and the probability of the EIRR falling below the test rate. 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, as well as the probability of the EIRR falling below the test rate.

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 decision ratios including the EIRR and the ENPV. This study will apply the Monte Carlo Simulation and Risk Analysis.

Methodology

The data used in this study was secondary data obtained from Fadama III project Implementation Completion Studies carried out in Kogi state, Nigeria. Kogi State is situated at the confluence of the Niger and Benue rivers, which significantly influences its landscape and culture. The state is bordered by nine other states: Nassarawa, Benue, Enugu, Anambra, Delta, Ondo, Ekiti, Kwara, and Niger, and also the Federal Capital Territory (FCT). Kogi is home to several ethnic groups, with the Igala being the most prominent, particularly in the eastern part of the state. Other

major groups include the Ebira, Yoruba (Okun subgroup), and various smaller groups like the Bassa, Nupe, and Gwari. Kogi is religiously diverse, with about equal percentages of Christians and Muslims along with a substantial minority of adherents of traditional ethnic religions. The state covers a land area of about 29,833 km^2 (11,519 sq miles), with an estimated population of 4,466,800 peoples (NPC, 2017). Fadama III Implementation Completion Survey used multi- stage stratified sampling design and clusters of focus group discussion to collect data from 200 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**.**

Analysis of the Mango-Guava-Cashew Plantation Cropping Pattern

The first aspect of the Mango-Guava-Cashew plantation to be analyzed was the cropping pattern. The enterprise was projected for 25 years but only the periods from year zero to year 5 could be accommodated in table 1 and subsequent tables in this study because of space, besides the entries from year 5 to year 25 were projections. In the years without the enterprise, the land was used for maize cultivation and this continued up to the fourth year of the plantation during which the canopy of the trees would no longer allow maize access to sunlight. The first year of the plantation was used for land preparation and planting the budded plants and the production of some maize for sale and farm use. The plantation started producing 50 percent of expected yield from the fourth year. From the fourth-year maize cultivation stopped as the canopy of the trees shaded maize from sunlight. The annual yield rates for mango, guava and cashew were: 2,150 kg/Ha; 5,750 Kg/Ha and 234 Kg/Ha respectively. Only one percent of produced mango, guava and cashew were used on the farm for consumption and other on-farm purposes. The rest were sold for cash. Details are in table 1.

Table 1: Mango-Guava-Cashew Plantation Cropping Pattern

Year		Unit	Price	1	2	3	With 4	
	Mango				0.1	0.35	0.35	0.35
							0.35	0.35
	Guava				0.1	0.35	0.35	0.35
							0.35	0.35
Crop Area	Cashew			0.1		0.3	0.3	0.3
Yield			130	0.7	0.4	0.4	0.3	
	Maize		500		1	1.4	1.4	1.3
							1.3	1
	intensity		300	0	0	0	0	1,575
					0	0	0	0
Farm use	Mango		1000				4,375	5,750
					0	0	0	0
	Guava	Kg	130				117	234
				1,300	1,300	1,300	1,300	
	Cashew	kg	300			0	0	
	Maize	Kg		390	390	390	0	0

Source: Study data

Analysis of Operating Inputs, Investment and Operating Cost

Table 2 analyzed the operating inputs, investment and operating cost. The inputs included:

Budded seedlings of mango, guava, and cashew as well as maize seeds. Other additional inputs required for the plantation enterprise included: Compound fertilizers (NPK), Ammonium Nitrate fertilizers (CAN), pesticides, hired labour,means of transportation, packaging materials and organic manure. The investment is made up of the plantation loan (₦565,276) taken from the bank. The prices attached to the inputs are the mean prices obtained from the Fadama III survey and the prices

were used to multiply the inputs to derive the operating costs over the years of the enterprise. The details are in table 2.

Table 2: Operating Inputs, Investment and Operating Costs

Year	Unit	Price	1-10	1	2	3	4	5
inputs			Without					With
Mango Buddedseedling	kg	2000	0	0	150	150	0	0
Guava Budded seedling	kg	1500	0	0	250	250	0	0
Cashew Bud seedling	kg	1500	0	0	150	150	0	0
Maize seed	kg	200	4	3	3	4	3	
Compound	50kg	15200	0	6	9	9	3	3
Pesticide	Naira	21000	0	3	6	6	6	3
Hired labor	WDs	1000	0	50	70	70	20	20
Transportation	days	1000	0	10	10	10	20	20
Packages	Nos	100	0	0	0	0	50	100
Manure	kg	5	0	1000	2000	100	100	100
COSTS								
Investment				565276				
Mango Budded seedling	kg	2000	0	0	300000	300000	0	0
Guava Budded seedling	kg	1500	0	0	375000	375000	0	0
Cashew Buddedseedling	kg	1500	0	0	225000	225000	0	0
Maize seed	kg	200	800	600	600	800	600	0
Compound	50kg	15200	0	91200	136800	136800	45600	45600
Pesticide	Naira	21000	0	63000	126000	126000	126000	63000
Hired labor	WDs	1000	0	50000	70000	70000	20000	20000
Transportation	days	1000	0	10000	10000	10000	20000	20000
Packages	Nos	100	0	0	0	0	5000	10000
Manure	kg	5	0	5000	10000	500	500	500
Total Operating Costs			800	219800	1253400	1244100	217700	159100

Source: Survey Data Analysis

Estimation 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 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 Kogi state 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 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 subtracting from cash flow before financing the cash flow without the mango-guava-cashew enterprise (which would have accrued if there was no mango-guava-cashew enterprise in the farm).

This was estimated as farm benefits that used to accrue annually during the steady state situation before the plantation enterprise. With the Incremental benefits before financing alone, one may estimate internal rate of returns (IRR) and net present value (NPV). Because the plantation 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 into the analysis 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 36%, and the base NPV was estimated at ₦8,131,328 and the BCR was estimated at 25.4. Since the IRR was greater than the hurdle rate of 12%, it was concluded that mango-guava-cashew plantation in the Kogi State 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, it was concluded that mango-guava-cashew plantation in the Kogi State of Nigeria is profitably viable. See details in table 3.

Table 3: Cash flow Analysis of Mango-Guava-Cashew plantation in Kogi State, Nigeria

		Without					With	
Unit	Price	1-10	Yr,1	Yr,2	Yr,3	Yr,4	Yr,5	Yr,6
Sales								
Mango	230.00	0	0	0	0	319275	638550	638550
Guava	1000.00	0	0	0	0	1293750	2587500	2587500
Cashew fruit	500.00	0	0	0	0	31590	63180	63180
Maize	1000.00	390000	390000	390000	390000	0	0	0
Pdn.Net		390000	390000	390000	390000	1644615	3289230	3289230
Farm use								
Mango		0	0	0	0	35475	70950	70950
Guava		0	0	0	0	143750	287500	287500
Cashew fruit		0	0	0	0	3510	7020	7020
Maize		910000	910000	910000	910000	0	0	0
Sub-Total Farm Use		910000	910000	910000	910000	182735	365470	365470
Pdn.Value		1300000	1300000	1300000	1300000	1827350	3654700	3654700
Pdn.Cost								
Investment		0	565276	0	0	0	0	0
Total Operating Cost		800	219800	1253400	1244100	217700	159100	159100

Total Taxes	0	0	0	0	0	0	0
TOTAL OUTFLOWS	800	785076	1253400	1244100	217700	159100	159100
Cash flow before financing	1299200	514924	46600	55900	1609650	3495600	3495600
Financial inflows :							
Disbursements from loan :							
Plantation Loan		565276					
Transfer from previous period		219800	1253400	1244100	217700	159100	159100
Contribution from own savings							
Sub-total Financial inflows :		785076	1253400	1244100	217700	159100	159100
Financial outflows :							
Debt Service							
Plantation loan		0	188425.3	188425.3	188425.3	0	0
Transfer to next period		1253400	1244100	217700	159100	159100	159100
Sub-Total Financial Outflows :		1253400	1432525	406125.3	347525.3	159100	159100
Net Financing	0	-468324	-179125	837974.7	-129825	0	0
Cash flow after financing	1299200	46600	-132525	893874.7	1479825	3495600	3495600
Farm benefits(AF)	1299200	46600	-132525	893874.7	1479825	3495600	3495600
Incremental benefits(BF)		-784276	-1252600	-1243300	310450	2196400	2196400
NPV (12%)	8168965	BCR=	25.35037				
IRR (25 years)	0.376778						
Incremental benefits(AF)		-1252600	-1431725	-405325	180624.7	2196400	2196400
NPV (12%) in Naira	8131328						
IRR (25 years)	0.357234						
Source: Result of Study Data Analysis							

Sensitivity Analysis

This study discretionally evaluated the impact of 10 percent fall in the yield of mango, guava and cashew, and 10 percent fall in the output prices of mango, guava, cashew and total benefits from production, as well as 10 percent rise in investment cost and 10 percent rise in operating cost on the Internal Rate of Returns (IRR) of mango-guava-cashew plantation enterprise to determine how sensitive the estimated IRR was to changes in these variables. The results were presented in table 4. It was evident that mango and cashew yields were insensitive to 10% decrease of yield and prices. A 10 percent decrease in mango yield caused a fall of the base IRR from 36 to 35 or a change of -3 percent. A 10 percent decrease in cashew yield did not change the base IRR. A 10 percent decrease in guava yield caused a fall of the base IRR from 36 to 33 or a change of -8 percent. A 10 percent decrease in mango price caused a fall of the base IRR from 36 to 35 or a change of -3 percent. A 10 percent decrease in guava price caused a fall of the base IRR from 36 to 33 or a change of -8 percent. A 10 percent decrease in cashew price had no impact on the base IRR. When the total benefits were decreased by 10 percent, the base IRR decreased from 36 to 33 percent which was a -8 percent change in the base IRR. An increase of 10 percent in investment decreased the base IRR from 36 to 35 percent which is a fall of -3 percent of the base IRR. An increase of 10 percent in operating

Table 4: Result of the Sensitivity Analysis

	Base IRR	Estimated IRR	% Change
Mango yield	36	**35**	**-3%**
Guava yield	36	**33**	**-8%**
Cashew yield	36	**36**	**0%**
Mango price	36	35	**-3%**
Guava price	36	33	**-8%**
Cashew price	36	36	**0%**
Benefit	36	33	**-8%**
Rise in Investment	36	35	**-3%**
Operating Cost	36	34	**-6%**

Source: Study Data Analysis

cost resulted in the fall of IRR to 34 percent which was only a -6 percent fall in the base IRR. It was concluded that the estimated IRR was stable but slightly sensitive to changes in yield and price of guava. The details are in table 4.

Switching Values at 14 percent Hurdle Rate

According to Belli, P., and J.R. Anderson, (2013), the preferred approach to sensitivity analysis was the use of switching values. The analysis of the switching value at 12 percent hurdle rate was carried out and the results were presented in table 5. The table showed that: the yields of mango and cashew as well as the prices of mango and cashew were insensitive to changes in the base IRR. A 100 percent fall in the yield of mango reduced the base IRR from 36 percent to 28 percent which is a fall of only 22 percent from the base IRR. A 60 percent fall in the yield of guava will reduce the base IRR from 36 percent to 11 percent which is a fall of 69 percent from the base IRR. A 100 percent fall in the yield of cashew reduced the base IRR from 36 percent to 35 percent which is only a fall of 3 percent from the base IRR. A 100 percent fall in the price of mango reduced the base IRR from 36 percent to 28 percent which is a fall of 22 percent from the base IRR.A 60 percent fall in the price of guava reduced the base IRR from 36 percent to 13 percent which is a fall of 64 percent from the base IRR. A 100 percent fall in the price of cashew reduced the base IRR from 36 percent to 35 percent which is a fall of 3 percent from the base IRR. A 70 percent fall in benefit reduced the base IRR from 36 percent to 12 percent which is a fall of 67 percent from the base IRR. A 1900 percent rise in the investment reduced the base IRR from 36 percent to 13 percent which is a change of 64 percent of the base IRR and 350 percent rise in the operating costs reduced the base IRR from 36 percent to 12 percent which is a change of 67 percent of the base IRR. It was apparent that the estimated IRR was stable but slightly sensitive to changes in yield and price of guava. The details are in table 5.

Table 5: Switching Values at 12 Percent Discount Rate

	% Change	Base IRR	Estimated IRR	% change
Mango yield fall	100	0.36	0.28	-22
Guava **yield fall**	60	0.36	0.11	-69
Cashew yield fall	100	0.36	0.35	-3
Mango price fall	100	0.36	0.28	-22
Guava price fall	60	0.36	0.13	-64
Cashew **price. fall**	100	0.36	0.35	-3
Benefit fall	70	0.36	0.12	-67
Investment rise	1900	0.36	0.13	-64
Operating Cost rise	350	0.36	0.12	-67

Source: Analysis from the Study

Monte Carlo Simulation and Risk Analysis

Simulation and risk analysis mitigates the shortcomings of sensitivity analysis. In Simulation and risk analysis the task of assigning probability distributions to component variables and specifying correlations was the most difficult step. Price search in Kogi markets follow a process of optimum optimorum. On getting to a market, there is a section of the market with the highest concentration of a particular commodity and that commodity price is cheaper there than in 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 Eight Million, One Hundred and Thirty-One Thousand, Three Hundred and Twenty-Eight Naira (₦8,131,328) only and 36 percent respectively.

Simulated Expected Internal Rate of Return (EIRR)

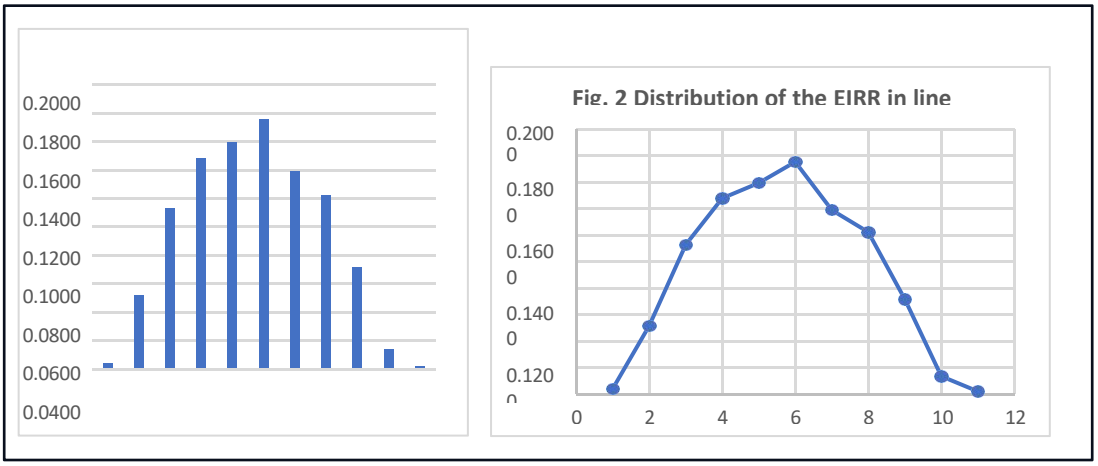
The simulated EIRR was 27 percent with a mean of 29 percent, a minimum of 18 percent and a maximum of 41 percent. This was distributed into 10 classes with a class interval of 2.3 percent. The result was presented in table 6. The distribution was presented as bar graph in figure 1, and as a line graph in figure 2. In the bar graph and line graph, the figures in the row represent the class interval of the expected internal rate of return 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.

istribution of EIRR

ɔm	To	Result
0.172	0.194	0.004
0.194	0.217	0.052
0.217	0.240	0.113
0.240	0.262	0.148
0.262	0.285	0.160
0.285	0.307	0.176
0.307	0.330	0.139
0.330	0.352	0.123
0.352	0.375	0.072
0.375	0.398	0.014
0.398	0.420	0.002

udy analysis

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



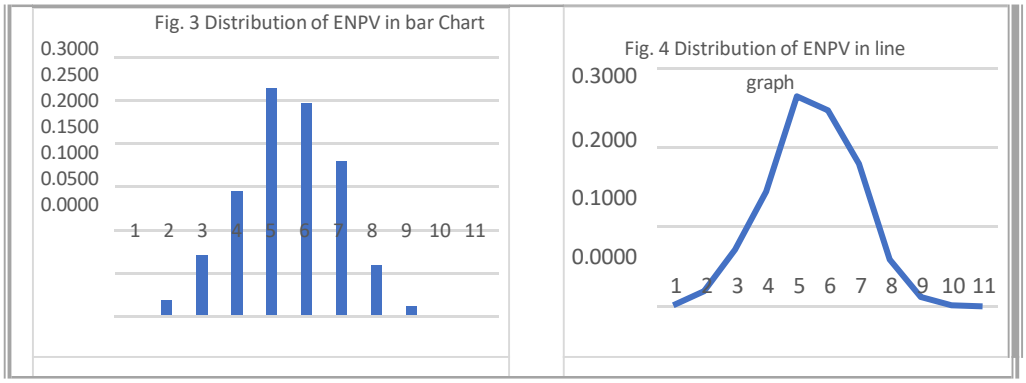
Simulated Expected Net Present Value (ENPV)

The simulated Expected Net Present Value (ENPV) was Seven Million, Four Hundred and One Thousand, One Hundred and Two Naira (₦7,401,102) only**,** with a mean of Seven Million, One Hundred and Ninety Nine Thousand Seven Hundred and Eighteen Naira (₦7,199,718) only; a minimum of Three Million Three Hundred and Fifty Thousand, One Hundred-and Seventy Five Naira, (₦ 3,350,175) only, and a maximum ofTen Million Six Hundred and Ninety Nine Thousand, Eight Hundred and Sixty Four Naira (₦10,699,864) only. This was distributed into 10 classes with a class interval of Seven Hundred and Thirty-Four Thousand, Nine Hundred-and Sixty-Nine Naira (₦734,969) 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.

Table 7: Distribution of ENPV

	From	To	Result
0	3018438	3856324	0.002
1	3856324	4694210	0.019
2	4694210	5532095	0.072
3	5532095	6369981	0.145
4	6369981	7207867	0.265
5	7207867	8045753	0.247
6	8045753	8883638	0.180
7	8883638	9721524	0.059
8	9721524	10559410	0.012
9	10559410	11397295	0.002
10	11397295	12235181	0.000

Source; Study analysis



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 Seven Million, Four Hundred and One Thousand, One Hundred and Two Naira (₦7,401,102) only with a mean of Seven Million, One Hundred and Ninety Nine Thousand Seven Hundred and Eighteen Naira (₦7,199,718) only; a minimum of Three Million Three Hundred and Fifty Thousand, One Hundred-and Seventy Five Naira, (₦ 3,350,175) only, and a maximum of Ten Million Six Hundred and Ninety Nine Thousand, Eight Hundred and Sixty Four Naira (₦10,699,864) only. The simulated EIRR was 27 percent with a mean of 29 percent, a minimum of 18 percent and a maximum of 41 percent. These were distributed into 10 classes and the percentage entries (probabilities) of each class estimated. The annual incremental benefit was Two Million Three Hundred and Eighty Thousand Five Hundred and Forty-Seven Naira (₦2,380,547) only. Considering the facts of a high simulated ENPV values with an average of (₦7,199,718) and minimum of (₦ 3,350,175) concomitant with an annual incremental benefit of (₦2,380,547) only, certainly, mango-guava-cashew plantation farming is a low risk, high return on investment enterprise even at risky conditions. It also suggests that youths may consider taking up mango-guava-cashew plantation for livelihood and growing the economy.

Summary and Conclusions

This study conducted the economic appraisal of mango-guava-cashew plantation in Kogi State, 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 Mango-Guava-Cashew Plantation generated: a positive Net Present Value (NPV); an Internal Rate of Return (IRR) which is greater than the opportunity cost of capital? and a Benefit Cost Ratio (BCR) which is 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 study used secondary data which were primarily collected during the Implementation Completion Analysis of Fadama III project in Kogi State.Available data was collated and analyzed using Microsoft Excel spread sheet**.** The yield rates for mango were 2150 kg/ha; guava 5750 kg/ha and cashew 234 kg/ha. Only one percent of the fruits produced 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 except for guava, mango and cashew yields were insensitive to 10% decrease of yield and prices. It was concluded that the estimated IRR was stable but slightly sensitive to changes in yield and price of guava. The estimated NPV was insensitive to changes in the prices of mango and cashew but 60 percent fall in the price of guava reduced the base IRR from 36 percent to 13 percent which is a fall of 64 percent from the base IRR. The simulated EIRR was 27 percent with a mean of 29 percent, a minimum of 18 percent and a maximum of 41 percent. The annual incremental benefit was Two Million Three Hundred and Eighty Thousand Five Hundred and Forty-Seven Naira (₦2,380,547) only. Certainly, mango-guava-cashew plantation farming is a low risk, high return on investment enterprise even at risky conditions and youths may consider taking-up plantain production for livelihood and growing the economy. The study revealed that constraints to plantation enterprise in the study area were pests and diseases inadequate capital high cost of inputs such as seeds, fertilizers and labour respectively, high cost of transportation and lack of access to markets.

Recommendations

The study recommended that:

i. Practical steps should be taken to address the problems of land fragmentation.
ii. Productivity enhancing support services such as fertilizers, herbicides and chemicals should also be readily available and at affordable prices to farmers.
iii. An effective and efficient agricultural extension service scheme should be put in place to avail farmers with the opportunity of managing their small farms more effectively for optimal productivity.
iv. Youths should take up mango-guava-cashew plantation farming as a means of livelihood and growing the economy.
v. Mango-guava-cashew plantation enterprise should ensure adequate monitoring of yield rate of guava and ensure that it does not fall below 60 percent. This could be achieved by proper application of agrochemicals, fertilizers, other inputs and labor.
vi. The Switching value analysis and Monte Carlo Simulation and Risk Analysis should be applied in analyzing agricultural production specifically mango-guava-cashew plantation enterprise.

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