KENYA FORESTRY RESEARCH INSTITUTE

GUIDE TO ESTIMATING FINANCIAL RETURNS FROM TREE GROWING IN KENYA

A guide for tree growers, extension agents and forest managers

David K. Langat and Joshua Cheboiwo

KENYA FORESTRY RESEARCH INSTITUTE

GUIDE TO ESTIMATING FINANCIAL RETURNS FROM TREE GROWING IN KENYA

A guide for tree growers, extension agents and forest managers

David K. Langat and Joshua Cheboiwo

Citation:
Langat D. K. and Cheboiwo J. 2015. Guide to Estimating Financial Returns from Tree Growing in Kenya: A guide for tree growers, extension agents and forest managers. KEFRI, Nairobi.

Cover caption:
A young plantation of *Eucalyptus grandis* in Turbo

Cover photograph by:
David Langat

Published by:
Kenya Forestry Research Institute
P.O. Box 20412 Nairobi 00200, Kenya
Tel: +254-722-157 414, +254-722-259781/2
Email: director@kefri.org
Website: www.kefri.org

Printed by:
Fiesta Works Agencies

Foreword

Tree growing in Kenya is increasingly being undertaken by farmers on a commercial scale. This is driven by supportive policy and legislative framework and the availability of domestic market for wood products. Commercial tree growing is expected to play a critical role in provision of wood products in the country and therefore farmers need relevant information to support their decisions in tree growing and enable them realize higher yields and benefits.

Financial profitability of tree enterprises is one of the key motivating factors for successful uptake of tree growing by farmers. Due to complexity of determining profitability of tree growing, farmers, extension agents and forest managers are faced with challenges of how to estimate returns from tree growing as a business. Simplified information on evaluation of tree enterprises is currently not available. This guideline provides information on procedures for evaluating financial viability of tree-based enterprises to enhance decision making by stakeholders in commercial tree growing.

This guideline provides step by step method for estimating returns from tree growing as a business. The steps described in this guideline are simple and easy to follow and no doubt useful to tree growers, extension agents and forest managers in evaluating financial viability of tree growing. It is my hope that the production of this guideline will assist our stakeholders in expanding and promoting tree growing in our country for enhanced livelihoods and support environmental conservation.

Ben E.N. Chikamai (PhD)
Director, Kenya Forestry Research Institute

Table of Contents

List of Figures

List of Tables

Boxes

Acknowledgements

We authors acknowledge KEFRI Management for supporting development of this guideline. We are grateful to Dr. Ben Chikamai and Dr. Bernard Kigomo and the KEFRI Editorial Committee namely; Dr. Ebby Chagala-Odera, Bernard Kamondo, Paul Tuwei, Dorothy Ochieng, Linus Wekesa and Josephine Wanjiku for editing the manuscript.

1.0 Introduction

In Kenya, trees are grown for subsistence, cash income and provision of environmental services. When growing trees for commercial purposes, it is essential that profitability analysis be undertaken before the project is initiated. This is because tree growing involves use of land and therefore tree growers should be able to compare profitability of various tree-based enterprises with competing land uses such as growing of maize, wheat and other agricultural enterprises to enable them make best choices that meet their financial expectations.

Profitability of tree growing will depend on several factors such as; the tree species, expected products, and rotation age. Financial analysis of tree growing therefore requires reliable data on; tree growth, cost incurred and benefits accrued. Tree growers are faced with challenges of estimating financial returns due to complexity of analytical processes applied in determining profitability of such investment options. This guide presents a simple framework for use in determining profitability of tree growing. The guide outlines the importance of key factors such as: time value of money; accounting for inflation in financial calculations; determination of costs and benefits of tree growing investment; and appropriate time for harvesting various tree products. The guide also outlines how each of these factors influences profitability of the tree growing enterprise.

2.0 Key Factors in Financial Analysis for Tree Growing

2.1 Time value of money

Tree growing is a long-term investment that involves incurring costs and accruing benefits over time. Costs incurred that should be taken into account include: establishment and management expenses; taxes; and harvesting and processing expenses. Revenue from tree growing is obtained through sale of intermediate products such as thinnings, and sale of the final products such as timber. Time has an effect on value of money, hence affecting profitability.

Revenues are worth more if earned earlier, while costs are less if incurred later. Consequently, there is need to account for time value of money through discounting when determining profitability of tree growing. Discounting is the process of adjusting the value of benefits accrued or costs incurred at some point in the future to the current value.

2.2 Accounting for inflation in financial calculations

In cases where prices and costs vary at the same rate, inflation is omitted from the financial analysis. Real interest rates and prices, or nominal interest rates and prices are used in undertaking financial analysis for tree growing. Real interest rates and real prices are those not adjusted for inflation while nominal rates are adjusted for inflation i.e. it is real rates plus inflation. The interest rates charged by banks are nominal rates, which are real rates adjusted for inflation. In financial analysis there is need to be consistent with use of applicable rate. Where real rates are used, then it should apply for all costs and revenues and likewise for nominal rates.

2.3 Determining costs and benefits of tree growing investment

Sound financial analysis of tree growing enterprises requires complete accounting of costs and benefits over time. It is important to keep a record of costs incurred and benefits earned. Amount and time of these cash flows determine profitability of a tree growing project. Determining costs and benefits of tree growing involves four steps (Figure 1).

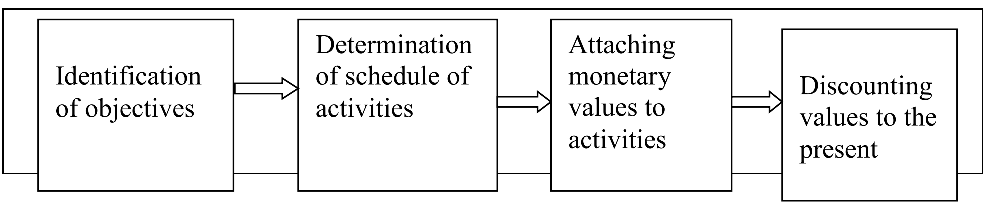


Figure 1: Steps in financial analysis of tree growing

2.3.1 Identification of objectives

The objectives for tree growing should be clearly identified and related to; ecological conditions, the desired product, appropriate time for harvesting, and availability of market for various products. For instance, if planning to grow trees in high rainfall areas of Kenya, Eucalypts would be one of the preferred species for timber production.

2.3.2 Determination of schedule of activities

The schedule of activities between planting and harvesting period should be determined. In tree growing, the schedule of operations will normally include:

- Identification of suitable land through purchase/lease or

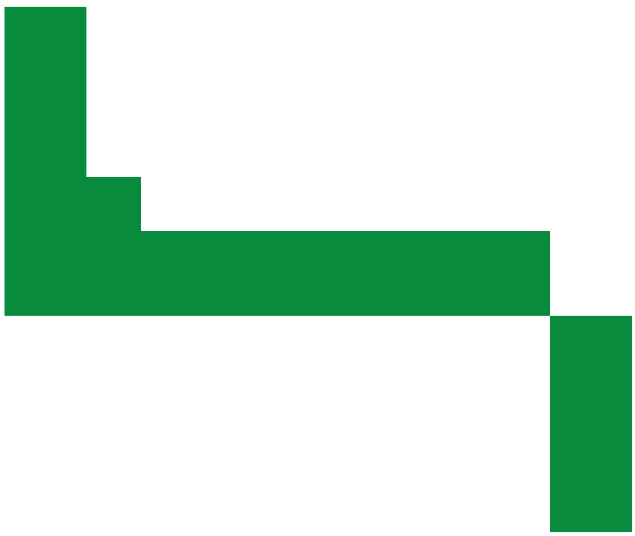
demarcation from own land;
- Acquisition of seedlings either through own production or purchase;
- Land preparation which involves fencing the planting area, cultivation of the land, staking out and pitting;
- Planting (involves transporting seedlings to site and use of labour to plant the seedlings);
- Replacement of dead seedlings ‘beating up’ within one year of planting;
- Maintenance that includes; provision of regular security, weed control, pest control, pruning;
- Selective harvesting and thinning;
- Final harvesting (includes felling, cutting to desired sizes and sorting).

The schedule of activities should be sequenced on a time line. A time line for production of power transmission poles from Eucalyptus with rotation period of 8 years is illustrated in Table 1.

Table 1: Timeline for growing Eucalyptus for power transmission poles at a rotation age of 8 years

2.3.3 Attaching monetary values to activities

	Activity	Year								
		1	2	3	4	5	6	7	8	9
1	Acquisition of land and seedlings									
2	Site preparation									
3	Tree planting									
4	Beating up									
5	Maintenance (slashing, cleaning, security, pest control)									
6	Harvesting									
7	Marketing									
8	Coppice management or replanting									



It is important to attach monetary values to each scheduled activity. Determining the timing and amounts of cash flows can be difficult as some of the activities are performed by the tree grower. In such cases, the principle of opportunity cost is used in attaching monetary value to the operation. If the tree grower is personally involved in management of the project, then the time spent is captured as a cost. This cost should reflect the value of the time spent. For example, if considering quitting a job to work on the land, the value of the time spent is the current wage.

Monetary values will depend on the present and future supply and demand of the products and inputs. It is therefore important to have the right market information and intelligence. As demand and supply situation is dynamic, it is important that the tree grower is able to predict current and future prices and costs. For example, if economics of power transmission poles appeared favorable in the recent past, many people may have planted Eucalyptus trees and increased supply may lower future prices to levels which may not justify current investment.

2.3.4 Accounting for the cost of land

The cost of land is considered in the financial analysis if land is purchased or leased for sole purpose of tree growing. However, if you own land and you are considering whether to grow trees or another crop, it is easier to omit the cost of land because it will be the same for all alternatives.

2.3.5 Discounting values to the present

Costs incurred and revenues accrued from tree growing projects are spread over the length of the rotation period. Time affects both the value of costs and revenues, making future value of money less than its current value. Effects of time on both costs and revenues therefore must be considered in financial analysis. Discount rate or alternative rate of return is applied in analyzing time value of money. Discount rate or alternative rate of return is the cost of borrowing money or the rate of return accruing from alternative investments. These investments may be alternative land uses or the rate of return on liquid capital investments e.g. interest on savings account or earnings from bonds.

Suppose the expected value of a tree product is KShs 1000 in ten years time at an interest rate of 6%, the present value would be calculated as follows:

$PV = (\frac{V_n}{(1+r)^n})$ 1

Where: PV-Present value, V_n - Future Value, r- Interest rate in decimal and n-Number of years that costs are incurred and benefits earned.

i.e. PV = 1,000/ (1+0.06)10 =558.40.

Therefore, KShs 1,000 to be received in 10 years from now is worth KShs 558.40 today.

3.0 Determining profitability

Procedures for determining profitability involves taking into consideration the range of costs incurred and benefits earned within the period between planting and harvesting of the trees. Various cost–benefit approaches may be applied in analyzing profitability of tree growing projects. However, in estimating future returns from tree growing enterprises, it is essential that all present and future costs of all operations and project revenue streams during investment cycle are identified and documented. Costs and benefits should be pegged to the timeline of the activities. For each year of the project, the difference between the revenue and costs give annual net revenue. Net revenue (NR) for the time (t) is derived as follows:

$NR=R_t - C_t$ ……………………………………………………………………….....2

where, R -revenue at time (t) and C - Costs at time (t).

The sum of discounted net revenue (NR) in each year for a rotation period gives the Net Present Value (NPV).

3.1 Calculation of NPV

The Net Present Value (NPV) is derived as follows: $\sum_{t=0}^{n}\left[\frac{B_t - C_t}{(1+r)^t}\right]$…………………3

where B_t - Benefit in each year; C_t - Cost in each year; t - (1, 2… n), n - Rotation and r- Discount rate

The following example shows steps in calculating NPV for a single harvest Eucalyptus growing project with a 10-year rotation period.

Box1: Steps in calculating NPV for a single harvest Eucalyptus growing project with a 10-year rotation period.

A stand of Eucalyptus is grown and then harvested after ten years. It is estimated that at the end of ten years, the stand will have accumulated a volume of 600 m3 and can be sold for KShs 600, 000. Assuming costs of establishment =KShs 40,000; annual costs of KShs 3000/yr; and interest rate is 4%. NPV is calculated as follows:

Step 1: Draw a timeline for a single harvest

Year	1	2	3	4	5	6	7	8	9	10
Establishment cost (Ksh)	40000									
Annual cost (Ksh)	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Benefits										600000

Step 2: Calculate present value of one-off and recurring costs

a) Establishment cost of KShs 40,000 occurred at the beginning of the first year and the present value is calculated using the present value formula:

$$PV = [(\frac{V_n}{(1+r)^n}] \quad \text{.......... 4}$$

Where: PV- Present value, Vn-Future value, n – number of years that costs are incurred and benefits earned.

Therefore, present value of establishment cost is $(PV) = \frac{40,000}{(1+0.04)^0} = 40000$

b) Annual cost of KShs 3000 occurs every year and is calculated to the present value using the formula for terminating annual series:

PV of terminating annual series = $\frac{\lambda\ (1+r)^n - 1}{r\ (1+i)^n}$ 5

Where, λ is the annual cost, r is interest rate in decimal, n is the number of years

$PV=3000\ \frac{\{(1+0.04)\ 10 - 1)}{0.04(1+0.04)\ 10} = 24332.58$

Step 3: Aggregate the present value of costs

PV Costs =KShs (40000.00+24332.58) =64332.58

Step 4: Calculate the present value of revenue using the formula in equation 4 in step 2.

Present Value Revenue $=[\frac{600000}{(1+0.04)^{10}}] = 405338.50$

Step 5: Calculate Net Present Value (NPV)

NPV =PV (Revenue) – PV (Cost) = 405338.50 – 64332.58 = 34005.42

3.2 Interpretation of NPV

If NPV is positive, the present value of revenues exceeds the present value of costs, and the investment is viable. A negative NPV value implies that the present value of costs exceeds the present value of revenue and the investment is not viable. An NPV of zero means that the present value of costs is equal to present value of revenue meaning the tree growing project will be undertaken at the break-even point.

4.0 Determining the Rotation Age

Optimal rotation age is commonly determined either using mean annual increment (MAI) data (biological rotation) or financial decision criteria such as Net Present Value (NPV, Rate Of Return (ROR) and Land Expectation Value (LEV) (Financial or economic rotation). To determine optimal rotation age, growth and yield values are essential because future revenues depend on expected yields.

4.1 Determination of rotation using mean annual increment procedure

In order to determine the optimal biological rotation, we need to determine the mean annual increment (MAI) at which harvesting could occur. The rotation age that maximizes MAI will maximize wood yield from a stand over time. This method is often used by public agencies in rotation age determination. This method is illustrated using a growth and yield data of *Eucalyptus grandis* grown in Sotik Tea Company, Kericho County. The mean annual increment is calculated using the formula below.

Mean annual increment(MAI)=Y/R……………….…………………6

Where Y=yield at rotation age and R=rotation age

Table 2. Determination of rotation using mean annual increment (MAI)

Age (years)	Volume (m^3ha^{-1})	Mean annual increment (MAI) ($m^3ha^{-1}yr^{-1}$)
5	151.76	30.35
6	252.11	42.02
7	368.41	52.63
8	488.34	**61.04**
9	517.25	57.44
10	543.00	54.30

Using this approach, the MAI is maximized at age 8 and therefore the tree crop should be harvested at this age using this criterion. MAI is the best criterion if the time value of money is 0, i.e., if you have no alternative uses for your resources. MAI simply considers physical timber growth and does not reflect the time value of money.

4.2 Determination of rotation using financial criteria

The tree crop or product should be harvested when it attains financial maturity to maximize profitability. Usually a tree is considered to be financially mature when NPV is highest. This is established by calculating NPV for all years in which harvesting could occur, and selecting a year at which NPV is highest. The example in Table 3 illustrates the procedure for determining the financial rotation. Using the growth data (table 2) and assumed price of wood at Kshs 1,200/ m^3, establishment cost of Kshs 40,000, annual cost of Kshs 3,000 and discount rate of 6%, the NPV at each age can be calculated (Table 3).

Table 3. Determination of financial rotation using Net Present Value (NPV)

Age (years)	Volume (m^3ha^{-1})	Revenue Yield (Kshs)	Discounted value of revenue yield	Establishment costs (Kshs)	Discounted annual cost (Kshs)	Net Present value(Kshs)
5	152	182112	136084	40000	12329	83755
6	252	302532	213273	40000	14162	159111
7	368	442092	294016	40000	16726	237290
8	488	585 600	367413	40000	18602	**308811**
9	517	620700	367391	40000	20390	307001
10	543	651600	363850	40000	22056	301794
11	569	682800	359690	40000	23661	296029
12	600	720000	357817	40000	25142	292675

Using this approach, the NPV is maximized at age 8 and therefore should be harvested at this age using this criterion.

Alternatively, appropriate time for tree crop or product harvesting is at the time when the tree's rate of value increase falls below a desired level. The rate of value increase of a tree is the difference of its value at the desired rotation age and its value in the previous year, and can be determined by comparing monetary value of its expected growth during a given time period (e.g. 10 years) with the monetary value of the tree prior to that growth. This value increase can be compared with alternative investments or a desired rate of return. If the tree's expected rate of value increase exceeds the desired rate, the tree is not financially mature and should be allowed to grow for the specified time period. If the tree's expected rate of value increase is less than the desired rate, the tree is financially mature and, based on that criterion the tree crop or product should be harvested.

Bibliography

Bullard S.H and Straka T.J. 1993. *Basic Concepts in Forest Valuation and Investment Analysis.* Edition 1.0.2

Brigham E.F. 1985. *Financial Management: Theory and Practice.* 4th edition. The Dryden Press. Chicago.

Friday J.B., Cabal C. and Yanagida J. 2000. *Financial Analysis for Tree Farming in Hawaii.* Resource Management. Cooperative Extension Service, University of Hawaii, Manoa, CTAHR Publication.

Klemperer W.D. 1996. *Forest Resource Economics and Finance.* Mc Graw-Hill, New York.

Michael B. and Ehmke C. 2012. *Capital Investment Analysis and Project Assessment*-Purdue University Extension leaflet –EC-731 (http://www.emba-agbus.purdue.edu/planner/) Accessed on 16th September 2010.

Pearse P.H. 1990. *Introduction to Forest Economics.* University of British Columbia Press, Vancouver, Canada.

Rose D.W., Blinn C.R. and Brand G.J. 1988. *A Guide to Forestry Investment Analysis.* Research Paper. NC-284. St Paul, MN: US Department of Agriculture, Forest Service, North Central Forest Experiment Station.

Kenya Forestry Research Institute
P. O. Box 20412-00200, Nairobi - KENYA
Tel: +254-724259781/2, +254-722-157414
Email: director@kefri.org Website: www.kefri.org