Economic Valuation of Investment in Bush Mango (*Irvingia gabonensis* .Baill) Plantation Establishment in Southern Nigeria

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Abstract: Bush mango is a non-timber forest species that has been contributing to the rural economy of southern Nigeria for a long time but whose potentials have not been fully exploited for economic development. Economic valuation of investment in Bush mango plantation per hectare of land was carried out using a discounted cash flow analysis to determine its financial viability to intending small-holders of this edible Non-Timber Forest Product (NTFP) in Rivers state. This was achieved by estimating the costs and evaluating the benefits involved in establishing a hectare of Bush mango plantation. Two tools of cash flow analysis; Net Present Value (NPV) and, Benefit Cost Ratio (B/C) were used in the analysis. The study showed that bush mango production is a profitable business with a positive NPV of ₦2, 054,188.32 ($12838.67) and B/C of 2.1 which indicates that the returns from Bush mango production would be high and economically viable in the study area. Given the high benefits relative to costs involved in Bush mango production, it is recommended that the capabilities of the smallholders should be enhanced by strengthening their access to small and medium scale forms of capital from cooperative societies, micro-finance houses, Agricultural finance institutions as well as government credit facilities at local, state and federal levels.

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Key words: Economic-valuation, investment, Bush mango, plantation establishment, cash flow analysis.

1. Introduction

The forests of southern Nigerian are blessed with numerous non-timber forest resources, Bush mango inclusive. However, the natural forest remains the major source of its supply to the users. Bush mango is indigenous to the humid forest zone of the Gulf of Guinea from western and eastern Nigeria to the Central African Republic, and south to Cabinda (Angola) and the westernmost part of DR Congo; it also occurs in São Tomé et Príncipe (Prota, 2010). It is cultivated in south-western Nigeria and southern Cameroon, and also in Côte d'Ivoire, Ghana, Togo and Benin.

The tree grows up to 40 m tall with a generally straight bole of up to 100 cm in diameter and buttresses up to 3 m high. The trees are abundant in densely populated areas of natural and secondary forests where the predominant land use system is tree-crop plantation farming. Bush mango is cultivated for commercial production in southern Nigeria on farmlands and agroforestry farms (Omokhua *et al*, 2010).

Kernels of the fruits of Bush mango, called 'ugiri' in Igbo or 'apon' in Yoruba, yield an important food additive popular in southern Nigeria. They are processed by grinding and crushing, and then used to thicken soups and stews. The kernels are also made into a cake for year-round preservation and easy use. Edible oil is extracted from the seed that is used in cooking. In its solid states it is been used as a substitute for cocoa butter, and for soap-making (Prota, 2010). Unlike the fruit pulp of most other *Irvingia* species which is bitter, the pulp of the fruit of *I. gabonensis* is juicy, sweet and eaten fresh. Households are reported to devote, on average, between 2% and 5% of their annual expenditure on *Irvingia* products (Ndoye *et al*., 1998). It is estimated that there is a demand for 78.8 million kilogrammes of bush mango per year; and 80% of this demand is in the southern parts of Nigeria. Its consumption is limited by supply and high prices (DFRM, 1986).

The inadequacy of information on plantation establishment by small holder forest products farmers in southern Nigeria impedes its commercial production for local users in the country. The shift from wild collection to commercial production does have important implications for resource management, with larger volumes being harvested and at a higher frequency and intensity.

In appropriate valuation of forest goods and services and other forest attributes (including non-market benefits) has been recognized as one of the key constraints for sustainable forest management (IPF, 1997). Whereas one of the main purposes of valuation exercises is to facilitate decisions in capturing demand values, to make them act as signals for economic agents such as forest owners and managers. Furthermore, several studies suggest that the value of

products extracted from particular forest areas is lower than what could be gained if the land were converted to plantations (Agbor, 1986; Omoluabi, 1994; Anegbeh *et al., 2003*). The advantages of forest plantations are many and far-reaching. They utilize time and space more efficiently, and yield raw material of comparatively uniform size and quality. Their products can be more or less custom made to meet certain technological requirements. They are relatively simple to manage and, unlike natural forests, their location can be planned. They are also more responsive than natural forests to the advances of science. However, the practical realization of this potential depends on the existence of appropriate information covering all phases of product development, production and marketing. In their absence, the campaign for sustainable management of tropical forest resources as a development opportunity has no place with the rural forest dwellers and Non-Timber Forest Product (NTFP) collectors. Even though the results of experimental trials have often been promising, they generally have not reached the forest-dwelling communities which depend on non-timber forest resources extraction for a significant share of their livelihoods (Leakey *et al.,* 2001 and 2004). Large scale production of food trees and shrubs for a conservation programme or for commercial scale planting will require efficient, economical, standardized nursery procedures, and knowledge of reliable practices for raising the planting stock from select or improved seeds. Standard nursery practices have been developed for several species including *Dacryodes edulis, Irvingia gabonensis* and *Treculia africana* (Okafor, 1981, 1990). Edible forest products contribute to nutritional and dietary needs of consumers of the forest food (Okafor, 1988, 1989; Falconer, 1990). It also generates substantial cash income for rural people, thereby contributing to their welfare and means of livelihood, and to the household budget (Okafor, 1989, 1990). There is significant potential for the improvement of this contribution through the development of cottage industries based on financial information for commercial production. The economic valuation of an investment could enhance the improved and efficient production of *Irvingia* products as well as promote the conservation of the species for the sustainable supply of raw materials (Okafor, 1981, 1990).

To create schedule for unlocking its potentials as a small holder plantation crop, this study investigates its plantation establishment, production, and cost return on 1 hectare plantation in Rivers States, Nigeria. Rivers State has bush mango tree in abundance but unevenly distributed. It is envisaged that proper documentation of cost and return from investment on small holder plantation of *Irvingia* is capable of creating awareness for investors and employment opportunities for numerous un-employed but able hands in the areas. It will also strengthen income that is presently been generated from wild collection as well as improved sustainable rural livelihood in Nigeria.

2. Methodology

2.1 Study Area

The study was carried out in Onne, Rivers State, Nigeria. It is located on Latitude $4^{0}50^{1}$N and Longitude 7^{0} 011E. The rainfall pattern is bimodal with July and October as peak periods. The ecosystem is made up of 3 types of vegetation. These are: the tropical lowland rainforest, the fresh water and mangrove swamp forests. The area has a mean annual rainfall of more than 2000mm and average temperature range of 25^{0} to 35^{0}C.

2.2 Data Collection:

Prior to the actual study a pre-field exercise was carried out which include: a review of available secondary data with key informant interviews involving Bush mango collectors, agroforestry farmers, homestead farmers, traders and scientist who worked on the fruit trees using participatory rural appraisal (PRA) method. Information collected include average cost of land, cost of land preparation for farming operations, average fruit collection per tree, average selling price per fruit, average age of tree at maximum fruiting period, impediment to commercial production and plantation establishment.

Primary data collected included number of fruits, weight of fruits and weight of depulped fruits (seeds/kernel) from ten sampled trees randomly selected at the Forestry Research Institute of Nigeria *Irvingia gabonensis* plantation experimental plots planted at a spacing of 8m X 8m with 156 trees per hectare in Onne, Rivers State to determine tree yield. All sampled trees were fairly uniform in height and girth and over 16years in age; this is because at age 16 and above bush mango fruiting system is full stabilized. 10 stands of trees were used because of the large number fruits involved. Fruits from sampled trees were appropriately collected over time after dropping from individual tree. The collected fruits were counted, weighed and documented. The mean number of fruits per tree was used to calculate a projected fruit production data in tones per hectare, Mean seed yield per tree was calculated from depulped dried fruit cotyledon.

2.3 Data Analysis

2.3.1 Profitability Analysis

The profit was determined using the formula;

$$Profit = TR - TC$$

The profitability of the enterprise was determined through the rate of returns on investment (RORI). The formula is represented by:

$$RORI = \frac{TR - TC}{TC} \times \frac{100}{1}$$

Where: TR= Total Revenue

TC= Total cost

Total cost = cost of inputs which include cost of materials (Pegs, seedlings), cost of transportation, cost of beating up, cost of labour in terms of man/days.

Total revenue = Sales at farm gate price

2.3.2 Cost- Benefit Analysis

A cost-benefit analysis (CBA) was used to analyze the viability of Irvingia plantation development in Nigeria. This analyzed the net benefits of the plantation to see whether Irvingia plantation should be accepted or rejected in respect of the financial and social gains from the utilization of this resource from the stand point of the society. To estimate costs and benefits, several factors are assumed in the baseline calculation. Other factors considered were: market trends, national bush mango prices, and measurement of costs and benefits. The present value of benefits [PV(C)] is estimated by using the formula:

$$\sum_{t=1}^{n} \frac{(Bt - Ct)}{(1+r)}$$

Where Ct denotes the costs incurred in t for t = 0, 1, 2…, n, r is discount rate. The major costs of the Bush mango plantation are the direct costs that will be disbursed over the whole project life, from years zero to 30. The potential costs are for land clearing, seedling purchase, *I*rvingia plantation, and salaried workers for the first three years. Accordingly, the costs for land preparation and Irvingia plantation in the first three years are estimated. After three years, bush mango become matured and start to producing fruits.

CBA was used to identify whether the project is economically and environmentally viable by weighing up benefits and costs throughout the project's life.

The Cost-benefit of bush mango plantation is estimated by applying formula:

NPV = PV(B)-PV(C) or

$$B/C = \frac{\sum_{t=0}^{i-n} \frac{B_t}{(1+r)^t}}{\sum_{t=0}^{i-n} \frac{C_t}{(1+r)^t}}$$

where Bt denotes the benefits received in period t; Ct denotes the costs incurred in t; t is year, t = 0, 1…, n; and r is discount rate.

The formula shows that the NPV is the difference between the present value of the benefits, PV(B), and the present value of the costs, PV(C), of a project. Costs and benefits of the bush mango plantation are monetized to find the NPV of the plantation. Cost benefit analysis is the economic working tool which was used for identifying and evaluating the cost and benefit from the society point of view. The benefit cost ratio (B/C) is determined by dividing the profit generated from cost incurred. If the B/C Ratio is < 1 it is not profitable but if B/C is > 1, then the enterprise is profitable and if it is =1 then they are equal.

2.3.3 Regression Analysis

Regression procedures was used to estimate the fruit yield per tree from year four to 30years, with quantity of fruits harvested as dependent variable while number of years represented the independent variables.

Regression equation

Y = a + bX

Where Y = Quantity

X = Time in years

b = Slope

a = Intercept

Yield of Irvingia plantation

Net weight = Gross weight – Tare weight

Where, Net weight = refers to the weight of the bush mango alone

Gross weight = refers to the total weight of bush mango and its measuring bucket

Tare weight = is the weight of the packaging alone (bucket).

Assumed that bush mango start providing fruits at 4 years old while economic yield can be attained after 7-8 years of planting and declining at 30 years old to 50 years. Sales price of bush mango used was the average farm gate price of sales from year 2006 - 2011 due to paucity of data from respondents. Hence average farm gate price of N5.00 /fruit was used in the calculation.

3. Results

3.1 Base Line Calculation

Land preparation for bush mango production holds between November and March. The process involves clearing, felling of unwanted trees, cross-cutting, packing and burning. After burning, the planting sites are mapped out as follows.

Determination of Stocking Density per hectare:

1 Hectare of land = 100m X 100m

Espacement for Irvingia trees = 8m X 8m (Standard spacing)

Total number of seedlings per hectare = 1 hectare/ Espacement

= 100m X 100m/ 8m X 8m

= 156 seedlings

Table 1: Costs of Operation for the Establishment of 1 Hectare Bush mango Plantation.

S/N	Operation	Man days	Cost for a Hectare in Naira Value (N)
1.	**Land Purchase**	1 hectare of land	N1,500,000.00 **(72%)**
2.	**Land Preparation**		
	Demarcation of land	5 man days @N1500 for 2 days	N15,000.00
	Brushing of land	10 man days @ N1500 for 2 days	N30,000.00
	Felling of trees	2 man days @ N1500 for 4 days	N12,000.00
	Burning of debris and Parking	5 man days @ N1500 for a day	N7,500.00
	Lining and pegging	2 man days @ N1500 for 2days	N6,000.00
	Sub-total		**N70,500:00(3.4%)**
3.	**Planting Preparation**		
	Supply of 200 pegs	A peg @ N10	N 2,000.00
	Supply of 156 potted seedling 50 seedling for beating up	A potted seedling @ N150 As above	N23,400.00 N7,500.00**(1.48%)**
	Transportation of Seedling	2 man days @ N1500 for a day	N3,000.00
	Sub-total		**N35,900.00**
4.	**Planting Exercise**		
	Planting of 156 seedling	2 man days @ N1500 for 2 days	N6,000.00
	Sub-total		**N6,000.00**
5.	**Tending Operation**		
	Year 1		
	Spot weeding	4 man days @ N1500 for 2 days	N12,000.00
	1st weeding	4 man days @ N1500 for 4 days	N24,000.00
	2nd weeding	4 man days @ N1500 for 4 days	N24,000.00
	Year 2		
	1st weeding	4 man days @ N1500 for 4 days	N24,000.00
	2nd weeding	4 man days @ N1500 for 4 days	N24,000.00
	Year 3		
	1st weeding	4 man days @ N1500 for 4 days	N24,000.00
	2nd weeding	4 man days @ N1500 for 4 days	N24,000.00
	Sub-total		**N156,000.00 (7.5%)**
6.	**Fire Tracing**		
	1st year clearing of rides 5m	2 man days @ N1500 for 4 days	N12, 000.00
	2nd year clearing of rides 5m	2 man days @ N1500 for 4 days	N12, 000.00
	3rd year clearing of rides 5m	2 man days @ N1500 for 4 days	N12, 000.00
	Sub-total		**N36,000.00 (1.7%)**
	Total operating cost		**N1,804,400.00**
7.	**Monitoring & Supervision**		
	Forestry consultant (10% of project cost)	**10% of N1,804,400.00**	**N180,440.00**
	Total cost		**N1,984,440.00**
8.	**Incidentals**		
	5% of the Total cost	**5% of N1,984,440.00**	**N99,220.00**
	GRAND TOTAL COST (N)		**N2,083,660**
	($)	**$1.00 = N160.00**	**USD13,022.88**

*Number in parentheses are percentages of total cost of plantation establishment

Table 2: Yield and Value of Tree/ Hectare of Bush mango Plantation.

Item	*Number/Tree*	*Number/Hectare*
Fruits	*1060 (180kg)*	165,360 (28,080kg)
Kernel	*100kg*	*15,600kg*

The bush mango production in Onne (Nigeria) of planted trees first fruit after 4 years, and a 16 year old tree yields on average 1060 fruits (180kg) per tree and kernel/cotyledon yields are about (100kg/ tree). While the projected mean fruit and kernel yield in one hectare consisting of 156 trees are 165,360 fruits (28,080kg) and 15, 600kg respectively.

Table 3: Regression Model Summary for data fitting

Regression Statistics	
Multiple R	0.999329
R Square	0.998658
Adjusted R Square	0.998611
Standard Error	40.68381
Observations	31

$Y = -80 + 120 X$

N.B: $R^2 = 0.998$, SE = 40.68, -Value= 0.000

Table 4: Model coefficients for *Irvingia gabonensis* variables

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*F*
Intercept	-80	14.26743	-5.60718	4.7E-06	21576
Age of Tree	120	0.816951	146.8877	3.32E-43	

Table 5: Discounted Cash Flow Analysis of 1Hectare *Irvingia* Plantation on a 30year Rotation

Year	**Age of Tree**	**Cost (₦)**	**Irvingia fruit yield/tree**	**Irvingia fruit yield/Ha**	**Price/Fruit (₦)**	**Benefit (₦)**	**Discounted cost (₦)**	**Discounted revenue (₦)**	**Discount rate 14%**
1	0	1,684,400	-	-	-	0	1,477,555.68	0	0.8772
2	1	60,000	-	-	-	0	46,170	0	0.7695
3	2	60,000	-	-	-	0	40,500	0	0.6750
4	3	60,000	400	62,400	5.00	312,000	35,526	184,735.2	0.5921
5	4	60,000	400	62,400	5.00	312,000	31,164	162,052.8	0.5194
6	5	60,000	520	81,120	5.00	405,600	27,336	184,791.36	0.4556
7	6	60,000	640	99,840	5.00	499,200	23,976	199,480.32	0.3996
8	7	60,000	760	118,560	5.00	592,800	21,036	207,835.68	0.3506
9	8	60,000	880	137,280	5.00	686,400	18,450	211,068	0.3075
10	9	60,000	1000	156,000	5.00	780,000	16,182	210,366	0.2697
11	10	60,000	1120	174,720	5.00	873,600	14,196	206,693.76	0.2366
12	11	60,000	1240	193,440	5.00	967,200	12,456	200,790.72	0.2076
13	12	60,000	1360	212,160	5.00	1,060,800	10,926	193,171.68	0.1821
14	13	60,000	1480	230,880	5.00	1,154,400	9,582	184357.68	0.1597
15	14	60,000	1600	249,600	5.00	1,248,000	8,406	174844.8	0.1401
16	15	60,000	1720	268,320	5.00	1,341,600	7,374	164882.64	0.1229
17	16	60,000	1840	287,040	5.00	1,435,200	6,468	154714.56	0.1078
18	17	60,000	1960	305,760	5.00	1,528,800	5,676	144624.48	0.0946
19	18	60,000	2080	324,480	5.00	1,622,400	4,974	134496.96	0.0829
20	19	60,000	2200	343,200	5.00	1,716,000	4,368	124924.8	0.0728
21	20	60,000	2320	361,920	5.00	1,809,600	3,828	115452.48	0.0638
22	21	60,000	2440	380,640	5.00	1,903,200	3,360	106579.2	0.0560
23	22	60,000	2560	399,360	5.00	1,996,800	2,946	98042.88	0.0491
24	23	60,000	2680	418,080	5.00	2,090,400	2,586	90096.24	0.0431
25	24	60,000	2800	436,800	5.00	2,184,000	2,268	82555.2	0.0378
26	25	60,000	2920	455,520	5.00	2,277,600	1,986	75388.56	0.0331
27	26	60,000	3040	474,240	5.00	2,371,200	1,746	69001.92	0.0291
28	27	60,000	3160	492,960	5.00	2,464,800	1,530	62852.4	0.0255
29	28	60,000	3280	511,680	5.00	2,558,400	1,344	57308.16	0.0224
30	29	60,000	3400	530,400	5.00	2,652,000	1,176	51979.2	0.0196
31	30	60,000	3520	549,120	5.00	2,745,600	1,032	47224.32	0.0172
TOTAL		**3,484,400**				**41,589,600**	**1,846,123.68**	**3,900,312**	

Note: Cost is monetary value of expenditure incurred from plantation establishment and maintenance year 1 till 30years, while benefits is the selling cost of one unit of fruit multiply by the harvest for the year in question.

Gross Margin = Total Revenue – Total Cost

₦41, 589,600.00- ₦3, 484,400 = ₦38, 105,200

Therefore, the present value of the benefits of plantation is:

PV (B) = ₦3, 900,312.00

PV(C) = ₦1, 846,123.68

Thus, NPV = PV (B) – PV(C) =

₦3, 900,312.00 - ₦1, 846,123.68 = ₦2, 054,188.32

NPV = ₦2, 054,188.32

Benefit Cost Ratio (B/C) i.e PV (B) / PV(C) =

$$= \frac{₦3,900,312.00}{₦1,846,123.68} = 2.1$$

3.2 Discussion

The estimated cost of establishing one hectare of Bush Mango plantation for intending small holder farmers from the first year to the third year is presented in Table 1. The estimate showed that land form the bulk of the establishment cost 72% (N1, 500,000). While land preparation, planting seedlings, tending operation and fire tracing were 3.4% (N70, 500), 1.5% (N30, 900), 7.5% (N156, 000) and 1.7% (N36,000) respectively. The implication of this is that for farmers who own lands, the cost of establishing 1ha of Bush mango plantation will be drastically reduced. A three-year's old Irvingia plantation including the land could worth N2, 083,660 (US$13,023) per hectare. Table 2 shows the mean fruit production of bush mango in plantation trials. The results showed that the mean fruit yields of *I. gabonensis* were 1060 *(180kg)*fruits per tree while the projected mean fruit production per hectare (ha) was 165,360 (28,080kg). The mean seed yields of bush mango per tree and per hectare are also shown in Table 2. The result indicates a mean of 100kg and 15,600kg of dry cotyledon yield per tree and hectare of plantation respectively. The figure is above that of Omokhua *et al* (2012) which evaluated the yields of fruits and seeds of bush mango in traditional agro forestry and compound farming systems. They observed that the mean fruit yield of 620 and 850 fruits/tree in traditional agro forestry and compound farming systems respectively while the projected mean fruit productions/hectare are 76,880 and 105,400 fruits in the two systems respectively. They also observed a mean seed yield of 18.24kg and 25kg of dry cotyledon per tree with a projected cotyledon yields/hectare of 2,262 kg/ha and 3,100 kg/ha respectively. The reasons for higher yield from plantation grown bush mango may be as a result of less competition for space, light and nutrients, unlike the traditional agroforestry system with strong competition from other cash crops. Also plantation grown bush mango is fast growing with early fruiting advantage when compared to those in agroforestry farms and home stead. Several scientists have reported early fruiting and high seed production in plantation grown tropical forest tree species (Aiyelaagbe *et al.,* 1996, 1998; Ejiofor and Okafor, 1997; Okafor, 1990). Anegbeh *et al.,* (2003) observed that plants from bush mango marcotts can fruit in 2–2.5 years after transplanting.

The relationship between numbers of fruits and age of trees showed a positive correlation using regression analyses. The number of fruits showed significant association with the age of trees (R^2=0.998). This is an indication that the age of tree determines the number of fruits per tree (Table 3-4). After four years of planting bush mango, annual income from the plantation would be N80, 000(US$500) per hectare rising to N869, 200(US$5,432.50) per hectare when the trees are twelve years old (Table 5).

Benefits and costs are linked to the age and fruiting of the trees. At the early stages, there are heavy costs which are then followed by annual benefits from age four that continue over the full life of the trees once they have reached maturity. The benefit cost analysis for bush mango per hectare at 14% discount rate for intending farmer for a thirty-year period is shown in Table 5. Results indicate positive NPV ₦2, 054,188.32 ($12838.67) per hectare and estimated benefit-cost ratio of 2.1, which is greater than one. Nkang *et al* (2009) in their study of benefit cost analysis for cocoa per hectare at 10% discount rate for owner managed farms for a thirty-year period estimated a positive NPV of N57, 166.37 per hectare and estimated benefit-cost ratio of 4.27 while Agbeja (2006) observed an NPV of ₦916, 695.32 (US$7,051.50) with a corresponding B/C 1.9 for one hectare of teak plantation establishment on a 15 year rotation.

These results imply that commercial bush mango production systems are viable since they can pay for the factors of production and the owner will still make profit. The findings indicate that small holder bush mango plantation can improve livelihood systems in the rural area and could be considered as a coping strategy to be adopted by the small and marginal crop farmers to cope with the fluctuation in supply from wild collection of bush mango fruits. Several studies showed that bush mango integrated livelihood systems provide the smallholders with ample capability for resilience during crises and ensure a sustained flow of income (Falconer, 1995; Ladipo, 1996, 1997; Ndoye, *et al.,* 1998, Nkwatoh *et al.,* 2010; Ugwumba *et al* (2013).

Plate 1; Bush mango plantation at Onne, Portharcourt

4. Conclusion And Recommendations

The establishment of small scale units of Bush mango plantations in the South-South ecological Zone of Nigeria would be a viable opportunity for the small scale producers for improved livelihoods. This is true because the cost benefit analysis using NPV and B/C revealed that the project is viable and capable of paying for the factors of production with reasonable profit margin. The study demonstrates the need to promote bush mango farm livelihood systems for smallholder in bush mango producing ecological zones of the country. The economic analysis of the bush mango farming systems also revealed that producing bush mango as a single crop was a viable option. The commercialization of this important tree is the best alternative for sustainability; it should go beyond reaching smallholders with planting stock, transferring the seedling production technology to smallholder nurseries needs but with support from the micro-finance institutions, commercial banks, cooperative societies and non-government organizations. It is imperative for the government to refine its credit scheme to farmers of cash crops and extend such assistance to smallholders of Non-timber forest products farmers.

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