Farm Forestry for the Market: Some Aspects of Financial Evaluation of Rural Woodlots in Tanzania

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Abstract

Wood is the most used primary form of energy in developing countries, and most of it is collected free from the wild, thus causing deforestation and its attendant environmental problems. The only possible way to conserve natural forests and woodlands in developing countries such as Tanzania, is by producing wood from planted woodlands. Sustainability in the production of wood from planted woodlands will be achieved only if the woodlands are financially viable. This paper dwells on the financial parameters needing to be considered to produce wood profitably in rural woodlots, taking into account problems which can be encountered in *ex-ante* financial evaluations.

1. Introduction

Producing wood for the market, otherwise called farm forestry for the market, is a possible business venture in many developing countries. Before an investor decides to invest on a woodlot, there should be *ex-ante* financial analysis on the project to ensure proper allocation of resources, more so in developing countries where resources for investment are very scarce.

Financial evaluation of a project consider the commercial profitability of a project in monetary terms only (Dasgupta *et al.*, 1972; Gregersen and Conteras, 1979). Financial evaluation views projects from the perspective of those contributing equity capital to the project. Market prices and values are used in measuring project inputs and outputs. At issue is whether investors will earn more from the project than they invested in it (Schreiner, 1989).

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This paper attempts to review some salient features of *ex-ante* financial evaluation of woodlots in a developing country such as Tanzania. These include features which can be encountered in the collection of cost and revenue data, and how to overcome them, risk considerations and commercial bank lending interest rates. The investment criteria of Internal Rate of Return (IRR) and Present Net Worth (PNW) are used in the case study.

2. Methodology

2.2 Brief description of case study area

The data for the case study was collected from Mgeta, Morogoro region. Mgeta is located in the Western slopes of the Uluguru mountains. It lies between latitudes 6°45' and 7°30' South, and longitudes 37°20 and 38° East, although the western foothills extend beyond these limits. The area covers more than two thousand square miles, extending for more than fifty miles from north to south, and from east to west (Sampson and Wright, 1964).

The Uluguru mountains are an old crystallic block which rises up to 2,668 metres high. It occupies a 60 by 30 km area in the western foreground of the Central African Plateau, about 200 km west of the Indian Ocean Coast.

Morogoro town, the administrative centre of Morogoro Region, lies on the northern foothills of the mountain massif. The mountains are of major importance as a water catchment area. Three important perennial rivers: Mgeta, Ngerengere and Ruvu, rise from these mountains. Dar es Salaam and Morogoro, as well as several industrial and agricultural areas, depend on the water from these rivers. The mountain area has for a long time been affected by severe erosion, most of it caused by deforestation and over-use of land for agricultural production. Erosion influences the water flow and quality of the rivers, as well as the crop yield. The vegetation around the catchment area makes conservation of the natural forests and woodlands important. eucalyptus, cypress and gravillea are the exotic tree species which were introduced by missionaries in the last century, and they are still grown today. *Eucalyptus spp* is the most favoured specie in the establishment of rural woodlots in the case study area.

2.2. Collection of costs data

Data on costs data need to be collected to enable the evaluation of Internal Rate of Return (IRR) and Present Net Worth (PNW) investment criteria. Data on costs were collected on per hectare basis. The data varies in different localities, as it depends on types of soils, grass, weeds and rainfall.

Items of cost data collected include, seedlings production and distribution, land preparation, weeding and protection. The costs of these items were extracted from records showing man-days. These were then converted to current costs by multiplying by the current man-day cost. This is due to the fact that wages increase faster in current price terms.

Machines are not very much in use in developing countries, especially in the rural areas. They are expensive and not available. Manual labour is plenty and cheap, and provide much required cash in the rural areas. All work in the raising and harvesting woodlots was expected to be undertaken by using hand farm implements.

Since there are no private farmers who have established woodlots as yet, the cost of raising one hectare of woodlot incurred by the Natural Resources Office (a government office) was assumed to be the same as that which would be incurred by a farmer who would decide to adopt farm forestry for the market. It is however known that private farmers are more efficient and would incur less costs than government departments in raising woodlots (FAO, 1978).

2.3. Collection of revenue data

2.3.1. *Volume estimations from Yield Tables*

Revenue data is an important input in the cash flow used in financial evaluations. In a woodlot, the main source of revenue is the sale of wood. In order to perform financial evaluation, the volume of wood which can be produced from different site classes and ages need to be known. In most cases foresters rely on indirect methods of predicting stand dynamics. Parameters like growth, basal area and mortality can be inferred from recorded studies of other stands. These inferences are made through the use of tables, equations or computer simulation models. Techniques used to predict stand dynamics are collectively called growth or yield models (Avery and Burkhard, 1983). Values read from the growth models for selected site classes and ages are used to compile normal yield tables.

For the purposes of revenue calculations to be used in the determination of investment criteria, wood volumes (in m^3) can be estimated from yield tables. Products considered in this study were woodfuel, poles and timber. However, since yield tables for many tree species are not developed, it may be necessary to use estimates.

Three different site classes are identified for *Eucalyptus spp* in Tanzania. They are favourable, medium and poor (MLNRT, 1989). There is no yield table for eucalyptus in Tanzania. The volume yield from experimental stations were used for comparison with yield tables from Uganda, South Africa, and Brazil. They were found to be nearly similar with corresponding site classes, with more similarity being observed with the Brazilian yield table. A more close similarity was observed on poor sites, and results of experiments carried out at Ruvu, Tanzania, and yields from Brazil (Solberg, 1988). The comparison is presented in Appendix 1. Thus, the yield table from Brazil was adopted for the revenue calculations in this paper.

Usually, fuelwood, poles and sawnwood are all produced from thinning or final harvest in various percentages. FAO (1979) has produced such percentages for Zambia. Such percentages have been assumed for eucalyptus in Tanzania, and for the purposes of calculation of revenues in this paper.

Two factors can reduce the volume obtained in the yield tables used in these calculations. These are the possibility of overestimation of the volumes in the yield tables, and destruction of crops in the field by various factors e.g., animals and fires. Usually an allowance of 15% is allocated for these factors (FAO, 1979). However, there were many estimations made in such evaluations concerning the yields as explained above, thus such correction was thought not to be worthwhile.

2.3.2. *Regulated* versus *market prices of wood*

In most developing countries, especially Tanzania, prices of wood are fixed by the government, because they originate from natural or planted forests, in most cases owned by the government itself. Private production of these products is not very well developed. Thus, there is a tendency for investors to use the government prices as an indication in *ex-ante* evaluations. In this case study, government regulated prices have been found to be low. Private investors have, however, indicated high prices which improve earnings.

2.4. Credit regulations

In many developing countries, most rural people are poor, and they are continuously struggling to survive. Raising woodlot may thus be an additional financial burden. Credit from commercial banking institutions may be an alternative to ease the burden. In Tanzania, various financial institutions have been set up with the aim of providing credit to smallholder investors, including those interested in investing in woodlots.

For quite some time, the banking system in Tanzania was centrally controlled. Lending was determined by government priorities rather than market criteria. But with the initiation of economic recovery programmes, lending has increasingly been determined through financial or economic viability (Due, 1993). During the survey, three banks were extending loans to individuals, cooperative groups and villages. These were: The Cooperative and Rural Development Bank (CRDB), National Bank of Commerce (NBC), and Tanzania Investment Bank (TIB). These loans could be extended to small scale investors in woodlots in the rural areas if they are found to be financially viable. Information on credit regulations and interest rate requirements was obtained at the banks' headquarters.

2.5. *Data analysis*

In calculating the investment decision criteria of IRR and PNW, current costs and revenues are assumed to hold in the future, for purposes of simplification. It will be of no use to try to estimate future costs of raising a woodlot and revenues accrued from the sale of products because of the unstable nature of the economy. Inflation may rise to unexpected proportions, and thus affect the estimated cost structure and render all calculations useless.

PNW was used to calculate optimum rotation age, using market prices. IRR was also calculated on these optimum rotation ages (Table 3).

2.6. *Sensitivity analysis*

To test the sensitivity of the PNW to different values of inputs and outputs, switching values were calculated. A switching value is defined as the value of an element a project would have to achieve as a result of a change in undesirable direction before the project fail to meet the minimum level of acceptance as indicated by measures of project worth (Gittinger, 1982), in this case PNW. To determine the switching values for costs and revenues, costs were increased and benefits left constant until the PNW was just above zero. Similarly, benefits were decreased while costs were left constant until PNW was just above zero.

2.7. *The investment criteria used*

In forestry, capital budgeting is important because of the long planning horizons needed in growing trees. Two time adjusted models used in this study are: Internal Rate of Return (IRR) and Present Net Worth (PNW). They are briefly reviewed below.

2.7.1. Internal Rate of Return (IRR)

IRR is defined as that rate of interest which gives a compounded (or discounted) sum of expenditure equal to compounded (or discounted) sum of revenues. The formula normally used to calculate IRR is:

$$IRR = \sum_{t=0}^{r} R_t (1+p)^{r-t} = \sum_{t-0}^{r} C_t (1+p)^{r-t} \text{..........(1)}$$

where:

R_t = revenue at time t
C_t = cost incurred at time t
r = rotation age
t = the year in which cost or revenue is incurred
p = interest rate corresponding to IRR

Basically the IRR represents the maximum payment in terms of interest that the investor could make if he/she borrowed the money equal to the cost and invested it in the proposal under consideration. The rule is to reject the investment proposal whose IRR is less than the guiding rate of discount.

2.7.2. Present Net Worth (PNW)

PNW is defined as the value of money at present which is earned in future. Th present value is obtained by discounting, using a given rate of interest. Formul used to calculate PNW is:

$$PNW = \sum_{t=0}^{r} R_t (1+p)^{r-t} - \sum_{t-0}^{r} C_t (1+p)^{r-t} \text{..........(2)}$$

where all terms are as defined in 2.7.1 above.

The rule is to reject all investment proposals with negative PNW. For mutually exclusive investment proposals, the one giving the highest PNW is preferred.

3. Results and Discussion

3.1 Collection of costs and revenue data

The results of collection of costs and revenue data are presented in Tables 1 and 2.

Table 1: Unit establishment and tending costs of eucalyptus at Mgeta

Year	*Silvicultural operation*	*Cost (Tshs)*
0	Nursery cost (cost per seedling)	9 000
	Land preparation	5 000
	Planting	2 800
1	Weeding (twice)	4 000
	Beating up (30%)	3 260
2	Spot weeding	2 800
3	Spot weeding	2 800
4	Spot weeding	2 800
5-10	Maintenance of firelines every year 5 x 1 000 =	5 000
	Total	37 460

Source: Morogoro Regional Natural Resources Office (1991).

Table 2: Unit revenues of eucalyptus at Mgeta (in Tsh)

Year	I	II	III*
5	13440	8580	5460
8	14400	9000	5880
11	12420	241200	5280
14	368280		163200

NB: 1. *I, II & III refer to Better, Medium and Poor site classes respectively.
2. Costs of harvesting are incurred by the customer.

Survey in banks showed the nominal interest rate charged was 30%. Inflation was around 22%. Using the complete formula, the real interest rate was 6.56% for medium and long term projects, forestry included. Real interest rate (inflation adjusted interest rate) is calculated using the formula:

$$I+r=\frac{I+n}{I+i} \quad \text{..........(3)}$$

where:

$r =$ real interest rate

$n =$ nominal interest rate

$I +$ inflation rate.

3.2 Present Net worth and Internal Rate of Return

Benefits which can be accrued from woodlots are woodfuel, poles, sawnwood and other intangible benefits. At Mgeta, the estimated market price of eucalyptus wood was Tshs 600 per m^3. The government regulated prices were Tshs 100 per m^3, Tshs 10 per running meter (estimated as Tshs 200 per m^3) and Tshs 300 per m^3 for woodfuel, poles and sawnwood respectively (URT, 1990). These are relatively low prices and not applicable in the Mgeta area.

Calculation of investment criteria of IRR and PNW show that wood is financially viable at Mgeta in all site conditions, and thus can attract private entrepreneurs. IRR is more than 6.56%, which is our benchmark interest rate. It is highest in the better site condition at 23.0%, and lowest in the poor site condition at 14.0% (Table 3).

Table 3: Summary of IRR and PNW at Mgeta as a measure of financial profitability (regulated and market prices)

Parameters	*Site condition* Better	*Medium*	*Poor*
Optimum rotation age (years)	14	11	14
PNW (Tshs)**	139856	96810	41117
IRR (percent)	23.0	23.5	14.0

NB: 1. Parameters were calculated using market prices.
2. PNW calculated at the 6.56% real interest rate.
3. In 1995 1 US$ = Tshs 550.
4. IRR and PNW are calculated as per formula (1) and (2) above respectively.

3.3. Private investors using higher interest rate as a proxy for their discount rate.

There are various factors contributing to risks involved in the establishment of woodlots. Two groups of factors are identified. The first one involves factors which are particular to rural woodlots. In the financial evaluation of rural woodlots, the risks involved due to such factors as climatic variations, fire, availability of labour (for tending operations at peak season), browsing and or trampling by both domestic and wild animals are high. The second group of factors are concerned with the financial infrastructure in developing countries and private investors in general, and are as follows (World Bank, 1991; Due, 1993; Harvey and Jenkins, 1994):

1. There are stringent conditions to meet for one to get a loan for indigenous investors from formal financial institutions. The financial institutions require detailed feasibility studies and fixed property as collateral for a loan applicant to be considered, and the amount of loan to be equal to the value of the property. Even when such conditions are met, at least six months are required to process the loan.

2. The requirement of collateral implies that since the majority of smallholder farmers do not have title deeds to their farms or houses, they are likely to be denied formal credit.

3. Indigenous entrepreneurs have the perception that financial institutions view them as unwelcome applicants, to be dealt with only when stringent conditions have been met.

4. The official payments, plus unofficial payments and time spent to negotiate with the bureaucratic machinery, adds to the fixed costs of securing the loans.

5. The policy decision to allow private investment in woodlots is relatively new, thus potential investors can view it as subject to frequent political revision in the future.

6. High inflation rates are a common feature in developing countries. In order to achieve a positive real interest rate, the nominal rate of interest has to be higher than the rate of inflation. This in turn increase the risk to the borrower. This is because high interest rates and high inflation rates are unstable, and greatly increase the risk of high interest rates in the future. The situation to the borrower may be that output prices may not rise in line with inflation, while input prices certainly will.

7. The interest rates and inflation rates of today are used to evaluate projects, and the assumption is that their difference will remain so in

> the future. But in these turbulent economies inflation can rise faster than interest rates. Thus investments which take relatively long time periods like woodlots can be very risky.

The willingness to invest and take all the risks will not be there unless there is an inducement in the form of increased profits in the investment. That is why a higher interest rate than the real should be considered by investors. Political uncertainties, especially strong in developing countries, reduce investors time horizons. Thus a high rate of return is preferable. The difference between the real and the realised rate of interest assures the investor that even if there are large variations in interest rates, the investor's decision will not be affected (Harvey, 1985).

3.4 Sensitivity analysis

The results of sensitivity analysis are shown in Table 4. The switching values at 6.56% opportunity cost of capital show that costs will have to increase by 488%, 365%, and 212% for better, medium and poor site condition respectively, for the plantation's PNW to fall to zero. The percentage figures decreases from better to medium site conditions because benefits decrease but costs remain the same. Costs are not likely to increase by such big percentages because private farmers are expected to be more efficient in resource use. Benefits will have to decrease by 79%, 73% and 53% for the better, medium and poor sites respectively for the plantations' PNW to fall to zero. The percentage figures decreases from better to poor site because of the same reason as explained above. It is not likely that benefits will fall by such percentages. The expectations are that prices of wood will increase due to scarcity.

Table 4: Switching values for eucalyptus plantation at Mgeta at 6.56% opportunity cost of capital

	Switching values percentage*	
Site condition	Costs	Benefits
Better	488	79
Medium	365	73
Poor	212	53

Note: *Percent by which costs will have to increase or benefits will have to decrease before the plantation's PNW falls to zero.

4. Conclusion

For private investors to commit their funds in rural woodlots, there should be evidence of financial benefits. This article shows that this can be achieved. If banks give due weight to environmental concerns in their *ex-ante* evaluations of projects than is currently the case in Tanzania (Kashuliza and Nyange, 1994), lending to rural woodlots entrepreneurs is likely to be more favourable. The huddles towards financial viability in the production of woodlots however, are there, and some of them are not financial in nature. For the interest of conservation they should be overcome.

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Appendix 1: Comparison of Yield of Eucalyptus from Tanzania and Brazil on Poor Site.

Country	*Age (years)*	*height (m)*	*diameter (cm)*	*MAI (m^3)*
Tanzania	4.5	13.3–14.5	8.0–10.5	
	5.5	9.1—18.3	6.5–16.2	5.1–12.1
	7.0	9.0–13.8	5.7–11.8	
	9.5	13.3–16.6	10.5–12.9	13.3–15.4
	4	8.2	8.3	10.3
	5	10.2	10.2	12.6
Brazil	8	14.0	13.4	16.6
	11	16.2	15.3	16.9

NB: The values of *h*, *d*, and Mean Annual Increment (MAI) for Tanzania are given as a range of figures because they were results from various experimental plots. The ranges given were from the lowest to the highest. The ages correspond to the years of assessment. The figures from Brazil were extracted from yield tables.

Source: FAO (1979); Solberg (1988).