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Profitability Assessment of a 50-Hectare-Mangrove Forest in Escravos, Warri South-West Local Government Area of Delta State, Nigeria: Implication for Utilization

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ABSTRACT : Economic assessment of a 50-hectare-mangrove forest at Escravos, Warri South-West Local Government Area of Delta State, Nigeria was carried out with a view to elucidating the Cost-Benefits Analysis for high tension transmission poles. The cumulative data obtained were analyzed using Smalian's formula to determine volume of standing trees per hectare and Discounted Cash Flow Analysis for profitability. The volume per hectare of mangrove in the study area was very high with a mean volume of 824.25m^3 per hectare in an estimated 50- year-old Natural Mangrove Forest. The Cost and Profit estimated for a 50-hectare-mangrove forest were ₦7,700,000 and ₦44,800,000 respectively. The estimated trees are valuable for high tension transmission poles. The Net Present Value (NPV) and the corresponding Benefit-Cost Ratio (B/C) were ₦95.48 and 5.77 respectively per hectare. The study therefore, revealed substantial benefits on a 50-hectare-mangrove for high tension poles. It is recommended that the mature trees should be felled for utilization to avoid decadence of stand so that the cropped area can pave way for another mangrove restoration since it is self-restocking from the mother trees.

Key words: *Profitability, High Tension poles, Benefit-Cost, Self-restocking*

INTRODUCTION

The perception of forestry development has changed over time. It initially consisted of acquisition of sustainable forest areas, constitution of forest reserves and consolidation of the forest estate. Subsequent development efforts involved introduction of various bills, rules, proclamations and ordinances aimed at enhancing forestry administration in Nigeria. According to Agbeja (2004) further development involved the exploitation and marketing of forest products, as well as forest renewal based on the adoption of various silvicultural techniques.

Mangrove forest is potentially capable of producing a multitude of goods which are of intimate importance to the welfare of mankind. Some of the goods are needed for sustaining life in form of transmission poles, timber, firewood, charcoal, railway sleepers, etc. Mangrove belongs to the economic species that earn the economy a foreign exchange. Mangrove is unique among the various economic tree species owing to the ecological zone it situates and its self-restocking ability from mother trees.

Escravos is one of the settlements along the coastal areas that are endowed with mangrove forest. A large tract of mangrove forest is mature for harvesting to avoid decadence. Having conceived such a large tract of mangrove, there is a necessity for planning the utilization of the mangrove forest products. The primary function of economic evaluation of mangrove forest is therefore, to equip the government agency at least, to be guided by commercial criterion that requires benefit-cost analysis.

According to Adeyoju (1975), timber started to generate revenue for the country since 1846. A review of wood products demand and supply in Nigeria according to Boungiorno *et al,* 1993 shows that Nigeria was in deficit in all types of individual wood supply. However, some economic species such as mangrove trees (*Rhizophora racemosa)* are left in the coastal area without utilizing them. This also corroborates the assertion that Nigeria is a net importer of wood products with annual imports averaging US$200 million (World Bank, 1990). The ability of a country to follow sustainable development paths is determined to a large extent by the capacity of its people and its institutions to conserve the forest reserves. This is achievable on the basis of good governance and sound forest policy. There is no record of sustainable forest management in Nigeria and the forest estate is under singular management (Adeyoju, 2001). For instance, state governments have used forests to solve demographic and other social problems. In such an environment, forestry has not been accorded the status of a business enterprise.

Value is the worth of a product or service to an individual or a like-minded group in a given context, often involving a complex set of relationships (Brown, 1984). The purpose of valuation is to make the value of each forest use explicit, and not necessarily to put a total value on nature (Michael, 1995). FAO (1995) suggests that forest valuation should always be attributed to the commodity studied and to the actual context and situation studied.

The main objectives of the exercise are to determine the Cost-Benefit of a 50-hectare *Rhizophora racemosa* (Red Mangrove) and to identify the most profitable utilization of the product. Before starting an enthusiastic manipulation of numbers, it is necessary to look at the purpose of decision analysis. The manager has to make choices- and this is the mandate for decision analysis: to develop information useful in guiding choice. The purpose of the study is therefore, to determine the worth of the *Rhizophora racemosa* as a naturally endowed species that could guide investment in future projects and their economic viability.

Materials and Methods

Study area

The study area covers a 50-hectare-mangrove forest surrounded by four communities namely Ugborodo, Ogigigben, Jaghala and Ugbelegi in Warri South-West Local Government Area of Delta State. The area is located between Latitudes $5^0\ 30^1$ and $5^0\ 36^1$ North and Longitudes $5^0\ 5^1$ and $5^0\ 10^1$ East.

The mangrove

Mangroves are the characteristic littoral plant formation of Tropical and Sub-tropical sheltered coastlines. They are coastal woodlands or tidal forests or mangrove forests. Mangroves are trees and shrubs growing below the higher water level of spring tides. Their roots are regularly inundated with saline water, though, it may be diluted due to fresh water surface run-offs and only flooded once or twice in a year. Mangroves are unique and highly productive ecosystem. Mangrove forest is natural and a source of renewable resources.

Floristic situation at Escravos

The mangrove forest at Escravos is dominated by *Rhizopora racemosa* (Red mangrove). Red mangrove is hardwood closed to the sea and attains an average height of 25m (82.5ft) Plate 1.

Instruments used for the exercise

i. Spiegel Relascope
ii. Diameter tapes
iii. Prismatic compass
iv. 3m Long tagged pegs
v. Fisco fibar measuring tape (Fx 30m)
vi. Recording Sheet
vii. Camera

Sampling

A simple random sampling procedure was used to obtain representative samples of the mangrove forest. Using random numbers of 1 to 25, Ten (10) sample plots were selected for enumeration. The number of standing trees, volume of standing trees per sample plot and per hectare was estimated. The costs of forest operation and benefits were derived for a hectare of forest in order to determine the economic efficiency of utilization.

Plate 1: Stand of *Rhizopora racemosa* sourced at Escravos with an average height of 25m.

Measurement of trees

A total of ten hectares were randomly selected from a 50-hectare-mangrove. A transect of 20 m x 20 m (0.04 ha.) sample plot was laid and 4 percent sampling intensity was taken per hectare. Trees within each sample plot were classified into different diameter classes. The arithmetic mean tree diameter at breast height was taken for detailed measurements of Diameter at Base (Db), Diameter at Top (Dt) and Merchantable Heights (Mh).

Costs of forest operation

The cost of forest operation in terms of land as a factor of production was estimated per year. Other variable costs for site preparation, planting and maintenance were not employed because the forest is naturally endowed. Using annual rings of the felled trees, the ages of the standing trees were estimated to be 50 years. Therefore, land rent was used and it was based on a 50-year-rotation of mangrove forest.

Analytical techniques

(i) *Volume Estimation*

The volume was determined using Smalian's formula:

$$V = \frac{h}{2}(Ab + At) \quad \text{---------- (1)}$$

Where

V = volume of tree
h = height
Ab = cross-sectional area at the base
At = cross- sectional area at the op
2 = constant

(ii) Area estimation

Cross sectional areas at the base and the top of a mean tree per sample plot was determined using

$$Area = \Pi r^2 \quad \text{---------- (2)}$$

Where $\Pi = pie$

r = radius of a stand tree.

(iii) Economic Evaluation

a. Gross profit analysis

This defines the levels of revenue per hectare of mangrove forest. It estimates the revenue on which suitability classification of land is based. The profit was estimated in three phases. First, the inputs (Land, Labour and Capital) and outputs of mangrove. Second, the value of inputs and outputs were estimated using market price obtained at Industrial Development Unit (IDU), Forestry Research Institute of Nigeria, Jericho, Ibadan (Appendix i). Third, the estimates of inputs were subtracted from the value of outputs in order to obtain profit or loss per unit area of mangrove.

b. Discounted cash flow analysis

Discounted cash flow analysis was used to examine whether commercialization of mangrove forest is profitable and economically viable. Net Present Value (NPV) and Benefit-Cost Ratio (B/C) were used for the economic efficiency of Mangrove Forest Utilization. A rate of 20% was used to discount the revenues and costs.

Results and Discussion

Efforts have been made to quantify mangrove potential at Escravos, Warri South-West Local Government Area of Delta State. Given the ecological zone in which the mangrove situates, the area is virtually dominated with a species called *Rhizophora racemosa* – the Red Mangrove. The mangrove trees are inundated with saline water. The plots studied had between 17 and 25 trees (Table 1). A hectare of mangrove trees with 4mx4m espacement should have 625 trees. However, based on enumeration conducted at Escravos, 525 standing trees are feasible (Table 2). Although, a few trees had withered, died and uprooted by tidal waves, yet the canopies are dense and contiguous in association with one another. A total volume of 824.25m^3 (Table 2) was estimated per hectare for a 50-year-old natural mangrove forest. The average stocking is adequate and encouraging. A 50-hectare-mangrove is rich for high tension transmission pole sizes.

The formula for NPV according to FAO (1992) is given as:

$$NPV = \sum_{t=1}^{n} \frac{(Bt - Ct)}{(1+i)^t} \quad \text{---------- (3)}$$

where

Bt = benefits in the rotation year t

Ct = costs in the rotation year t

n = number of years to rotation year

i = discount rate

t = year of rotation

The **NPV** estimates the relative profitability of a project and the decision criterion is to accept a project with higher NPV.

The formula for B/C is:

$$B/C = \frac{\sum_{t=1}^{n} \frac{Bt}{(1+i)^t}}{\sum_{t=1}^{n} \frac{Ct}{(1+i)^t}} \quad \text{---------- (4)}$$

Bt, Ct, n , i and t are as defined for NPV

The **B/C** measures the social equity and economic efficiency of resources utilization from the stand point of the society. It expresses the sum of discounted revenue as a ratio of the discounted cost. A decision criterion of B/C is to accept the project with a ratio above one i.e. B/C > 1.

Table 1: Mean Tree Parameters for Mangrove Forest at Escravos, Delta State

	Parameters			
Sample Plot	Mean DB (cm)	Mean Diameter (cm)	Mean Mh (m)	Total Number of Trees per Plot
Plot 1	38.5	28	20	22
Plot 5	40	29	21	21
Plot 7	35	26	17	25
Plot 10	36.5	26.8	18.1	21
Plot 13	34	25.5	16	22
Plot 16	38.1	29	20	20
Plot 18	36.5	27	18	19
Plot 21	36.8	26.9	18	17
Plot 25	37.8	27.2	21	21
Plot 1	37	27	20.5	21

Source: Field Survey, 2001

Table 2: Cross Sectional Areas and Volume Estimation

Mean Cross Area at Base (m^2)	0.108
Mean Sectional Area at Top (m^2)	0.058
Volume of a mean tree (m^3)	1.57
Volume per plot (m^3)	32.97
Volume per Hectare (m^3)	824.25
Total Number of Trees per Hectare	525

Source: Field Survey, 2001

The costs of forest operations were devoid of overhead costs and some variable costs. The reason is not far fetched. The mangrove forest is naturally regenerated and it is self-restocking from the mother trees. However, the costs of harvesting per hectare and land rent were estimated for this exercise because no capital is costless. The total costs expected for a 50-hectare-mangrove will be ₦7,700,000 while the total revenues will be ₦52,500,000 (Table 3). The profit therefore, will be ₦44, 800, 000. This indicates a profitable venture. i.e. Benefits are greater than costs.

Table 3: Estimated Cost incurred and Revenue Generated on Mangrove Pole Size

Land Rent and Cost of Harvesting a Hectare of mangrove in Naira	₦154, 000
Cost of Harvesting a 50-Hectare-Mangrove in Naira	₦7, 700, 000
Revenue per Hectare of Mangrove in Naira	₦1, 050, 000
Revenue for a 50- Hectare Mangrove in Naira	₦52, 500, 000

Source: Field Survey, 2001

Profit per Hectare = Revenue – Cost = ₦1, 050, 000 – ₦154, 000 = ₦896, 000

Profit for a 50-Hectare Mangrove = ₦52, 500, 000 – ₦7, 700, 000 = ₦44, 800, 000

Conclusion and Recommendations

The information on cost-benefit analysis of a 50-year-old mangrove forest in Escravos has been estimated and it is concluded that the mangrove forest is naturally endowed, partially disturbed and self-restocking. Having a good market orientation channeled towards a highly lucrative local use and export drive could fetch substantially high returns on the total logs after a 50-hectare mangrove is harvested. Decision makers always justify and legitimize decisions they make via the employment of NPV and B/C. The NPV (₦95.48) and

Table 4: Discounted Cash Flow Analysis for Mangrove Forest at Escravos (₦ / ha) used for High Tension Transmission Poles

Years	49 years	50 years
Costs in Naira	₦154,000	-
Benefits in Naira	-	₦1, 050, 000
Discount factor (20%)	0.00013	0.00011
Present Value of costs (PVC) in Naira	₦20.02	-
Present Value of Benefits (PVB) in Naira	-	₦115.5

Source: Field Survey, 2001.

NPV = PVB – PVC = ₦(115.5 –20.02) = ₦ 95.48

B/C = ₦115.5 / ₦20.02 = 5.77

corresponding B/C ratios (5.77) are favourable for a 50-hectare mangrove forest using a discount factor of 20% (Table 4). The venture will be viable, economical and profitable.

Among the various uses to which mangroves can be put include high tension transmission poles and cross arms. This could be the most rewarding end use because the heights of the trees are far higher than any standard lengths of high tension transmission poles and cross arms at Industrial Development Unit (IDU), Forestry Research Institute of Nigeria, Jericho, Ibadan . Another advantage of this end use is that the poles need little immersion into preservatives. The hardwood mangrove has since its secondary thickening formation been absorbing a lot of nutrients from the saline water which made the standing trees unaffected by molluscs and teredo. This is a proof that the *Rhizopora racemosa* poles and cross arms will resist termite and other insect attacks. Other uses to which mangrove trees can be put are scaffolding, railway sleepers, charcoal and fuelwood.

Delta State is rich in mangrove species. However, the land area is fast diminishing due to lack of adequate forest management to reserve the area in perpetuity. The mangrove is also under a singular management under state government. It is recommended that sound forest policy be put in place because of the long term benefits of mangrove to mankind and plural ownership of mangrove management be entrenched for land use efficiency, continuous stewardship and promotion of family forestry in rural areas of Delta state. It is also recommended that the mature trees should be felled for utilization to avoid decadence of stand so that the cropped area can pave way for another mangrove restoration since it is self-restocking from the mother trees.

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Appendix i: Selling Price of Wood Products at IDU, FRIN, Ibadan

Selling Price of Treated and untreated Poles with different Dimensions	Amount in Naira Value
1. High Tension Transmission Pole (Treated) 34ft (10.36m)	₦2,500
2. Low Tension Transmission Pole (Treated) 28ft (8.53m)	₦2,000
3. Transmission Cross Arms 4insx4ins (9ft) Treated	₦250
4. High Tension Transmission Pole (Untreated) 34ft (10.36m)	₦2,000
5. Low Tension Transmission Pole (Untreated) 28ft (8.53m)	₦1,800
6. Transmission Cross Arms 4insx4ins (9ft) Untreated	₦200

Source: Industrial Development Unit, Forestry Research Institute of Nigeria, Jericho, Ibadan, 2001.