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PROFITABILITY OF TEAK PLANTATIONS IN THE DORMAA DISTRICT OF THE BRONG AHAFO REGION OF GHANA

Bentil Julian Kobina*

Bannor Richard Kwasi**

Abstract: *Dwindling forests in the world have led many to show interests in tree plantation development especially teak both as an investment potential and natural resource conservation. We discuss the profitability of teak plantations in the Dormaa District of the Brong Ahafo region of Ghana using the net present values, benefit-cost ratios, the financial rate of returns and sensitivity analysis. This paper adds to the virtually non-existent data on the cost and expense structure and return on investments of teak plantations in the district; a valuable information for would investors. Teak plantation in the district is a profitable investment.*

Keywords: *Profitability, Net present Value, Benefit Cost analysis, Financial Internal Rate of Return, Sensitivity Analysis, Return on Investment*

***Ministry of Food and Agriculture, Accra, Ghana

**Institute of Agribusiness Management, SK Rajasthan Agricultural University, India

INTRODUCTION

Forestry plantations are seen by the wood processing industry as providing a means of increasing the availability of logs (FAFPIC,1987), and by environmentalists as a means of conserving native forests (Australian Conservation Foundation 1987). As a result of the felling of trees for export and fuel wood, the natural forests in Ghana and Africa in general is dwindling very fast. Aside the government's efforts at reforestations, there is the need to encourage the setting up of tree plantations as an investment potential. There has been so much interests in teak plantation development in Ghana as an investment potential with very good returns but there is little knowledge pertaining to the various cost components and its financial viability in the country. Many research on teak plantations in Ghana have been conducted but most are concentrated on its adaptability, survival and cultural practices with little on the cost and returns and its financially viability though it is generally accepted to be viable. This study will thus examine the financial profitability of teak plantations in Ghana especially in the Dormaa District of the Brong Ahafo region and also find answers to the following research questions;

- Are teak plantation establishments profitable?

A plantation is defined as 'a forest crop or stand raised artificially, either by sowing or planting' (Ford-Robertson 1971). The global demand for forest products such as timber, paper and firewood increases as the world population and the global economy continue to grow. This puts a very big strain on the world's forests and plantations can help meet the increasing demand. A deciduous tropical hardwood teak (*Tectona grandis*), is one of the premier timbers of the world. Its wood is highly valued for its colour, fine grain, durability, strength, lightness and weather resistance (Keogh 1996). Teak is commonly used for shipbuilding, furniture, cabinetry and general carpentry (Weaver 1993). Teak is one of the most valuable timbers in the world, demand and interest in this species continues to grow every year. Teak is one of the few species of tropical hardwoods that grows well under plantation conditions (Keogh 1996). Teak grows very well in Ghana, with a mean annual increment of 8 – 10 m^3 per hectare (Bhat and Ma, 2004) and is one of the main hardwood species used in plantations in Ghana, having been planted for the first time in 1905. Most of the research conducted on teak plantations in Ghana have concentrated most entirely on its

adaptability, survival and cultural practices with little on the cost and returns and its financially viability though it is generally accepted to be viable.

This research seeks to add to the body of knowledge on teak plantations in Ghana, the costs and returns and financial viability of such a venture. As noted by Ball *et al* (1999), "The need for reliable and objective information is especially important to the growing number of investors in the private sector, especially small landowners who may lack the means or the knowledge to carry out their own evaluations of the potential risks and rewards from a stake in a teak plantation. In addition to the theory, this research assesses the profitability of teak plantations in the Dormaa district of the Brong Ahafo region of Ghana using the net present values, internal rate of return and benefits-costs ratios along with a sensitivity analysis.

MATERIALS AND METHODS

Assumptions Made

i. The analysis uses a project life of 15 years, for which a discount factor of 26% is employed as cost of capital being the lending rate of the Agricultural Development Bank to Agriculture and Forestry.
ii. The calculations are done in constant currency terms, thus involve no yearly cost escalation.
iii. Environmental and climatic conditions prevailing are favourable.
iv. Rotation period is 15 years.
v. A planting distance of 3.0m x 3.0m was considered.
vi. The volume per tree at the end of 15 years is $0.50m^3$
vii. Teak price of US$350/$m^3$ quoted by the Timber Industries Development Division of the Ghana Forestry Commission was used.
viii. The exchange rate of the Ghanaian cedis to the United States dollar is GH¢3 = $1
ix. Risk of fires, wind-blown and diseases are minimal and hence ignored.
x. There is no taxation of any kind on the trees sold.

DATA ANALYSIS

Primary data from teak plantations in the district was used to estimate relative costs and returns of teak plantations. The benefits and costs of growing teak per hectare was analysed using discounted cash flow analysis. The net present value, the internal rate of return and

benefits-costs ratio was used to determine the profitability of teak plantations in the Dormaa district of the Brong Ahafo region. Inflation was tackled by considering the constant prices in valuation, since it affects only the price level and does not affect the real value of the resources.

A sensitivity analysis was carried out to assess the stability of the project subjected to various changes in cost and benefit structure. Here, 10% increase in operating costs, 7.7% increase in interest rate and 10% decrease in price were considered.

The analysis involves the following measures(Gittinger,1982):

i) **Net Present Value (NPV):** The NPV estimates the relative probability of a project and the decision criterion is to accept a project with high NPV of teak plantation. NPV measures the profit or surplus income from a project after the project has satisfied the rate of return on capital desired by the investor. If the NPV of a prospective project is positive, it should be accepted. However, if NPV is negative, the project should probably be rejected because cash flows will also be negative.

The formula for estimating NPV is as follows:

$$NPV = \sum_{t=1}^{n} \frac{(Bt - C_t)}{(1+i)^t}$$

Where,

B_t = Benefits in each project year t

C_t = Costs in each project year t

n = Number of years to the end of project (n ranges from 1 to 15)

i = Discount rate

ii) **Benefit Cost Ratio (B/C):** The discounted gross benefit divided by the discounted gross cost. The B/C ratio measures the social equity and economic efficiency of resource utilization from the stand point of the society. A decision of B/C ratio is to accept projects with a ratio above one that is B/C>1. Its formula for estimation is as follows:

$$BCR = \sum_{t=1}^{n} \frac{B_t}{(1+i)^t} \Big/ \sum_{t=1}^{n} \frac{C_t}{(1+i)^t}$$

B_t, C_t, n, t, i as defined for NPV

iii) **Financial Internal Rate of Return (FIRR):** FIRR is essentially a break-even discount rate in the sense that the present value of benefit equals the present value of costs. It shows the decision maker what society can expect to receive back in consumption benefits for a given investment of its scarce resources. The formula for FRR is as follows:

$$FRR = \sum_{t=1}^{n} (B_t - C_t) \Big/ (1+i)^t = 0$$

B_t, C_t, n, t, i as defined for NPV

FIRR = $a + b\left(\frac{c}{d}\right)$

a = low rate of discount

b = difference between both rates of discount

c = Positive NPV

d = Absolute difference between positive and negative NPVs

STUDY AREA

The Dormaa District is located at the Western part of the Brong Ahafo Region. It lies within longitudes 3° West and 3° 30' West and latitudes 7° North and 7° 30' North. Jaman and Berekum Districts bound the district on the north, on the east by the Sunyani District, in the South and southeast by Asunafo and Asutifi Districts respectively, in the southwest by Western Region and in the West and northwest by La Cote d'Ivoire. The District Capital is Dormaa Ahenkro, located about 80 kilometres west of the regional capital, Sunyani.

The District has a total land area of 1,368 square kilometres, which is about 3.5 percent of the total land area of Brong Ahafo Region and about 0.6 percent of that of the country. It has 345 settlements, one traditional authority and two constituencies, namely: Dormaa East and Dormaa West. The district is linked to Accra by a first class road. Dormaa district is

located within the wet semi-equatorial climate region with a double maximal rainfall regime.

CLIMATE AND VEGETATION

Dormaa District is located within the wet semi-equatorial climate region with a double maximal rainfall regime. The mean annual rainfall is between 125cm and 175cm. The first rainy season is from May to June; with the heaviest rainfall occurring in June while the second rainy season is from September to October. The dry seasons are quite pronounced with the main season beginning around the latter part of November and ending in February. It is often accompanied by relative humidity of 75 – 80 percent during the two rainy seasons and 70 – 72 percent during the rest of the year. The highest mean temperature of the district is about 30ºC and occurs between March and April and the lowest about 26.1ºC in August.

The major vegetation types are the unused forest, broken forest, grassland and extensively cultivable forestland and forest reserves. The unused forest is located at the extreme northeast where it extends to Sunyani and Asutifi Districts. The forest reserves are Mpameso (197.67 square kilometres), Pamu-Berekum (116.80 square kilometres)) and Tain II (297.6 square kilometres). The highest mean temperature of the district is about 30ºC and occurs between March and April and the lowest about 26.1ºC in August. The main soil type in the district is forest ochrosols made up of the Birimian formation. Soils in the district belong to the Bekwai-Nzema Compound Associations. The Nkrankwanta Association dominates the south-western section of the district. The Nzema series, which are made up of quartz gravels and ironstone are moderately well-drained. These soil types tend to support both industrial and food crops, which include cocoa, coffee, oil palm, citrus, cola-nuts, plantain, cassava and maize. The district is thus very conducive for teak plantation establishment. The mainstay of the district economy is agriculture. Currently, it employs about 60% of the district's economically active labour force.

RESULTS

Table 5.1 Results of discounted and undiscounted Costs and Benefits for 3.0m x 3.0m

	Gh ¢
Undiscounted Benefits	194,425.00
Undiscounted Costs	15,668.13
Undiscounted Net benefits	178,756.87
Discounted Benefits	6,070.07
Discounted Costs	4,817.47
Discounted Net benefits	1,252.60

Source: Computed from Survey Data, 2014

The value of time affects both revenues and costs. Revenues are worth more if earned earlier, while costs are less costly if incurred later. In long term business project like the establishment of a teak plantation, time has effects on the value of revenues and costs hence, profits. Thus accounting for the time value of money by discounting at an interest rate of 26%, the discounted costs for the plantation per hectare is GH¢4,817.47 and discounted benefits of GH¢ 6,070.07 with a discounted net returns of GH¢ 1,252.60.

Table 5.2 Results of financial returns for 3.0m x 3.0m

Measure	Scenario I (3.0m x 3.0m)
Net Present Value (NPV)	GH ¢ 1,252.60
Benefit/Cost Ratio (BCR)	1.26
Financial Rate of Return (FRR)	28%

Source: Computed from Survey Data, 2014

At a 3m x 3m spacing, one hectare of teak plantation with 15 years rotation yields a net present value of GH ¢ 1,252.60, benefit-cost ratio of 1.26 and a financial internal rate of return of 28%.

Table 5.3 Results of Sensitivity Analysis for 3.0m x 3.0m spacing

Scenario I	Assumption	NPV	FRR
'A'	10% increase in operating costs	863.41	28%
'B'	10% decrease in log prices	645.59	28%
'C'	lending rate increases to 28% (7.7% increment)	202.53	28%

Source: Computed from Survey Data, 2014

The sensitivity analysis yields positive net present values for scenarios of a 10% increase in operating costs, 10% decrease in log prices and with a lending rate of 28% but the financial rate of returns generated are more than the opportunity cost of capital.

DISCUSSION

Cost and Expense Structure

The cost and expense structure per hectare comprised of all the expenses for rent, site preparation, planting preparation, planting exercise and maintenance operations. At a spacing of 3.0m x 3.0m a total of 1111 teak seedlings were planted per hectare. From the study, it is found out that the total cost for establishing a hectare of teak at a 15 year rotation is GH¢ 15,668.13 (US $5,222.71) for a 3.0m x 3.0m spacing, yielding a returns of Gh¢194,425.00 and a net returns of GH¢178,756.87.

RETURN ON INVESTMENTS

From the study, it was determined that at a volume of 0.50m^3 per tree with a market price of Gh¢ 1,050(US$350)/$m^3$ the net present value of the investment is Gh¢ 8,900.9 on a one-hectare site at a discount rate of 26% for a 3.0m x 3.0m spacing. The positive net present values indicates that teak plantation establishment in the district is profitable as it yield positive net returns with a financial rate of return of 13% which is far less than the opportunity cost of capital(26%). A benefit cost ratio of 1.26 indicates that for every cedi invested a return of 1.6 is expected. Since the benefit cost ratio is greater than one teak plantation establishment in the district is profitable.

SENSITIVITY ANALYSIS

Sensitivity analysis is used for treating uncertainty since a degree of uncertainty surrounds every estimated value .It is an inherent companion of projects and ex ante assessment (FAO,1992 cited in Abeja,2004). In this study the sensitivity analysis was carried out to assess the stability of the project subject to various changes in costs and benefits structure. Here, 10% increase in operating costs, 10% decrease in log prices and 7.7% increase in lending rates were considered.

A 10% percent increase in operating costs still resulted in a positive net present value of GH¢863.41 and a financial rate of return of 28% which is more than the cost of capital thus making it profitable under this circumstance. A further 10% decrease in log prices yielded a positive net present value of GH¢645.59 and a financial rate of return of 28% which is

greater than the cost of capital. With the discount rate of 28%, the project still yielded a positive net present value of GH¢ 202.53.

SUMMARY AND CONCLUSION

From the study, teak plantation establishments in the Dormaa District are financially viable and a profitable venture and this is backed by the surging world demand for teak. Teak plantations are tree farms that represent great investment opportunities and the climate is very suitable for its growth. Teak has always been valued for its unique properties thus it has a high market viability. Its high oil content makes it extremely dense and virtually impervious to water. It holds up under heat, cold, wind and rain. It resists disease, and has the extraordinary ability, when in contact with metal, to prevent rust.

A capital investment of GH¢15,668.13 in teak plantations in the Dormaa District results in positive net present values and financial rate of returns greater than the opportunity cost of capital. If the conditions and climate are right, teak plantation can be grown, maintained successfully and harvested so that maximum efficiency can be achieved. Teak plantations are not only profitable to its owners, beneficial to the employees but it is a step towards replenishing the environment as well and a source of income generation. It is also important because it is a resource that retains high value due to its fantastic natural properties.

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