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INVESTMENT ANALYSIS OF LARGE-SCALE PRIVATE FOREST PLANTATION DEVELOPMENT IN OGUN STATE, NIGERIA

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ABSTRACT

Nigeria, like most African countries, has experienced a noticeable degradation and depletion of its natural forests over the past years. As natural forests decline, actions such as private forestry should be used as a strategy for restoring the ecosystem and increasing wood supply. This study, therefore, investigates the feasibility of large-scale forest plantation development in Ogun State, Nigeria, in order to inform forest stakeholders and policymakers about the benefits accruable to fast growing tree species establishment. Financial indicators such as Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR), Return on Investment (ROI) and Discounted Payback Period (DPBP) were used to analyse the cash flow of the investment. The study revealed that 75 hectares large scale Tectona grandis and Gmelina arborea plantation of 16-year rotation had NPV of ₦ 16,581,015.00 (US$ 45, 427.44), BCR of 2.04%, IRR of 29.71%, LEV of ₦23,046,895.46 ha^{-1} (US$ 63, 142.18) and DPBP of 15.2 years. The results revealed that the investment's payback period is lengthy due to the large capital outlay at the start of the investment as well as the lack of revenue until near the end of the rotation year. So, until the end of the rotation, when the investment yield returns, initial investment will never be fully repaid. Nonetheless, findings confirmed that large-scale forest plantation development is profitable. Therefore, all forest stakeholders and environmental conservation organizations should collaborate with the government to encourage private investment in forest plantation development so as to restore and maintain healthy ecosystems.

Keywords: Private investment, financial analysis, investors, sustainable forest development

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INTRODUCTION

Agbi and Oluku (2012) reported that the forest estate of Nigeria has been highly depleted and only about 974,674 hectares of the forest reserves are productive while 2,342,147 hectares of free areas are partially productive. The acclaimed constituted forest reserves (10% of the total land area of the country) has reduced drastically as a result of rapid population growth, land-use pressures and intensive urban development which are triggering new types of vulnerability to natural disasters. In essence, the total forest area in Nigeria has been decreasing at an increasing rate and the demand for wood raw materials by industries and citizens in recent times in Nigeria has outstripped the production capacity of natural forest (Fasoro and Ajewole, 2019).

To address the diverse and severe effects of environmental degradation that have continued to ravage the global community, the Federal Government of Nigeria proposed long-term afforestation and sustainable forest management programs to raise national awareness about the need to mitigate the negative consequences of climate change caused by indiscriminate deforestation. Udofia *et al.* (2011) and Ajewole and Fasoro (2020) reported that afforestation and reforestation started in 1920s in Nigeria, and it was directed against desertification. Small-scale plantations of tree species such as *Gmelina arborea* and

Tectona grandis were established in Olokemeji Forest Reserve, and later large-scale plantations of tree species were established in many parts of the country, particularly in areas where deforestation has become a major concern as a result of indiscriminate felling of trees and depletion of forest resources due to the booming business of charcoal production (for domestic use, industrial use and for export) and the conversion of forest lands to other land uses (converted to agriculture land, settlements, industries etc.).

Unfortunately, studies have revealed that crude exploitation has infiltrated the funded forest plantation projects. The afforestation projects, in the same manner, have been destroyed and exported out of the country on a scandalous scale, with little or no tree planting done to compensate for the rate of deforestation. This is because foreign financial assistance for the forestry sector in Nigeria, including the World Bank and African Development Bank funds, has ended, and the sector has become largely dependent on public funding. Regrettably, public funding for forest projects and programs in Nigeria has been insufficient and delayed at both the Federal and State government levels, thus, impeding sustainable forest development.

From the foregoing discussion, it is obvious that the efforts by the public sector at managing the country's forest resources through forest reservation and other approaches of managing the natural forests and forest plantations have not yielded desirable outcomes particularly in the sustainable supply of forest goods and services. To confront this gap, the Federal Government of Nigeria began emphasizing private forestry, the establishment of forest plantations, especially ones planted with fast-growing, exotic species, such as Teak, Gmelina, Pine and Eucalyptus.

Udofia *et al.* (2011) and Fasoro and Ajewole (2019) reported that private investment in forest plantation development is deemed critical to the overall success of sustainable forestry development. Forest plantation is a "quick fix" solution to the recurrent problems of overexploitation of natural forest resources, with the potential to increase wood supply and relieve pressure on Nigeria's natural forests. World Bank (2008) affirmed that private sector investments in forestry are one of the main financing sources for sustainable forest development in developing countries. Private forest plantations are highly productive and maximize profit, assuming that the right species are planted in the right places and that proper management practices are implemented. According to Wang *et al.* (2014), forest plantation development is expected to be a successful solution for issues with timber production and supply in many forestry areas around the world. As a result, determining the financial returns of forest plantation development is critical to ensuring the long-term viability of private forestry.

Calculating financial returns aids in determining investment profitability and selecting the best investment options; the evaluation ensures that projects make effective use of limited resources and meet the minimum economic standards demanded by investors; the assessment can also assist in determining which benefits are more valuable to citizens, which is useful for forest policy decisions such as developing forestry programs for local communities; assist in the efficient production of goods and services, make payments for environmental services, and assist in the conservation of natural resources. However, Wang *et al.* (2014) observed that the financial returns of forest plantations are unquestionably a major concern all over the world and the absence of data on the financial returns of forest plantation investment acts as a disincentive to potential investors.

This study, therefore, investigated the feasibility of large-scale forest plantation development in Ogun State, Nigeria, to inform forest stakeholders and policymakers about the benefits accruable to fast-growing tree species establishment.

MATERIALS AND METHODS

Study Area

The total land area of Ogun State is 16,980.55 km^2. In the State, Forest Reserves occupy about 15.9% of the land area (273,162 ha). The projected population density was 4,412,299 in 2011 (NBS, 2012). It has a total annual rainfall of over 1500 mm and average temperature ranges between 21.8^{0}C to 33.2 ^{o}C throughout the year. The climate is tropical and characterized by wet and dry seasons. About 10% of the forest reserve (27,740 ha) has been

converted to forest plantations and this comprises 18% of total forest plantations in Nigeria (Sanwo *et al.*, 2006).

Alamala is located in Abeokuta, Ogun State, Nigeria. The forest plantation is privately owned by an individual and spans 75 hectares of land. The forest plantation is depicted in Figure 1 and Table 1 shows the scheduled activities for plantation establishment.

Table 1: Activities Schedule for the Establishment of 75 Hectares of Teak Plantation at 2.5 M x 2.5 M Spacing

S/No	Operation	Work calendar
1	Survey, demarcation blocking and mapping	November – December 2000
2	Land clearing by mechanical method	December 2000
3	Land preparation (Ploughing & Harrowing)	March – April 2001
4	Seedlings procurement (potted seedling) 1600 seedlings per hectare	April – June 2001
5	Pegs and pegging	April – May 2001
6	Planting	May – June 2001
7	Beating up (20% replacement)	June – July 2001 June – July 2002
8	Maintenance (2 line hoeing and six weeding)	June 2001 – July 2002
9	Ride Construction 5m wide internal & external tracks	February – April 2001
10	Fire Protection & Patrol	February – April 2001
	A 4 X 4 vehicle fitted with a 1000 litre tank and high low volume pump will always be ready to attend to fire attack calls.	November – December 2001
	Land crews on foot, bicycle and motor bikes equipped with cell phones, rakes, machetes, buckets and drums of water mixed with detergents.	December – February 2002 April 2002
	Day and night well trained patrol and security men for public enlightenment campaign, fire fighter and security patrol	
	Reopening of Rides and access roads	

Plate 1: 75 hectares forest plantation at Alamala, Abeokuta, Ogun State

Data Collection

The forest plantation, which was established in 2001, was planted with teak (*Tectona grandis*) and Gmelina (*Gmelina arborea*). The plantation was established for timber production, aesthetics, and environmental improvement. The proposed rotation age for the plantation was sixteen years (16 years), but selective harvesting had already occurred in the plantation.

The cost of forest plantation establishment and revenue generated was obtained from the owner. A private owner incurs a certain amount of initial cost in establishing his or her forest plantation. Thus, the cost and benefits associated with forest plantation investment were assessed. The breakdown of cost of establishment and revenue generated is provided in Table 2. Major elements estimated include the Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR), Land Expected Value (LEV) and Pay Back Period (PBP) of the investment.

Specification of Financial Analysis

The Net Present Value (NPV)

The net present value (NPV) is the difference between the sum of discounted benefits and the sum of discounted costs. The Net Present Value (NPV) is a calculation that takes a series of recurring revenue streams and turns them into a single number that can be used to compare mutually exclusive investments at a given discount rate (cost of capital). Positive NPVs for single investment decisions indicate that the project is feasible (Cubbage *et al.*, 2013).

$$NPV = \sum_{t=0}^{t=n} \frac{R_t}{(1+r)^t} - \sum_{t=0}^{t=n} \frac{C_t}{(1+r)^t} \quad \text{.....Eqn..1}$$

Where

NPV = Net Present Value
R_t = revenues in each year n,
C_t = costs in each year n,
R = discount rate,
N = an index for years and
T = number of years of discounting.

Benefit Cost Ratio

The benefit-cost ratio is useful for allocating a fixed sum of money among various investment options. The benefit-cost ratio compares the total discounted benefits to the total discounted costs (Cubbage *et al.*, 2014). If an investment project's benefit-cost ratio is one or greater, the project is feasible and acceptable. The criterion can be expressed mathematically as

$$B/C = \frac{\sum_{t=0}^{t=n} \frac{Bt}{(1+r)^t}}{\sum_{t=0}^{t=n} \frac{Ct}{(1+r)^t}} \quad \text{.....Eqn..2}$$

Where:
Bt = Benefits (revenue) in each project year
Ct = Costs in each project year
n = Duration of the project in years
r = Discount rate
t = Number of years of discounting

Internal Rate of Return (IRR)

This is the discount rate at which the project's net present value equals zero (NPV = 0). The Internal Rate of Return (IRR) is also known as the discount rate that equalizes the present value of project revenues and costs. In the case of individual investments, the IRR is typically compared to any other rate of return (Cubbage, 2013). In forestry, it is frequently referred to as financial yield or economic rate of return. The IRR is widely used and preferred because it provides a more accurate representation of the productivity of capital in an investment (Cubbage *et al.*, 2014).

It can be expressed as follows:

$$\text{IRR} = \sum_{t=0}^{t=n} \frac{R_t}{(1+r)^t} - \sum_{t=0}^{t=n} \frac{C^t}{(1+r)^t} = 0$$

……..Equation 3

IRR can be obtained either by calculation or by iterations which involve the use of different discount rates by trial and error. Two interest rates, one at which the NPV is positive, and the other at which NPV is negative, need to be selected to calculate IRR. The discount rate between the two NPV which is equal to zero is the IRR.

IRR can be approximated by using the following formula:

IRR = Discount rate resulting in the last positive NPV

$$+\left[Difference\ between\ the\ two\ discount\ rates\ X\ \frac{positive\ NPV}{increamental\ NPV}\right] \text{..... [4]}$$

Land Expectation Value

Bullard and Straka (2011) stated that Land Expectation Value (LEV) is a financial tool used to estimate the value of a tract of land for growing timber, and the land cost is not included when calculating it. As a result, the LEV can be used to determine the value of a specific land parcel based on the costs and revenues associated with both tree and agricultural production. In this case, the LEV is interpreted as the most a land user can pay for land while still earning the minimum acceptable rate of return on investment. LEV for timber production is calculated on the assumption that the land will be used to produce a perpetual series of even-aged or uneven-aged stands, with each stand in the perpetual series having the same revenues and costs as the first rotation or cutting cycle.

$$\text{LEV} = \frac{NPV\ (1+r)^t}{(1+r)^t - 1} \text{ ……. [5]}$$

Payback Period

The payback period is the amount of time required to recoup the funds invested or to reach the break-even point (Wang *et al.*, 2014). The payback period intuitively measures how long it takes for something to "pay for itself." The payback period is the time it takes for an investment's initial cash outflow to be recovered by cash inflows. The formula for calculating a project's payback period is determined by whether the project's cash flow per period is even or uneven. If they are equal, the formula for calculating the payback period is:

$$Payback\ Period = \frac{Initial\ Investment}{Cash\ Inflow\ per\ period} \quad [6]$$

When cash inflows are uneven, we need to calculate the cumulative net cash flow for each period and then use the following formula for the payback period:

$$Payback\ Period = A + \frac{B}{C} \text{ …….. [7]}$$

A is the last period with a negative cumulative cash flow;
B is the absolute value of cumulative cash flow at the end of period A;
C is the total cash flow during the period after A

RESULT

The cashflow statement for a 16-year rotation plantation is shown in Table 2. The plantation's base year was 2001. According to the Table, no revenue was generated from the investment until 2013, the thirteenth (13th) year, which was the first harvest of timber. During the year, hundred (100) stands were harvested, each stand cost seven thousand naira (₦7,000) while the cost of harvesting and transportation per stand cost five hundred naira (₦500). Thus, the first harvest generated a total of seven hundred thousand naira (₦700,000). The second harvest took place in 2014 (the 14th year), with a total of 280 stands harvested and a revenue one million, nine hundred and sixty thousand naira (₦1,960,000) was generated.

Furthermore, the third harvest was done in the year 2015 (15th year), and a total of 2200 stands were sold, however, only few stands were sold at the rate of eight thousand naira (₦8,000) while others were sold seven thousand naira (₦7,000). At the end of the third harvest, the total revenue generated was sixteen million, five hundred thousand naira (₦16,500,000). The projected revenue for the final harvest is eight hundred and eighty million, six hundred and fifty thousand naira (₦880,650,000), taking into that the cost of silvicultural practices (tending and maintenance) decreases over time, and that timber prices may rise or fall due to inflation or other economic factors.

The World Bank (2015) recorded Nigeria's lending rate in 2001 as 23.44%; thus, 23.44% was used as the discount factor (r). Financial indicators (NPV, BCR etc.) were calculated and represented in Tables 2 and 3 using the investment's cashflow statement.

Table 2: 75 Hectares Forest Plantation's Cashflow for a 16-year Rotation Plantation

Year	Items	Cost (₦)	Revenue (₦)	NPV	r (23.44%)	D.C	D.R	DNPV (23.44%)	DNPV (30%)
1	Land	2,250,000		-10612500	1	10612500		10612500	10612500
	Survey, demarcation, land clearing and preparation, seedlings, pegs and pegging, planting.	8,362,500							
	Total	**10612500**							
2	Cleaning, application of fertilizer, beating up	1,200,000		-1200000	0.66	792000		792000	709200
	Planting activities								
	Planting exercise								
	Tending& maintenance								
	Monitoring supervision								
3	Cleaning, beating up	1050000		-1050000	0.54	567000		567000	478800
	Tending& maintenance								
	Monitoring supervision								
4	Tending& maintenance Monitoring supervision	975000		-975000	0.44	429000		429000	340275
5	Monitoring & supervision	1050000		-1050000	0.36	378000		378000	282450
6	Monitoring supervision	1125000		-1125000	0.29	326250		326250	232875
7	Monitoring & supervision	1200000		-1200000	0.23	276000		276000	190800
8	Monitoring & supervision	1200000		-1200000	0.19	228000		228000	146400
9	Monitoring & supervision	750000		-750000	0.16	120000		120000	70500
10	Monitoring & supervision	375000		-375000	0.13	48750		48750	27000
11	Monitoring & supervision	375000		-375000	0.10	37500		37500	20625
12	Monitoring&supervision	375000		-375000	0.083	31125		31125	15750
13	Harvesting and transportation cost	50000	700000	+650000	0.068	3400	47600	44200	21450
	Timber								
14	Harvesting and transportation cost	140000		+1820000	0.055	7700	107800	100100	45500
	Timber		1960000						
15	Harvesting and transportation cost	1100000		+15400000	0.045	49500	742500	693000	292600
	Timber		16500000						
16	Harvesting and transportation cost	58710000		+821940000	0.036	2113560	31703400	29589840	12329100
	Timber		880650000						
Total						**16020285**	**32601300**	**16581015**	**-481425**

Nigeria lending interest rate in 2001 was 23.44%

Table 3 shows the calculated NPV, BCR, IRR, LEV and PP of the investment.

Table 3: Financial Analysis Results

S/No	Financial analysis calculated	Outcome	1 US$ ≈ ₦ 365 in 2018
1	Net Present Value (NPV)	₦ 16,581,015.00	45, 427.44
2	Benefit Cost Ratio (BCR)	2.04%	
3	Internal Rate of Return (IRR)	29.71%	
4	Land Expectation Value (LEV)	₦23,046,895.46ha-1	63,142.18
5	Payback Period (PP)	15years 2 months	

DISCUSSION

The study emphasized that when using these financial prices for forestry projects, the changes should be small enough (marginal) to not distort current market costs and prices. This study confirmed that as time passes, the number and cost of labour required for forest plantation development does not remain the same throughout the production period. Therefore, various timber prices, silvicultural, and administrative costs were projected due to long-term production constraints. For a 16-year rotation age forest plantation, harvesting costs, transportation costs, and revenue generated was projected. The study showed that selective harvesting has occurred in the plantation, with the final harvest scheduled for the 16th year.

The study showed that the first harvest was done in 2013 (the 13th year) and 100 logs were harvested at the rate of ₦7000 per log. The revenue generated was ₦700,000. In 2014 (the 14th year), a second harvest was made, 280 logs were harvested and the revenue generated was ₦1,960,000. The third harvest was done in 2015 (15th year), 2200 stands with a girth of 0.9 to 1m were fell and sold at a rate of ₦8000 per stand, generating revenue of ₦16,500,000. The final harvest was expected to be in 2017(the rotation year) and a total of 117420 logs was expected to be harvested. The projected revenue for the final harvest is ₦880,650,000. Nigeria lending interest rate in 2001 (23.44%) was used to compute the discounted rate from the first to sixteenth years. When costs and revenues were discounted from year one to year sixteen, the NPV was 16,581,015.00, with a B/C of 2.04, LEV of 23,046,895.46ha-1, and DPBP of 15years 2months. To calculate IRR, NPV must be negative. Since the NPV for this investment is positive, there is need to increase the discount factor to get negative NPV. Therefore, at 30% discount factor, NPV= -481425 and the last positive NPV = 1181165 at 29% discount factor. The difference between the two discount rates is 30 – 29 = 1. Thus, IRR = 29.71%.

A significant amount of money was invested at the outset, but no revenue was generated until the end of the rotation year. As a result, the initial investment will never be fully repaid until the end of the rotation, when the investment will yield returns. However, based on the economic measures' criterion, the NPV is positive, and the corresponding B/C is greater than 1.

CONCLUSION

Financial return data are used to establish a baseline or guideline for determining the efficiency and profitability of forest plantation investment. The NPV and IRR of large-scale forest plantation development were positive in this study, indicating that the investment is profitable, economically efficient, and socially acceptable. This shows that private investment in forest plantations can offer a viable solution to Nigeria's timber supply and trade issues. Investment financial data will also provide policymakers and potential investors with critical information for planning investment for forest plantation development, as well as an incentive to improve the formulation of sound management strategies and decision making. To persuade and encourage the public to invest in forest plantation development, there is a general need for government at all levels (particularly forest officials and forest extension agents) to educate the public on the fundamentals of forest asset valuation, forestry investment, and risks.

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