AN ECONOMIC EVALUATION OF THE FOREST RESOURCES MANAGEMENT PROJECT IN MWANZA REGION, TANZANIA

BY

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ABSTRACT

This study was conducted in Mwanza Region covering Magu, Misungwi and kwimba districts. The objective of the study was to perform an economic evaluation of the Forest Resources management project (FRMP) in order to examine the projects' economic efficiency in utilising resources. The study employed multi-stage sampling technique in which purposive sampling was done to select districts and villages based on the performance of the project and ease of communication of the areas. Primary data was obtained through questionnaire and informal surveys to the sampled households, forest extension agents in the project area and buyers of trees for construction poles. Secondary data was obtained from projects' reports and records. Linear regression and Cost Benefits Analysis (CBA) were used to analyse the information extracted. Results indicated that about 91.6% of the households in the surveyed villages planted trees in their farms. Of these, 51.8% planted trees for fuelwood and sale of poles; 22.9% planted trees for poles, fuelwood, windbreak and shade whereas 16.9% planted trees primarily for construction poles and timber. Also, about 50.6% of the households had constructed improved wood stoves. Of the socio-economic factors involved in the regression model, family size, farm size, distance to the source of fuelwood and education had positive influence to the number of trees planted per household, while Age and number of livestock had a negative correlation. The project was economically with a net present value of about 4383.6 millions Tshs at the discount rate of 10% per annum in a period of 20 years. The return on investment was about 41.5%. Sensitivity analysis indicated that the project's net

present value would fall to zero when benefits were reduced by about 69.2%.

Finally, the study has come up with the following recommendations:

- More efforts should be made to invest in native and drought resistant tree species so as to increase supplies from tree planting in the area.
- Credit facilities need to be established to help farmers conduct other economic activities such as Beekeeping in order to generate income.
- Introduction of water harvesting technique through simple technologies in order to increase water supply in the area
- To sensitise and educate farmers to be self-reliant in situations where they are have ability to stand for themselves.
- Explore ways of growing trees in rural areas more efficiently and effectively in association with Livestock.
- More efforts to establish property rights regime is needed in order to promote investment in tree planting and management of natural woodlands.

DECLARATION

I, RICHARD GEORGE NGATE, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is a result of my own original work and it has never been submitted for a high degree award in any University.

Signature.....

Date 6/06/2001

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This work is dedicated to my beloved parents, Mzee George Ngate and my mother Magreth Lugenzi.

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ABBREVIATIONS

BCR: =Benefit Cost Ratio

CBA: =Cost Benefit Analysis

FRMP: =Forest Resources Management Project

IRR: =Internal Rate of Return

KRP:: =Kwimba Reforestation Project

MLNRT: =Ministry of Land, Natural Resources and Tourism

NPV: =Net Present Value

SPH: =Stocking Per Hectare

URT: =United Republic of Tanzania

CHAPTER 1

1.0 INTRODUCTION

1.1 Background information

Deforestation has been most significant in the tropics, where about 2.5 billion people depend on natural forest resources for many economic and environmental goods and services (Rowe *et al.*, 1992). Social, economic and political factors have created incentives for rapid exploitation of forests and intensified pressure on remaining tropical forests and woodlands. The increasingly intense gathering of trees for fuelwood and construction, combined with other causes of forest depletion such as clearing of forests for agriculture, have shrunk the globe's tree covered areas and considerably reduced the wood volume produced by spontaneous natural regeneration (Guggenhein and Spears, 1991; Goodland, 1991). In Africa, more than 3 million hectares of tropical forests are lost each year and in Asia forests are disappearing at a rate of at least 5 million hectares per year (Cernea, 1992). Recent remote sensing data and ground surveys indicate that a total of about 17 million hectares of forests are lost worldwide every year (Word Bank, 1991). In Tanzania, it is reported that about 130,000 to 150,000ha of forests and woodlands are lost annually (MNRT, 1998).

The environmental situation in many parts of Tanzania has become critical during the last half century due to land degradation and deforestation (Myrnas and Prytz, 1995).

The forested areas of Tanzania are under enormous pressure from expansion of agricultural activities, livestock grazing, forest fires and other human activities of which agriculture accounts for 60% of the total deforestation (Pauw, 1995). As Sharma, (1992) reports, extensive deforestation is associated with loss of biodiversity, climatic change, and threat to cultural survival of indigenous population and degradation of watershed in the tropics. Deforestation has threatened the ecological integrity in terms of reduced products and functional values such as control of soil erosion, increasing infiltration, reduced floods, maintaining biodiversity and serving as a carbon sink (Pauw, 1995).

In the past, miombo woodlands covered the western part of Mwanza region and Acacia predominantly covered the eastern part and *Commiphora* wooded grassland (Mawe and Kaale, 1995). However, massive deforestation became apparent since 1970s with local communities experiencing scarcity of wood products and pronounced environmental degradation (Kiwale *et al.*, 1998). Soft wood timber was not accessible in the region particularly to the low-income group in rural areas while about 80% of sawn hardwood used in the region came from other regions. This situation made the prices of forest products such as charcoal, fuelwood and timber to be rather high in Mwanza (Mnzava, 1980; Kajembe and Kessy, 1999). The region also experienced a decline in soil fertility through soil erosion as well as shortage of fodder for livestock.

Efforts have been made by government of Tanzania to alleviate the problem by

introducing afforestation programs in the region. One of these afforestation programs is The Forest Resources Management Project (FRMP). The project was established in 1992/93 and was primarily oriented towards the fuelwood problems resulting from deforestation (Kiwale *et al.*, 1998). More emphasis was on tree planting to increase forest product supplies such as fuelwood and poles in order to relieve pressure on the existing forest resources. In the course of implementing the program other activities were also carried out. Such activities included revenue collection by the project from forest resources, promotion of improved wood stoves, undertaking bee-keeping and management of natural woodlands locally known as '*Ngitiri*' in order to improve income of the people.

This study intends to evaluate the economic efficiency of the Forest Resources Management Project in Mwanza region in order to examine its efficiency in utilizing scarce resources to bring about sustainable development.

1.2 Problem Statement and Study Justification

Tanzania has in recent years given high priority to the development and application of improved forest resources management strategies for rural communities. The overall goal of this prioritization is to enhance the contribution of the forest sector to sustainable development, conservation and management of natural resources for benefit of present and future generation.

Forest projects have many different impacts on the welfare of people and on the environment. If viewed in economic perspectives, such projects affect societies in various ways both positively and negatively (Monela, 1989). Several studies has been done to provide information related to different approaches used in forest management in the region (URT, 1997); sustainable forestry extension systems used in afforestation programs (Mawe, 1998); and the assessment of the impacts and sustainability of forestry extension systems applied by Forest Resource Management Project (Kajembe and Kessy, 1999). However, no study has been done on economic evaluation of the project. This makes it necessary to perform an economic analysis of the FRMP as an investment. The evaluation is expected to provide information for making decisions on the acceptability of the project from the socio-economic point of view in order to influence future decisions on similar investments.

1.3 Objectives

The overall objective of the study was to perform an economic evaluation of the forest resources management project in Mwanza Region in order to examine the project's economic efficiency in utilizing resources. The specific objectives were:

a). To identify the various forest resources management activities proposed and carried out by the project,

b). To examine the socio-economic factors which have influenced project

performance,

c) To quantify the costs and benefits associated with various activities of the project.

d) To assess the project's economic efficiency using Cost Benefits Analysis.

1.4 Limitations of the study

It was difficult to obtain information on the sizes of farms. This was due to several scattered and different sized plot farmers have. In such cases, the size of farms was sometimes determined in relation to the farm surrounding the homestead.

Also in this study it was important to consider both number of trees planted and those survived after planting in order to establish the average survival rate of trees in the region. Although it was easier for the farmers to remember and mention the number of trees planted, sometimes it was difficult for some of them to tell the number of trees survived in their farm plots. In this case, consultation was required from other members of the households who started counting the trees, which survived.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Forest Resources Management

In the broadest sense, forest management can be defined as taking a firm decision about the future of any area of forest, applying it and monitoring the decision (FAO, 1989). Thus forest management covers what is done to forests and how it is done to meet certain specific purposes. These purposes broadly include environmental protection and amelioration of forests (FAO, 1989).

Traditionally forest management focused on biological or ecological and economic aspects. However, as Wiersum (1989) argues, the concept of social forestry puts forest management in a broader perspective by taking social aspects into consideration. Forest management therefore integrates all the biological, social and economic factors in making forest management decision (Leuschner, 1984).

Traditionally, forestry programs pursued by many government and development agencies have lacked an explicit action-oriented sociological foundation. Cernea, (1992) reports that forestry programs have been little concerned with social actors, beyond the forestry departments and their technicians. The programs tended to regard people only as part of the problem. Even the social forestry promoted in the 1980s,

particularly those based on community woodlots, were not designed around adequate analyses of social actors. In addition they lacked adequate incentives and benefits distribution arrangement. In Tanzania, the style of management of forest was developed during the colonial era (Mgeni, 1993). This style was characterized by the activities that involved establishment and expansion of the protected areas, formulation and enforcement of forest legislation and development of modern systems of management of forest resources. This approach has some contribution to conservation, but again it has negative impacts on the welfare of indigenous people. Since local people were largely denied access of these resources, they lost interest of maintaining and conserving the resources. Consequently, forests were highly depleted through illegal cutting of trees by local people living in close proximity with many of the protected forest areas. This situation led to the realization that, the most promising emerging strategies is to promote sustainable forest management policies and programmes that enable the active involvement of local communities and indigenous people in public forest use and protection (Poffernberger, 1996; Levin *et al.* 1986 cited by Lema, 1997).

2.2 Community participation in Forest Management

Recent years have witnessed marked social trends including movements towards greater democracy, decentralization of power, and communication systems that penetrate even into the remotest areas (Sergent and Bass, 1992). On one hand these trends have led to many strong voices calling for control of forests by local people.

On the other hand they have led to more national and international forestry initiatives such as the Tropical Forestry Action Plan (TFAP). Similarly, UNEP (1994) and Veit *et al.*, (1995) advocates for local empowerment and decentralization of natural resources management systems to achieve sustainability.

Community forestry interventions seem to be one of the best ways to change the negative perception of local people against forest resources owned and managed by government. The concept of community forestry is used for any forest management situation, which closely involves local people in the management of local forest and tree resources, for which people assume part of the responsibility and from which they derive benefits through their own efforts (Wiersum, 1991). According to Kiss (1990), forest management that emphasize local community participation is important for reducing mistrust and conflicts between local communities and forest managers. Shama *et al.* (1992) argue that forests are unlikely to be managed sustainably without the direct involvement of the people whose economic and social well being depends on these resources. Therefore, increased efforts to promote local participation are needed to achieve forest conservation and development goals.

2.3 Fuelwood scarcity and proposed solutions

2.3.1 Fuelwood scarcity

The concern over the "Fuelwood crisis" facing the world's poor has been widespread

since the late 1970s (Eckholm *et al.* 1984, Soussan 1988). Among of the factors, which appeared to exacerbate the fuelwood, crisis is the rapid increase in human population. Evidence suggest that while population growth rates have been constant or even declining in some parts of the world, in sub-Saharan Africa they have increased from 2.5% in 1960s to 3% per annum in 1983 (Pearce *et al.* 1991). This led to deforestation particularly in Africa and thus to fuelwood scarcity. The use and scarcity of fuelwood reflect complex and variable interactions between local production systems and the environmental resources on which they are based. The significance and origins of fuelwood problems in rural localities (where fuelwood is usually a free good gathered locally) are very different from those in urban areas (where fuelwood is a commodity produced elsewhere). For example, in rural areas, these problems reflect changes to economic and environmental relationships that affect local supply and demand (Armitage and Schramm 1989). These changes can be gradual, for instance, erosion of local woodlands as a result of land colonization, increased herd sizes in semi-arid regions, increased export of fuelwood to meet growing urban demands. As urbanization proceeds, the effect of urban fuelwood use and the problems associated with it are growing rapidly (Soussan *et al.* 1990, Floor 1987). As in rural areas, most fuelwood in cities is used in the household sector, although the use of fuelwood in small industries such as brick kilns can be significant locally.

Several factors have been identified to limit access to wood resources in relation to location of resources, demand, land tenure, ownership of biomass resources as well as

the way in which biomass resources are managed (ETC 1987, Johnson and Tompkins 1989). The location limitations on access reflect features of the landscape. Most important is the distance between the sources of supply and the point of use. In many localities biomass fuels are gathered freely from the environment and the main cost of fuelwood use is the time to collect the fuel (Johnson and Tompkins 1989). Resources beyond a certain distance will take too long to collect. Also features of the terrain such as hills, steep slopes and rivers add significantly to collection time. As pressures on the local resource base develop, the distance traveled, collection times and other demands on women increases. In addition, because fuelwoods are smokier and dirtier than modern fuels, women's health may be impaired by fuelwood use.

2.3.2 Response to fuelwood stress

Evidence from a number of developing countries suggests that households adapt to fuelwood scarcity in different ways. For instance increasing labour time on fuelwood collection, better fire tending, switching to the collection of the less preferred species of fuelwood and reducing the number of meals cooked, different ways of food preparation, for example presoaking beans to reduce cooking time (Kgathi *et al*,. 1997). In many rural areas there is even the concept of communal shared cooking (Ayling 1991, Dewees 1989). In Bangladesh, where all fuelwood has gone, women have shifted to alternative fuels such as cattle dung and crop residuals, coconut husks, rice hulls, millet stalks or herbs (Dankelman and Davidson 1988). This state has also been reported in some areas of Tanzania. In Mwanza region in Irugwa Island

Ukerewe people are using grass for cooking, while in some parts of Magu District namely Kivukoni, Busega, Itumbili and Sanjo divisions families use farm residuals and animal dung as a source of domestic energy (URT, 1997).

Adaptations to fuelwood scarcity are associated with socio-economic and environmental costs. For instance, an increase in labour time on fuelwood collection has an adverse effect on productive and reproductive activities. The crisis of increasing labour time is described by many as a crisis of women (Wisner 1988; Munslow *et al.* 1988). This is because women are responsible for fuelwood collection and food preparation. On the other hand, the use of cow dung and crop residues has adverse effects on the environment because it withdraws important nutrients and organic matter from soil (Pearce and Turner 1990). Unfortunately, the diversion of cow dung and crop residues from agriculture is equivalent to burning food in order to cook food. It is estimated that each ton of cow dung burned may mean a loss of 50kg of grain (Arnold and Jogma 1978 as cited by Ishengoma 1994).

2.3.3 The proposed solutions to the fuelwood problems

Since mid of the 1970s most governments and donor agencies have approached the fuelwood crisis as an energy demand and supply problem. Both the diagnosis of problems and the design for solutions have been based in large part on simple models of supply and demand (Foley 1988; Leach and Mearn 1988). Viewed from this perspective the solution was to plant more trees to increase fuelwood supply.

However, most these early efforts failed to have lasting effects on fuelwood scarcity or forest depletion. These failures led more thinking of contributing factors and solutions to the fuelwood crisis (Armitage and Schram, 1989). However, the crises vary widely between and within regions. Fuelwood problems are now more clearly seen as manifestations of more fundamental failures in rural land, labour, capital markets, and urban energy markets. It is also the failures of governments (local and national) to establish the conditions that would allow efficient and sustainable allocation of land resources between forest and cropland, wood and food production (Dewees 1989). Therefore, in addition to tree planting to increase the supply of fuelwood the following solution were also proposed:

- Natural forests or woodlands management: Experience has shown clearly that when tree planting is encouraged as a response to fuelwood scarcities, trees often assume much higher economic values to the farmer. Consequently trees that produce high quality fuelwood may be highly valued in rural economy as a source of building or construction poles (Dewees 1997). This situation has resulted into increased interest in managing the natural forest for fuelwood and other products. Also as large proportion of the fuelwood supply for urban area comes from woodlands, the proper management and regulation of natural woodlands is essential in establishing a sustainable supply of fuelwood. Advantages to natural forest management include lower investment costs (e.g. no land clearing, seeding or planting costs) and the greater the adoption to local conditions. The

goal of natural forest management is to produce a sustained yield of forest products while maintaining ecosystem balance.

- To reduce fuelwood demands through efficient use of woodfuels: The widespread fuelwood crisis has resulted into more emphasis on the introduction and use of improved stoves and kilns (for charcoal production) in order to reduce fuelwood consumption.

- To reduce woodfuel demand by encouraging the use of other renewable energy sources such as biogas, wind, solar energy etc.

2.4 Tree planting in Tanzania

2.4.1 The trend in tree planting

Tree planting by rural people is not a new practice. In many parts it has been taking place since the beginning of settled agriculture (Senkondo 1999). However, the extent to which these trees are grown varies depending on several factors like demand, institutional factors, local ecological patterns of agriculture and cultural practices and the extent of fuelwood and other tree products demand (Filius 1997, Senkondo 1999). In some parts of Tanzania, trees are a major element of the traditional farming systems. Good examples are the "Chagga and Meru" homegarderns of Northern Tanzania, where coffee is traditionally grown in combination with banana, beans and timber species such as *Albizia* and *Grevillea* (Lundgren 1992).

During the 1920s and 1930s, the colonial administration in Tanzania recognized the problems of soil erosion and shortage of fuelwood. Measures that were taken to contain these problems were terracing, mulching along contours and planting trees.

These measures were effected mostly on mountainous areas like the Usambara and Uluguru Mountains in Tanzania (Mnzava 1980, Nilsson 1986, Harrison 1987). However, the implementation of tree planting and other conservation measures during colonial period experienced difficulties as local people resented foreign initiatives; lack of education among farmers and the force used by colonial masters to implement conservation measures and tree planting, further alienated people from adoption and participation.

After independence, conservation problems became a major concern for the government. And in the year 1967/68 a national wide reforestation effort began, with the objective of providing in perpetuity enough fuelwood and building materials to the rapidly growing population as well as maintaining a sound environmental conditions for sustainable agricultural production (Kaale, 1983). In the 1970s, afforestation efforts came to be motivated by a belief that the country faced a massive fuelwood deficit. The Forestry and Beekeeping Division in the Ministry of Land, Natural Resources and Tourism estimated that the per capita consumption of fuelwood in rural areas was 2 cubic meters of solid wood. Using this as a basis, calculations showed that the total consumption of fuelwood was greatly in excess of the estimated wood production of the country. This led to an increasing emphasis on village woodlots as a means of meeting future fuelwood shortages.

In an effort to achieve this goal, the government through the Forest and Beekeeping Division produced seedlings from central nurseries and distributed the seedlings to

villages in the country. Political pressure was often placed on village leadership to ensure that land was set aside for the woodlots. Kajembe (1994), reports that the total annual planting needed to meet projected fuelwood demand was calculated to be about 400 000 hectares per year. The rate of planting, however, never approached this figure. Up to the end of the 1970s it was still well below 10 000 hectares per year and even this was not realistic, due to the use of number of seedlings issued, and espacement to calculate areas without considerations of survival rates (Kajembe, 1994). Similarly, the area planted up to 1989, of nearly 80 000 hectares was also an optimistic figure as it was based on the number of seedlings distributed and assumed a high survival rate. This figure in the real situation may be as low as 40 percent (Kowero and Temu 1985, and MLNRT 1989). In addition, the area planted annually covered only 12 percent of the target (Mongella 1986).

One of the suggested reason for the limited impact of the program is the perception that, the village forestry program was the responsibility of the forest management section of the 'Forest Division (Kajembe 1994; Kerkhof 1990). More emphasize based on telling villagers on how to establish forest plantation. For instance, an extension film of the time explained that village woodlots should be planted with conventional forestry species such as *pinus* and *cupressus* at 2.5meter spacing. This was completely the lack of experience in extension work.

By the early 1980s, the Forest Division was convinced that a change in direction was required (Mnzava, 1983). A separate Village Forestry unit was set up to develop new

promotional methods. It produced a number of publications for foresters and extension workers in which a more participatory approach was emphasized. Although there were villages, however, where woodlots were established and managed satisfactorily, the overall rate of trees planting didn't show any significant improvement.

Several studies were carried out to establish the reasons for the relative lack of impact of the program (Skutsh 1985., Kajembe 1988). These revealed a number of fundamental flaws in the analysis on which the program was based. One of the major premises had been that Tanzania farmers were facing a fuelwood crisis that had to be solved by tree planting. In fact, farmers placed a very low priority on producing fuelwood and were generally more interested in planting trees for construction wood, poles, fruit or other non-fuel purposes. The farmer's interest in forest products other than fuelwood has also been reported in social forestry programs instituted in other countries. For instance in India, although there has been some spectacular successes in promoting tree planting by individual farmers, the end products are usually higher valued building poles or pulpwood rather than fuelwood (World Bank 1985, Arnold *et al.*, 1987).

The production and distribution of seedlings from central nurseries to thousands of villages in the country was clearly impossible due to the lack of resources at the disposal of the Forest and Beekeeping Division. In many cases, the degree of collaboration with the villagers was also found to be insufficient. On the other hand, it

was realized that the communal approach was not popular among the majority of farmers (Kajembe 1994). People turned out to be distrustful of village leadership in many ways. There were instances where village chairmen said to have sold the produce of woodlots and kept money or used the wood for their own dwellings. There was also uncertainty about what to do with the woodlot once it has been established and how to allocate responsibility within the village for managing it (Skutsch, 1985). At this stage it was obvious that the policy of communal woodlots has failed to have lasting effects on fuelwood scarcity or forest depletion.

The failure of the communal woodlots approach in Tanzania, led to the establishment of rural forestry projects emphasizing tree growing by individual farmer's in their own woodlots or in agroforestry systems. Under this new approach known as "Farm Forestry", rural people are encouraged to plant trees according to their preferences. The production of seedlings is also being decentralized from large Forest and Beekeeping Division nurseries to village, school and individual nurseries. However, it is important to note that farmer's decision about tree planting and management are influenced by a number of socio-economic factors that affect the costs and benefits of doing so, and the returns relative to returns from alternative uses of the resources available to the farmer. The values that implicitly enter into such considerations include cultural beliefs and attitudes toward risk.

2.4.2 Factors influencing tree planting

Several socio-economic factors have been found to affect efforts in tree planting at household level. Kajembe (1988) studied the socio-economic constraints and institutional aspects, which have a bearing effect on afforestation efforts. The socio-economic factors which were identified to be responsible include, area of individual land holding, labour availability, education level, distance to the source of fuelwood, number of trips for fuelwood collection per week and number of cooked meals per day. The study also showed that gender issues, marketing systems of wood products, government licenses for tree cutting, community aspects in relation to production, perception about trees and compatibility of trees with agricultural systems are important factors in tree planting programs.

It has also been argued that farmers will not plant trees if there is uncertainty as to whether they will continue to have rights of access to their holdings. The implication here is that farmers will not make long term investments in their holdings unless there is security of tenure associated with freehold or private property (Chambers *et al.* 1989, Migot-Adholla *et al.* 1990). Insecure tenure discourages investment in tree planting because farmers can not be confident of the opportunity to reap the returns from such investment. Many trees are so slow to mature that they must be treated differently from annual crops. When trees take up the land that would have been used for other crops, there are considerable opportunity costs involved, costs which will only be recovered in the long run. For instance, in Tucurrique and Costa Rica,

research found that farmers were growing trees on land held in more secure tenure and annual crops on less secure land holding (Bruce and Fortman 1989).

Growing short rotation wood products for markets has often been the primary motives for tree planting in different areas (Warner 1997). This response has been most pronounced in wood shortage areas, where site and tenure conditions are favourable for tree growing, and where there has been transition from predominantly subsistence oriented agriculture towards greater involvement in commodity markets. It is generally argued that as land holding declines, its more intensive use for the cultivation of food crops will preclude the growing of trees. Farmers with land needed for subsistence food and cash crop production are normally reluctant to join in activities that necessitate prolonged fallow periods of part of their land (Kajembe 1988). Similarly, Arnold (1991) argue that smaller farmers without alternative sources of food or income encounter difficulties in setting aside land for long gestation non food crops such as *Eucalyptus*. However, in situations where agroecological conditions favour vertically structured joint tree/crop/livestock systems, farmers may respond to declining land availability through more intensive intercropping of trees and other perennial and annual crops. Such an evolution has been widely observed in the humid tropic belt of Asia and Africa within homegardens features as an important part of farming systems (Arnold 1990).

2.5 Project evaluation

Evaluation is defined as a process, which aims at assessing systematically and objectively the relevance, effectiveness and impact of activities of a project (Casley

and Kumar, 1987). As Brooks *et al.*(1990) pointed out, there is often incomplete and uncertain knowledge about interrelationships among the project activities, resources and environmental systems and the impacts on the welfare of people. The need to evaluate project activities to determine the extent to which each contributes in achieving the project goals and objectives becomes apparent.

Different evaluation techniques have been adopted and their point of departure is the degree at which the effects of different alternatives are aggregated or disaggregated in the evaluation process (UNIDO 1972, Hufschmidt *et al.*, 1983. Conyers and Hills 1984). The aggregation is considered with respect to different kinds of effects (e.g. social, cultural, health, ecological, market-oriented etc); effects that related to different phases of time as well as that related to different individuals or interest group in the society.

Using the degree of aggregation as a criterion, Soderbaum (1983), classifies the approaches into highly aggregated, intermediate and highly disaggregated. In this classification, CBA and multiple or multi-criteria analysis fall under the highly aggregated approaches, Cost effectiveness analysis is classified as the intermediate while environmental impact assessment, trade-off and positional analysis are considered as the highly disaggregated approaches.

2.5.1 CBA as an evaluation technique

Cost - Benefit analysis is defined as a systematic method of identifying and measuring the economic benefits and costs of a project (Hufschmidt *et al.*, 1983). The benefits of a project are values of incremental outputs of goods and services, including environmental services made possible by the project and the costs are the values of the incremental real resources used by the project.

The great expansion of interest in environmental and natural resource economics has led to many applications of benefit cost analysis and related techniques to the valuation of natural systems and environmental quality. The applications of CBA in evaluating projects have been most numerous in developing countries. In Tanzania, Kessy (1992) applied CBA technique to evaluate the integrated agroforestry project in Legho Mulo. Similarly, Serenge (1991) used the technique in evaluating the Chongwe rural afforestation project in Zambia. On other hand Hufschmidt *et al.*, (1983) reported that financial institutions funding different projects in developing countries (e.g World bank) put forward a prerequisite that the project to be funded must be socially and economically justified using CBA as a criterion. In this context, CBA is used as a tool for planning and rational utilization of scarce resource. By measuring both benefits and costs with this tool, it is possible to indicate in project analysis if the net impact is positive or negative basing on the chosen objective. The net impact is positive when the project resources have been used in an economically efficient way, while the negative net impact indicates inefficiency.

A fundamental assumption of CBA is that individuals are the best judges of their own welfare. Under this assumption, the degree of satisfaction or level of economic welfare experienced by individuals can be measured in terms of the price they were prepared to pay for the consumption of goods and services (Bojo, 1991). CBA is based on values measured in socially desirable prices. Such prices frequently take the form of imputed or shadow prices, which are obtained by adjusting, where necessary, actual market prices and deriving appropriate economic values in non market existence. Shadow prices often are used in developing economies to assist resources allocation decisions. According to Hufschmidt *et al.*, (1983), three criteria are traditionally used to measure production efficiency (profitability) in project analysis, all of which utilize the discounted cash flows of the project over time. These include the Net present value (NPV), Benefit-cost ratio (B/C ratio) and the Internal rate of returns (IRR).

The NPV determines the present value of net benefits by discounting the streams of benefits (B) and costs(C) back to the beginning of the base year (t= 0). Mathematically, NPV can be expressed as follows:

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

Where: NPV = Net present value;

B_t = Project Benefits in year t;

C_t = Project costs in year t;

r = Discount rate;

n = number of years in the planning horizon.

According to this criterion a project is economically efficient if the NPV is greater than zero.

The B/C ratio indicates the amount of present value revenue per unit of present value of cost by dividing the sum of the discounted revenues by the sum of discounted costs. Like NPV, its calculation depends on knowing the appropriate guiding interest rate. The relationship can be presented as:

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

In this case, if the ratio is exactly 1, the project will produce zero net benefits over lifetime. If the B/C ratio is less than 1, it means that the project generates losses from an economic point of view.

The IRR is defined as the rate of return on an investment, which will equate the present value of benefits and costs. It is found by an iterative process and is equivalent to the discount rate(r) that satisfies the following relationship:

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

In this criterion, only project with IRR greater than the discount rate(r) are economically preferred. The disadvantage with this criterion is that multiple interest rate solutions are possible, all of which satisfy the equation. Fortunately most forestry projects have costs early and revenues later, giving only one sign change, so multiple interest rate solutions is normally not a problem.

Dixon *et al.* (1986) gives a summary of the existing relationship between the three criteria as far as project evaluation is concerned:

i. If NPV > 0 then B/C ratio > 1 and IRR > r.

ii. If NPV < 0 then B/c ratio < 1 and IRR < r.

iii. If NPV = 0 then B/C ratio = 1 and IRR = r.

2.5.2 Financial versus economic analysis

Economic analysis differs from financial analysis in the sense that the latter focuses in the money profits accruing to the project enterprises based on market or financial costs (Little and Mirrles, 1992, Munasinghe, 1992). Economic analysis measures the effect on efficiency objectives in relation to the whole economy. In this instead of

using financial prices, shadow prices are used which reflect opportunity costs, including valuation of externalities wherever practical (Munasinghe, 1992). In a distorted economy shadow prices more accurately reflect the value of the factors of production in evaluation. It suggests prices that will more accurately reflect the value of factors of production considered in evaluation (Squire and Van der Tak, 1975). Such prices will ensure efficient allocation of resources in the economy. Shadow price exists for factors of production such as labour, capital and foreign exchange. Labour should be shadow priced because the labour market is imperfect. The discount rate used in economic analysis reflect the social opportunity cost of capital (Schreiner, 1989). Several possibilities available in determining the shadow price for different components. In this study revealed preferences and market prices for commodities was used. According to Dixon *et al.*, (1986), the revealed preference approach assumes that the value people place on commodities such as fuel wood or fodder which are sometimes collected as "free goods" must at least equal their costs in collecting these commodities including travel time. The time used in these activities is valued at its opportunity cost in terms of foregone labour.

In determining the shadow price of employment, the approach presented in UNIDO, (1972) and Solberg, (1988) was adopted. According to this approach, employment is categorized into unskilled, semi-skilled and skilled. Weights are used to convert the market wage rates for these categories into shadow wage. Details about the weighting system can be found in UNIDO, (1972). For the purpose of this study the following weights were used in shadow pricing of employment (Solberg, 1988):

Unskilled and semi-skilled labour = 0.7 of market wage; and

Skilled labour = 1.3 of market wage rate.

All prices used were constant 1999 prices.

2.6 Application of regression analysis

Social forestry has over the past years become a more discussed solution to the energy crisis of the rural world. It takes a number of forms including agroforestry, individual woodlots, farm forestry and village woodlots where members jointly plant and maintain energy woodlot. However, farmer's decision to adopt any of these practices is governed by different sets of factors, though the impacts of each factor differ from one locality to another. Linear regression analysis is used to identify the factors influencing forestry activities and the magnitude of their influence.

2.6.1 Linear regression analysis

Regression analysis is concerned with the study of dependence of one variable, *the dependent variable*, on one or more other variables, *the explanatory variables*. It is aimed at estimating and/or predicting the (population) mean or average value of the former in terms of the known or fixed (in repeated sampling) values of the latter (Madnani, 1990, Gujarati, 1995). These *dependent* and *explanatory variables* are denoted by '**Y** and **X**' respectively.

Linear regression analysis can either be simple or multiple depending on the number of

explanatory variables involved. In case of studying the dependence of a variable on only single explanatory variable, such relation is referred to **simple** or **two-variable, regression analysis**. On the other hand, studying the dependence of one variable on more than one explanatory variable, the relation is known as **multiple linear regression analysis**.

According to Lewis-Beck (1980), multiple regression is preferred to simple regression analysis due to the fact that, first it almost inevitably offers a fuller explanation of the dependent, since very few phenomena are products of a single cause. Secondly, the effects of a particular independent (explanatory) variable is made certain, because the possibility of distorting influences from other independent variables is removed

A multiple linear regression model is described as:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_k X_{ki} + u_i$$

Where,

Y_i is the dependent variable.

$X_{2i}....X_{ki}$ are explanatory variables (or regressors) for the i^{th} observation.

Further K = total number of predictor variables.

U_i is the stochastic disturbance term.

β_1 is the y-intercept for the model's regression. It gives the mean or average effect on 'y' of all the variables excluded from the model.

$\beta_{2....k}$ are regression coefficients for each predictor variable. They measure the change in the mean value of dependent per unit change in particular

predictor variables, holding other factors constant.

When the model is used in hypothesis testing, inference is made from the regression coefficients ($ß_{2,3...k}$). To assess the goodness of fit or strength of the linear relationship in multiple linear regression, an index which shows how well the straight line model fits the available data is used. This index is referred to as ' **the multiple coefficient of determination**' (denoted as R^2), which is reported as a percentage. The R^2 value considers the proportion of the variability in the response variable that is explained by the linear relation. In other words, it tells how much variation is explained by a set of independent variables. Predictions from models with high R^2 value are preferred because the model explains a high variation in the response variable. However, small R^2 values indicate that a straight line in a relation does not give a good fit to the data.

It is important to note that R^2 is a non-decreasing function of the number of explanatory variables or regressors present in the model, as it almost invariably increases with the increase in the number of independent variables (Madnani 1990; Gujarati 1995). That means if a higher R^2 value was the only goal in the analysis, then the researcher could simply add independent variables to the equation till their numbers equal to n-1, implying that the degrees of freedom are exhausted and R^2 value = 100%. Such a perfect explanation becomes merely a mathematical necessity. Instead of entering variables to the model to enhance R^2, the analyst must be guided by the theoretical considerations in deciding which variables to include.

2.6.2 The Multicollinearity problem

Regression analysis is sometimes associated with a number of problems. One of these is the problem of multicollinearity. Multicollinearity refers to the existence of a perfect or exact linear relationship among some or all explanatory variables of a regression model (Gujarati 1995). On the other hand the variables are said to be orthogonal if they are uncorrelated. This indicates absence of multicollinearity. However, in practice neither of these extreme cases is often met (Madnani, 1990). In most cases there is some degree of intercorrelation among the explanatory variables due to interdependence of many economic variables over time. Montgomery and Peck (1982) as cited by Gujarati (1995) pointed out that multicollinearity may be due to the following factors:

1. The data collection methods employed. For example, sampling over limited range of values taken by the regressors in the population.
2. Constraints on the model or in the population being sampled. This is attributed to the physical constraints in the population. e.g. families with higher income versus those with low incomes in adopting a certain innovation.
3. An overdetermined model. This happens when the model has more explanatory variables than the number of observations.

Therefore, it can be seen that, multicollinearity is a sample phenomenon arising out of the largely non-experimental data collected in most social sciences. Practically this phenomenon can be detected by the presence of large covariance, wide confidence intervals, insignificant t-ratios, high correlation among independent variables and high R^2 value with few significant t-ratios (Gujarati 1995).

There are several methods used as a remedial measures for multicollinearity, however, success of each depends on the severity of the collinearity problem (Gujarati, 1995). Since multicollinearity is a sample feature, it is possible that in another sample involving the same variables collinearity may not be so serious as in the first sample. Sometimes simply increasing the size of the sample (if possible) may attenuate the collinearity problem. Unfortunately, this remedy can be impractical in case the researcher is in the data analysis stage of the research and has a fixed sample size.

Together with other remedies, Gujarati (1995) suggest that, one of the simplest thing to do is to drop one of the collinear variables (the variable that responsible for the multicollinearity problem in the model).

CHAPTER 3

3.0 MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Geographical Location of the study area

Mwanza region lies in the northern part of Tanzania located between latitude 1° 30' and 3° south of the equator. Longitudinally the region is located between 31° 45' and 34° 10' east of Greenwich. Regions bordering Mwanza region are Kagera to the west, Shinyanga to the southeast. To the north east border is Mara region. The northern part of the region is surrounded by water of Lake Victoria, which in turn separates the region from neighboring countries of Uganda and Kenya.

3.1.2 Land area and administrative unit

Mwanza region occupies a total area of 35,192 sq. km, out of this area 20,200 sq. km is dry land and 15 092 sq. km covered by Lake Victoria. Thus 43 percent of the region's surface area is water. The region, which was formerly divided into six administrative districts, has been reorganized into seven districts as from July 1996. Misungwi being the newly established district of the region excised from kwimba district. FRMP covers all seven districts of Mwanza region namely Magu, Kwimba, Misungwi, Mwanza, Sengerema, Geita, and Ukerewe. However, the study was conducted in Magu, Misungwi and Kwimba, districts only.

3.1.3 Climate and soil

3.1.3.1 Climate

Average temperature is about 31°C. The average rainfall in Mwanza region is about 930 mm varying from 1 800 mm in the western parts of Ukerewe Island to 750 mm in the southern parts of the region. Under normal conditions the rainfall is distributed mainly during two periods, namely short rains in October to December and the long rains from March to may. There is a dry spell from January to March and frequently these rains are of erratic pattern.

3.1.3.2 Soil

According to URT (1997), the soil of Mwanza region can be classified into three groups:

a) sandy soils derived from granite;

b) Red loams derived from limestone;

c) Black clays.

The first group of soils is only of very moderate natural fertility and steadily deteriorates under conditions of cultivation. These type of soils are slightly acidic and have low cation exchange capacity with low organic matter. The second group is of very much higher potential but tend to be found in areas of low rainfall.

3.1.4 Vegetation

In the past, Miombo woodlands covered the western part of Mwanza region, while Acacia covered the eastern part and *Commiphora* wooded grassland. However, since in the 1970s the region started to experience high rate of deforestation through extensive clearing of forest for agricultural production, eradication of tsetseflies to pave way for livestock grazing and the cutting of trees for timber, poles and firewood without replenishment. As a result, the destruction of these forests has left the regions land area with less than 10 percent forest cover. The existing natural forests at present are in Geita and Sengerema districts. Table 1 indicates the forest area in the region.

Table 1: Area covered by Forests in Mwanza region.

Districts	District area (sq. km)	Forest area (sq. km)	% of total area	% of coverage of total district land area.
Gita	6 775	88.5	68.1	1.3
Ukerewe	640	3.0	2.3	0.5
Magu	3 070	5.4	4.2	0.2
Sengerema	3 335	28.8	22.2	0.9
Mwanza	425	-	-	-
Total	20 095	129.8	100	0.69

Source: URT (1997).

3.1.5 Population and Socio-economic aspects

Mwanza Region is a densely populated Region in the lake zone. It has a population of 1,878,271 people with annual growth rate of 2.6% in 1992 (Bureau of statistics, 1992). This was about 8.1 percent of the total population of Tanzania mainland which was 23 174 443. The Regional population density was 96 people per square kilometer (Kiwale *et al.*, 1998).

The agricultural sector is dominated by small scale farmers, which contributes about 60% of the total Regional income (Mawe and Kaale, 1995). Agriculture provides food for the fast growing population, raw materials for the Agro-industries, foreign exchange for the country and lastly employment for the majority of the rural population. Main agricultural crops are Maize, Rice, Millet and Livestock. Cotton is the only cash crop. Livestock keeping in Mwanza region is an important economic activity for a large part of the rural population. The rural community in the region relies on livestock to fulfill their social as well as their economic needs. According to 1984 livestock population census, the region had a total of 1,515,166 cattle, 627,196 goats and 274,989 Sheep.

3.2 Methodology

3.2.1 Primary data collection

3.2.1.1 Questionnaire survey

Before the actual survey took place, sampling criteria for questionnaire survey had to be made clear. Further a questionnaire had to be designed, pre-tested and modified before the onset of the research.

Sampling criteria for questionnaire survey

The multi-stage sampling technique was used, in which purposive sampling was done to select districts and villages based on the performance of the project as well as ease of communication in the area. Kajembe and Kessy, (1999) reported that the project's performance from one district to another is different. In some villages the FRMP interventions contributed up to 90% of the entire tree planted. Based on this criterion, three districts were selected which are Magu, Misungwi and Kwimba. Similarly one village in each district, making a total of three villages was selected. Of the three districts, Magu has shown excellent performance, followed by Misungwi, which recorded average performance, and in Kwimba district the project has not performed well. The villages selected were Ng'haya, Nyanhorongo and Jojiro from Magu, Misungwi, and Kwimba districts respectively.

Questionnaire design and pre-testing:

An open-ended questionnaire was designed based on the specific objectives. Pre-testing of the questionnaire was done on the onset of the research to check reliability and validity of the questionnaire items. As argued by Mettric (1993), pre-testing is essential before beginning any survey. The pilot testing was conducted in 15 randomly selected households in Ng'haya village in Magu district. After the pre-testing phase, questions, which were found to be redundant, were dropped and more useful ones were added. Farmer's response in this early survey were used in restructuring the final questionnaire (Appendix 1) which elicited among other things, household status, fuelwood consumption, and project activities such as tree planting, Bee-keeping and management of natural woodlands locally know as *'Ngitiri'*.

Sampling for questionnaire administration

According to Boyd *et al.*, (1981), a random sample should at least constitute 5% of the total population to be a representative of the population. In this study, 6% of the households in each village surveyed were selected to constitute the sample. Random numbers were used in picking names of household's heads from the list of households in the villages.

Questionnaire Administration

The questionnaire survey was conducted between October and January 1999. The researcher administered the questionnaires to each sampled household with the assistance of two enumerators, all of which were fluent in English, Kiswahili and the local language 'Kisukuma'. Respondents in this study were male and females.

3.2.1.2 Informal Surveys

In order to obtain general information on the day to day running of the project activities in villages surveyed together with other useful information, some informal surveys were conducted involving village leaders, forest extension agents, and district forest officers in the district involved. Other informal surveys were conducted at Iteja village in Misungwi district in order to get the possible rotation age of the planted trees species in the 'Bega kwa bega farm' organized by KRP which could be used in the analysis. The buyer of poles and farmers were contacted to get information on the labour involved in harvesting of trees.

3.2.2 Secondary Data collection

Data in this category was obtained from reports and records at the regional, district and village offices. Also survey of literature relating to the planted species in the project was done in order to get information concerning their characteristics, growth potentials, possible rotation ages and expected yields particularly for those tree

species mostly harvested for fuelwood in the study area. This information was used in the Cost-Benefit Analysis for the project.

3.3 Data analysis

The quantitative and qualitative information collected through questionnaire survey and records was edited and coded. The coded answers were then hand tabulated to allow entry into the computer. The Statistical Package for Social Science (SPSS) was employed to analyze both quantitative and qualitative data. Data analysis involved both descriptive and inferential statistics, content analysis, and cost benefit analysis.

3.3.1 Descriptive analysis

Qualitative data was summarized in frequency tables and the percentages were used to indicate the distribution of farmer's responses towards specific project activities. Quantitative information was analyzed statistically to get averages and standard deviations.

3.3.2 Inferential statistics

The function of inferential statistics was to provide an idea about whether the patterns described in samples were likely to apply in the population from which the sample were drawn (Devause, 1986). In this regard, multiple regression equations were

developed to show the relationships between socio-economic factors (independent variables) and the number of trees planted.

The model and the Hypothesis tested:

In developing the linear regression model and doing hypothesis testing, the dependent and independent variables were defined as follows:

The dependent variable:

TTSP = The total number of tree seedlings planted by each household in their plots. This was the dependent variable because it was hypothesized that the impact of the factors that influence project activities in the farmer's plots would be reflected on the number of trees that the household managed to plant.

The Independent variables were taken to be:

Farm size (FS): The size of the farm owned by the household. Since planting was to take place in the farmer's plots, **FS** was considered as quite an important factor. Therefore, it was hypothesized that all things being equal, farmers with bigger farm size would plant more trees.

Number of Animals (NO.LSK): The number of animals (herbivorous animals)

considered here cattle, goats, sheep and donkeys. Animals in the study area are taken out to graze on communal grazing areas. Grazing require some members of the household to spend many hours during daytime looking for livestock. Therefore, it was hypothesized that the larger number of animals could lead to labour shortage in the household resulting into fewer trees planted by the household.

Household size (HS): The hypothesis in this case was that the bigger the **HS**, the more the labour would be available in the household for tree planting, resulting into high number of trees planted by the household, other factors held constant. In defining this variable, household members who were potential participants in tree planting (except young children at home) were considered. School children were also considered since tree planting activity in the study area mostly take place during short rain seasons (December and January), the time which school children are on holidays giving them a chance to participate in tree planting.

Distance to the source of fuelwood (DFUEL): Since the local communities in the study area have experienced shortage of fuelwood and other forest products, it was hypothesized that **DFUEL** could influence the planting activity in two ways. On one hand it could lead to labour shortage in the household resulting into less trees planted by the household as DFUEL increased since many hours are used in for fuelwood collection. On the other hand, increase in DFUEL could imply that fuelwood shortage at household level was more acute, motivating farmers to plant more trees to mitigate the scarcity of fuelwood and other forest products.

Age of the household head (Age): In many African societies, age is normally a very important factor, which influences decisions that someone can make. The hypothesis here was that older household heads would tend to put less weight in tree planting activity either because of short time preference or their inability to participate due to old age problems, implying less trees planted by the household as age increased.

Education of Household head (EDUC): Education is an important tool (factor) enhancing individual farmer's decision making power to adopt new technologies. Therefore it was hypothesized that household head with high education level would plant more trees than the less educated one, since education provides the farmer with a rational basis to adopt the practice.

Statistically, the hypotheses tested was:

HO: TTSP = f(FS, NOANI, HS, DFUEL, AGE, EDUC)

+ - + +/- +/- +

(implying that there is no correlation between dependent and independent variable ; $\mathbf{b_{1...6} = 0}$)

Against;

HI: TTSP = f(FS, NOANI, HS, DFUEL, AGE, EDUC)

+ - + +/- +/- +

(Implying that there is a positive or negative relationship between dependent and independent variables; $\mathbf{b_{1...6} \neq 0}$)

The signs (+, -, and +/-) below each factor indicate the hypothesized impact of that factor on TTSP caused by an increase in that particular factor.

Using a two tailed t-test at 0.05 probability level of significance, **HO** would only to be rejected when $P < 0.05$.

3.3.3 Content analysis.

The component of verbal discussions held with different respondents were analyzed in details with the help of content analysis method. In this way the recorded dialogue with informants was broken down into smallest meaningful units of information or themes and tendencies. This helped the researcher in ascertaining attitudes of respondents.

3.3.4 Cost Benefit Analysis

3.3.4.1 Decision Criterion

Cost Benefit analysis in this study is done to establish whether the project is economically efficient using "Net present value" as the criterion. This criterion is widely relied upon as a guide to economic efficiency (Dixon and Hufschmidt, 1986). The time horizon for the project is set at 20 years, from 1992/93 when the FRMP was established. This period is considered under the assumption that most tree species can reach economic maturity (basing on their biological growth characteristics) and can be

harvested for fuelwood and construction poles at different harvest cycles.

In most developing countries the social rate of discount is assumed to be between 8 and 15% (Gittinger, 1982). Also the World Bank recommends a 10% discount rate in project evaluation for development project with external funding. In this case, the proposed study will use a discount rate of 10%, which is within the range.

3.3.4.2 Cost and Benefit Components

The cost components:

The project was initiated since in 1992/93 and the first phase of the project was six years. The costs involved are:

Administrative costs - cover the salary for the forest officers in charge of the project; costs of administrative vehicles; Consultation costs; training of forest workers, farmers and school teachers which was done to intensify implementation capabilities and skills in afforestation and woodland management. These costs were obtained from project reports and records.

Labor costs -the amount of farmer's labor used in different activities related to the project in their farms and in the woodland was quantified. For the activities, which had already taken place such as tree planting, construction of improved wood stoves,

the number of mandays used for such activities was obtained from questionnaire/informal surveys carried out during the study. Children labour was valued at half-adult labour cost rate. The mandays of self-supplied labour was costed in terms of alternative employment that the farmers can get as unskilled casual labour.

Costs of seedlings: - the minimum price of seedlings in Mwanza region was used as the cost of seedlings planted. The number of seedlings recorded each year by the project was considered in valuing the cost of trees planted in the region.

Traditional beehive -The costs involved in purchasing these type of hives by farmers in the project areas was involved in evaluating the project.

The benefit components:

Supply of fuel wood - the supply of fuel wood from harvests of fuelwood species was valued based on the proposed management harvest schedules. Available literatures together with the survey results were used to estimate the expected fuelwood yield from the farmer's plots. The reduced time on fuelwood collection was considered as a benefit to the society and was valued in terms of the alternative use for the labour.

Revenues from sale of trees for construction poles: - under the assumption that farmers would sale their trees as construction poles, the revenues from sale of trees

formed part of the benefits in the analysis. The price give by the farmers and tree purchasers in the study area was used as market price for trees.

Honey and Wax - the price of honey was obtained from beekeepers in the project area. However, the market price of wax per kilogram was used in this study since most farmers in the study area do not process wax.

Revenues collection by the projects: The revenues collected as royalty from timbers, charcoal and fine imposed to offenders and logging particularly in forest reserves by the project in the region were considered as benefits to the project.

Benefits from stoves: The benefit from stoves was valued in terms of reduced or saved time in fuelwood collection and also reduced fuelwood consumption. The stove is said to reduce fuelwood consumption by 50 percent (Kiwale *et al.* 1998). The per capita fuelwood consumption in Mwanza region is estimated at 1 m^3 solid. Using this estimate, the per capita woodfuel saving through the use of stove is 0.5m^3 solid of the previously per capita consumption.

Environmental benefits: In this case it was assumed that the decreased fuelwood consumption as a result of introduction of improved stoves reduced the cutting of forests for fuelwood. Therefore, the estimated yield of natural woodlands, that is 10m^3 per hectare, was used to determine what part of woodland would not be cut and then the expected yield was valued in monetary terms.

3.3.4.3 The time horizon and management assumptions

The time horizon for the project was taken to be 20 years. This was based mainly on two arguments:

1. Available literature shows that with 20 years, most of the species planted in the project can be harvested for poles and fuelwood at different rotation ages.
2. With high discount rates, characteristics in the third world, events beyond 20 years have little value to farmers and are difficult to promote.

It was assumed in the analysis that trees species planted in the project would behave in the same way as if they were planted in pure stands. With this assumption, the total number of trees planted in the region per each year was converted into hectares equivalent of pure stands (that is 1600 stocking per hectare, except for Acacia, which was planted at 400 stocking per hectare). Available literature on the characteristics of these trees was used to predict the expected yield, growth characteristics and hence the expected benefits.

It was further assumed that the sample households in the surveyed villages were true representatives of the population.

Also in relation to unskilled labour which is mostly used in the project evaluated, first it is important to note that surplus labour may disappear over time, especially during

peak agricultural seasons. Thus it was assumed that the labour situation would remain constant over the evaluation period. Secondly, unskilled labour may be drawn from family members, as is often the case in rural areas (World Bank, 1991). However, it is still acceptable to estimate its marginal product by the going rural wage rate, provided that labour market is fairly active and the family generally participates in the market.

With 20 years as the time horizon for the analysis of the project, a number of assumptions were made regarding the management of the planted species by the farmers in their plots. Most of these are based on the characteristics of the species (from literature) and on the survey done in the study area during data collection period.

CHAPTER 4

4.0 RESULTS AND DISCUSSION

This chapter presents the survey results and the model results of the socio-economic factors influencing tree planting in the study areas together with Cost Benefit Analysis (CBA) results.

4.1 Project Activities

4.1.1 Tree planting

Tree planting has been the main intervention used in addressing problems of fuelwood supply, other forest products and protect soil cover in order to reduce soil erosion. In the study area, majorities of the farmers have responded positively to tree planting. The results reveal that about 91.6% of the households have planted trees on their farms (Table 2). The findings show that 48.2% of the households scattered trees on the farms (trees mixed with crops), 32.5% had their own woodlots whereas 12% of the households planted trees along boundaries.

Table 2: Participation of households in tree planting in the study area

	Villages			
Response	Ng'haya	Nyanhorongo	Jojiro	Total
Yes	37(92.5%)	18(90.0%)	21(91.3%)	76(91.6%)
No	3(7.5%)	2(10%)	2(8.7%)	7(8.4%)

Source: Own survey data (1999).

The high response for tree planting suggests that a majority of the village households are aware of the importance of forest products for their domestic and commercial use. The results show that about 51.8% of the households in the surveyed villages planted trees for fuelwood and sale of poles; 22.9% planted trees for poles, fuelwood, windbreak and medicine as compared to about 16.9% of the households who planted trees primarily for construction poles and timber. As it has been argued by Combe, 1982 cited by Kessy, (1992) farmers become motivated to take care of trees once the market for wood products exists. Opportunity to earn cash income is a strong incentive for farm forestry (Sharma *et al.*, 1992). Despite high response in tree planting, the study also revealed that about 8.4% of the households in the surveyed villages did not plant trees on their farms. The reasons advanced by the respondents for not planting trees includes inability to purchase seedlings as well as land shortage. Since most of the people in the study area are subsistence farmers, they failed to divert their funds to buy seedlings due to the fact that the same money was required for other immediate or more pressing needs in the household e.g. buying foods as most of people tend to have less stock of food, especially during the rainy season. It is also important to note that availability of land for tree planting at household level depends among other things on the size of individual land holding. Farmers with land needed for subsistence food and cash crop production are normally reluctant to join in activities that necessitate prolonged fallow periods of part of their land (Kajembe 1988). Similarly, Arnold (1991) argue that small farmers without alternative sources of food or income encounter difficulties in setting aside land for long gestation non food crops such as *Eucalyptus*.

Further, the results show that there was a variation of labour used in planting trees across the surveyed villages (Table 3). On average, two adults participated in tree planting in each of the surveyed village. However, the number of children participated in planting activities per household in Nyanhorongo village were more (that is 1.67 children per household) as compared to 1.3 child in the other two surveyed villages. The reason could be that people in Nyanhorongo village are more aware of the advantages of planting trees and they are assured of the market since the village is situated along the main road where it is easier for tree buyers to reach the village.

Table 3: Labour used in tree planting in the studied villages

	Villages		
Labour used	Ng'haya	Nyanhorongo	Jojiro
No .Of Adults per household	2.23	1.87	2.15
No. Of Children per household	1.3	1.67	1.3
No. Of day used per household	5.00	6.28	4.00
Time(Hours used) per household	4.18	4.00	4.07

Source: Own survey data (1999).

Species mostly planted in the study area include those of fruits trees and non fruit trees. Fruit trees include *citrus* fruits (Oranges and lemons), *Psidium gujava* (Guava), and *carica papaya* (pawpaw). These are mostly grown close to the homestead. The non-fruits trees, which are planted for fuelwood, poles and soil conservation on different preferential areas of farm plots, are shown in Table 4 below.

Table 4: Summary of tree species planted in the study area and their uses.

Species:	uses:
Eucalyptus spp	Poles, fuelwood
Melea azederach	Poles, fuelwood and medicinal purposes
Senna siamea	Poles, fuelwood and borders
Grevillea robusta	Poles, Timber and fuelwood
Acacia arabica	Fuelwood, fodder
Albizia lebbeck	Fuelwood, poles, poles and shade
Sesbania sesban	Fuelwood, fodder
Azadirachta indica	medicine, poles, fuelwood, shade
Leucaena leucocephala	fuelwood, fodder and soil fertility
Terminalia catapa	Mainly shade, and fruits.

Source: own survey data (1999).

Table 5: Average number of trees planted and survived per household in the surveyed villages.

	Vilages								
	Ng'haya			Nyanhorongo			Jojiro		
	Average tree			Average tree			Average tree		
Species	planted	survived	Survival rate	planted	survived	Survival rate	planted	survived	survival rate
Eucalyptus	52	33	63.5	207	146	70.5	62	43	69.4
Melea azedrach	24	14	58.3	128	91	71.1	26	17	65.4
Senna siamea	23	16	69.6	10	4	40	13	8	61.5
Grevilia robusta	3	2	66.7	-	-	-	3	1	33.3
Acacia arabica	38	28	73.7	-	-	-	8	4	50
Albizia lebbeck	16	11	68.8	50	37	74	11	5	45.5
Leucaena L	21	13	61.9	7	2	28.6	19	8	42.1
Sesbania sesban	3	2	66.7	-	-	-	-	-	-
Teminalia catapa	2	1	50	-	-	-	-	-	-
Azadirachta indica	4	2	75	6	1	16.7	12	5	41.7
Total	**186**	**122**	**65.5**	**408**	**281**	**68.5**	**154**	**91**	**59**

Source: Survey data (1999).

The overall survival rate for the species in farmer's plots in the surveyed villages was about 64.5%. This compares well with the survival rate of 65% reported by Kiwale *et al.*(1998). The low survival rate of the tree species in the region is due to drought conditions, termite attacks for some species particularly *Eucalyptus* and grazing of livestock for fodder species such as *Leucaena* and *Albizia*. During interview, farmers mentioned that drought increased the death and severity of termite attack to newly planted seedlings. In response to extensive losses of *Eucalyptus spp* seedlings due to termite attack, farmers in the study area have adopted a remedial practice using locally available materials. Farmers do mix ashes into the soil and spread around trees. In Kwimba district farmers also used berry extract of *Melia azederach* provided by KRP to prevent termite attack. In addition to the above problems, the study conducted by Kajembe and Kessy (1999) in the project area point out that farmers also lack the general information with regard to tree planting and management. Great variations in tree planting space from one individual tree farm to another and failure of the people to prune their tree properly was observed. This indicate that more emphasis was directed in encouraging people to plant many trees than management of trees at different stages of growth or maturity.

4.1.2 Management of Natural woodlands and Beekeeping

During implementation of the project farmers were also sensitised on the registration and management of natural woodlands locally known as *'Ngitiri'*. Results indicate that about 38.6% of the households in the surveyed villages had their own *ngitiri*

(Table 6). Most of these *ngitiri* are woodland patches, and less than 1ha in size. Also about 61.4% of the household in the surveyed villages do not own *ngitiri*, as they have no enough land to create it.

Table 6: Ownership of natural woodlands (*'Ngitiri'*) in the studied villages.

	Villages			
''Ngitiri'' ownership	Ng'haya (n=40)	Nyanhorongo (n=20)	Jojiro (n=23)	Total (n=83)
Own *'Ngitiri'*.	10(12.0%)	9(10.8%)	13(15.7%)	32(38.6%)
Do not own *'ngitiri'*.	30(36.1%)	11(13.3%)	10(12%)	51(61.4%)

Source: Own survey data (1999).

The purposes of woodland management were varied depending on the owner. Some were managed for fuelwood production others for grazing and others for multiple uses. About 30.1% of the households do benefits fuelwood, thatching grasses and grazing from *ngitiri*; 12% of the households benefits fuelwood and other building materials (poles) from *ngitiri*, while 6% of the respondents claimed to obtained both fuelwood, thatching grasses, construction poles and grazing from *ngitiri* (Table 7).

Table 7: Benefits from *Ngitiri* as perceived by respondents

Benefits	Villages			
	Ng'haya (n= 40)	Nyanhorongo (n =20)	Jojiro (n = 23)	Total (N = 83)
Firewood, thatching grasses & grazing.	16(19.3%)	2(2.4%)	7(8.4%)	25(30.1%)
Firewood and other building mateials.	2(2.4%)	3(3.6%)	5(6.0%)	10(12.0%)
All above.	1(1.2%)	3(3.6%)	1(1.2%)	5(6.0%)
Do not own *ngitiri*.	21(25.3%)	12(14.5%)	10(12.0%)	43(51.8%)

Source: Own survey data (1999).

According to Kiwale *et al.* (1998) there are two main categories of *ngitiri*. The first category is the completely depleted woodlands that are mainly manage to allow restoration of trees. The second category of *ngitiri* is that with some tree remnants, which are managed for the purpose of upgrading them by active management to ensure sustained supply of forest products to the owners. However, the study revealed that about 33.7% of households who own '*ngitiri*' conducted singling, and pruning once per year to obtain fuelwood and poles, as compared to only 4.8% of the households who preserved their *ngitiri* in order to regenerate (Table 8). The results indicate that in the first phase of the project, many individuals who own *ngitiri* placed more emphasis upon production enhancing operations such as singling and pruning for the purpose of getting fuelwood and poles. Although the project encouraged

owners of woodland to initiate enrichment planting to intensify wood production, in the surveyed villages no individuals appeared to have conducted this. This suggests that more extension efforts are needed to educate people over the whole issue of management of natural woodlands (ngitiri).

Table 8: Management of '*Ngitiri* 'as reported by respondent during the study

Practices done	Villages			
	Ng'haya (n= 40)	Nyanhorongo (n= 20)	Jojiro(n=23)	Total(N= 83)
Preserved for restoration.	2(2.4%)	1(1.2%)	1(1.2%)	4(4.8%)
Singling, pruning, for fuel & poles.	8(9.6%)	8(9.6%)	12(14.5%)	28(33.7%)
Do not posses 'ngitiri'.	30(36.1%)	11(13.3%)	10(12%)	51(61.4%)

Source: Own survey data (1999).

Collection of fuelwood and harvest of poles in 'Ngitiri' is normally done from August to September. This is the period whereby households in the study area collect and stock fuelwood to be used during rain season. For construction poles, individuals in the first phase of the project were advised to protect their woodlands ('*Ngitiri*') for five years before harvest. Five years was set to provide enough time for the trees to

regenerate and grow to the utilisable size for poles. From then, it was expected that one could at least selectively harvest poles in each harvesting season.

Awareness creation on management of natural woodlands has developed the spirit of ownership of woodlands and reduced the feelings of no man's land (Kiwale *et al.*, 1998). Studies in Zimbabwe have indicated that, despite rapid rates of deforestation, residual woodlands and other trees resources are being managed to meet local needs (Dewees, 1989). Beekeeping was also initiated in the course of project implementation with the aim of improving income generation from woodlands. The study indicate that only 6% of the households in the surveyed villages do keep bees, while 94% do not engage in beekeeping. The study also revealed some problems with regard to beekeeping. About 2.4% of beekeepers mentioned weather changes, lack of capital to purchase beehives, and harvesting gears as the main problems, while 3.6% of the beekeepers, problems were weather changes, lack of capital, and pests such as red ants which invades beehives and cause bees to vacate from the hive. In response to pests (red ants) farmers do search their habitat and destroy their nests. However, the study revealed that, Beekeeping was successfully adopted only in areas where it is traditionally practised. In order to get good estimates of honey and wax production it was important to visit 'Lutarutale' village in Misungwi district where bee keeping is traditionally practised and where many beekeepers were registered by the project. On average one log hive in the village produce 14.5 litters of honey and 1.35kg of wax. Since investments in forestry are of long-term nature, beekeeping would serve as an incentive to woodland conservation. Products from bee keeping are valuable commodities that can contribute both to subsistence and income generation. In

addition to this direct output, improved pollination by honeybees means better harvest of early crops (Pawlick 1989).

4.1.3 Use of efficiency wood stoves.

Due to the experienced fuelwood shortages in some parts of the region, the project introduced the technology of improved wood stoves to increase fuelwood consumption efficiency. The results indicate that about 50.6% of the households in the villages surveyed had improved wood stoves (Table 9). Of these, 22.9%, 10.8% and 16.9% of the constructed wood stoves were from Ng'haya, Nyanhorongo, and Jojiro village respectively. The results further show that about 49.4% of the households have not constructed improved wood stoves. FRMP officials in Mwanza region, pointed out that the failure of some people to adopt the use of efficiency wood stoves was attributed to a number of factors. Some people have not experienced shortages of fuelwood in their areas; others have not received the knowledge and others failed to adopt the technology because they are used to the traditional three stone stoves.

Table 9: Use of improved wood stoves.

Response	Villages			
	Ng'haya (n=40)	Nyanhorongo (n=20)	Jojiro (n=23)	Total (N =83)
Households with stoves	19(22.9%)	9(10.8%)	14(16.9%)	42(50.6%)
Households with no stoves	21(25.3%)	11(13.3%)	9(10.8%)	41(49.4%)

Source: Own surveyed data (1999).

4.2 Fuelwood in the study area

In the study area, fuelwood is collected from different sources. The study has revealed that about 73.5% of the households collected fuelwood from public lands; 15.7% from own individual natural woodlands, while about 10.8% of the households obtained fuelwood from their household woodlot (Table 10). The results indicate that pressure for fuelwood in public lands is relatively high as compared to other sources. The researcher whilst discussing with village heads established that many people who planted trees in their farms have not yet realised fuelwood or other products from their trees. This has been confirmed by 45.5% of the households in the study area who planted trees, but has not realised any of these benefits. This is due to the fact that forestry undertakings require quite a long time before returns can be realised.

Table 10: Source of fuelwood in villages surveyed.

Sources	Villages			
	Ng'haya (n= 40)	Nyanhorongo (n=20)	Jojiro (n=23)	All (N = 83).
Own woodlands	12(14.5%)	1(1.2%)	-	13(15.7%)
Public lands	27(32.5%)	17(20.5%)	17(20.5%)	61(73.5%)
Own woodlots	1(1.2%)	2(2.4%)	6(7.2%)	9(10.8%)

Source: Own survey data (1999).

In rural areas most of domestic energy comes directly from the forest. The clearance for agriculture, control of tsetseflies using fire, and charcoal burning has contributed to shortage of fuelwood in the region (Kiwale *et al.*, 1998). With this depletion of forests the burden of the fuelwood crisis is borne by women because they have the responsibility for meeting household energy needs through fuelwood collection and use. The results show that 73.5% of the households' fuelwood collection was the task for women and children, women participation in fuelwood collection was about 15.7%, where as husbands constituted about 10.8% of fuelwood collection. The average hours spent in walking for fuelwood collection varied from village to village. Women and children in Ng'haya, Nyanhorongo and Jojiro villages spent 3.78, 3.7 and 3.5 hours respectively in collecting fuelwood. This implies that majority of rural women and children are already overworked and the further away the source of fuelwood, the greater their work load becomes. As a result rural women, in particular, have less time and energy to spend on other income generating activities. Kajembe (1988), observed that as fuelwood gets scarce the people who gather it, who are

usually women and children of the household, have to carry heavy loads of fuelwood over longer distances.

4.3 The developed linear regression model.

The results for multicollinearity test and the developed linear equation are presented in the following subsections.

4.3.1 Test for multicollinearity

Before specifying the model, the variables were checked to see if they are highly correlated. The correlation matrix for the variables is presented as follows:

	EDUC	FS	HS	DFUEL	AGE	NO.LSK	TNTP
EDUC	1.000						
FS	-.100	1.000					
	(.369)						
HS	.072	.462*	1.000				
	(.520)	(.038)					
FUEL	-.133	-.084	.112	1.000			
	(.230)	(.450)	(.315)				
AGE	.024	-.062	-.115	-.115	1.000		
	(.832)	(.578)	(.301)	(.301)			
NO.LSK	-.150	-.046	-.005	.034	.014	1.000	
	(.175)	(.681)	(.966)	(.758)	(.899)		
TNTP	.045	.697**	.241*	-.036	-.072	-.130	1.000
	(.683)	(.000)	(.028)	(.747)	(.520)	(.242)	

NB: 1. 2-tailed significance ** .01, * 0.05;

2. Probabilities are shown in brackets.

The values in the correlation matrix are the correlation coefficients for each pair of variables tested. The results indicate that the situation of having perfectly uncorrelated variables could not be attained. Madnani (1990) argue that, in practice neither perfectly correlated or uncorrelated situation is often met among socio-economic variables. In most cases there is some degree of intercorrelation among the explanatory variables due to interdependence of many of these variables over time. The results indicate that **HS** and **FS** had high correlation among the independent variables. However, these variables were accepted in the model because the ''r'' value is .462 (r2 value of 21.3%) which was considered reasonably far from 100%. In addition, it was considered illogical to drop any of these variables because households were considered as the production and consumption unit in the study.

4.3.2 The linear regression equation

The regression equation

$$TNTP = -1299 + 57\,HS + 26.4\,DFUEL + 422\,FS + 92\,E\,DUC - 7.0\,NO.LSK - 1.96\,AGE \qquad (R2 = 53.5\%).$$

Significance tests:

Table 11: Significance tests between the total number of tree planted per household and the Socio- economic factors in the study areas.

Predictor	Coeff.	Stdev	t- ratio	P
(Constant)	-1298.6	426.6	-3.04	0.003
AGE	-1.966	4.8	-0.199	0.842
NOLSK	-7.0	7.9	-0.888	0.377
HS	56.6	26.9	2.601	0.034*
DFUEL	26.4	56.1	0.471	0.663
FS	422.0	68.7	6.144	0.000**
EDUC	91.6	86.9	1.054	0.268

Key: *=Significance at 95% level

**=Significance at 99% level.

4.3.2.1 Family size

The results revealed that family size was positively correlated to dependent variable and was statistically significant at 95% probability level. The implication is that households with larger families planted more trees in the study area. The attribution is that with large labour force, it is relatively easier to participate in tree planting. The results are comparable with other similar findings done in Tanzania (Kajembe, 1988; Kessy, 1992).

4.3.2.2 Distance to the source of fuelwood

The study shows that the number of trees planted is positively correlated with the distance to the source of fuelwood (Table 11). It implies that people living far away from the source of fuelwood plant more trees than those living close to the forest. This is due to the fact that people with fuelwood shortages and lack of other forest products tends to have high interest in tree planting so as to mitigate the scarcity of forest products. Akitanda (1994) observed that those people who live close to the forest are the ones who greatly contribute to the consumption and probably destruction of the forests. Although distance to the source of fuelwood was positively correlated, it was found not to be statistically significant. The reason could be that some individuals in the region have not experienced fuelwood shortages in their areas. This behaviour is somehow contrary to other studies done in Tanzania (Kessy, 1992), which showed significant relation to tree planting.

4.3.2.3 Farm size

The results revealed that farm size was positively correlated to dependent variable and was statistically significant at 99% probability level. The implication here is that individuals with larger land have planted more trees in the study area. The reason could be that with large farm, it is easier for the household to devote part of the land for tree planting. The results compare well with other studies done in Tanzania (Kajembe, 1988, Kessy, 1992, Katani, 1999).

4.3.2.4 Number of Animals.

The results in Table 11 indicate that the number of animals in the study area was negatively correlated to the number of tree planted per household. This implies that the larger number of cattle (livestock) results into decrease in the number of trees planted per household. Larger number of grazing animals (livestock) kept in the area can have two implications with regard to tree planting. First, keeping many livestock could lead to labour shortage in the household resulting into fewer trees planted by the household. Second, the free range grazing system commonly practised in the study area could have negative impacts on the trees planted especially tree species which can be grazed by and palatable to livestock, such as *Albizia, Leucaena* etc.

4.3.2.5 Age of the household head

The results show that age of the household head in the study area was negatively correlated to the number of tree planted per household. This indicate that the older the age the less number of trees planted per household. The possible explanation is that older household heads put less weight in tree planting either because of short time preference or their inability to participate due to old age problems. The behaviour was also observed in other studies done in Tanzania (Kessy, 1992).

4.3.2.6 Education level of the household head

The study show that the number of trees planted is positively correlated with education level (Table 11). This indicates that farmers with high education level planted more trees than the less educated. This study compares well with other similar studies done in Tanzania (Katani, 1999). Further Kajembe and Luoga, (1996) reported that there is no development without education. A study of village agroforestry in Tanzania for instance, showed that farmer's adoption rate of the practice through tree planting increase with the level of education (Kajembe, 1988). Therefore availability of education of any kind in the study area is an important factor to improve farmer's potentiality and creating awareness, positive altitudes towards innovation and self-confidence in taking part in conservation and general environmental resource management.

4.4 Economic analysis

This requires determination of the likelihood that a project contributes significantly to the development of the whole economy and that if its contribution will be enough to justify using the scarce resources of the national economy. Economic prices are applied to reflect the opportunity cost to the society for the projects' input and output. The economic analysis results are presented in two sections. The first section presents a summary of costs and benefits of the project, while the second section present the sensitivity analysis of NPV.

4.4.1 Summary of costs and Benefits

The identified, quantified and valued effects of the project, aggregated at regional level are summarised in Table 5. For details of the calculations the reader is referred to Appendix 2 of this work.

Table 12: Summary of Costs and Benefits (Value X 1000 000, Constants 1999 prices)

Costs	Year 0	Year 1	year 2	year 3	year 4	year 5	year 6	year 7	year 8	year 9	year 10
Buildings		14.78	8.8	0.53		1.03					
Vehicles	6.99	49.2	2.1	41.58	176.24	2.29					
Office equips & fern.		2.56	14.2	6.57	1.17						
Annual expenditure		10.9	71.2	138.55	173.45	229.84					
Staff salary	75.5	88.77	88.77	88.77	88.77	88.77	88.77	88.77	88.77	88.77	88.77
Seedlings		13	30.56	81.51	76.89	57.99	46.12				
Planting		6.97	16.39	43.72	41.24	31.11	24.74				
Harvesting fuelwood in planted trees					0.43		1.01	2.7	4.17	1.92	6.84
Harvesting poles in planted poles						3.22	0.26	7.56	28.62	20.66	19.11
costs per hive			0.24	0.11	2.62	1.85	0.7				
Improved stoves			0.1	0.24	0.65	1.11	0.31				
Total Costs	**82.49**	**186.18**	**232.36**	**401.58**	**561.46**	**417.21**	**161.91**	**99.03**	**121.56**	**111.35**	**114.72**
Benefits:											
Fuelwood from planted trees					1.3		3.05	8.14	21	5.79	37.19
Sale of poles from planted treee						116.69	9.5	274.29	754.03	749.72	693.45
Fuelwood from Ngitiri			87.93	97.99	204.99	228.43	228.43	228.43	228.43	228.43	228.43
Poles from Ngitiri							42.68	47.56	99.49	110.86	110.86
Honey production			2.78	4.01	34.42	55.83	63.92	63.92	63.92	63.92	63.92
Wax production			0.81	1.17	9.98	16.21	18.57	18.57	18.57	18.57	18.57
Benefits from stoves			3.88	12.79	37.01	78.24	89.84	89.84	89.84	89.84	89.84
Environmental benefits			1.44	4.75	13.76	29.09	33.39	33.39	33.39	33.39	33.39
Revenue collected			9.03	50.65	74.58	84.38	84.38	84.38	84.38	84.38	84.38
Total Benefits	**0**	**0**	**105.87**	**171.36**	**376.04**	**608.87**	**573.76**	**848.52**	**1393.05**	**1384.9**	**1360.03**
Net Benefits	**-82.49**	**-186.18**	**-126.49**	**-230.22**	**-185.42**	**191.66**	**411.85**	**749.49**	**1271.49**	**1273.55**	**1245.31**

Table 12: continued next page...

Table 12:continued...

Costs	year 11	year 12	year 13	year 14	year 15	year 16	year 17	year 18	year 19	year 20
Buildings										
Vehicles										
Office equips & fern.										
Annual expendtiture										
Staff salary	88.77	88.77	88.77	88.77	88.77	88.77	88.77	88.77	88.77	88.77
Seedlings										
Planting										
Harvesting fuelwood in planted trees	10.2	13.55	16.58	7.98	9.33	11.06	9.42	8.6	8.04	10.92
Harvesting poles in planted poles	12.58	8.75	20.17	19.64	19.23	12.96	8.77	21.48	19.13	17.65
costs per hive										
Improved stoves										
Total Costs	**111.55**	**111.07**	**125.52**	**116.39**	**117.33**	**112.79**	**106.96**	**118.85**	**115.94**	**117.34**
Benefits:										
Fuelwood from planted trees	83.58	83.06	67.28	59.37	13.7	34.61	62.37	61.03	48.4	42.24
Sale of poles from planted treee	456.37	317.49	731.71	712.49	697.52	413.99	318.28	779.2	694.21	662.66
Fuelwood from Ngitiri	228.43	228.43	228.43	228.43	228.43	228.43	228.43	228.43	228.43	228.43
Poles from Ngitiri	110.86	110.86	110.86	110.86	110.86	110.86	110.86	110.86	110.86	110.86
Honey production	63.92	63.92	63.92	63.92	63.92	63.92	63.92	63.92	63.92	63.92
Wax production	18.57	18.57	18.57	18.57	18.57	18.57	18.57	18.57	18.57	18.57
Benefits from stoves	89.84	89.84	89.84	89.84	89.84	89.84	89.84	89.84	89.84	89.84
Environmental benefits	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39
Revenue collected	84.38	84.38	84.38	84.38	84.38	84.38	84.38	84.38	84.38	84.38
Total Benefits	**1169.34**	**1029.94**	**1428.38**	**1401.25**	**1340.61**	**1077.99**	**1010.04**	**1469.62**	**1372**	**1334.29**
Net Benefits	**1057.79**	**918.87**	**1302.86**	**1284.86**	**1223.28**	**965.2**	**903.08**	**1350.77**	**1256.06**	**1216.95**

4.4.2 Sensitivity analysis of NPV

4.4.2.1 NPV at 10%, 15% and 20% discounts rates

Table 13 shows variations in NPV as the discount rate(r) was varied from 10% to 20% per annum. Discount rate, which would approximate the NPV to zero, that is the internal rate of return is also presented.

Table 13: Sensitivity of project's NPV to choice of discount rates (value X 10^6 Tshs, constant 1999 prices).

				NPV when:			
Year	Costs	Benef.	Net. B	r=10%	r=15%	r=20%	r=41.5%
0	82.5	0.0	-82.5	-82.5	-82.5	-82.5	-82.5
1	186.2	0.0	-186.2	-169.3	-161.9	-155.2	-131.6
2	232.4	105.9	-126.5	-104.5	-95.6	-87.8	-63.2
3	401.6	171.4	-230.2	-173.0	-151.4	-133.2	-81.2
4	561.5	376.0	-185.4	-126.6	-106.0	-89.4	-46.2
5	417.2	608.9	191.7	119.0	95.3	77.0	33.8
6	161.9	573.8	411.9	232.5	178.0	137.9	51.3
7	99.0	848.5	749.5	384.6	281.8	209.2	65.9
8	121.6	1393.1	1271.5	593.2	415.7	295.7	79.0
9	111.4	1384.9	1273.6	540.1	362.0	246.8	55.9
10	114.7	1360.0	1245.3	480.1	307.8	201.1	38.6
11	111.6	1169.3	1057.8	370.7	227.4	142.4	23.2
12	111.1	1029.9	918.9	292.8	171.7	103.1	14.2
13	125.5	1428.4	1302.9	377.4	211.8	121.8	14.3
14	116.4	1401.3	1284.9	338.3	181.6	100.1	9.9
15	117.3	1340.6	1223.3	292.8	150.3	79.4	6.7
16	112.8	1078.0	965.2	210.1	103.1	52.2	3.7
17	107.0	1010.0	903.1	178.7	83.9	40.7	2.4
18	118.9	1469.6	1350.8	242.9	109.1	50.7	2.6
19	115.9	1372.0	1256.1	205.4	88.3	39.3	1.7
20	117.3	1334.3	1217.0	180.9	74.4	31.7	1.2
Total	**3643.6**	**19455.8**	**15812.3**	**4383.6**	**2444.8**	**1381.0**	**0.005**

Source: Own survey data (1999)

Results in Table 13 show the NPV values of 4383.6, 2444.8, and 1381.0 millions Tshs at discount rates of 10%, 15% and 20% per annum respectively. This shows that the project is still economically efficient even the discount rate is as high as 20% p.a. The analyses indicate that the magnitude of the NPV decreases by 68.5% with increase in discount rate from 10 to 20%. This implies that investment and project costs can be recovered at the end of the assumed project life of 20 years. The possibility that the whole economy will benefits is from the project is very high. A proof to this is the rate of returns (IRR) of 41.5%.

Similar studies conducted in developing countries, Tanzania inclusive, suggest that community forestry projects can be quite efficient in using resources. Evaluating the village afforestation project in Legho Mulo in Tanzania, Kessy (1992) found a positive NPV of about 270.25 millions, at 10% discount rate and 20 years time horizon. Similarly, Serenge (1991) in evaluating the Chongwe rural afforestation project in Zambia, found a positive NPV of about Zambian Kwacha 5.8million, equivalent to US$19,000 at a 10% discount rate and 8 years time horizon. In the same project, the NPV decreased by 40% with a variation of the discount rate from 10 to 20%. Also planting of *Acacia nilotica* by local farmers in Pakistan was found to be economically attractive with a net present financial return of about US Dollars 460 per hectare over a 5 years rotation period and the Cost-Benefit ratio of about 1:1.72(Sheikh, 1984). It is therefore advisable for the government to promote more project of this type in many of degraded areas in the country since the study and other similar studies show that such projects could be efficient in use of resources.

4.4.2.2 The 'Switching Value' approach

According to Gittinger (1982), in carrying out project evaluation it is important to find out how much should project elements change in unfavourable direction before the project would fail to meet the minimum level of acceptance as indicated by measures of project worth, in this case the NPV. In carrying out this, the switching value approach was used to establish the value of the variable, which would, turns the NPV of the project to zero. Table 14 shows the variation in NPV when benefits were reduced by different magnitudes without varying the costs and the discount rate.

Table 14: The project NPV at r=10% with reductions in Benefits (value X 10^6Tshs, at constant 1999 prices).

Year	Costs	Benefits	NPV when Benefits are reduced by:			
			50%	69%	69.5%	69.2%
0	82.5	0.0	-82.5	-82.5	-82.5	-82.5
1	186.2	0.0	-169.3	-169.3	-169.3	-169.3
2	232.4	105.9	-148.3	-164.9	-165.4	-165.1
3	401.6	171.4	-237.3	-261.8	-262.4	-262.1
4	561.5	376.0	-255.1	-303.9	-305.1	-304.4
5	417.2	608.9	-70.0	-141.9	-143.7	-142.6
6	161.9	573.8	70.5	9.0	7.4	8.4
7	99.0	848.5	166.9	84.2	82.0	83.3
8	121.6	1393.1	268.2	144.8	141.5	143.5
9	111.4	1384.9	246.4	134.9	131.9	133.7
10	114.7	1360.0	217.9	118.3	115.7	117.3
11	111.6	1169.3	165.8	88.0	85.9	87.2
12	111.1	1029.9	128.7	66.3	64.7	65.7
13	125.5	1428.4	170.5	91.9	89.8	91.1
14	116.4	1401.3	153.8	83.7	81.9	83.0
15	117.3	1340.6	132.4	71.4	69.8	70.8
16	112.8	1078.0	92.8	48.2	47.0	47.7
17	107.0	1010.0	78.8	40.8	39.8	40.4
18	118.9	1469.6	110.8	60.6	59.2	60.0
19	115.9	1372.0	93.2	50.6	49.5	50.1
20	117.3	1334.3	81.7	44.0	43.0	43.7
Total	**3643.6**	**19455.8**	**1216.1**	**12.4**	**-19.3**	**0.003**

Source: Own survey data (1999)

Results in Table 14 indicate that economically the project would still worth undertaking or viable even when the benefits were reduced by 69%. The project would break even (NPV=0) when the reduction in benefits was in the magnitude of about 69.2%. Reduction beyond 69.2% would make the project inefficient.

CHAPTER 5

5.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter synthesises the survey results and model results of the socio-economic factors influencing tree planting in the study area. It illustrates what policy makers can learn from a study of this type and ends by prescribing policy recommendations based on the study.

5.1 Conclusions

The results revealed that about 91.6% of the surveyed households in the study area planted trees on their farms. The results also confirmed that about 51.8% of the households planted trees for fuelwood and sales of poles; 22.9% planted trees for poles, fuelwood, windbreak and shade whereas about 16.9% planted trees primarily for construction poles and timber. Also the results have indicated that the overall survival rate for the species planted in farmers' plots was about 64.3%. The low survival rate was attributed to drought, termite attacks, and intensity of grazing of livestock for fodder.

The findings indicated that, about 30.1% of the households reported to have benefited from fuelwood, thatching grasses, and grazing; 12% of the households benefited from fuelwood and other building materials (poles) whereas 6% of the respondents obtained both fuelwood, thatching grasses, construction poles and grazing. The study

has revealed that collection of fuelwood and harvest of poles in 'Ngitiri" is usually done from August to September. The results have shown that bee keeping was well initiated in the course of the project implementation to increase income generation from woodlands. But disappointingly in the surveyed villages only 6% of the households engaged in bee keeping. The poor responses has been attributed to a number of problems such as vagaries of weather and inadequate cash capital to purchase hive as well as harvesting gears. It was also established from the study that about 50.6% of the households in the surveyed villages had improved wood stoves as opposed to 49.4% who didn't construct stoves. This indicate that a considerable number of individuals have shown interest in the use of improved stoves.

The results further indicated that about 73.5% and 15.7% of the households collects fuelwood from public lands and own individual natural woodlands ('Ngitiri') respectively; whereas 10.8% of the households obtained fuelwood from their household woodlots. This suggests that pressure for fuelwood in public lands is relatively high. The results also showed that women and children did about 73.5% of the household fuelwood collection, women for about 15.7%, whereas men did 10.8% only.

The regression model results revealed that, given the socio-economic factors on family tree planting: family/household size, farm size, distance to the source of fuelwood and education were positively correlated to tree planting; and indication that they positively augment tree planting activities in the study area. On the other hand,

age and number of livestock were negatively correlated. The results showed that the R^2- coefficient of determination had an ability to explain only 53.2% of the association of the independent variables on tree planting programme (Dependent variable).

Based on economic analysis the project was found to be economically efficient in terms of scarce resource utilization, at 10%, 15% and 20% discount rates, with a net present values of about 4383.6, 2444.8 and 1381.0 millions Tshs respectively. The study also revealed a number of uncertainties which likely to affect the projects' economic efficiency. These include weather changes (drought conditions), termite attacks and damage of young seedlings by livestock. Using the switching value approach in sensitivity analysis, it was found that at a 10% discount rate the project would still be economically efficient even if the uncertainties would reduce the project benefits by 41.5%. This would be a break-even point whereby higher reductions in benefits would result into negative NPV, making the project economically inefficient.

5.2 Recommendations

The foregoing discussions have led to the logical conclusions that the Forest Resources Management Project (FRMP) is profitable both to local community and the economy as a whole. In order to facilitate sustainable forest resources management, the study has come up with the following recommendations:

1. As the study revealed, tree planting and survival in the study area are constrained

by severe and prolonged droughts. More efforts should be made to invest in native and drought resistant tree species so as to increase supplies from tree planting.

2. While bee keeping is an important economic activity for many parts of the region, beekeepers through traditional harvesting system of using fires, they cause environmental destruction and death of many bees. So in order to avoid these effects, it is important to provide simple loans which farmers can afford and which can be used to purchase harvesting gears. Also the government through the project should assist farmers to find markets for their bee products, particularly wax which most farmers appeared unaware of. In addition, farmers should be made aware of the need to operate on strict economic principles, in order for their operations to be profitable. As such they should therefore cultivate the habit of proper credit management and repayment.

3. Like other semi arid areas, some parts of the region mostly experience water shortage in the dry period. Therefore, the project in collaboration with other NGOs should introduce other components such as simple water harvesting technique so as to increase water supply in the region. This will also reduce the workload for women and children who are mostly responsible for fetching water in many households. In the dry season, it is common to find women and children spending many hours day and night fetching water.

In addition to that, underground water catchment tanks need to be constructed to

gather water from different areas during rain season. These tanks can supply drinking water for human, livestock and for small-scale irrigation during dry periods. This would enable people to raise tree seedlings or grow better crops, such as vegetable for improved diet and the associated benefits of good health e.g. resistance to diseases etc.

4. At the same time, most farmers were expecting to get free inputs from the project. This habit was observed even to those farmers who have started to harvest their produce as a result of the presence of the project in the area. It is therefore necessary to sensitize and educate farmers to act independently in situation where they have ability to stand themselves.

5. Improve dissemination of information (farm forestry extension services) regarding tree planting and management at different stages. For example, information related to proper spacing of trees, which will optimize the benefits from tree planting. These will increase the capabilities of rural communities to manage their trees and other natural resources. Although the main driving force for tree planting is to meet household needs, development of marketing institutions and infrastructures will gradually attract or make people participate more in tree planting in the region.

6. The study has shown that livestock has a negative impacts on the number of trees planted. It is therefore advised to explore ways of growing trees and livestock in

rural areas more efficiently and effectively. This means that extension package should involve educating people on how to incorporate trees and livestock at the same time.

7. Even when the government overcome the technical problems for growing sufficient amounts of fuelwood in agroforestry systems or under natural forest management systems, as long as enough free open access forest resources remain to dominate market prices, tree growing approaches are likely to be ineffective. Even if property rights are enforced for privately owned tree stocks, the existence of nearby open access forests tends to make tree growing on small farms uncompetitive, because commercial tree growing must take into account not only the costs of harvesting but also the land, planting and maintenance costs. Therefore, consideration should be given to the development of policies that promote development property rights and common property regimes in order to achieve sustainable management of natural resources and sustainable harvest of resources.

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APPENDICES

Appendix 1. Questionnaire to households

Name of Household head...

Village...District...

Date of interview...

Respondent(s):

Name 1...Age...Sex...

2...Age... Sex...

Questionnaire NO....

A: HOUSEHOLD INFORMATION:

1. What is the number of members in the household?

Adults...

Children...(below 18 years)

3. Education levels of household members:

i. Household head...

ii. Wife...

iii. Other members

4. what is the major occupation of the household members

5. a) How much land do you own?....(acres or Hectares)

b) How much land do you cultivate each year?

c) If not all the land what do you use the uncultivated land for?

d) How did you acquire land?

6. Which crops do you grow?

. Food crops...

. Cash crops...

. Fruit trees...

Households participation in project activities:

Tree planting in farmer's plot:

7 a) Do you plant trees in your farm? (yes/no)

b) If yes, where in your farm do you grow trees? At what spacing?

c) If you do not grow trees give reasons

8 a) What tree species do you grow? (Mention them)

b) What do you think are the main causes of tree death/ mortality in your farm?

c) What motivated you to adopt tree planting in your farm?.....

d) Have you realized any benefit from tree planting activities?

Construction of improved wood stoves:

9. a) Do you use improved wood stoves?

b) How do you get it?

c) How does it cost? ...Estimate the time used to construct it...

d) How many pieces of fuelwood are used per cooking... per day...

10. a) where do you collect fuelwood ?

How far is the area from home...(km)

b) Who are involved in firewood collection in your family? (give the number)

c) How many time do they collect per week?....

d) Can you estimate the time used in firewood collection per day?

11 a) Have you ever happen to buy firewood for cooking or any other uses?

b) How much does it cost per bundle of firewood?

12 In your opinion, which one between improved wood stove and the traditional three stone stoves uses small amount of fuelwood pieces per cooking?

Management of woodlands:

13. a) Do you own any natural woodland?

b) If yes, how many acres or hectares do you have?

c) How do you manage it...

d) Did you get any advice on how to manage your woodland?(explain)

14 what forest products expected from the woodland? (Mention)

Beekeeping:

15. a) Do you practice bee keeping?

b) If yes, give the number of beehives, stocked /empty per year

c) Amount produced per beehive per year?

Honey...

Wax...

d) Do you sell the products?

e) How much do you sell per unit? ...Where do you sell?

16. a) How many times do you harvest per year? (specify the time of harvest/year)

b) In your family who are involved in bee keeping?

c) Are there any problems faced in Beekeeping? How do you solve them?

Appendix 2:CBA Calculation

Cost and Benefits calculation

In Mwanza Region, the minimum cost is 50/= Tshs per seedling. This was used to value the number of seedlings planted per each year in the region.
The cost of seedling per year:

1993/94:

The number of tree planted = 260,000.

Cost: 260,000 Seedlings x 50 Tshs/seedling =**13,000,000 Tshs.**

1994/95:

The number of seedlings planted = 611,133.

Thus, 611,133 seedlings X 50 Tshs/seedling = **30,556,650 Tshs.**

1995/96:

The number of seedlings planted = 1,630,267.

Thus, 1,630,267 seedlings X 50 Tshs/seedling = **81,513,350 Tshs.**

1996/97:

The number of seedlings planted = 1,537,750.

Cost: 1,537,750 seedlings X 50 Tshs/seedling = **76,887,500 Tshs.**

1997/98:

The number of seedlings planted = 1,159,878.

Cost: 1,159,878 seedlings X 50 Tshs/seedling = **57,993,900 Tshs.**

1998/99:

The number of seedlings planted = 922,395.

Appendix 2 continued..

Cost: 922,395 seedlings X 50 Tshs/seedling = **46,119,750 Tshs.**

LABOUR COSTS.

The minimum wage was used to price labour whereby:

Minimum wage = 1260 Tshs/man day (For adult).

Children rate = ½ adult rate = 630 Tshs/ man day.

Farmer's and children's was categorized as unskilled labour. Therefore in shadow pricing this labour the factor used was 0.7 meaning that:

Adult wage = 1,260 X 0.7 = 882 Tshs/day.

Children wage = 630 X 0.7 = 441 Tshs/day. These were used as shadow wage rates throughout the analysis.

Therefore:

In Ng'haya village:

Average number of trees planted per household = 186.

On average 2 adults and 1 child per household participated for an average of 5 days during the planting season. The questionnaire survey revealed that about 4.18 hours were used every planting day.

Adult hours/hhold:

2 adults X 5 days X 4.18 hours/day = 41.8 hours. This is equivalent to 5.225 man-days.

1 man-day = 8 hours = 882 Tshs.

Thus, 5.225 days X 882 Tshs/day = **4,608.45 Tshs.**

Children hours/hhold:

1 child X 5 days X 4.18 hours/day = 20.9 hours. This is equivalent to 2.6125 mandays.

Children rate: 1 man-day = 441 Tshs.

Thus, 2.6125 day X 441 Tshs/day = **1,152.11 Tshs**

Total planting cost/hhold in Ng'haya village:

Appendix 2 continued...

4,608.45 + 1,152.11 = **5,760.56 Tshs.** This was considered as the cost for planting 186 trees per household. Therefore the cost for planting 1 tree = 5,760.56/186 = **30.97 Tshs.**

Nyanhorongo Village:

Average number of tree planted per household = 408.

On average 2 adults/household and 2children/household participated for an average of 6.28 days during the planting season. Planting in most cases done in December and January, the time, which school children are in Holiday that makes them to participate in tree planting for the days, mentioned. During the survey, it was also revealed that on average about 4.0 hours/day were used in tree planting.

Adult hours:

2 adults/hhold X 6.28 days X 4.0hours/day = 50.24 hours. This is equivalent to 6.28 man days.

Thus, 6.28 mandays X 882 Tshs/day = 5,538.96 Tshs.

Children hours:

2 child/hhold X 6.28 days X 4.0 hours/day = 50.24 hours(6.28 mandays).

Thus, 6.28 days X 441 Tshs/day = 2,769.48 Tshs.

Total planting costs/household:

5,538.96 + 2,769.48 = **8,308.44 Tshs.**

Planting 408 trees per household could cost 8,308.44 Tshs. That means a planting 1 tree could cost:

8,308.44/408 = **20.36Tshs.**

Jojiro Village:

In Jojiro village average number of trees planted per household = 154. On average 2 adults and 1 children participated for an average of 4 days during the planting season. About 4.07 hours were used every planting day.

Appendix 2 continued...

Adults labour costs:

2 Adults/hhold X 4 days X 4.07 Hrs/day = 32.56 hours. This is equivalent to 4.07 days. Thus, 4.07 days X 882 Tshs/day = 3,589.74 Tshs.

Children labour:

I child/hhold X 4 days X 4.07 Hrs/day = 16.28 hrs. This is equivalent to 2.035 mandays. Thus, 2.035 days X 441 Tshs/day = 897.44 Tshs.

Total costs: 3,589.74 + 897.44 = **4,487.18 Tshs.**

Therefore planting 154tree/hhold could cost 4,487.18 Tshs. Thus, planting 1 tree could cost **29.14 Tshs** (4,487.18/146).

Therefore on average planting one tree in Mwanza region required **26.82 Tshs.** This price was used to value labour for trees planted in each year by the project

Table 15: The planting cost for the trees planted in each year.

Years	1	2	3	4	5	6
Trees planted	260,000	611133	1,630,267	1,537,750	1,159,878	922,395
Planting cost	6,973,200	16,390,587	43,723,761	41,241,114	31,107,928	24,738,634

Source: Project annual report (1997/98).

Implementation of the project:

Since the project covered the whole region, it appeared important to estimate the Costs and Benefits of trees planted per each year. In carrying the analysis, it was assumed that the proportion (percentage composition) of a particular tree spp eg Eucalyptus in the average number of trees planted per household would retain the same proportion in the total number of trees planted per year in the region. Because the percentage per tree species per household indicate preference to some species by the people in the study area. This was done because records by tree spp in the

Appendix 2 continued...

Region(project area) could not be accessed..

Table 16: Total trees survived by percentage in the region.

Year.	1	2	3	4	5	6
Trees planted per year	260 000	611 133	1 630 267	1 537 700	1159 878	922 395
Tree survived (at 64.32% SR).	167,232	393,081	1,048,588	989,049	746,034	593,284.
Eucalyptus(45.0%)	75,305	177,004	472,179	445,369	335,939	267,156
Melea (24.75%)	41,390	97,288	259,526	244,790	184,643	146,838
Senna (5.68%)	9,499	22,327	59,560	56,178	42,375	33,699
Grevillea(0.41%)	686	1,612	4,299	4,055	3,059	2,432
Albizia(10.75%)	17,977	42,256	112,723	106,323	80,199	63,778
Leucaena(4.67%)	7,810	18,357	48,969	46,189	34,840	27,706
Acacia spp(6.49%)	10,853	25,511	68,053	64,189	48,418	38,504
Sesbania(0.41%)	686	1,612	4,299	4,055	3,059	2,432
Terminalia(0.2%)	334	786	2,097	1,978	1,492	1,187
Azadirachta(1.6%)	2,676	6,289	16,777	15,825	11,937	9,493

Source: Own survey data (1999).

Harvesting costs:

Considered in this category were the costs of harvesting trees (used for construction poles or clearfelled for fuelwood) in the project areas. During the survey it was revealed that, for those tree spp harvested for poles, trees of around 10 to 15 cm diameter are highly preferred for construction poles than trees with more diameter. The high market demand for construction poles in the region have compelled people to adopt short rotations of harvest as well as high preference for pole species. It was further revealed that a minimum of two coppice usually allowed to grow to the next rotation. The purchaser of poles estimated that about 10 to 15 minutes were used to fell one tree and debranch it to obtain pole. According to the proposed harvest

Appendix 2 continued...

schedule only Eucalyptus, Melea, Senna and Grevillea robusta would be harvested for construction poles while Leucaena, Acacia, and Albizia are mostly harvested for firewood. It is also important to note that for those species farmers appeared uncertain to estimate the harvest cycle, rotation age reported in literature were used to propose the harvest schedule. For spp such as *Azadirachta indica* though sometimes can be used for poles and fuelwood, but in the project area mostly used for medicinal purposes. *Teminalia catapa* valued as a shade tree in the project.

1993/94:

Eucalyptus (year 5, 10, 15, 20):

It was estimated that the time required to harvest one Eucalyptus tree and debranch to obtain pole is 0.25 hours. The total number of trees survived per year = 75,305

Harvesting time required: 75,305 trees X 0.25 hours/tree = 18,826.25 hours. This is equivalent to 2353.28125 mandays. Therefore harvesting costs: 2353.28125 days X 882 Tshs/day = **2,075,594.06 Tshs.**

Melea (Year 5, 10, 15, 20):

Total tree survived per year = 41,390 trees.

Harvesting time required: 41,390 trees X 0.25 hours/tree = 10347.5 hours. This is equivalent to 1293.4375 man days. Thus, costs 1293.4375 days X 882 Tshs/day= 1,140,811.88 **Tshs.**

Total costs for Eucalyptus and Melea:

2,075,594.06 +1,140,811.88 = **3,216,405.94 Tshs.**

Senna (Year 6, 12, 18):

Total tree survived per year = 9,499

Harvest time required: 9,499 tees X 0.25 hours/tree = 2374.75 hours. This is equivalent to 296.84375 days.

Appendix 2 continued...

Thus, cost: 296.84375 days X 882 Tshs/day = **261,816.19 Tshs.**

Grevillea (Year 15):

Total trees survived per year = 686.

Harvest time required: 686 trees X 0.25 hours/tree = 171.5 hours. This is equivalent to 21.4375 days.

Thus, costs: 21.4375 days X 882 Tshs/day = **18,907.88 Tshs**

Abizia (at year 10):

Total number of trees survived = 17,977trees.

Harvest time required: 17,977 trees X 0.75 hours/tree = 13482.75 hours. This is equivalent to 1685.34375 days.

Thus, costs: 1685.34375 days X 882 Tshs/day = **1,486,473.19 Tshs**

Leuçaena (year 4, 8, 12, 16, 20):

Total number of trees survived per year = 7,810

Harvest time required: 7,810 trees X 0.5 hours/tree = 3905 hours. This equivalent to 488.125 man days.

Thus, costs: 488.125 days X 882 Tshs/day = **430,526.25 Tshs.**

Acacia (Year 8, 14, 20):

Total number of trees survived per year = 10,853 trees.

Harvest time required: 10,853 trees X 1hour/tree = 10,853 hours. This is equivalent to 1356.625 man-days.

Thus, costs: 1356.625 days X 882 Tshs/day = **1,196,543.25 Tshs.**

1994/95:

Eucalyptus (Year 7,12, 17, 22*):

The number of eucalyptus trees planted per year = 177,004.

Appendix 2 continued...

Harvest time required: 177,004 trees X 0.25 hours/tree = 44,251 hours. This is equivalent to 5531.375 mandays. Thus, cost: 5531.375 days X 882 Tshs/day = **4,878,672.75 Tshs.**

Melea (Year 7, 12, 17):

The number of *Melea* planted per year = 97,288 trees.

Harvest time required: 97,288 trees X 0.25 hours/tree = 24322 hours. This is equivalent to 3040.25 days.

Thus, costs 3040.25 days X 882 Tshs/day= **2,681,500.5 Tshs.**

Total costs: 4,878,672.75 + 2,681,500.5 = **7,560,173.25 Tshs.**

Senna (Year 8, 14, 20):

Total number of Senna trees planted per year = 22,327 trees.

Harvest time required: 22,327 trees X 0.25 hours/tree = 5581.75 hours. This is equivalent to 697.71875 man-days, Costs: 697.71875 days X 882 Tshs/day = **615,387.94 Tshs.**

Grevillea (at year 17):

Number of Grevillea trees planted per year = 1,612 trees.

Harvest time required: 1,612 trees X 0.25 hours/tree = 403 hours. This is equivalent to 50.375 days.

Costs: 50.375 days X 882 Tshs/day = **44,430.75 Tshs.**

Albizia (Year 12, 22*):

Number of Albizia trees planted per year = 42,256.

Harvest time required: 42,256 trees X 0.75 hours/tree = 31692 hours. This is equivalent to 3961.5 days.

Costs: 3961.5 days X 882 Tshs/day = **3,494,043 Tshs.**

Appendix 2 continued...

Leucaena (year 6, 10, 14, 20):

Number of Leucaena trees planted per year by the project = 18,357 trees.

Harvest time required: 18,357 trees X 0.5 hours/tree = 9178.5 hours. This is equivalent to 1147.3125 days.

Costs: 1147.3125 days X 882 Tshs/day = **1,011,929.625 Tshs.**

Acacia (year 10, 16, 22*):

Number of Acacia trees planted per year = 25,511

Harvest time required: 25,511 trees X 1hour/tree = 25,511 hours. This is equivalent to 3188.875 days.

Costs: 3188.875 days X 882 Tshs/day = **2,812,587.75 Tshs.**

1995/96:

Eucalyptus (Year 8, 13, 18,):

Number of Eucalyptus trees planted per year = 472,179..

Harvest time required: 472,179 trees X 0.25hrs/tree = 118044.75hrs. This is equivalent to 14755.59375 days.

Costs: 14755.59375 days X 882 Tshs/day = **13,014,433.69 Tshs.**

Melea (year 8, 13, 18):

Number of trees planted per year = 259,526

Harvest time required: 259,526 trees X 0.25 hours/tree = 64,881.5 hours. This is equivalent to 8110.1875 days.

Costs: 8110.1875 days X 882 Tshs/day = **7,153,185.375 Tshs.**

Total costs: 13,014,433.69 + 7,153,185.375 = **20,167,619.07 Tshs.**

Senna (Year 9, 15, 21):

The number of trees survived per region per year = 59,560.

Appendix 2 continued...

Harvest time required: 59,560 trees X 0.25hrs/tree = 14,890 hours. This is equivalent to 1861.25 man-days.

Costs: 1861.25 days X 882 Tshs/day = **1,641,622.5 Tshs.**

Grevillea (Year 18):

Number of trees survived per year = 4,299.

Harvest time required: 4,299 trees X 0.25hours/tree = 1074.75 hours. This is equivalent to 134.34375 man-days.

Costs: 134.34375 days x 882 Tshs/day = **118,491.1875 Tshs.**

Albizia (Year 13):

Number of trees survived per year = 112,723.

Harvest time required: 112,723 trees x 0.75 hours/tree = 84542.25 hours. This is equivalent to 10,567.78125 mandays. Costs: 10,567.78125 days X 882 Tshs/day = **9,320,783.063 Tshs.**

Leucaena (Year 7, 11, 15, 19):

Number of trees survived per region per year = 48,969.

Harvest time required: 48,969 trees X 0.5hours/tree = 24484.5 hours. Equivalent to 3060.5625 days.

Costs: 3060.5625 days X 882 Tshs/day = **2,699,416.13 Tshs.**

Acacia (Year 11, 17, 23*):

Number of trees survived per region per year = 68,053 trees.

Harvest time required: 68,053 trees X 1 hour/tree = 68,053 hours. Equivalent to 8506.625 days.

Costs: 8506.625 days X 882 Tshs/day = **7,502,843.25 Tshs.**

1996/97:

Eucalyptus (year 9,14, 19, 24*):

Number of trees survived per region per year = 445,369.

Appendix 2 continue:

Harvest time required: 445,369 trees X 0.25hrs/tree = 111,342.25 hours. Equivalent to 13,917.78125 days.

Costs: 13,917.78125 days X 882 Tshs/day = **12,275,483.06 Tshs.**

Melea (Year 9, 14, 19):

Number of tree survived per region per year = 244,790

Harvest time required: 244,790 trees x 0.25hours/tree = 61,197.5 hours. Equivalent to 7649.6875 days.

Costs: 7649.6875 days X 882 Tshs/day = **6,747,024.38 Tshs.**

Senna (Year 10, 16, 22):

Number of trees survived per region per year = 56,178.

Harvest time required: 56,178 trees X 0.25 hours/tree = 14044.5 hours. Equivalent to 1755.5625 days.

Costs: 1755.5625 days X 882 Tshs/days = **1,548,406.125 Tshs.**

Grevillea (Year 19):

Number of trees survived per region per year of planting = 4,055 trees.

Harvest time required: 4,055 trees X 0.25hrs/tree = 1013.75 hours. Equivalent to 126.71875 days.

Costs: 126.71875 days X882 Tshs/day = **111,765.94 Tshs.**

Albizia (year 14, 24*):

Number of trees survived per region per year of planting = 106,323.

Harvest time required: 106,323 trees X 0.75 hours/tree = 79742.25 hours. Equivalent to 9967.78 day.

Appendix 2 continued...

Costs: 9967.78125 days X 882 Tshs/day = **8,791,583.06 Tshs.**

Leucaena (year 8, 12, 16, 20):

Number of trees survived per region per year of planting = 46,189

Harvest time required: 46,189 trees x 0.5 hours/tree = 23094.5 hours. Equivalent to 2886.8125 days.

Costs: 2886.8125 days X 882 Tshs/day = **2,546,168.625 Tshs.**

Acacia (Year 12, 18, 24*):

Number of trees survived per region per year of planting = 64,189.

Harvest time required: 64,189 trees X 1 hour/tree = 64,189 hours. Equivalent to 8023.625 man days. Costs: 8023.625 days X 882 Tshs/day = **7,076,837.25 Tshs.**

1997/98:

Eucalyptus (Year 10, 15, 20, 25*):

Number of trees survived per region per year of planting = 335,939.

Harvest time required 335,939 trees X 0.25hrs/tree = 83,984.75 hours. Equivalent to 10,498.09375 days.

Costs: 10,498.09375 days X 882 Tshs/day = **9,259,318.69 Tshs.**

Melea (Year 10, 15, 20, 25*):

Number of trees survived per region per year of planting = 184,643.

Harvest time required: 184,643 trees X 0.25hrs/tree = 46,160.75 hours. Equivalent to 5770.09375 days.

Costs: 5770.09375 days X 882 Tshs/day = **5,089,222.69Tshs.**

Total costs: 9,259,318.69 + 5,089,222.69 = **14,348,541.38 Tshs**

Appendix 2 continued...

Senna (Year 11, 17, 23*):

Number of trees survived per region per year of planting = 42,375.

Harvest time required: 42,375 trees X 0.25hrs/tree = 10,593.75 hours. Equivalent to 1324.21875 days.

Costs: 1324.21875 days X 882 Tshs/day = **1,167,960.94 Tshs.**

Grevillea (Year 20):

Number of trees survived per region per year of planting = 3,059.

Harvest time required: 3,059 trees X 0.25 hours/tree = 764.75 hours. Equivalent to 95.59375 days.

Costs: 95.59375 days X 882 Tshs/day = **84,313.69 Tshs**

Albizia (Year 15, 25*):

Number of trees survived per region per year of planting = 80,199.

Harvest time required: 80,199 trees X 0.75hrs/tree = 60149.25 hours. Equivalent to 7518.65625 days.

Costs: 7518.65625 days X 882 Tshs/day = **6,631,454.81 Tshs.**

Leucaena (Year 9, 13, 17, 21*):

Number of trees survived per region per year of planting. = 34,840.

Harvest time required: 34,840 trees X 0.5hrs/tree = 17420 hours. Equivalent to 2177.5 days.

Costs: 2177.5 days X 882 Tshs/day = **1,920,555 Tshs.**

Acacia (Year 13,19, 25*):

Number of trees survived per region per year of planting = 48,418.

Harvest time required: 48,418 trees X 1hour/tree = 48418hours. Equivalent to 6052.25 days.

Costs: 6052.25 days X 882 Tshs/day = **5,338,084.5 Tshs.**

Appendix 2 continued...

1998/99:

Eucalyptus (Year 11, 16, 21*):

Number of trees survived per region per year of planting = 267,156.

Harvest time required: 267,156 trees X 0.25 hours/tree = 66789hrs. Equivalent to 8348.625 days.

Costs: 8348.625 days X 882Tshs,day = **7,363,487.25 Tshs.**

Melea (Year 11, 16, 21*):

Number of trees survived per region per year of planting = 146,838.

Harvest time required: 146,838 trees X 0.25hrs/tree = 36,709.5 hours. Equivalent to 4588.6875 days.

Costs: 4588.6875 days X 882 Tshs/day = **4,047,222.38 Tshs.**

Senna (Year 12, 18, 24*):

Number of trees survived per region per year of planting = 33,699.

Harvest time required: 33,699 trees X 0.25 hours/tree = 8424.75 hours. Equivalent to 1053.09375 days.

Costs: 1053.09375 days X 882 Tshs/day = **928,828.69 Tshs.**

Grevillea (Year 21*):

Number of tree survived per region per year of planting = 2,432.

Harvest time required: 2,432 trees X 0.25hrs/tree = 608 hours. Equivalent to 76 days.

Costs: 76 days X 882 Tshs/day = 67,032 Tshs.

Albizia (Year 16, 26*):

Number of trees survived per region per year of planting = 63,778.

Harvest time required: 63,778 trees X 0.75 hours/tree = 47,853 hours. Equivalent to 5979.1875 days.

Costs: 5979.1875 days X 882 Tshs/day = 5,273,643.38 Tshs.

Appendix 2 continued...

Leucaena (Year 10, 14, 18, 22*):

Number of trees survived per region per year of planting = 27,706

Harvest time required: 27,706 trees X0.5 hours/tree = 13853 hours. Equivalent to 1731.625 days.

Costs: 1731.625 days X 882 Tshs/day = **1,527,293.25 Tshs.**

Acacia (Year 14, 20, 26*):

Number of trees survived per region per year of planting = 38 504

Harvest time required: 38,504 trees X 1 hour/tree = 38 504 hours. Equivalent to 4813 days.

Costs: 4813 days X 882 Tshs/day = **4 245 066 Tshs.**

Staff salaries:

Forest and bee-keeping division staffs:

Only the salaries of workers involved in the project (categorised as skilled labour) were considered because the government is paying it. From 1995 there were about 109 staff involved in the project. Because it was difficult to get individual salaries (including their promotion from time to time), the initial salary (according to 1999 circular) one supposed to get during recruitment were used to rate project staffs. Staff strength from 1994/95 to 1997/98 comprised of:

Degree holders (4 staffs):

According to 1999 circular, the initial salary for degree holders is 69,200 Tshs/month, which is 830,400 Tshs. The factor of 1.3 was used to get the shadow Wage rate for the staffs.

Thus, 830,400 X 1.3 = 1,079,520 Tshs.

Therefore, for four staffs: 1,079,520 X 4 = 4,318,080 **Tshs.**

Appendix 2 continued...

Diploma holders (7 staffs):

Initial salary/month/person in this category is 51,660 Tshs, which is 619 920 Tshs/year.

The shadow wage rate: 619,920 X 1.3 = 805 896 Tshs/person/year.

For 7 staffs: **5,641,272 Tshs.**

Certificate holders (22 staffs):

Initial salary in this category = 48 990 Tshs/month, which is 587 880 Tshs/year. The shadow wage rate per staff: 587 880 X 1.3 = 764,244 Tshs/year.

For 22 staffs: **16 813 368 Tshs.**

68 Rongai trainees:

Initial salary/month is 41 100 Tshs. One personnel is supposed to receive 493 200 Tshs.

The shadow wage rate: 493 200 X 1.3 = 641 160 Tshs.

For 68 staffs: **43 598 880 Tshs.**

One messenger (RFO), 2 typist (RFO), and 5 drivers:

Initial salary/month = 41,100 Tsh, which is 493 200 Tshs/year.

Shadow wage rate = 641 160 Tshs.

For 8 staffs = 5 129 280 **Tshs.**

FBD payments/year:

4,318,080 + 5,641,272 + 16,813,368 +43,598,880 + 5,129,280 = 75,500,880 **Tshs.**

World Bank staffs (4 staff):

Payment per month is 1,195,663 Tshs. That means **14 347 956 Tshs** annually.

Total staff payment: 74 421 360 + 14 347 956 = **88 769 316 Tshs**

Appendix 2 continued...

Benefit components:

a) **Fuelwood from the planted tree species:**

The benefits from fuelwood were estimated using the amount of fuelwood expected from harvest. These were valued in terms of the opportunity cost/benefit the time used in fuelwood collection. In this case the average number of trees planted (only those trees clear felled for fuelwood) by each household were converted to hectare equivalents, at the stocking level of 1600 SPH at 2.5m X 2.5m,(except for acacia which is 400 SPH at 5m X 5m). This was achieved by dividing the number of trees survived in each planting year by hectare equivalents specified above. The estimated yield per hectare per year for each species is used in determining the harvestable volume per species because harvests were not supposed to exceed sustainable harvesting. Therefore, harvestable volume per species per each planting year was taken to be the equivalent hectares of that species times annual growth per hectare for that particular species to obtain harvestable volume per project per year (Table 17)

Table 17: Harvestable volume/year for tree spp mostly clear felled for fuelwood in the Region.

Year	*Species*	No. Of Trees survived	Hectare equivalent (n/SPH)	yield in m^3 per year	Harvestable volume per project
1993/94	*Albizia.*	17,977	11.24	5	56.2
	Leucaen	7,810	4.88	30	146.4
	Acacia	10,853	27.13	25	678.25
1994/95	*Albizia*	42,256	26.41	5	132.05
	Leucaen	18,357	11.47	30	344.1
	Acacia	25,511	63.78	25	1594.5
1995/96	*Albizia*	112,723	70.45	5	352.25
	Leucaen	48,969	30.61	30	918.3
	Acacia	68,053	170.13	25	4253.25
1996/97	*Albizia*	106,323	66.45	5	332.25
	Leucaen	46,189	28.87	30	866.1
	Acacia	64,189	160.47	25	4011.75
1997/98	*Albizia*	80,199	50.12	5	250.6
	Leucaen	34,840	21.78	30	653.4
	Acacia	48,418	121.05	25	3026.25
1998/99	*Albizia*	63,778	39.86	5	199.3
	Leucaen	27,706	17.32	30	519.6
	Acacia	38,504	96.26	25	2406.5

Source: Own data (1999).

Guided by the proposed harvest schedule for the planted species, the values in Table 6 were used in calculating the following benefits in Ng'haya village.

1993/94:

Albizia (for year 10):

Harvestable volume every 10^{th} year = $56.2m^3$/year X 10 years =$562m^3$. According to

Appendix 2 continued...

O'kting'ati *et al.*, 1986 as cited by Kessy, (1992) an adult load of fuelwood is estimated to have volume of about 0.182m^3. Based on this estimate, the 562m^3 is equivalent to 3087.912 loads. The questionnaire survey revealed that about 3.66 hours (overall average) were required to collect one load of fuelwood in the surveyed villages. This was used to value time saved for the planted trees in the region. Therefore, time saved:

3087.912 loads X 3.66 hours/load = 11301.758 hours. This is equivalent to 1412.71978 days. When valued at the shadow price of labour, this worth 1,246,018.85 **Tshs.**

Leucaena (year 4, 8, 12, 16, 20):

According to the proposed harvest schedule, yield of fuelwood from Leucaena is expected every 4th year. Harvestable volume after every 4th year = 146.4m^3/year X 4 years = 585.6 m^3. This is equivalent to 3217.582418 loads.

Therefore, time saved: 3217.582418loads X 3.66 hours/load = 11776.35 hours. This is equivalent to 1472.043956 man days. When valued at the shadow price of labour this worth **1,298,342.77 Tshs.**

Acacia (year 8, 14, 20):

According to the proposed harvest schedule, yield of fuelwood from acacia was expected after 8 years in the first harvest. and ,at 6 years in the next harvest cycles. Harvestable volume per year from acacia is 678.25m^3.

For the first 8 years: 678.25 m^3/year X 8 year = 5426m^3. This gives to about 29813.18681 loads of fuelwood.

Therefore, time saved: 29813.18681 loads X 3.66hours/load = 1,09,116.2637 hours. This is equivalent to 13,639.53297 man-days. When valued at the shadow price of labour this worth **12,030,068.08 Tshs.**

After 6 years in the next rotation:

678.25m3 X 6 years = 4069.5m3. This gives 22359.890 loads.

Appendix 2 continued...

Time saved: 22359.890 loads X 3.66 hours/load = 81837.1978 hours. This is equivalent to 10,229.64973 man-days. This worth: 10,229.64973 man-days X 882 Tshs/day = **9,022,551.06 Tshs.**

1994/95:

Albizia (year 12):

According to the proposed harvest schedule, yield of fuelwood from Albizia was expected after every 10 years. Harvestable volume after every 10th year: 132.05m^3/year X 10 years = 1320.5m^3. This gives to about 7255.494505 loads of fuelwood. Therefore, time saved: 7255.494505 loads X 3.66 hours/load = 26555.10989 hours. This is equivalent to3319.388736 days. At the shadow price of labour this worth **2,927,700 Tshs.**

Leucaena (year 6, 10, 14, 18, 22*):

Harvestable volume per year from Leucaena is 344.1m^3.

For every 4th: 344.1m^3/year X 4 years = 1376.4m^3. This gives to 7562.637363 loads of fuelwood. Time saved: 7562.637363 loads X 3.66hours/load =27679.25275 hours. This is equivalent to 3459.906593 days. At the shadow price of labour this worth **3,051,637.62Tshs.**

Acacia (Year 10, 16, 22*):

Harvestable volume after the first 8 years: 1594.5m^3 X 8 years = 12756m^3. This gives to 70,087.91209 loads of fuelwood. Time saved: 70087.91209 loads X 3.66hours/load = 256,521.7582 hours. This is equivalent to 32065.21978 mandays. When valued at the shadow price of labour this worth: **28,281,523.85 Tshs.**

The next rotation is expected after 6 years: 5941.2m^3 X 6 years = 1594.5m^3. This gives to 52565.93407 loads.

Appendix 2 continued...

Time saved: 52565.93407 loads X 3.66 hrs/load = 192,391.32 hours. Equivalent to 24058.91484 man days. This worth: 89,607.66 days X 882 Tshs/day = **24048 Tshs.**

1995/96:

Albizia (year 13):

Yield of fuelwood from Albizia is expected after every 10 year :

352.25m^3 X 10 years = 3522.5 m^3. This gives to about 19354.3956 loads of fuelwood. Therefore time saved:

19354.3956 loads X 3.66 hours/load = 70837.08791 hours. This is equivalent to 8854.635989 days. At the shadow price of labour this worth **7,809,788.94 Tshs.**

Leucaena (year 7, 11, 15, 19):

Harvestable yield of fuelwood from Leucaena per year is 918.3m^3. After every 4 years the yield expected was: 918.3m^3 X 4 years = 3673.2 m^3. This gives to about 20182.41758 loads. Therefore, the time saved:

20182.41758 loads X 3.66 hours/load = 73,867.64835 hours. This is equivalent to 9233.456044 days. When valued at the shadow price of labour this worth **8,143,908.23 Tshs.**

Acacia (year 11, 17, 23*):

Harvestable volume per year from Acacia is 4253.25 m^3. Cropping in the first harvest is s expected after 8 years.

Harvestable volume after 8 years: 4253.25 m^3/year X 8 years = 34026m^3. This gives to 186956.044 loads of fuelwood. Time saved: 186,956.044 loads X 3.66 hours/load = 684259.1209 hours. This is equivalent to 85532.39011days. At the shadow price of labour this worth **75,439,568.08 Tshs.**

After every 6 years: 4253.25m^3 X 6 years = 25519.5m^3, which give to 140217.033 loads. Time saved: 140217.33 loads X 3.66 hrs/load = 513194.3407 hours. This is equivalent to 64149.29258 man days.

64149.29258 days X 882 Tshs/day = **56,579,676.06 Tshs.**

1996/97:

Albizia (Year 14, 24*):

Harvestable after every 10th year: 332.25m^3 X 10 years = 3322.5m^3. This give to 18255.4945 loads. Time saved: 18255.4945 loads X 3.66 hours/load = 66815.10989 hours. This is equivalent to 8351.888736 man days. 8351.888736 days X 882Tshs/day=**7,366,365.865Tshs.**

Leucaena (Year 8, 12, 16, 20):

Harvestable volume per project per harvesting year =866.1m^3. harvest of fuelwood from leucaena is expected after every 4th year: 866.1m^3 X 4 year = 3464.4m^3, which give 19,035.16484 loads.

Time saved: 19,035.16484 loads X 3.66hrs/load = 69,668.7033 hours. Equivalent to 8708.587912 days. When valued at the shadow price of labour this worth:

8708.587912 days X 882 Tshs/day = **7,680,974.54Tshs.**

Acacia (Year 12, 18, 24*):

Harvestable volume after the first 8 years: 4011.75m^3 X 8 years = 32094m^3 which give 176,340.6593 loads.

Time saved: 176340.6593 loads X 3.66 hours/load = 645406.8132 hours. Equivalent to 80675.85165 days.

This worth: 80,675.85165 days X 882 Tshs/day = **71,156,101.15 Tshs**

Harvest in the next rotations is expected at every 6 years: 4011.75m^3 X 6 years = 24070.5m^3. which give

132255.4945 loads of fuel wood.

Time saved: 132255.4945 loads X 3.66hrs/load = 484055.1099 hours. Equivalent to 60506.88874 man days.

This worth: 60506.88874 days X 882 Tshs/day = **53,367,075.87 Tshs.**

Appendix 2 continued...

1997/98:

Albizia (year 15, 25*):

Harvestable volume per project after every 10th years: 250.6m^3 X 10 years = 2506m^3. This give 13769.23077 loads.

Time saved: 13,769.23077 loads X 3.66 hours/load = 50395.38462 hours. Equivalent to 6299.423077 days.

This worth: 6299.423077 days X 882 Tshs/day = **5,556,091.15 Tshs.**

Leucaena (Year 9, 13, 17, 21*):

Harvestable volume per project after every 4th year: 653.4m^3 X 4 years = 2613.6m^3 which give 14,360.43956 loads.

Time saved: 14,360.43956 loads X 3.66 hrs/load = 52559.20879 hours. Equivalent to 6569.901099 days. This worth: 6569.901099 days X 882 Tshs/day = **5,794,652.77 Tshs**

Acacia (Year 13,19, 25*):

Harvestable volume per project per harvesting year = 3026.25m^3. First harvest of fuel from Acacia is expected after 8 years: 3026.25m^3 X 8 years = 24210m^3. This gives 133021.978 loads of fuel wood.

Time saved: 133021.978 loads X 3.66 hrs/day = 486,860.4396 hours. Equivalent to 60857.55494 days.

This worth: 60857.55494 days X 882 Tshs/day = **53,676,363.46 Tshs.**

The next rotations are expected after every 6 years: 3026.25m^3 X 6 years = 18157.5m^3 which is 99766.48352 loads.

Time saved: 99766.48352 loads X 3.66 hrs/load = 365145.3297 hours. This is equivalent to 45643.16621 man days.

This worth: 45643.16621 days X 882 Tshs/day = **40,257,272.6 Tshs.**

Appendix 2 continued...

1998/99:

Albizia (Year 16, 26*):

Harvestable volume per project after every 10th year: 199.3m^3 X 10 year = 1991m^3. This is equal to 10950.54945 loads.

Time saved: 10950.54945 loads X 3.66 hours/load = 40079.01099 hours. This is equivalent to 5009.876374 mandays.

This worth: 5009.876374 days X 882 Tshs/day = **4,418,710.96 Tshs.**

Leucaena (Year 10, 14, 18, 22*):

Harvestable volume per project expected after every 4th year: 519.6m^3 X 4 year = 2078.4m^3. This is equal to 11419.78022 loads.

Time saved: 11419.78022 loads X 3.66 hours/load = 41796.3956hours: This is equivalent to 5224.5494451 man days.This worth: 5224.549451 days X 882 Tshs/day = **4,608,052.62 Tshs.**

Acacia (Year 14,20):

Harvestable volume of fuelwood per project from Acacia was expected after 8 years in the first harvest and after every 6 year in the next rotations.

After 8 years: 2406.5m^3 X 8 years = 19252m^3. This is equal to 105,780.2198loads.

Time saved: 105,780.2198 loads X 3.66 hours/load = 387155.6044 hours. This is equivalent to 48394.45055 days.

This worth: 48394.45055 days X 882 Tshs/day = **42,683905.38 Tshs.**

After 6 years in the next rotation: 2406.5m^3 X 6 years = 14439m^3, which is equal to 79335.16484 loads.

Time saved: 79335.16484 loads X 3.66hrs/day = 290366.7033 hours. This is equivalent to 36295.83791 man-days.

This worth: 36295.83791 days X 882 Tshs/day = **32,012,929.04 Tshs.**

Appendix 2 continued...

b) Sale of trees for construction poles:

Considered in this category were the revenues to the farmers from sale of trees for construction poles. Farmers in the project area were advised to retain or leave a minimum of two coppices after the first harvest. During informal survey in the study area it was revealed that the coppice sprouts usually grow vigorously and harvests obtain at shorter rotations than the first crop grown from seedlings. The tree species mostly harvested for construction poles in the project area are Eucalyptus, Melea, Senna and Grevillea. It is also important to note that, in Mwanza Region, price for one construction pole from planted tree species varied from 800 to 1500 Tshs, but the price which is commonly applied is 1000 Tshs.per pole. This was used as the price per pole throughout the analysis.

In 1993/94:

Eucalyptus (year 5, 10, 15, 20):

Number of Eucalyptus tree survived per project = 75,305

Valued at 1000 Tshs/poles this worth 75,305,000 **Tshs.**

Melea (year 5,10, 15, 20):

Number of Melea trees survived per project = 41,390.

This worth **41,390,000 Tshs.**

Total worth for Eucalyptus and Melea = **116,695,00.00 Tshs.**

Senna (year 6, 12,18):

Number of trees/project: = 9,499 Valued at 1000 Tshs/pole this worth: **9,499,000.00 Tshs.**

Grevillea (Year 15):

Number of trees in the region = 686. This worth: **686,000.00 Tshs.**

Appendix 2 continued...

In 1994/95:

Eucalyptus (year 7,12,17, 22*):

Number of trees per project = 177,004. These worth: **177,,004,000.00 Tshs.**

Melea (year 7, 12, 17,22*):

Number of trees survived per project = 97288. This worth: **97,288,000 Tshs.**

Total worth (Eucalyptus & Melea): 177,004,000 + 97,288,000 = **274,292,000 Tshs.**

Senna (year 8, 14, 20):

Number of trees/project = 22,327. This worth: **22,327,000 Tshs.**

Grevillea(Year 17):

Number of trees survived per project: 1,612. This worth: **1,612,000 Tshs.**

In 1995/96:

Eucalyptus (year 8, 13, 18, 23*)

Number of trees survived per project = 472,179. This worth: **472,179,000 Tshs.**

Melea (year 8, 13, 18, 23*):

Number of trees survived per project = 259,526. These worth: **259,526,000 Tshs.**

Total worth: **731,705,000.00Tshs.**

Senna (year 9, 15, 21*):

Number of trees survived per project = 59,560 These worth: **59,560,000 Tshs.**

Grevillea (year 18):

Number of trees survived per project = 4,299. This worth: 4,299,000.00 Tshs.

Appendix 2 continued...

1996/97:

Eucalyptus (Year 9, 14, 19, 24*):

Number of trees survived in the region = 445,396. This worth: **445,369,000 Tshs.**

Melea(Year 9, 14, 19, 24*):

Number of trees survived per project = 244,790. This worth: **244,790,000 Tshs.**

Total worth: **690,159,000 Tshs.**

Senna (Year 10, 16, 22*):

Number of trees survived in the region = 56178. These worth: **56,178,000 Tshs.**

Grevillea (Year 19):

Number of trees survived in the region = 4,055. These worth: **4,055,000 Tshs.**

1997/98:

Eucalyptus (Year 10, 15, 20, 25*):

Number of eucalyptus trees survived = 335,939. This worth: 335,939,000 Tshs.

Melea (Year 10,15, 20, 25*):

Number of trees survived in the region = 184,643. This worth: 184,643,000 Tshs.

Total worth: **520,582,000 Tshs**

Senna (Year 11, 17, 23*):

Number of trees survived per project = 42,375. This worth: **42,375,000 Tshs.**

Grevillea (Year 20):

Number of trees survived in the region = 3,059. This worth: **3,059,000 Tshs.**

Appendix 2 continued...

In 1998/99:

Eucalyptus (Year 11, 16, 21*):

Number of trees survived in the region = 267,156. This worth: 267,156,000 Tshs.

Melea(Year 11, 16, 21*):

Number of trees survived in the region = 146,838. This worth: 146,838,000 Tshs.

Total worth: 413,994,000 **Tshs.**

Senna (Year 12, 18, 24*):

Number of trees survived per project = 33,699. This worth: **33,699,000 Tshs.**

Grevillea (year 21*):

Number of trees survived per project = 2,432. These worth: **2,432,000 Tshs.**

Note: * **Harvest is beyond the time horizon used in this study, and that Costs incurred and Benefits are excluded in the project activities.**

NGITIRI MANAGEMENT COST.

Informal discussions revealed that, in the first phase of the project, individuals who own 'Ngitiri" placed more emphasis upon production enhancing operations such as thinning, singling of trees and pruning to obtain fuelwood. These operations are mainly done annually from August to September. In the study area this is the period of mass fuel collection. Many people do collect fuelwood to be used during rain season. Also harvest of poles is done in the same period of each year. But harvesting of poles started after five years Five years in the first phase was set to provide enough time for to regenerate and grow to utilizable size for poles. Based on this situation, ngitiri management cost could be assumed to zero.

Appendix2 continued...

Fuelwood from natural woodland (Ngitiri):

Awareness creation on management of natural woodland has developed the spirit of ownership. This situation is now developing into inter-house trade in fuelwood and poles at the community level. The questionnaire survey revealed that an overall of about 20.5 percent of households in villages visited reported to buy fuelwood for home consumption. The price of fuelwood varied from 150 to 200Tshs The minimum price was used in this study. Harvests of fuelwood in ngitiri was estimated in terms of estimated yield per hectare which is $10m^3$ solid (Kiwale *et al.*, 1998). Based on this estimate the number of hectares registered in each year was multiplied by $10m^3$ to obtain annual production (m^3). This was divided by 0.182 m^3 (1 adult load = $0.182m^3$) to get the expected number of fuel loads.

Table 18: Hectares of Ngitiri (natural woodlands) registered in the region.

year.	Hectares registered annually.	Estimated Annual production(m^3)	Estimated fuel loads(1 =$0.182m^3$) Load	Value at 150 Tshs per Load (At local market) .
1	10,669	106,690	586,208.79	87,931,318.5
2	1,220	12,200	67,032.97	10,054,945.5
3	12,983	129,830	713,351.65	107,002,747.5
4	2,844	28,440	156,263.74	23,439,560.44

Source: Own survey data (1999).

Sale of trees for poles from Ngitiri:

The sale of tree for poles from natural woodlands is also becoming common in the study area. One tree from natural woodland is sold at 200 to 400 Tshs depending on the size of the tree. Kiwale *et al.*, (1998) estimated that one hectare of natural woodland in the region can yield at least 20 trees suitable for poles. The first five years from registration was set to provide enough time for trees to regenerate and grow to utilizable size for poles. Therefore, harvest of trees in natural woodlands

(Ngitiri) expected to begin from five years onward.

Table 19: Annual Production of trees for poles in the registered natural woodlands (Ngitiri).

Year	Hectares registered annually	Trees/hectare from five year since registration (20 trees/ha)	Valued at 200 Tshs/Tree
1	10,669	213,380	42,676,000
2	1,220	24,400	4,880,000
3	12,983	259,660	51,932,000
4	2,844	56,880	11,376,000

Source: Own survey data (1999).

Improved wood stoves:

Since the beginning of the option by the project, about 10,953 stoves has been constructed. Thus, it was important to consider the cost involved in the construction of stoves in each year.

Table 20: The number of stoves constructed Annually.

Year	Stove constructed	Labour Costs
1	475	104,737.5
2	1,086	239,463
3	2,953	651,136
4	5,026	1,108,233
5	1,413	311,566.5

Source: FRMP annual reports (1993-1998).

The questionnaire survey in the villages visited revealed that about 2 hours was used to construct one stove.

Appendix 2 continued...

For 475 stoves:

Time required for construction:

475 stoves X 2 hours/stove = 950hrs. This is equivalent to 118.75 man days. Valued at the shadow price of labour this worth: 118.75 days X 882Tshs/day = **104,737.5 Tshs.**

For 1,086 stoves:

Time required to construct:

1,086 stoves X 2hrs = 2172 hrs, which is equivalent to 271.5 man days. At the shadow price of labour this worth: 271.5 days X 882Tshs/day = **239,463 Tshs.**

For 2,953 stoves:

Time required for construction:

2,953 stoves X 2 hrs = 5906 hours. Equivalent to 738.25 man days. This worth **651,136.5 Tshs.**

For 5,026 stoves:

Time required to construct:

5026 stoves X 2 hrs/stove = 10052 hours. Equivalent to 1256.5 man days. Valued at the shadow price of labour this worth: 1256.5 days X 882 Tshs/day = **1,108,233 Tshs.**

For 1,413 Stoves:

Time required:

1413 stoves X 2 hours/stove = 2826 hours, which is equivalent to 353.25 man-days. Valued at the shadow price of labour this worth: 353.25 days X 882

Tshs/day = **311,566.5 Tshs.**

Benefits From improved stoves:

The benefits from stoves was valued in terms of reduced time in fuelwood collection as well as reduced fuel consumption which eventually reduces the cutting of forests for fuelwood production. The questionnaire survey revealed that household size in the surveyed villages on average is 7.4 people. This was used to estimate fuel consumption in the households with stoves recorded by the project. It was further revealed that only one stove was constructed per family (household).

For 475 stoves:

These cover a population of 3,501 people.. The stove is said to reduce fuel consumption by 50%. An open fire stove is said to extract only 10% of the energy potential of wood, while properly operated and maintained improved stove can use 20% or more (NAS, 1980). Therefore fuelwood consumption is to decrease since by 10/20 or 0.5 as much wood will supply the energy required to cook a given amount of food. According to kiwale *et al.*,(1998) the per capita consumption in Mwanza region is $1m^3$ solid. Based on this estimate, the per capita woodfuel saving through the use of stove is $0.5m^3$ solid which is 50% of the previously per capita consumption.
Therefore, fuelwood saving per stove per household per year:

0.5m3/person X 7.4 persons = $3.7m^3$. This is equivalent to 20.32967 loads per year per households. The questionnaire survey revealed that hours used to collect one load of fuel wood ranged from to with an average of 3.66 hours.

Therefore time saved:

20.32967loads/hholds X 3.66hrs/load X 475 hholds = 35343.13187hrs. This is equivalent to 4417.89 man days.

When valued at the shadow price of labour this worth: 4417.89 days x 882Tshs/day = **3,896,580,28 Tshs.**

Environmental benefits:

It was assumed that the decreased fuelwood consumption reduces the cutting of forests for fuelwood production. Therefore, the estimated yield of natural woodlands per hectare ($10m^3$) was used to determine what part of a hectare would not be cut by using the stove. The use of 475 stoves could result into $1757.49m^3$ (175.49ha) being saved annually. This is equivalent to 956.59 loads of fuel. At the community level (local market) this worth: 9617.45 loads X 150tshs/load = **1,448,488.99Tshs.**

For 1,086 stoves:

Estimated to cover a population of 8,036.4 people (1,086 families).

Saving per stove per year = $3.7m^3$ (20.32967 loads).

Therefore, for 1,086 stoves = 22,087.02 loads of fuelwood.

Time saved in using stoves:

- 22,078.02 loads X 3.66 hrs/load = 80,805.56 hours, which is equivalent to 10,100.69 days.

When valued at the shadow price of labour this worth: **8,908,813.04 Tshs.**

Environmental benefits:

The use of 1,086 stoves could result into $4,018.2m^3$ (22,078.02 loads) being saved from harvest. If valued at the community level, that is at 150 Tshs/load this worth **3,311,703Tshs.**

For 2,953 stoves:

Estimated to cover 21,852.2 people. Annual fuel consumption before the introduction of stoves was $21,852.2m^3$solid. The use of stoves reduced consumption to $10,926.1m^3$(60,033.52 loads).

Time saved:

60,033.52 loads X 3.66hrs = 219,722.67 hours, which is about 27,463.33 man days. At the shadow price of labour this worth: 27,465.33 days x 882Tshs/day = **24,224,424.4 Tshs.**

Environmental benefits:

The use of 2,953 stoves could result into 10,926.1m^3 (60,033.52 loads) saved from harvest. If valued at 150Tshs per load this worth: **9,005,028 Tshs.**

For 5,026 stoves:

Estimated to cover a population of 37,192.4 people. Annual consumption before the use of stoves was 37,192.4m^3. With the use of stoves, the population were able to consume 18,596.2m^3(102,176.92 loads).

Time saved:

102,176.92 loads X 3.66hrs/load = 373,967.54 hours, which is about 46,745.94 man-days.

This worth: 46,745.94 days X 882Tshs/day = **41,229,921.11 Tshs**

Environmental benefits:

The use of 5,026 stoves could result into 18,596.2m^3(102,176.92 loads) saved from clearfelling for home consumption. Valued at 150Tshs/load this worth **15,326,544 Tshs.**

For 1,413 stoves:

Estimated to cover a population of 10,456.2 people. Annual fuel consumption before the use of stoves was 10,456.2m^3 solid annually. The stove could reduce consumption to 5,228.1m^3 solid (28,725.82 loads).

Time saved:

28,725.82 loads X 3.66 hrs/load = 105,136.52hrs, which is about 13,142.06 man-days.

This worth: 13,142.06 days X 882Tshs/day =**11,591,300.94 Tshs.**

Environmental benefits:

The use of 1,413 stoves could result into 5,228.1m^3 solid(28,725.82 loads) saved from harvest annually. If valued at 150 Tshs/load this worth **4,308,873 Tshs.**

Honey and Wax production from natural woodlands:

From villages surveyed during the study, it was noticed that bee keeping in the region is practised only in some parts of the region. In order to estimate annual honey and wax production in the region, it was important during the survey to visit Lutarutale village in Misungwi District where bee-keeping is traditionally practised using traditional hive ('Log hive'- constructed from *Borassus aethiopum* trees locally known as Mihama). Estimation by beekeepers mainly was in terms of bucket or a 20 liters plastic bucket or container. The average honey production per hive in the area is 14.5 liters per hive. Rough estimates of honey production per hive by beekeepers varied from 10 to 20 liters of crude honey. Record of honey collection from the districts beekeeping officers in the region indicate that 20 litres (one plastic bucket) of crude honey is equivalent to 28kg of crude honey. However, bee-keepers were not able to estimate the quantity of wax produced per hive probably because they have no market information about the value of wax and also it is not their traditional to process and sale wax. They could only sale honeys for local brewers in the village and other areas outside the village eg Town at 800 Tshs/litre. According to URT (1998), the average national colony productivity with cylindrical bark or log hives is 15kg of honey and 1kg of beeswax per year. This rate will be used to estimate the quantity of wax to be produced.

Estimation of wax per hive:

20 litres plastic bucket is equivalent to 28 kg crude honey.

Average honey production per hive (Log hive) in the study area = 14.5 litres.

This is equivalent to (14.5 litres X 28 kg honey)/20 litres = 20.3kg honey.

But 15 kg honey is equivalent to 1kg wax (URT, 1998).

20kg honey = 1.35kg wax.

Table 21: Number of hives constructed per year in the project area.

Year	1	2	3	4	5
Hive constructed	240	106	2,621	1,846	697

Surce: Project annual report

For 240 hives:

Annual honey production:

240 hive X 14.5litres/hive = 3,480 liters. This worth **2,784,000 Tshs** (at 800 Tshs/litre)

Wax production:

240 hive X 1.35kg/hive =324kg wax. Since many beekeepers in the region do not traditionally sale of wax, the market price of wax was used which is 2,500 Tshs.

324 kg X 2,500 Tshs/kg of wax = **810,000 Tshs.**

For 106 hives:

Honey produced per year:

106 hive X 14.5liters/hive= 1,537 liters. This worth **1,229,600 Tshs.**

Wax production:

106 hive X 1.35kg wax/hive = 143.1 kg wax. This worth = 357,750 Tshs.

Appendix 2 continued...

2,621 hives:

Honey production per year:

2,621 hive X 14.5 litres/hive = 38,004.5 litres. This worth **30,403,600 Tshs.**

Wax production:

2,621 hive X 1.35 kg wax/hive = 3526.2kg wax. This worth: 8,815,500 Tshs.

1,846 hives:

Honey production per year:

1,846 hives X 14.5 litres/hive = 26,767 litres, which worth 21,413,600 Tshs (at 800 Tshs/litre).

Wax production:

1,846 hive X 1.35kg wax/hive = 2492.1kg wax. This worth: 6,230,250 Tshs.

697 hives:

Honey production per year:

697 hives X 14.5 litres/hive = 10,106.5 litres, which worth **8,085,200 Tshs** annually.

Wax production:

697 hive X 1.35kg wax/hive = 940.95kg wax. This worth: 2,352,375 Tshs.

Revenue collected by the project:

Revenue collection in the project started 3 years later after the beginning of the project. Increase in the revenue collected per year to the end of the first phase of the project was considered to determine the trend of revenue collection. Revenue collection trend was:

1995/96 - 9,033,600 Tshs

1996/97- 50,649,135

1997/98 - 74,599,495

Appendix 2 continued...

1998/99 - 84,381,334.30 (from July 1998 to March 1999).

The trend indicates a substantial increase in the revenue collected from the first year of collection to the second year by 461%. In the third year revenue collected increased by 47.25% and in the fourth year increase was 13.14% only, implying that revenue collection has stabilised. This revenue performance was largely attributed to good control in revenue collection by the project as compared to the past. From this ground, it was assumed that revenue collection will remain constant from the end of first phase of the project for the whole time horizon used in this study.