CONTRIBUTION OF BAMBOO TO HOUSEHOLD LIVELIHOOD IN NJOMBE DISTRICT, IRINGA, TANZANIA

BY

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ABSTRACT

This study was conducted in four villages in Njombe district, Iringa region to assess the contribution of bamboo to household livelihood for the purpose of generating information which will help to promote it. Specifically the study aimed to assess utilisation, the current and potential market of bamboo main product, determine the contribution of bamboo to household income and food security and to carry out economic analysis of bamboos main product. Primary data were obtained through Participatory Rural Appraisal questionnaire (structured and unstructured) and participatory observation. Secondary data were extracted from available literature. Data analysis was done using, descriptive statistics, inferential statistics, Soil Expectation Value (SEV) and Strength Weaknesses Opportunities and Challenge (SWOC) analysis. Bamboo wine came strongly as the main dependable product from locally grown bamboo in the district. The marketing of bamboo wine consisting of chain of vertical interactions involving households, middlemen and consumers and was informal. Bamboo contributed 49% of household's income (TAS 283 200) of which 36% was used in purchasing food and the remaining was used to purchase other household items. The results of economic analysis indicated an annual net cash flow of TAS 270 371 per household which is equivalent to SEV of TAS 2 650 607 per household at 10.2% nominal discounting rate. SWOC analysis on bamboo business indicated that strengths and opportunities out weighed weaknesses and challenges. Since the area is very suitable for bamboo farming, local communities need to be encouraged to plant more bamboo so as to get themselves out of the poverty cycle. Encouragement and promotion of bamboo farming, formation of farmers' cooperatives and formalized markets are needed.

DECLARATION

I, Bernadetha Gervas Kadala, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work and has not been submitted nor concurrently being submitted for a higher degree in any other University.

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DEDICATION

To Almighty God Jesus Christ who gave me energy and strength to complete my studies.

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
°C	Degrees Centigrade
Cal	Calories
CRDB	Cooperative and Rural Development Bank
E	East
df	Degree of freedom
FAO	Food and Agriculture Organization
INBAR	International Network for Bamboo Research
IR	Interest Rate
kg	Kilogram
Km	Kilometer
mm	Millimeter
MNRT	Ministry of Natural Resource and Tourism
NDR	Nominal Discount Rate
NMB	National Microfinance Bank
NWFPs	Non Wood Forest Products
p	Probability level
pH	Measure of alkalinity or acidity
PRA	Participatory Rural Appraisal
RDR	Real Discount Rate
S	South

S.E	Standard Error
SEV	Soil Expectation Value
SPSS	Statistical Package for Social Sciences
SWOC	Strength, Weakness, Opportunities and Challenges
t	T- test
TAS	Tanzania Shillings
TAZARA	Tanzania Zambia Railways Authority
UN	United Nations
URT	United Republic of Tanzania
USD	United States Dollars

CHAPTER ONE

1.0 INTRODUCTION

1.1 Back ground information

Many people in the world depend on forest resources of which their contribution to people's livelihoods can come in various guises (Dubois, 2002). Benefits from the forest are either direct or indirect; including subsistence goods such as fuelwood, medicines, wood for building, ropes, bush meat, fodder, mushrooms, honey, edible leaves, roots, fruits. These can also be considered as goods for sale including, arts and crafts, timber and other wood products. Forests also provide income from employment, both in the formal and the informal sectors (FAO/DFID, 2001). At the same time trees have been an important part of the farm economy where the farmers grow trees in the homesteads along with other crops to maximize their land returns.

Beside wood forest products, life in rural communities also depends on the availability of the non wood forest products (NWFPs). The non wood terminology is usually used in preference to non timber since it excludes not only timber but also fuel wood and poles (Simons, 1996; Walter, 2001). There have been a lot of efforts in promoting NWFPs worldwide. Since 1991, the FAO Forestry Department has maintained a programme on the promotion and development of non-wood forest products, which is aimed at enhancing the sustainable use of NWFPs in order to contribute to the wise management of the world's forests and the conservation of their biological diversity, and to improve food security for rural people.

Bamboo is among the NWFPs and it contributes to the income of many people in the world. According to Kant and Chiu (2000), income from fresh bamboo shoots benefited

poor as well as rich groups and moved many households from the poorer to the richer classes in China. Kant and Chiu (2000) noted further that the average contribution of bamboo to farmers' income rose from 10% of total household income in the early 1980s to approximately 33% in 1996. Rural, poor people in particular depend on these products as source of construction material, piping, furniture making, hand craft, fodder, source of energy, food and importantly production of wine. It has been noted that bamboo's high calorific value (4600-5400 cal kg^{-1}) makes it a good source of energy in some industries (Lipangile, 1990).

1.2 Problem statement and justification

Bamboo products play an important role in the daily life and well being of millions of people worldwide. Traded products contribute to fulfilment of daily needs and provide employments as well as income particularly for rural people. Njombe district for example is dominated by bamboo species which mainly produce wine and building poles which contribute direct or indirectly to the livelihoods of the rural people. Despite their real and potential importance of goods and services from bamboo, very little has been done in research on socio-economics contribution of bamboo as opposed to timber and agricultural products (MNRT, 1989; Lipangile, 1990; Sharma, 1993; Arnold and Townson, 1998; Chihongo *et al.*, 2000; FAO, 2001a; Munishi *et al.*, 2004).

Despite the fact that bamboo is well known to local people in Njombe district, information about utilisation of bamboo, current and potential market of bamboo main products and promotion of cultivation of the crop is also limited or unknown. It is very important to investigate the social and economic importance of bamboo to the daily life of local communities which contribute to their economy. It is therefore appropriate to determine

their contribution to household livelihood and assess market potentials of its main product (bamboo wine). This study was conducted to partially fill this existing knowledge gap.

1.3 Study objective

1.3.1 Overall objective

The main objective of the study was to assess the contribution of bamboo to household livelihood for the purpose of generating information that can help to promote it.

1.3.2 Specific objectives

Specific objectives of the study were to:

(i) assess utilisation of bamboo in Njombe district,

(ii) assess the current and potential market of bamboo main products (bamboo wine) in Njombe district,

(iii) determine the contribution of bamboo to household income and food security and

(iv) carry out economic analysis of bamboo main products (bamboo wine).

1.4 Research questions

- What is the socio economic importance of bamboo?
- At what extent is bamboo resource utilized?
- What is the contribution of bamboo to household income and food security?
- What cost is incurred in bamboo farming and harvesting?
- Where are the markets and how is the marketing of bamboo products?

1.5 Hypothesis tested

H_1: Bamboo contribute significantly to household livelihood.

1.6 Conceptual framework

The conceptual framework model of the study showing possible hypothetical relations is as presented in Figure 1. Appropriate local arrangements in bamboo and bamboo products trade may lead into improvement of households' livelihood. Marketing of products from bamboo resource base may lead to increase in households' income and food security. Furthermore it will contribute in socio economic development of the study area through collection of taxes from bamboo products business which can ultimately be used in development activities like construction of schools, dispensary and maintenance of infrastructure. Income from bamboo resource base may be used in construction of modern houses, paying school fees, buying household items, purchasing fertilizer and paying for hospital services. These entire contributions eventually lead to improvement of livelihood.

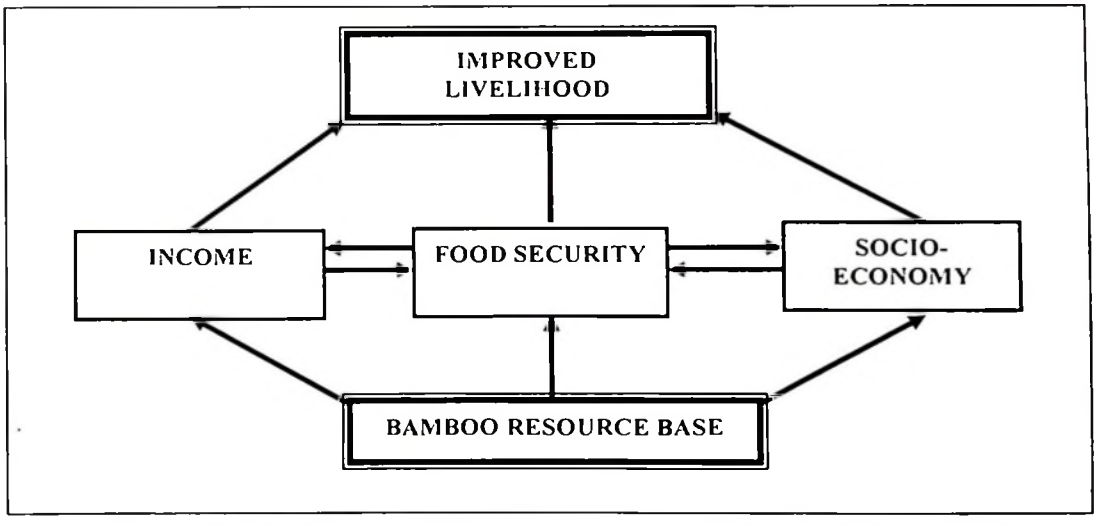

Figure 1: Conceptual framework of bamboo economy in Njombe District, Tanzania

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Basic concepts

2.1.1 Livelihood

A livelihood comprises people, their capabilities and their means of living, including food, income and assets. (Chambers and Conway, 1992; Carney, 1998). However rural households in developing countries have three broad options to improve their livelihoods; these include natural resource based activities, non-natural resource based activities and migration to other agricultural areas or to urban areas (Carney, 1998; Ellis 1998). Carney (1998) and Ellis (1998) further stated that, most people especially in the rural areas obtain their means of livelihood from their immediate environment.

2.1.2 Food security

Food security has been the core of discussion in development and poverty alleviation policies in many developing countries. Despite all the discussions and advanced technologies in food production in many countries, many people in the world suffer from chronic food insecurity (FAO, 1999). Food security is defined as economic and physical access to food for all people at all times to enough food for a health and active life (World Bank, 1986 and FAO, 1989). The definition is widely accepted and in this respect the concept is taken to embrace three specific aims: ensuring production and adequate food supplies, maximizing stability in the growth of supplies, and securing access to available supplies. During hunger periods, members of the household look for food supplement. Forests and trees contribute to the food supplement as other food sources, although it is clear that forests and trees cannot replace agricultural food sources to any significant extent (FAO, 1995). Both agricultural and forests crops contribute to household food

security at different levels. Therefore food security exists when all people at all times have physical and economic access to sufficient, safe nutritious food to meet their dietary needs and food preference for an active and health life (USAID, 1992).

2.2 Non wood forest products

The term "Non-Wood Forest Products" (NWFPs), and similar terms such as "minor", "secondary" and "non-timber" forest products, have emerged as umbrella expressions for the vast array of both animal and plant products other than wood derived from forest trees. FAO (2003) uses the term "non-wood forest products" and defines it as "goods of biological origin other than wood that may be gathered from the wild, or produced in forest plantations, agroforestry schemes and from trees outside forests".

NWFPs usually support livelihoods and are both a source of income and a source of affordable subsistence goods for nearly 80% of the East African rural population (Shiva, 1993; World Bank, 2002), Tanzania inclusive. These products range from those used for local consumption to products which are traded in the international markets and which have represented the major commodities for a long time.

At the same time, NWFPs play an important role in food security and as an income-earning source for the rural community (Neumann and Hirsch, 2000). Utilization of NWFPs is sometimes associated with subsistence utilisation that is linked to the problem of poverty (Zinyama *et al.*, 1990). Monela *et al.* (2000), showed that, households living in miombo woodlands in Tanzania derive more than 50% of their cash incomes from selling forest products such as honey, wild fruits, charcoal and firewood beside other timber crops. Trees yield many non-wood products such as, bark, leaves, nuts and roots that are

useful for food, fodder (leaves, fruits or flowers), medicine (gums exudates, leaves, bark and roots) and cosmetics (oils and other products) (Walter, 2001). Luoga *et al.* (2000), reported other products like dyes and tannins (mainly bark and leaves), utensils, handcrafts (rattan), construction materials (bamboo stems, wrapping leaves, fibres and thatch) and ornamentals (entire plants e.g. orchids and plant parts like flowers). They also include mushrooms and bush meat.

The Tanzania National Forest Policy takes into consideration non-wood based industries and products. The policy statement number 13 states that "Investments in NWFPs industry, products development and marketing will be encouraged in order to utilize the full potential as well as to domesticate and commercialise the products with high demand". The policy further explains that, trade in wood and NWFPs offers considerable potential for increased economic development through income and employment generation as well as export earnings (MNRT, 1998). Bamboo is among the NWFPs. The policy is implemented through the National Forestry Programme by undertaking strategies and mechanisms for NWFPs (MNRT, 2001).

2.3 Bamboo as a non wood forest products

Being among NWFPs, bamboo species are giant woody, tree-like grasses, and have a long history as versatile and widely-used renewable resources. It is the widely utilised group of plants with a range of uses from basketry, weaving, mats, traditional implements and furniture to industrial ply-bamboo panels, flooring and construction materials, and from paper making to bamboo shoots, essential oils and medicines (Kumar *et al.*, 1994; Wong, 1995; Pérez *et al.*, 1999).

Bamboos are woody members of family Gramineae and subfamily Bambusoideae. The subfamily has both reproductive and vegetative characters. There are as many as 75 genera and 1,250 species of bamboo distributed in tropical and temperate zones of the globe (Kumar *et al.*, 1994; Banik, 1995; Mohamed *et al.*,1997; Bansal *et al.*, 2002). Tropical Asia has been referred to as the centre of bamboo diversity with as many as 45 genera and 750 species with China having the highest recorded bamboo species between 300 – 500 growing naturally (Pérez *et al.*, 1999).

Bamboo is one of the important fast growing grasses growing in various ecological zones of Tanzania. It is perhaps the fastest growing plant on earth gaining approximately 75 to 400 mm per day (Mbuya *et al.*, 1994; Kigomo, 1995). Its physiological characteristic as a very fast-growing species has given bamboo recognition as a suitable species for plantation purposes. It has an extensive rhizome system, which stores a tremendous amount of nutrients required for the plants rapid growth. It is one of the old multipurpose plant associated with rural people. In areas where it is grown, there is a strong relationship between household livelihood and bamboo. Besides the shoot, its culms can be used anytime, especially in the rural areas, for small cottage industries. Land areas where agricultural crops cannot be planted with maximum yield can be planted with bamboo either as food from shoots or for the higher value-added culms. According to Othman and Mohamed (2003), it is hoped that large tracts of land available in the forest can be rehabilitated as a money-spinner, and create job opportunities for the rural communities. However, the frequent labeling of bamboo as "minor forest product" causes it to be overlooked by official forestry policies and development projects (Pérez *et al.*,1999). The bamboo can be very important in Carbon sequestration (Castaneda *et al.*, 2005) as it grows fast and evergreen.

2.4 The role of bamboo in community livelihood

Bamboo is an important renewable resource on which around 2.5 billion people all over the world depend greatly for a wide range of products and services as it has more than 1000 documented uses (Bansal *et al.*, 2002). The role of bamboo in livelihood is derived from its uses ranging from being an architectural material to acting as a medium of soil conservation. In Tanzania, bamboos are said to cover about 123, 000 ha with species like *Arundinaria alpina* (mountain areas of Kilimanjaro, Iringa and Arusha), *Bambusa vulgaris* in low altitudes (around Lake Victoria) and *Oxytenanthera braunii* commonly found in the southern highlands. Table 1 summarises different bamboo species and their uses.

Commercially important species usually mature in four to five years. The plant can be used in rehabilitation of marginal lands either in small-scale or plantation. Bamboo shoots have nutritional value containing sugars, fats, proteins and amino acids. According to Lipangile (1990) the high calorific value (4600-5400 cal kg^{-1}) of bamboos makes it a good source for fuel and energy.

It is a source of income in many parts it is grown and its importance goes beyond many other plants. In Kerala India for example, bamboos are sold more frequently than other trees in the homesteads and it is a close substitute for *Eucalyptus* (Krishnamurthy, 2004).

Table 1: Degree of use of different bamboo species in Tanzania

Bamboo species	Major uses						
	Construction	Trays, mats basketry	Furniture	Household items	Props	Bamboo wine	Others
A. alpina	20	70	5	5	0	0	0
O. buchwaldii	80	20	0	0	0	0	0
O. braunii	15	0	0	0	0	85	0
B. vulgaris	33	10	2	0	50	0	5[1]
Nondo	0	100	0	0	0	0	0
Misuni	95	0	0	0	0	0	5[2]

Key: 1 = ornamentals, 2= fishing rods

Source: Chihongo *et al.*, 2000

2.4.1 Bamboo as source of food and fodder

Use of young bamboo shoots as source of food for human consumption is common in many parts of the world. Reports of shoot production for food are provided from Asia especially China, Japan, Taiwan, Thailand and Uganda (Kigomo, 1995; Pérez *et al.*, 1999; Idris and Mohamed 2002; Li *et al.*, 2002; Wang *et al.*, 2002; Singh *et al.*, 2003; Hunter, 2003; Bhatt *et al.*, 2004). The bamboo shoots are consumed in the form of fermented-slice, crushed-fermented moist, crushed-fermented dry, fermented whole shoot, roasted whole shoot and boiled whole shoot (Bhatt *et al.*, 2005). The potential of using bamboo as source of food in Kenya is also reported by Kweyuh (1993). Commonly, however, bamboo is used as a source of fodder to animals. Studies from China showed that bamboo shoot shell of *Bambusa arundinacea* has a high potential nutritional value making it suitable for feeding heifers (Liu *et al.*, 2000).

2.4.2 Bamboo as source of income

Bamboo has been noted to be a major source of income to improve household income in places where it is grown. Bamboo products are well established in internal markets and on

the world trade market. Accurate statistical information on this trade is difficult to find. International trade statistics suffer from outdated customs' codes. However, the volume of world trade exceeds $2.5 billion and may reach $7 billion (Hunter, 2003). Trade is generated from a narrow range of utilized species (perhaps 50 out of 1500 total bamboo species) (Hunter, 2003). According to Bhatt *et al.* (2005), in North-Eastern Himalayan region, India, Cost–return analysis for sales of edible bamboo products revealed a net income of 23 million rupees per annum (USD 502 950) from the entire region with the highest (17.5 million rupees/year or USD 38 270) in Arunachal Pradesh and the lowest in Sikkim (0.47 million rupees/year or USD 10 280). In India Bamboo shoots can earn a large share of household income to an amount of Rupees 2 130 million (USD 45 million) annually (Singh *et al.*, 2003).

In Tanzania bamboo produces wine of qualities with alcohol content of 5.5 % v/v just above that of industrial Safari larger (5.0% v/v) (Mosha *et al.*, 1996). Table 2 summarizes properties of bamboo wine and other local and industrial wines.

Table 2: Comparison of some properties of Bamboo wine to some other local and industrial alcoholic beverages in Tanzania

	Alcohol (v/v)	Sugar (% w/v)	Acidity (mmol/litre)	pH[1]	pH[2]
Coconut palm wine	6.1-7.8	5.6-8.0	60.5-79.0	3.91	3.62
Bamboo wine	5.5	8.5	76.8	4.00	3.80
Banana wine	2.0-3.5	6.2-9.5	28.0-55.4	4.52	4.21
Safari larger[3]	5.0	6.5	25.2	4.3	-

[1]Fresh market ready sample; [2]After 24 hours; [3]Licenced commercial products

Source; Mosha *et al.*, 1996.

The beneficiaries to the bamboo wine business include tapers, distributors and those who sell the juice. Some families have educated their children using money from sale of

bamboo wine. Besides the wine, the species *Oxyternanthera braunii* provides fuel, raw material for various constructions and effective means of erosion control along river banks.

2.4.3 Bamboo as source of building material

According to Paudel and Lobovikov (2003), one of the visible indicators of the growing poverty is 'lack of shelter'. Millions of people live in hovel 'life- and health-threatening homes', simply due to their inability to afford the houses. This demands seriously to look for alternative housing materials that are cheap, widely available and require less technical know-how. Bamboo is an alternative.

About one billion people live in bamboo houses worldwide (Bansal *et al.*, 2002). According to Pabuayon (2004), household use of bamboo is for building rural houses and making farm implements. Bamboo could be more widely used in construction, for example, bamboo can be used to reinforce cement, or to construct inexpensive houses and buildings that resist earthquakes and landslips. Also, bamboo can substitute wood in many of wood's traditional uses - paper, fiberboard, glue-laminated furniture, panels and flooring (Hunter 2003). Bamboo materials can be used for building public or private constructions in developed countries such as: garden houses, pergolas, pavilions and carports. Bamboo-made constructions appear to have a good market potential in developed countries and could involve developing-country-based suppliers of bamboo materials (Vantomme *et al.*, 2003). In India the housing sector experiences severe shortage of bamboos for construction, as the pulp and paper industry purchases bamboos on a large scale by offering higher prices (Muraleedharan *et al.*, 2004).

2.5 Properties of bamboo

Bamboo is quite different from wood coming from gymnosperms and dicotyledonous angiosperms. All the growth in bamboo occurs longitudinally and there is no lateral or radial growth as in trees (Kumar *et al.*, 1994). Characteristically, bamboo has a hollow stem, or culm (solid in some species only), which is closed at frequent intervals (nodes). Bamboo culm comprises about 50% parenchyma, 40% fibres and 10% vessels and sieve tubes (Kumar *et al.*, 1994). Fibres percentage is higher in the outer one third of the wall and in the upper part of the culm, contributing to its superior slenderness. Bamboo possesses very high moisture content which is influenced by age, season of felling and species. Season has great influence than any other causes. Moisture is at its lowest in the dry season and reaches maximum during rainy season. It varies from the bottom to the top and from the innermost layers to the periphery. Green bamboo may have up to 150% moisture (oven-dry weight basis) (Kumar *et al.*, 1994).

Bamboo show superior properties preferred for various uses as compared to many other materials. At household level, bamboos are very useful in construction of suitable grain storage facilities (Basunia *et al.*, 1997). It is reported and believed in some area that rough rice stored in bamboo bin was good in terms of temperature, moisture content and germination capacity in comparison with those stored in wooden and metal bins (Basunia *et al.*, 1997). It is also indicated that, in four ecological zones in Benin, where evaluation of maize storage practices was done, fewer aflatoxins were found when maize was stored in the "Ango"(storage container) made from bamboo (Cardwell *et al.*, 2000).

2.6 Bamboo farming

Bamboo farming is common across the world. It can grow almost everywhere and it has many advantages over timber especially its speedy growth. Bamboo is basically a

household species, can be grown around houses, wells, compounds, on farmlands and any other available places in the holdings (Shanmughavel and Peddappaiah, 2000). It can give products to meet farmers' need of poles, fuel and fodder and other services and the surplus sold to markets. Cultivation of bamboo can provide a cost effective return within a short term. It can be harvested after three or four years and then every year after that. When you cut a bamboo down, it will produce another shoot and it is ready for harvest in one or two years.

Another advantage of bamboo compared to many other trees, is that it has very high water use efficiency and it is environmentally friendly (Bansal *et al.*, 2002) with high potentiality as source of fuel (Parikesit *et al.*, 2001). Most bamboos grow well in a moderately acidic loamy soil. If the soil is very heavy, one can add organic material. This can be done by digging into the soil where the bamboo is to be planted, but the easiest thing is to mulch very heavily and let the earthworms do the work. Village farmers have knowledge of bamboo cultivation on a limited scale, based mostly on personal experiences and not on systematic scientific studies (INBAR, 1997).

It is proven that bamboo can also be used as an ideal species for agroforestry system (Shanmughavel and Peddappaiah, 2000). However, bamboo produces very scanty seed and therefore planting is mainly done from culms. Because of its wide distribution, availability, rapid growth, easy handling and desirable properties, has been used widely in the daily life of the local community as a sustainable resource. When comparing nutrient returns in a pure bamboo and the intercropped stand, Shanmughavel and Peddappaiah (2000), found that nutrient returns were higher in the soil of the intercropped than the pure stand. Contrary to that, reports are available which are based on the nutrient pumping

action of the bamboo, the slow decomposition of its silica-rich litter and the extremely high biomass of bamboo fine roots. Christanty *et al.* (1997), reports that bamboo recovers much of the nutrients leached deeper into the soil profile during the first two years of cropping and deposits them at or near the soil surface as above ground litter and dead fine roots.

Just like any other crop, bamboo needs some management. These include cleaning, culm selection and fertilizing. It is noted that bamboo responds very well to different cultural and agronomical practices like hoeing, weeding, irrigation and use of fertilizers (Hunter, 2003). Routine cleaning is important so that healthy and vigorous culms can be obtained for successive harvests. It is also directed that mature culms which are more than three years old, should be felled in order to control the culms density per clump (Mohamed *et al.*, 1997). With systematic management productivity of the clump can be guaranteed.

2.7 Economic analysis technique

Just like other projects, bamboo farming need economic analysis to measure the effect on efficiency in relation to the whole economy. The economic analysis of the project on the other hand, measures the effect on the efficiency objectives in relation to the whole economy. Rather than financial prices, shadow prices are used which reflect opportunity cost, including valuation of externalities whenever practical (Davis and Johnson, 1987; Munasinghe, 1992).

Maximizing Present Net Worth (PNW) is a common objective criterion reflecting the goal of maximizing the market value of the enterprise for forest industry and many private forest owners. According to Davis and Johnson (1987) economic efficiency analysis is the

simultaneous choice of both the level of inputs and outputs of products that maximize total net return.

Several indices or indicators of project worth which take the influence of time into account (i.e., involving discounting) are in common use. There is no single measure of projects worth which is universally accepted since all share the characteristics of providing only partial information on project performance. Different indicators are needed and used for answering different questions. Several measures are widely used in financial and economic analysis to measure profitability. There are the Net Present Value (NPV), Internal Rate of Return (IRR) and the Benefit Cost Ratio (B/C) which are most commonly used (Hanley and Spash, 1995). These criteria use compound interest to adjust for costs and revenues occurring at different points in time (Dixon and Hufschmidt, 1986; Davis and Johnson, 1987).

Management problems in bamboo farming like in any other realm often involve choosing among several aspirant projects, each of which satisfies all physical, biological or economic constraints specified for a problem. These achievable candidate projects can be grouped as mutually exclusive and independent projects (Dixon & Hufschmidt, 1986; Gregersen and Contreras, 1992). Choosing between or ranking projects involve establishing measures of net revenue as criteria for the choice.

2.7.1 Net Present Value (NPV)

There is a need to calculate NPV so as to know the future value of the bamboo project in reference to its present value. NPV has several names including: Present Net Worth (PNW), Net Discount Revenue (NDR) and Discount Cash Flow (DCF). Decisions concerning whether to undertake projects with long-term benefits or with long term costs

frequently turn on the choice of discount rate. Discounting is performed to calculate the present value of a stream of future costs and benefits associated with the project or policy. If benefits exceed costs in every time period, the present value is positive for any discount rate. Therefore NPV is the sum of discounted revenues less discounted costs over a defined planning period.

$$NPV = \sum_{t=1}^{n} \frac{Rt}{(1+i)^t} - \sum_{t=1}^{n} \frac{C_t}{(1+i)^t} \quad \text{.....(i)}$$

Where Rt = Revenue in year t,

Ct = cost in year t,

i= guiding interest rate,

n = number of years in the planning period,

According to Gregersen and Contreras (1992) and Hanley and Spash (1995), the criterion for the project acceptance is: accept if NPV>0 for independent project and for mutually exclusive accept alternative with highest NPV.

2.7.2 Soil Expectation Value (SEV)

Just like other plantations, bamboo farming needs land. According to Leuschner (1984), this is a special case of financial analysis in forestry in which the value of a particular parcel of bare land is calculated when used to grow timber. SEV is calculated over a perpetual series of timber crops grown on land. SEV is known by several names. The most well known is the Faustmann Formula but the name Land Rent (LR), or Land Expectation Value (LEV) are also used (Leuschner, 1984).

The simplest form of the SEV is given as

$$V_o = a\left[\frac{1}{(1+i)^w - 1}\right] \quad \text{.....(ii)}$$

Where Vo = Value of an amount at present (n=0)

a = Amount of payment of a perpetual period annuity,

w = Length of multi-period group in perpetual series.

An alternative SEV formula which has been derived from the basic financial formula for compounding and discounting interest calculations is given as:

$$SEV = NPV\left[\frac{(1+i)}{(1+i)^{w}-1}\right] \quad \text{(iii)}$$

Where NPV = Net Present Value as defined in formula (i)

The assumptions to the SEV analysis are as follows-

(i) All tree growing costs are included in the analysis including relevant management (weeding, thinning and pruning).

(ii) The guiding interest rate correctly reflects the context and outlook.

(iii) The prescription for future management of the stand has been decided and the same prescription will be used for each future timber production cycle.

(iv) Land value is zero, and had no residual stand and

(v) The land will be forested in perpetuity.

2.7.3 Internal Rate of Return (IRR)

Bamboo farming as an investment needs investment decision tool (IRR). IRR measures are frequently employed in financial investment appraisal. It is the rate of interest which, if used as discount rate for a project, would yield a NPV of zero. IRR is flawed as a measure of resource allocation for two principal reasons:

(i) Many projects can generate multiple IRRs from the same data set, so the analyst does not know which to select as the decision-making criterion.

(ii) The IRR is unreliable when comparing performance across many projects in a portfolio.

The IRR is measured by the rate the project actually earns on money invested (Gregory, 1972). It can be found by computation or by trial and error. Therefore;

$$IRR = i$$

$$\sum_{t=1}^{n} \frac{Rt}{(1+i)^t} = \sum_{t=1}^{n} \frac{C_t}{(1+i)^t} \quad \text{.....} \quad \text{(iv)}$$

(Luoga, 1994)

2.7.4 Benefit Cost Ratio (BCR)

The calculation for BCR can also be done to bamboo farming. The Benefit Cost Ratio is the ratio of discounted benefits to discounted costs (B/C). The decisions rule becomes: proceed if the benefit-cost ratio exceeds unity. The benefit-cost ratio is another way of presenting the NPV of project (Hanley and Spash, 1995).

$$BCR = \sum_{t=1}^{n} \frac{R_t}{(1+i)^t} \Big/ \sum_{t=1}^{n} \frac{C_t}{(1+i)^t} \quad \text{.....(v)}$$

For mutually exclusive projects, then one has to select the alternative for implementation that maximizes the overall NPV, B/C or IRR. If the projects are truly independent selection is made for projects for which NPV > 0, B/C >1 or IRR > guiding rate (table 4).

Table 3: Comparison of the three measures of present value (NPV, IRR and B/C) for independent and mutually exclusive projects

Selection or ranking rule for:		Net present value	Internal rate of return	Benefit cost ratio
Independent Project:	No constraint on costs.	Accept alternatives where NPV>0. Project ranking not required.	Accept alternatives with IRR greater than cut off rate of return; Project ranking not required.	Select all projects with B/C>1; Project ranking not required.
	Constraint on costs.	Not suitable for ranking projects as it favors large projects.	Ranking all projects by IRR may give incorrect ranking.	Ranking all projects will always give correct ranking.
Mutually Exclusive Projects:	No constraint on costs.	Accept alternative with highest NPV.	Select all alternative with highest IRR may give correct result.	Selection of alternative with highest B/C may give incorrect result.
Discount Rate:		Appropriate Discount rate must be adopted.	No discount rate required, but cut off rate of return be adopted.	Appropriate discount rate must be adopted.

Source: Modified from Gregersen and Contreras (1992)

2.7.5 Social Cost Benefit Analysis (SCBA)

SCBA approach differs from that pursued by private organization who will only be interested in cost and benefits that directly affect themselves and will therefore ignore any broader social costs and benefits which may result from their investment decisions. It is the mostly widely used appraisal technique of justification of investment for in forest for several decades (Hufschmidt *et al.*, 1983; Soderbaum, 1990).

2.7.6 Determination of the discount rate

Bamboo business can also be affected by changes on discounting and inflation rates. In the financial analysis, the on going rate of interest is the one to use. That will vary from situation to situation (Gregersen and Contreras, 1992). In the case of more established entities operating entirely in the monetary sector, an estimated average bank lending rate may be appropriate. The analysis will have to use judgment in choosing an appropriate rate. There is neither formula nor mechanistic means for deriving a rate. Relative (real)

price changes are of relevance with discounting being done at the real discount rate. Nominal historical value can be converted into real value using a price index (Hanley and Spash, 1995). Table 3 shows the inflation rate in Tanzania which can affect the discount rate in each year.

Table 4: Tanzania inflation rate (consumer prices)

Year	Inflation rate	Year of information
2003	4.80%	2002
2004	4.40%	2003
2005	5.40%	2004
2006	4.30%	2005
2007	5.90%	2006

Source: URT (2006)

2.7.7 Sensitivity analysis

According to Lawrence and Norman (1987), sensitivity analysis can provide usefully information to the final decision. Sensitivity analysis shows how the value of the criterion changes with changes in the value of any variable in the discount cash flow analysis. It may be expressed either as the absolute change in PSV (Positive present Social Value) (or IRR) divided by a given percentage or a given absolute change in the variable, whichever seems more appropriate. Usually a percentage change will be chosen. Thus the sensitivity will most often be expressed as

$$X = \frac{dSEV}{dX} \quad \text{.....(vi)}$$

Where X is the chosen value of the variable.

It is usually desirable to test the sensitivity of project out come to a combination of changes in input/output values for given inputs or outputs. The sensitivity analysis can be carried out using either NPV or IRR, though NPV is most commonly used (Gregersen and

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Contreras, 1992). Sensitivity analysis shows how the value of criterion changes with switching the value of any variable in the discounted cash flow analysis (Little and Mirrlees (1992). Sensitivity analysis can also be done to bamboo business. This is important in evaluating sensitive variables in a project in order to make decision.

2.7.8 Market and marketing of bamboo

Bamboo and bamboo products do not have formal markets in India. The trade is usually done at household level in rural areas, urban markets and along roadsides. Many entrepreneurs have small enterprises selling raw bamboo, utilitarian items and furniture (Duraisamy, 2003). Examples from India indicate that bamboo marketing does not follow the general hypothesis, as in wood marketing where limited knowledge of the producers about market flows and prices. Limited market access, excessive marketing margins of middlemen, interlocking credit and rigid legislation being the main characteristics (Jayasanker and Muraleedharam, 2000). According to Jayasanker and Muraleedharam (2000) bamboo and bamboo products marketing have different levels of market chains and these include;

i. Household through sub-trader and trader to domestic consumer, other traders or pulp and paper (industry)
ii. Household through brokers and traders to domestic consumer, other traders or pulp and paper (industry)
iii. Household to local households.

2.7.9 Financial analysis

Bamboo as an enterprise it need labour, material, space and capital in order to obtain profitability, it is important to carry out financial and economic analysis.

Financial analysis is a process of providing information about individual projects, plans or policies to a decision maker and is not it self a decision making technique (Leuschner, 1984; Davis and Johnson, 1987). According to Munasinghe (1992), financial analysis is the root from which stems the economic Efficiency and Social Cost benefit Analysis approaches.

There are four procedural steps involved in financial analysis (Davis and Johnson, 1987)

(i) deciding on the length of the planning period over which costs and revenues will be evaluated,

(ii) identifying the schedule of events associated with a project,

(iii) converting the events to their equivalent schedule of monetary measured costs and revenues,

(iv) adjusting the costs and revenues for time, using compound interest formula.

In particular the financial analysis differs from economic analysis. The former focuses on the money profits accruing to the project enterprise based on market or financial costs (Little and Mirrlees, 1992), while the latter focuses on measuring the effect of the efficiency objectives in relation to the whole economy (Munasinghe, 1992).

2.8 Strength, Weaknesses, Opportunities and Challenges (SWOC) analysis of bamboo farming

SWOT is done so as to provide the basic frame within which decision alternatives are evaluated with respect to each operating factor. Both internal and external environments are considered in order to attain a systematic approach and support for the reached decisions (Kangas *et al.*, 2003). In management sciences, it plays a paramount role in

understanding the management problems in micro-and macro-environment at all stages irrespective of the type of organization. It is one of the effective tools of strategic management which may help policy makers and managers in shaping the strategic agency operating within a given situation or context (Chandel and Jain, 1998). The internal and external factors most important to the enterprise's future are referred to as strategic factors and they are summarized within the SWOC (Kangas *et al.*, 2003). However, SWOC could be used more efficiently than normally has been the case in its applications (Kangas *et al.*, 2003). According to Marshall (2001), SWOC analysis can be used to illustrate an approach to answering the basic question, "Why". To get a deeper understanding of the factors influencing the bamboo sectors in Ecuador and Colombia with an emphasis on the countries' export potential, an elaborate SWOC analysis was conducted based on interviews with various key stakeholders in the countries' bamboo sectors. The analysis shows that the sector is improving but nevertheless is still hampered by various constraints, mostly based on a lack of commercialisation and marketing skills, which prevent both countries from fully taking advantage of (export) opportunities available (Van der Lugt, 2005).

CHAPTER THREE

3.0 MATERIAL AND METHODS

3.1 Description of the study area

3.1.1 Location and Climate

The study was conducted in Njombe District which is located between latitudes 8°4' to 9°35'S and longitudes 34°30' to 35°8'E at an altitude of between 700 – 2,900 m.a.s.l. Administratively Njombe has seven divisions namely Igominyi, Imalinyi, Wangingombe, Makambako, Lupembe, Mdandu and Njombe town (Fig.1). There are 25 wards and 172 villages covering an area of 10,668 km^2. The study involved four villages of Mlevela, Igodivaha, Kitandililo and Mlowa.

The area receives a single rain season, which begins in November up to May. The mean annual rainfall varies from less than 900 mm a^{-1} in Northwest to over 1600 mm a^{-1} in the Southern and western highlands. Temperatures vary between 14°C and 20°C.

3.1.2 Vegetation

Njombe is characterized by humid forest remnants, extensive grasslands and miombo woodland which are commonly found in the southern highlands. The larger part, which is much drier, is characterized by miombo woodlands.

3.1.3 Soils

Soils within Njombe district are predominantly feralsols which usually have low nutrient status with low values for exchangeable Calcium and Magnesium (URT, 1997). Soils are well-drained red or yellow of an old landscape with pH 5 - 6. They are highly weathered

with poor ability to store and release artificial fertilizers when used. They are generally of low fertility and not very much productive without use of fertilizers.

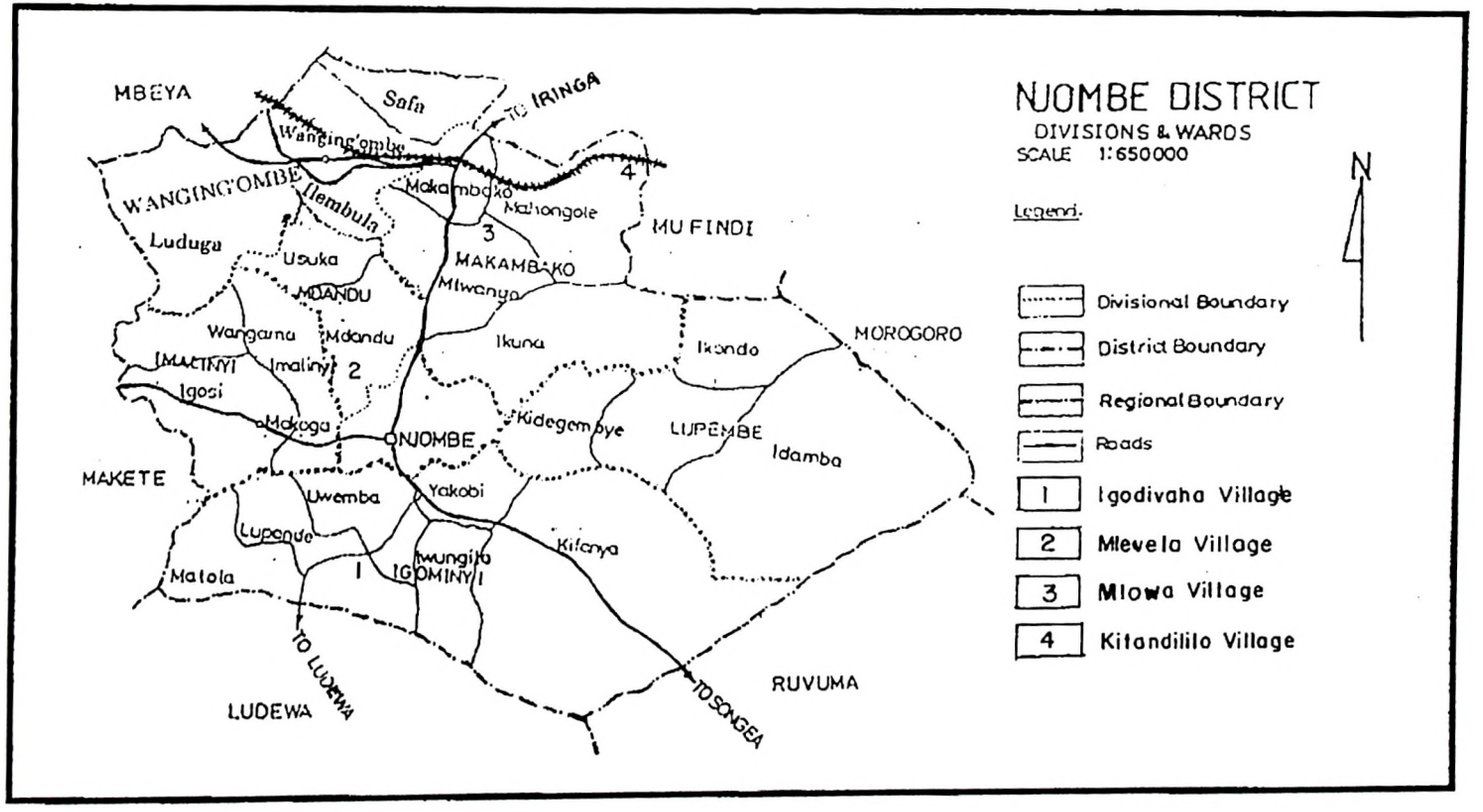

Figure 2: Map of Njombe District

3.1.4 Population

According to the 2002 census report, Njombe district had a population of 420 348 out of which 224 218 were females and 196 130 males (URT, 2003). Average household size is 4.3 members and the annual average population growth (1988-2002) was 1.5%.

3.1.5 Socio-economic activities

About 90% of the population live in rural areas and depend on agriculture and livestock for their daily lives (URT, 1997). The commonly planted agricultural crops in the district include sweet potatoes (*Ipomea batata*), beans (*Phaseolus vulgaris*), finger millets (*Eleusine corocana*), maize (*Zea mays*) and irish potatoes (*Solanum tuberosum*). Maize is both a major staple food and one of the most important marketed crop in the district. Livestock include cattle, sheep, goat, pigs and donkey. Mining and manufacturing industries are other opportunities that provide employment to the people living in the district. Gold mining is at Makanjaula, Kidugula and Mjimwema and germstone at Wanging'ombe. Processing industries include tea, seed oil and wattle extraction (URT, 1997). Carpentry and wood related industries, brick making and grain milling are common.

3.1.6 Communication

The district is accessible from other districts. Njombe town is 65 km from Makambako along the main road to Songea. Makambako is an important junction on both the Tanzania Zambia tarmac highway and the Tanzania Zambia Railway (TAZARA) which link the port of Dar-es-Salaam to Zambia and an important centre for business. All surveyed villages (Mlevela Igodivaha, Mlowa and Kitandililo) were accessible from both Njombe and Makambako towns.

3.2 Methods

The study used both qualitative and quantitative approaches with an extensive use of focus group discussion, key informants interviews and feedback systems.

3.2.1 Sampling procedure

A sampling unit for this study was a household of which according to World Bank (1986) it is defined as "A unit consisting of one or more persons related or unrelated who live together in one part or of more than housing/dwelling and have common catering arrangement". Purposive selection of villages engaged intensively in bamboo and bamboo products business was done. From each village a crosscut of population taken at random and based on age and gender was involved in the study. Random sampling of 5% of the present households (but not less than 30 households) was used to get significant population representation (Boyd *et al.*, 1981). The study involved a total of 120 respondents (30 from each study village) from four villages of Mlevela, Igodivaha Kitandililo and Mlowa (Table 5).

Selection of these villages was based on the intensity of bamboo farming and accessibility to markets. In this context the selected villages practice bamboo farming in larger scale compared to other villages. Two villages (Mlevela and Mlowa) were near the market (20 km from the markets at Njombe and Makambako respectively) and two others (Igodivaha and Kitandililo) far (30 km and 35 km respectively) from the respective markets.

Table 5: Demographic characteristic and sample intensity of survey villages at Njombe District

Division	Village	Population	Household	Households that were to be interviewed (5%)
Mdandu	Mlevela	4990	598	30(30)
Makambako	Mlowa	2145	477	24(30)
Makambako	Kitandililo	3666	520	26(30)
Imalinyi	Igodivaha	1684	373	19(30)
Total		12485	1968	99(120)

NB. Figures in parentheses indicate actual number of households interviewed

3.2.2 Primary data collection

Primary data collection methods included: participatory rural appraisal (PRA), questionnaires, unstructured interviews, semi structured, participatory observation, focus group discussion, and review of secondary information. PRA tools used are well documented by Chambers (1992).

3.2.2.1 Participatory Rural Appraisal (PRA)

Chambers (1992) defines PRA as "A growing family of approaches and methods to enable local people to share, enhance and analyze their knowledge of life and conditions, to plan and to act". For the purpose of this study the PRA tools involved participatory mapping, matrix scoring and ranking, wealth ranking, pair wise ranking, seasonal calendars and resource map and historical trend analysis These tools were selected because they allow local people to apply their knowledge, experience and capacity to share information (Luoga, *et al.*, 2000). The information gathered through PRA helped to assess contribution of bamboo to household income and food security. Matrix scoring, ranking and pair wise ranking were used to shortlist and finally select a bamboo product which is most popular in the study area for further economic analysis. The village committee members and 32 villagers in the four sample villages were involved in doing the exercises.

3.2.2.2 Questionnaires survey

Questionnaire survey was used to solicit socio-economic information from the households that govern bamboo farming and business in the area. Basic information of household, information of crop production, livestock keeping, utilization of bamboo, contribution of bamboo to household income and food security and marketing was collected. Before embarking on a major survey, a pre-testing of questionnaires was done to 10 households to check the reliability of the questionnaires, ability and likelihood of the interviewees in understanding and answering questions and minimize possibilities of missing relevant information. The questionnaires were designed to obtain both quantitative and qualitative data in which both open and closed-ended questions were used to solicit information. Three types of questionnaires were designed and administered to three different target groups: households, middlemen and businessmen (Appendices 1, 2 and 3).

3.2.2.3 Unstructured interviews

Checklists were prepared and used to collect information from key informants. This was guided interview in which some questions and topics were predetermined and more questions emerged during discussion. The interviews were used to solicit information from key actors and a few focus groups at different levels. The method supplemented the information obtained from questionnaires and PRA. Key informants were representatives from Agriculture section, Land and Natural resource section from district and ward level dealing directly or indirectly with bamboo and bamboo products activities.

3.2.2.4 Participant's observation

This method was used to collect qualitative data of different activities, behavior, relationship, phenomena, network or process in the field. Curiosity and willingness to learn were the tools (Kajembe and Luoga, 1996). This method linked the observed

information to the responses from four study villages. Supplementary information was collected through personal observation in the field and in the market for the purpose of cross checking information obtained from the questionnaire survey such as information on number of culms, farm size and site.

3.2.3 Secondary data collection

Secondary data was obtained from research records and reports available from various sources at village, ward and district levels. Other information was also collected through literature search, from reports, and other relevant document from Sokoine University of Agriculture library (SNAL), Tanzania Forestry Research Institute (TAFORI) and Internet search.

3.3 Data analysis

3.3.1 PRA data

This was analyzed with the assistance of the local people right in the field and the information obtained was communicated back to them. During analysis in all four villages bamboo wine came out strongly as the main dependable product from bamboo followed by other uses like construction materials, fodder and fuel wood.

3.3.2 Descriptive and inferential statistics

Data collected by questionnaires was analysed using the Statistical Package for Social Sciences (SPSS) and excel computer programmes. Descriptive statistics such as percentages, frequencies and cross tabulations were used to analyse socio economic characteristics of the study area and sales in the local markets. A One way Analysis of Variance (ANOVA) was done to compare the means of income from bamboo between the four surveyed villages. Student's t-test was used to compare the means of bamboo wine

income between the two surveyed divisions. Pearson's χ^2 test for goodness or fit was used to measure the overall discrepancy between the observed and expected frequencies MaCein, (2002).

$$\chi^2 = \sum \frac{(O-E)^2}{E} \quad \text{.....(vii)}$$

Where O = Observed value

E = Expected value

3.3.3 Economic analysis of bamboo wine

3.3.3.1 Soil Expectation Value (SEV)

SEV was used in economic analysis (formula ii) because bamboo like any other forest has assumptions mentioned under section 2.7.2 page 18.

Bamboo grows in continuity, where new shoots always come out to replace old ones. There is no record which shows the rotation period for this species and bamboo operations are done yearly (n = 1). Labour was assumed to have a shadow price of zero because of persistent unemployment in the area, and the opportunity cost of labour was also very close to zero because there was no commercial farming. However, the real discount rate was used as guiding discount rate. The nominal discount rate was 18% (NMB personal communication). The Real Discount Rate (RDR) was derived from Nominal Discount Rate (NDR) and the Inflation Rate (IR) i.e. RDR = (NDR – IR)/ (NDR + 1) whereby the current inflation rate was 5.9 % (Table 3). Therefore RDR = (0.18 – 0.059)/ (0.18 + 1) =10.2% (Luoga *et al.*, 2000).

3.3.3.2 Sensitivity analysis

Sensitivity analysis was carried after identification of sensitive variables like labour costs, revenues and different discount rates, which were likely to have significant impact on the profitability of the bamboo production (formula vi, section 2.7.7 page 21). Direct benefits consisted of revenues received from bamboo products sales, while net revenue was calculated as the difference between annual revenue and cost, i.e. net revenue (revenue minus direct costs). Assumptions on this study were:

(i) Inflation rate will increase each year by 1% (Table 3)

(ii) Shadow wage was set at 100% (TAS 45 000 per person per month) and farmers will employ a casual labour during harvest for six months.

(iii)The shadow wage will increase each year by 50% (as was the case of 2006/2007 where the government minimum pay rose from TAS 45 000 (2005/2006) to 70 840 per person per month), and

(iv) Income from bamboo products will not increase due to low market price.

3.3.4 Content analysis

Data from participant's observation and that from unstructured questionnaire were analyzed by content by interring meaning and relationship words and concepts which the data explain (Lehman and Richard, 1991).

3.3.5 Strength, Weakness, Opportunities and Challenges analysis

SWOC analysis of bamboo wine was done to provide the basic frame within which to perform analyses of decision situations (Section 2.8 page 23).

3.4 Limitations of the study

The study had two limitations:

(i) Majority of respondents in the study area did not keep records of their activities or products. Sometimes it was even difficult to mention the number of culms and size of land area they own which posed a problem during related data collection exercise. Therefore, collection of the required information depended mainly on the memory of respondents, which was difficult for many of them. As a result, probing had to be employed in order to get close approximations of truth.

(ii) Respondents thought that after this research bamboo wine will be taxed.

The situation was addressed by informing the respondents on the objective of the study which was aiming to promote bamboo farming and products, to solve any problem facing bamboo farming and products in order to increase the economy of local communities in Njombe district. This was later responded positively by respondents.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter is divided into nine sections which include; house hold social economic profile, utilization of bamboo, marketing of bamboo products, current and potential of bamboo wine, contribution of bamboo in household income, contribution of bamboo to food security, economic analysis of bamboo SWOC analysis of bamboo and problem in bamboo farming and marketing.

4.1 Household Socio-economic profile

This section presents socio-economic characteristics of the respondents in the study villages. It is considered that the socio-economy of the respective population influences the business of bamboo in terms of planting, management and selling of the products. The discussion covers education, ethnicity, household economy, land acquisition and ownership, bamboo farming and its utilization.

4.1.1 Respondents education levels

Results indicated that about 63% of households had primary education, as opposed to 34% which did not have any formal education (Table 4). Moreover χ^2 showed that there was significant difference at 0.05 level of significance in terms of level of education between villages (Table 4). More than half of respondents in Mlevela village had no formal education. From these findings it can be concluded that this society had low level of education indicating that farming and utilization of bamboo in the study area was based on the long experience than formal knowledge and skills. However, this level of education was enough to undertake and adopt new intervention. Bamboo improvement technologies

can easily diffuse into the society, as increased levels of education has a positive impact in awareness creation in tree planting (TAFORI, 2004).

Table 6: Characteristics of respondents in villages surveyed in Njombe District, Tanzania

		Responses					
Scio-economic attribute		Mlevela (n=30)	Igodivaha (n=30)	Kitandililo (n=30)	Mlowa (n=30)	Total (n=120)	χ^2 and P value
Education	No formal	17(57)	9(30)	6(20)	9(30)	41(34)	18.986 P=0.004
	Primary	13(43)	18(60)	24(80)	21(70)	76(63)	
	Secondary	0(0)	3(10)	0(0)	0(0)	3(3)	
Gender	Male	21(70)	25(83)	27(90)	14(47)	87(73)	16.510 P=0.001
	Female	9(30)	5(17)	3(10)	16(53)	13(27)	
Marital status	Single	1(3)	0(0)	1(3)	0(0)	2(2)	8.084 P=0.526
	Married	23(77)	27(90)	27(91)	26(87)	103(85)	
	Divorced	0(0)	1(3)	1(3)	1(3)	3(3)	
	Widowed	6(20)	2(7)	1(3)	3(10)	12(10)	
Ethnic	Bena	29(97)	30(100)	26(87)	29(97)	114(95)	12.982 P=0.370
	Muanji	0(0)	0(0)	1(3)	0(0)	1(1)	
	Pangwa	0(0)	0(0)	1(3)	0(0)	1(1)	
	Hehe	0(0)	0(0)	2(7)	1(3)	3(2)	
	Kinga	1(3)	0(0)	0(0)	0(0)	1(1)	
Land acquisition	Inherited	27(90)	30(100)	17(57)	20(66)	94(78)	21.982 P=0.001
	Purchased	2(7)	0(0)	6(20)	5(17)	13(11)	
	Given by government	1(3)	0(0)	7(23)	5(17)	13(11)	
Land ownership	men	24(80)	28(93)	27(90)	20(67)	99(83)	8.947
	women	6(20)	2(7)	3(10)	10(33)	21(17)	P=0.030

Figures in parentheses indicate percentage

4.1.2 Respondents gender and marital status

Of the total respondents, 73% were males and 27 % females. Most of the respondents (85%) were married compared to 2% who were singles. More than half of respondents in

Mlowa village were female, as opposed to other villages where most of respondents were males, resulting into significant differences in terms of gender between villages (Table 6). Most households are headed by men while female headed household were for widowed and divorced women. Gender and marital status can influence bamboo economy mainly in decision making. For men headed houses, decision on the area to be planted with bamboo was under men. In case the man was interested the business would be done and vice versa.

4.1.3 Ethnicity

The study area has mixed ethnic groups. The majority (95%) were Bena followed by Hehe (2%). The Kinga, Wanji and Pangwa contributed about 1% each. This composition is more or less the same across the study village (Table 6). Bena are the native to Njombe District and the history of bamboo cultivation and utilization in the district was reflected to cultural aspects of the main ethnic group..The Bena tribe has more indigenous knowledge on management and utilization of bamboo in the study area than other ethnic groups but all tribes were involved in practicing the bamboo farming. Similar situation was reported from China where bamboo management and use was reported to have strong cultural ties (Pérez *et al.*, 1999).

4.1.4 Land acquisition and ownership

About 78% of households inherited their land and 11% were allocated by village governments and the remaining 11% purchased from other households which had larger pieces of land (Table 6). Findings from χ^2 analysis indicated that there was significant difference in terms of land acquisition and ownership between the villages. Almost all land acquisition in Mlevela and Igodivaha villages was through inheritance. Increasing in

population will cause land fragmentation and lessen household land sizes and ultimately affecting bamboo farming due to other land uses like agriculture.

The bamboo farm/plot was usually owned by men in most households (82.5%) as according to the Bena tribe customs, women were not entitled to inherit land, and therefore the power in deciding what to do with the piece of land lies on the hands of men. The right on land was vital, not only because of its economic value but also primarily because it was the basis to conduct other economic activities. It gives people the right to settle or return to a place, gives access to other social relationships which can provide social security, and generally strengthen a women's bargaining position vis-à-vis her husband and relatives (Yang and Sucuiwei, 2004). The situation of the divorced woman was even worse. It was reported in the study area that woman usually loses land and other family properties to the husband's relatives once she gets divorced. Women's right to land was a very complicated issue and varies considerably with time and location.

4.1.5 Household economy

4.1.5.1 Main occupation

The main occupations of the respondents were in four main categories: farming, petty business, employment and casual labour. The larger number of respondents (95%) in Njombe district comprised of farmers, Pearson Chi square analysis (χ^2) indicated no significant difference in terms of occupations among villages in the study area (Table 7). This implies that farming is the back born of these societies as most of households are actively involved in farming as a main source of food and income. Most residents use hand hoe in land preparation, seeds sowing and weeding. The whole family participate in farming activities.

4.1.5.2 Types of agricultural crops

Maize was the main staple food as all households grow maize either by mixing with other crops or as monoculture (Table 7). It was found that Mlevela households grow maize, beans and round potatoes only while in Igodivaha they grow maize, beans, round potatoes, sunflower and wheat. These villages (Mlevela and Igodivaha) are in the same location and weather. This was probably because 70% of Igodivaha villagers have formal education as compared to only 43% from Mlevela. This means Igodivaha village has relatively higher opportunity of generating income from different types of crops than Mlevela village. For the case of Kitandililo and Mlowa which are in the drier parts of Makambako Division, most households grow maize, beans and very few grow round potatoes. Few households (3%) in Kitandilo tried to grow wheat. From the four surveyed villages, those which receive relatively high rainfall have more opportunities of growing different types of crops than those in drier condition.

Table 7: Household economy in Njombe District, Tanzania

Scio-economic attribute		Responses					
		Mlevela (n=30)	Igodivaha (n=30)	Kitandililo (n=30)	Mlowa (n=30)	Total (n=120)	χ^2 and P value
Main occupation	Farming	30(100)	29(97)	27(90)	29(97)	115(95)	11.165
	Petty business	0(0)	0(0)	2(7)	0(0)	2(2)	P=0.265
	Employment	0(0)	1(3)	0(0)	0(0)	1(1)	
	Casual labour	0(0)	0(0)	1(3)	1(3)	2(2)	
Types of crops *	Maize	11(37)	0(0)	8(27)	6(20.0)	25(21)	68.418
	Maize, Beans and round potatoes	12(40.0)	2(7)	1(3)	5(17)	20(17)	P=0.000
	Maize and beans	7(23)	10(33)	17(57)	18(60)	52(43)	
	Maize and sunflower	0(0)	12(40)	3(10)	1(3)	16(13)	
	Maize, beans and wheat	0(0)	6(20)	1(3)	0(0)	7(6)	
Petty business	Agricultural crops	2(40)	7(51)	2(12)	6(33)	17(31)	27.530
	Carpentry and handcraft	2(40)	2(14)	2(12)	3(17)	9(17)	P=0.070
	Bar	0(0)	1(7)	9(52)	6(33)	16(30)	
	Kiosk	1(20)	1(7)	2(12)	3(17)	7(13)	
	Animal products	0(0)	2(14)	2(12)	0(0)	4(7)	
	Masonry	0(0)	1(7)	0(0)	0(0)	1(2)	
Livestock kept	Chicken	5(21)	6(24)	7(26)	9(41)	27(28)	26.307
	Guinea pigs	4(17)	5(20)	1(4)	1(3)	11(11)	P=0.010
	Cattle	1(4)	3(12)	5(19)	10(46)	19(19)	
	Chicken, guinea pigs, goat and pigs	9(37)	8(32)	10(37)	2(9)	29(30)	
	Pigs	5(21)	3(12)	4(15)	0(0)	12(12)	

* Bamboo is not listed because it has been taken separately as a special long term non wood forest products.

It was found that maize is grown for both household consumption and marketing. Maize was further used in preparation of local brew during shortage of bamboo wine. Other crops like beans, round potatoes, wheat and sunflower if produced in large quantities are sold at farm gate price or in the market. Crop diversification is very important in stabilising the household economy as dependency on one crop could be risky because of unforeseen circumstances. Chi Square test also indicated that there was significance difference in types of crops grown across villages (Table 7).

4.1.5.3 Livestock keeping

About 28 % of households keep livestock (Table 7). Livestock keeping was very common for home consumption, sales and farm manure. Cattle were also useful as drought animal for farming, particularly in Kitandililo and Mlowa villages. Sometimes they earn money by hiring the oxen to others for land preparation prior to the rain season. It was found that Mlowa households keep more chicken and cattle compared to other villages. This was due to availability of market at Makambako town. Furthermore livestock keeping does not influence communities engagement in bamboo economy but with an advantage of using bamboo leaves as fodder. Even the findings from Pearson Chi square analysis shows that there was significant difference in terms of livestock keeping between villages (Table 7).

4.1.5.4 Petty business

Petty business was practiced by nearly 45% of respondents and was strongly related to the cropping systems, as leading pet business was of selling agricultural crops Pearson Chi Square analysis showed no significant difference in terms petty business done among villages (Table 7). The agricultural crops sold include maize, sunflower, wheat, round potatoes, and beans. This business was done in all the four villages (Table 7). Some crops were transported to distant markets in Njombe and Makambako. Kiosk business was done in all the four villages by selling small household items like soap, salt, sugar and cooking oils. Local bars normally sold bamboo wine during the season and maize brew within the village. The local bar business was not reported by Mlevela village respondents but was a leading one at Kitandililo village as more than half of respondents conducted it. Mlevela villagers usually drink bamboo wine at home in free after harvesting instead of using local bar. Animal products which were sold included milk, eggs, chicken and meat (pork and

beef). Masonry, carpentry and handcraft were done locally through construction of houses, furniture and basket (matenga) making.

4.1.6 Bamboo farming

The results revealed that all respondents practiced bamboo farming (Table 8), implying that bamboo farming played a very big role in the household economy either directly or indirectly. The costs of growing bamboo were generally low and thus initial capital was not a constraint in bamboo farming. In fact bamboo farming costs were considered negligible by the household. Bamboo culms were intercropped with other agricultural crops, along the boundaries or as a monoculture. It was observed that bamboo was suitable in agroforestry if planted carefully to avoid shade and root system interactions. Similar observation was reported by Shanmughavel and Peddappaiah (2000) in India that bamboo was suitable in agroforestry if well managed. According to Singh *et al.* (2003), bamboo is important from childbirth to death and every household maintains a bamboo colony of certain species in their private land.

4.1.6.1 Planting stock

About 89% of households reported to obtain planting materials from their own farms while 11% obtain from their neighbours (Table 8), indicating that planting stock was obtained freely, reducing further the cost of bamboo farming. The knowledge of how to extract the planting stock and how to plant was available among households. For the new ones in the village the knowledge is obtained by asking the fellow villagers to instruct on how to plant new culms and space in between as this knowledge was indigenous to the area. This knowledge is disseminated through physical observations amongst community

members. The Pearson Chi square analysis showed that there was no significant difference in terms of where they obtain planting stock among villages in the study area (Table 8).

Table 7: Responses on bamboo farming in Njombe District, Tanzania

Socio-economic attribute		Responses					
		Mlevela (n=30)	Igodivaha (n=30)	Kitandililo (n=30)	Mlowa (n=30)	Total (n=120)	χ^2 And P value
Bamboo farming	Yes	30(100)	30(100)	30(100)	30(100)	120(100)	
Place grown	In drier areas	21(70)	20(66)	28(94)	30(100)	99(83)	21.169 P=0.012
	In wet areas	8(27)	8(27)	1(3)	0(0)	17(14)	
	Drier and wet valley	1(3)	2(7)	1(3)	0(0)	4(3)	
Source of planting stock	Own farm	27(90)	29(97)	27(90)	24(80)	107(89)	4.400 P=0.221
	Neighbour	3(10)	1(3)	3(10)	6(20)	13(11)	

4.1.6.2 Place grown for bamboo

About 83% of household's planted bamboo in drier area, 14% in wet areas while 3% in both wet and dry areas. The bamboo farms which were in drier places influence bamboo production especially during dry period (no wine production) but for a case of bamboo grown in wet area (Vinyungu in Bena local language) the production was throughout the year. This indicates that bamboo production can be influenced by water availability in the soil. All bamboo in Mlowa village for example was planted in rain-fed dry areas (Table 8), indicating that bamboo wine in this place was available only during rain season. Findings from Pearson Chi square analysis showed that there was significant difference between villages in places where bamboo was grown. This meant that there was a shortage of bamboo wine during dry season.

4.1.6.3 Land area available for bamboo farming

The results summarized in Table 9 gives details of arable land per household against areas planted with bamboo. The average arable land per household in the study area was 2 hectares. The average land planted with bamboo was 0.5 hectares per household (25%). The average arable land was 1.4, 2, 2.5, and 5.75 hectares in Mlevela, Mlowa, Igodivaha, and Kitandililo villages respectively. However Chi square analysis showed that there was no significant difference in terms of average arable land and land planted bamboo between villages in the study area (Table 9), although Kitandililo households had larger arable land compared to other villages hence more opportunity of expanding bamboo farms. This means that land ownership was not an important factor for someone to engage in bamboo farming.

Table 8: Average arable land and land planted with bamboo in hectares in Njombe District, Tanzania.

Variable	Mlevela	Igodivaha	Kitandililo	Mlowa	Overall avarage	χ^2 and P value
Average arable land (ha)	1.4	2.5	5.75	2	2	67.893 p=0.057
Land planted with bamboo(ha)	0.5	0.5	0.4	0.5	0.5	37.319 p=0.277

Although bamboo grown for wine production in wet valleys could produce wine throughout the year, people introduced tomato farming which was claimed to have a high pay-off than bamboo wine. This endangers the future of bamboo farming. However, if calamity like diseases, pests or drought happens to tomatoes then households economy will be affected.

4.2 Utilisation of bamboo

4.2.1 Bamboo as a source of wine

The study showed that bamboo wine was the major product obtained from bamboo (Fig. 3), and each household plant bamboo species suitable for producing bamboo wine (*Oxytenanthera braunii*). These questionnaire results tally well with PRA results which indicated that wine was the major product from locally grown bamboo in the district.

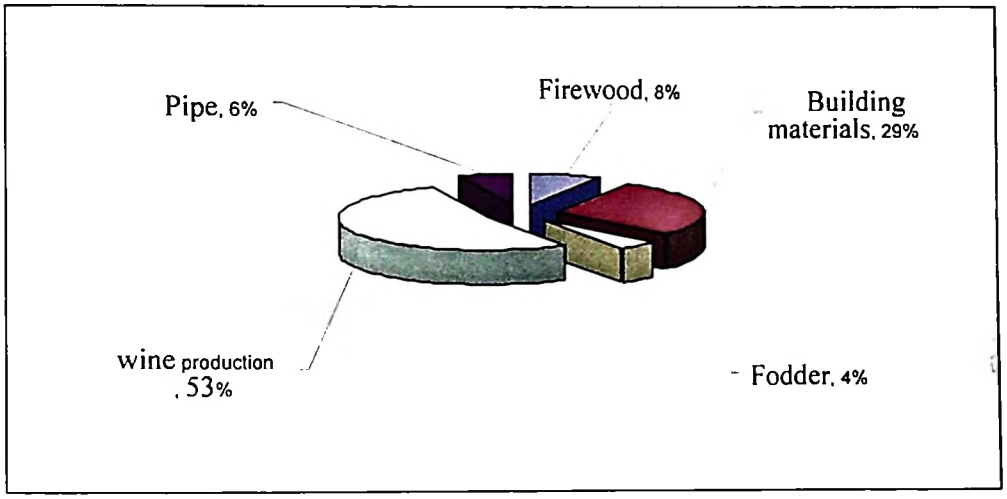

Figure 3: Different uses of bamboo in Njombe district, Tanzania.

Tapping of bamboo juice was done by using sharp local knife where by young shoots of bamboo culms were cut off slanted and the stem portion is bruised every morning and evening. The exudates from each cut and bruised shoot are then collected in a container made up from mature bamboo stem called "mbeta" tied at the cut place and bamboo juice tapped (Plate. 1).



Plate 1: Taping bamboo wine from young culms in Njombe District, Tanzania

Collection of bamboo juice was done twice a day, early in the morning and late evening. Bamboo juice was collected in a plastic bucket and carried home with bamboo leaves dipped into the wine (Plate. 2) to control shacking when carrying juice home. The juice was then sieved and stored in plastic buckets and allowed to ferment naturally to become bamboo wine (ulanzi) the highly cherished alcohol drink by the people in the vicinities and some townships. There was no any chemical involved during harvesting or storage of wine. The disadvantage with bamboo wine however is that its shelf life is not more than one day (it is a perishable material). After one day the taste changes and becomes a very strong bamboo wine "Mkangafu". Further more there was no available local technology to cane or bottle the wine in the study area. Meanwhile the research for possibility of canning and bottling the wine is going on in Iringa town at Dabaga Fruit Canning Factory. Bamboo wine produced at households can be used locally as beverage during farming, ceremony or sold to middlemen. Mosha *et al.* (1996) reported that production of bamboo wine goes beyond restrictions to social and ceremonial roles. When carrying out research on processing (filtering, pasteurizing and canning) bamboo juice, Bangu *et al.* (2006)

found that the processed product was found acceptable although not as good as the unprocessed one.



Plate 2: Bamboo wine after harvesting in Njombe District, Tanzania

4.2.2 Bamboo as building material

Use of bamboo as a source of building materials was reported by 29% of respondents (Fig. 3). It was observed that, bamboo was formally used as roofing material in place of corrugated iron sheets especially for households with low income. However, the situation had changed due to improvement in income levels thus most people used corrugated iron sheets. Bamboo poles and leaves are used in roof construction. The poles are also sometimes used as ceiling material. Furthermore, people used bamboo in construction of grain storage facilities known as "Vihenge" and making hedges. Bamboo provided cheap alternative to metal and plastic containers in grain handling. However, use of bamboo in construction and other engineering structures need be taken with precautions as bamboo

deteriorates quickly. The life span of bamboo when is in contact with soil may be only 1 - 3 years (Baqui, 1994).

In India studies by Muraleedharan *et al.* (2004) found that there are several constraints in promotion of bamboo houses in towns and these include: poor economic conditions of the dwellers, low availability of bamboos in the construction sector and high prices of bamboo. Nevertheless, bamboo-made constructions appear to have a good market potential in developed countries such as Italy (Vantomme *et al.*, 2003).

4.2.3 Bamboo as water pipes

About 6% of households reported to use bamboo in making water pipes (Fig. 3). The use of bamboo water system was quite feasible, cheap and easy to implement. The outstanding advantage of bamboo pipes over conventional ones in the study area was that bamboo was abundant therefore farmers could install and maintain pipes at any time needed. The pipes installed were of short distance and commonly used when watering tomatoes in swampy areas crossing to other side. The bamboo culms used in installing pipes were thick and straight with short inter node lengths as these are strong and durable as opposed to those with long inter node lengths. The use of bamboo as water pipes was also reported by Lipangile (1990) and Wong (1995) in Tanzania and Malaysia respectively.

4.2.4 Bamboo as source of food

It was revealed that some households used fresh bamboo juice which is sweet when cooking porridge instead of sugar. It was reported that, the young bamboo culms were sweet therefore are chewed as sugar cane by children. The tradition of using young bamboo calms as direct source of food was not common in the study area. However, the

habit is very common in other parts of the world. For example it was revealed during PRA that during construction of Tanzania-Zambia Railways (TAZARA) Chinese workers used young bamboo shoots as food as they were familiar with the use of shoot as delicious food in their country. Also, results were reported by Kigomo (1995) and Bhatt *et al.* (2004) that shoot production for food was more common in oriental countries of Asia especially China, Japan, Taiwan and Thailand. He further indicated that, in east Africa, young shoots of *A. alpine* was eaten by local people in the Mount Elgon area of Uganda. Hunter (2003) reported that edible bamboo shoots have developed rapidly in world markets.

4.2.5 Bamboo as source fodder

Use of bamboo as source of fodder was reported by 4% of respondents (Fig. 3). The use of bamboo leaves as fodder material was reported by all households keeping herbivore livestock in the study area. Leaves were being cut from old culms or from those culms which were removed as building poles. For those households practicing zero grazing, leaves were collected from the farm and chopped into small pieces ready for feeding animals. Free range animals fed directly in the farm after cutting the old culms. It is further explained that bamboo leaves play a big role as fodder especially during the dry season when grass become scarce. Use of bamboo as fodder is also reported by Azzini *et al.* (1995) in Malaysia where bamboo shoot residues (sheaths and pieces of soft culms) were found to have high contents of protein (131.4 g/kg), sugars (115.3 g/kg), fibres (235 g/kg and hydrocyanic acid (213 mg/kg). However, the later has to be removed by boiling for 20 minutes.

4.2.6 Use of bamboo in furniture making

Use of bamboo in furniture making was not very common in the study area except for only making small items like baskets, chairs, benches, winnowing items and mats. The species

(*O. braunii*) was found not so suitable for furniture making, but used mainly in the production of a bamboo wine (Chihongo *et al.*, 2000). However, bamboo is used intensively in Far East countries as source of materials for furniture making. Unfortunately, in many other places they are viewed as inferior products, labeled as the "poor man's timber" (Pérez *et al.*, 1999).

4.2.7 Use of bamboo in soil conservation and land demarcation

The results indicated that 85% of the respondents used terraces for soil conservation especially in the sloppy areas while the rest (15%) use bamboo. It was observed that bamboo culms are planted across the slope in areas with steep slopes in order to control soil erosion. Bamboo have a fibrous network of roots (intermingled roots) whereby they become so strong in such a way that it was not easy for the soil to be eroded. Furthermore the use of bamboo in conservation supplements efforts used in soil conservation through trees planting. Because of the extensive rhizome system spread primarily in the top part of soil, bamboo works well to prevent soil erosion occurring in flood plains, along riverbanks and on steep hillsides. Reports on the use of bamboo in soil conservation in India are also given by Shanmughavel and Peddappaiah (2000).

About 38.3% of the respondents used bamboo culms in land demarcation in Njombe district (Plate 3) while 47.5% used difference tree species for demarcation. Others (7.5%) used sisal and the rest (6.7%) do not used any biological boundaries or mark.



Plate 3: Farm boundary bamboo planting in Njombe District, Tanzania

4.2.8 Other uses of bamboo

Bamboo was used as fuel although its use was limited to only 8% of the respondents (Fig. 3). Most of the household which use bamboo poles as fuel were those living far away from forest areas and those with no woodlots. Similar results were reported by Perikesit *et al.* (2001) who found that the role of non forest fuelwood including bamboo (*Gigantochloa apus*, *G. atter, G. verticillata* and *Bambusa vulgaris*) in fulfilling domestic energy in rural areas of Indonesia was very significant. Other uses reported during PRA were making of local drums, whistles, use as pesticide and ornamentals.

4.3 Current and potential market of bamboo based products

Large amount of bamboo wine (79.2%) was being sold at the household level and 20.8% carried to the market. Domestic use of other products beside wine was not well pronounced as it was reported by nearly 2% of respondents. It was indicated by household that the government does not have any interest with bamboo wine hence leaving the business to private traders (100%). It was also noted that farmers have no the capacity to

transport large amount of liquor to the market and have depend on middlemen. No license or permission is needed to sell bamboo wine and no tax was paid at household level. This is a very positive move in promoting bamboo business and fighting poverty.

Unfortunately, dissemination of new technologies from research centers was very limited in the area because there were no directives or services on farming and marketing of bamboo products from either Forest or Agriculture Departments. This was due to fact that extension personnel have scarce knowledge on bamboo farming and harvesting. This assistance is strongly needed by these communities but not delivered according to the farmers., the needed assistance include education on bamboo farming (33%), market for bamboo products (35%), access to loan for improving bamboo farming (7%) and fertilizer loans for agricultural crops (5%). The need for transport and land was reported by very few respondents (5% and 3% respectively) indicating that they are not limiting factors in bamboo production.

4.4 Contribution of bamboo in household income

The average annual household income from bamboo products and other sources are presented in table 10. Compared to National per capita income, which is about 340 USD (equivalent to about TAS 428 400) per year, no village could be considered economically better off because of bamboo farming, despite the indication that in all four villages bamboo products are the main contributors to the household income (Table 10).

Table 9: Summary of average yearly household income (TAS) from four villages in Njombe District, Tanzania

Income sources	Mlevela (n=30)	Igodivaha (n=30)	Kitandililo (n=30)	Mlowa (n=30)	All (n=120)	χ^2	P value
Bamboo	390 900 (68.8)	419 444 (63.2)	350578 (39.6)	407 125 (54.2)	392 012 (56.6)	286.933	0.267
Agriculture	150 600 25.5)	185 000 (27.9)	232 600 (32.1)	178 900 (23.8)	186 800 (27)	284.000	0.357
Livestock	17 600 (3.1)	19 700 (3)	55 400 (7.7)	52 200 (7)	36 200 (5.2)	136.947	0.437
Petty business	9 200 (2.6)	39 400 (5.9)	149 400 (20.6)	112 800 (15)	77 700 (11.2)	92.725	0.576
Total	568 300 (100)	663 544 (100)	787 978 (100)	751 025 (100)	692 712 (100)	344.000	0.505

Note: Exchange rate in year 2006 1USD = 1 260 TAS

Figure in parentheses presents percentages

The highest income from bamboo products per household is seen at Igodivaha village in Imalinyi Division. However Analysis of Variance (ANOVA) showed that this income was not significantly different from other villages (p=0.598) (Table 11). Kitandililo village had the highest income from agricultural crops, livestock and petty business. Moreover, Chi square test indicated no significance difference on income from agriculture, livestock and petty business in all four villages (Table 10).

Table 10: One-Way ANOVA for revenue from selling bamboo products per household

Source of variation	Sum of squares	df	Mean square	F	Sig.
Between villages	1.62E+11	3	5.401E+10	0.629	0.598
Within village	9.96E+12	116	8.588E+10		
Total	1.01E+13	119			

The highest yearly revenue of TAS 787 978 for all products per household was obtained from Kitandililo village in Makambako Division (Table 10). When compared to the set poverty line of less than 1 USD per day (UN, 2005), it can be concluded that no village

live under poverty line. The Analysis of Variance (ANOVA) showed that the value obtained from various sources of revenue were significantly different from other villages (P= 0.042) (Table 12).

Table 11: One-Way ANOVA for total revenue from various sources per household

Source of variation	Sum of squares	df	Mean square	F	Sig.
Between villages	1.88E+12	3	6.266E+11	2.813	0.042
Within village	2.58E+13	116	2.228E+11		
Total	2.77E+13	119			

Similar results reported by Yang and Sucuiwei (2004),in China, indicated that bamboo farming household earned total yearly income of no more than 1,000 Yuan (around USD120) far below the poverty line set by UN. Other studies on bamboo resources of Manipur reported that bamboo shoots, both in raw and fermented forms can earn a large share of household economy to an amount of Rupees 2130 million (USD 45 million) annually for the nation as a whole (Singh *et al.*, 2003). It was also found that an average bamboo handicraft maker obtained MK 20 684 (USD 190) per year from the cash sales of assorted handicrafts in Malawi (Sosola-Banda and Johnsen, 2005).

Comparison of incomes from bamboo between villages closer to the market villages (Mlevela and Mlowa) and far from the market villages (Igodivaha and Kitandililo) using t-test showed that there was no significant difference (t=0.251, df=118, p=0.802) for bamboo wine income between villages. Therefore distance from the market has no effect on the income from bamboo wine.

It was further revealed that 49% of the total household income in the study villages was obtained from bamboo products, 32% generated from other agricultural products.

Furthermore, 13% of the household income was generated from petty business while livestock keeping generated only 6%. These results indicated that bamboo contributes higher percentage in household income per year (Fig. 4) hence the dependence of livelihoods of these communities to bamboo.

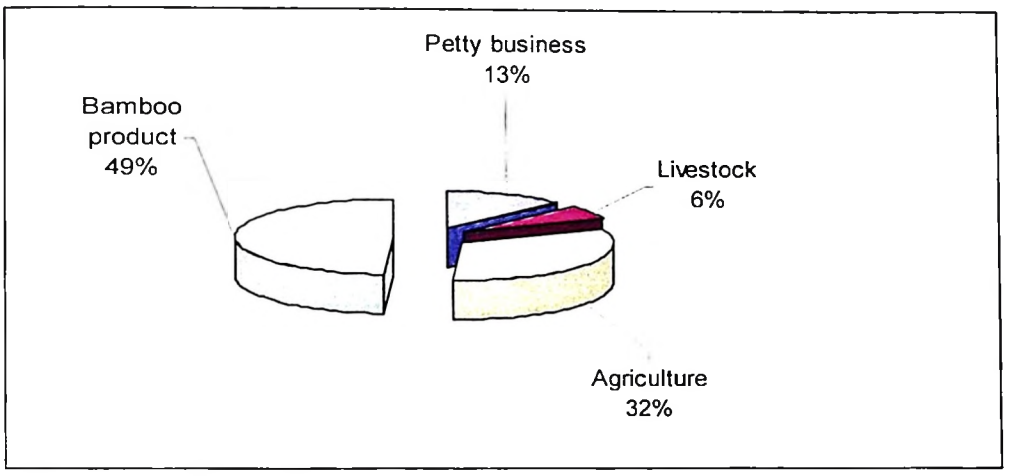

Figure 4: Percentage of household income sources in Njombe District

Study by Li (2002) in India indicate that ratio of bamboo income to whole income of most households varied from 0 to 70 percent when studied the role of *Phyllostachys heterocycla* var. *pubescens*. The revenue from bamboo in Njombe was almost twice that reported by Pérez *et al.* (1999) for the Anji County in China, Pérez *et al.* (1999) reported that about 25% of household economy came from bamboo and was the second most important source of income after off-farm work.

While in Njombe other bamboo products beside wine do not have much influence in household economy, Yang and Sucuiwei (2004) reported that bamboo chopsticks, bamboo shoots and bamboo weaving handicrafts were three main types of bamboo products closely connected with the local people's livelihood and household economic status in Xiang, China. This indicates the importance of bamboo products as NWFP.

The value of NWFP should not be underemphasized. For example, Nyingili, (2003) reported that NWFPs contributed 7.5% of total household income in Mbozi district. Lema (2003) reported that 51% of income in rural households in Morogoro rural District was obtained from selling of NWFPs. Development groups in China proposed bamboo production as an opportunity for increasing the wealth of the lower income groups (Pérez *et al.*, 1999).

4.5 Contribution of bamboo to food security

Despite the fact that majority of households (62.5%) were self sufficient in food requirements, 37.5% of respondent reported to supplement staple food through purchases using about 36% of income obtained from sales of bamboo wine and other products. The purchased food materials include maize, beans, vegetables, fruits, cooking oil, sugar, tea leaves and salt. Other expenditures beside food include paying school fees (21%), buying clothes (12.5%), construction of modern houses (11%) expanding other business (10%), and medical services (5%). The use of income from bamboo for buying food may be considered to contribute to household food security.

Similar findings are reported by Mapolu (2002). The author showed that in Tabora District, collection and utilization of NWFPs had a direct contribution to household food security. Similar situation was also reported by Nyigili (2003) for Mbozi district where 59% of income realized from sales of NWFP was reported to be used for buying food items. In Asia bamboo also play an important role in food security (Pérez *et al.*, 1999; Li 2002). The income from bamboo was mainly sourced from dried bamboo shoot and was used to buy daily life items like oil, salt, and clothes to high-level life need items like televisions, motorcycles, and washing machines.

4.6 Economic analysis of bamboo

4.6.1 Soil Expectation value (SEV)

The economic analysis presented in this chapter is guided by the assumption that there were no costs of equipments because they were of very low capital outlay and at the same time are used in other farming activities at household level. Containers for taping wine are obtained free because they were used for other household activities like basket which also used in fetching water.

The results of economic analysis indicated an annual net cash flow of TAS 270 371 per household which is equivalent to SEV of TAS 2 650 607 per household at 10.2% nominal discounting rate (Table 13). The positive value of SEV in all for villages means that farming of bamboo in the study area was profitable. Therefore investment of bamboo was a worth to be undertaking. However, there are variations of SEV between villages, indicating a variable potential of bamboo farming among the study villages.

Table 12: SEV of bamboo farming in four villages in Njombe district, Tanzania

Variables	Mlevela	Igodivaha	Kitandililo	Mlowa	All (average)
Costs (TAS)	158 864	10 798	128 097	188 804	121 641
Revenues (TAS)	390 900	419 444	350 578	407125	392 012
Net cash flow ((Annuity) (TAS)	232 036	408 647	222 481	218 320	270 371
SEV (TAS)	2 274 861	4 006 340	2 181 187	2 140 400	2 650 697

4.6.2 Sensitivity analysis

Table 14 present the results from sensitivity analysis of bamboo products. The results indicated that the anticipated changes in inflation rate would reduce the profitability but will not affect the viability of the business. This means that the bamboo farming in the

study area would still be profitable when considering a unit rise of inflation rate. Assuming that labour has an opportunity cost and valued at TAS 45 000 per person per month, (shadow wage), the SEV was still positive indicated that bamboo farming was economically viable (Table 14). Increasing the shadow wage by 50% i.e. TAS 67 500 per person per month resulted into a negative SEV signifying that the business turned to be not profitable

.

Therefore increasing the shadow wages will affect the farming of bamboo in the study area. When studying management of bamboo stands in Malaysia, Mohamed *et al.* (1997) reported a positive incremental benefit at 70 percent harvesting intensity but when using higher discounting rate the business became unattractive to investors. This may indicate that bamboo farming is most feasible under small-scale production.

Table 13: Sensitivity analysis on bamboo products in TAS per household in Njombe district

Scenario	Model input				
	Discount rate	Labour cost (TAS) per year	Raw materials	Price market (tin^{-1})	SEV/household (TAS) per year
1	Real (10.2%)	121 641	Free	Market rate 2 500 tin^{-1}	2 650 697
2	Increased by 1% (11.2%)	121 641	Free	Market rate 2 500 tin^{-1}	2 366 6 94
3	Real (10.2%)	Wage (45 000 $month^{-1}$)	Free	Market rate 2 500 tin^{-1}	128 412
4	Real (10.2%)	Wage (67 500 $month^{-1}$)	Free	Market rate 2 500 tin^{-1}	-1 1 95 118

4.6.3 Marketing of bamboo products

4.6.3.1 Market chain of bamboo wine

Market survey was done for the most important product (bamboo wine). Bamboo wine marketing consisted of a chain of vertical interactions involving households, middlemen

and consumers. It was revealed that there were four main marketing channels in the marketing system of bamboo wine in the study area (Fig.5). These channels were:

(i) Household → middle men → town pubs → consumer

(ii) Household → local bar → consumer

(iii) Household → town pubs → consumer

(iv) Household → home consumption

Of the four channels, the first two channels were more prominent than the other two and households were more assured of marketing large amount of wine through those two channels. These marketing channels were similar to what was reported by Jayasanker and Muraleedharam (2000), in the study of efficiency of agroforestry product marketing in India.

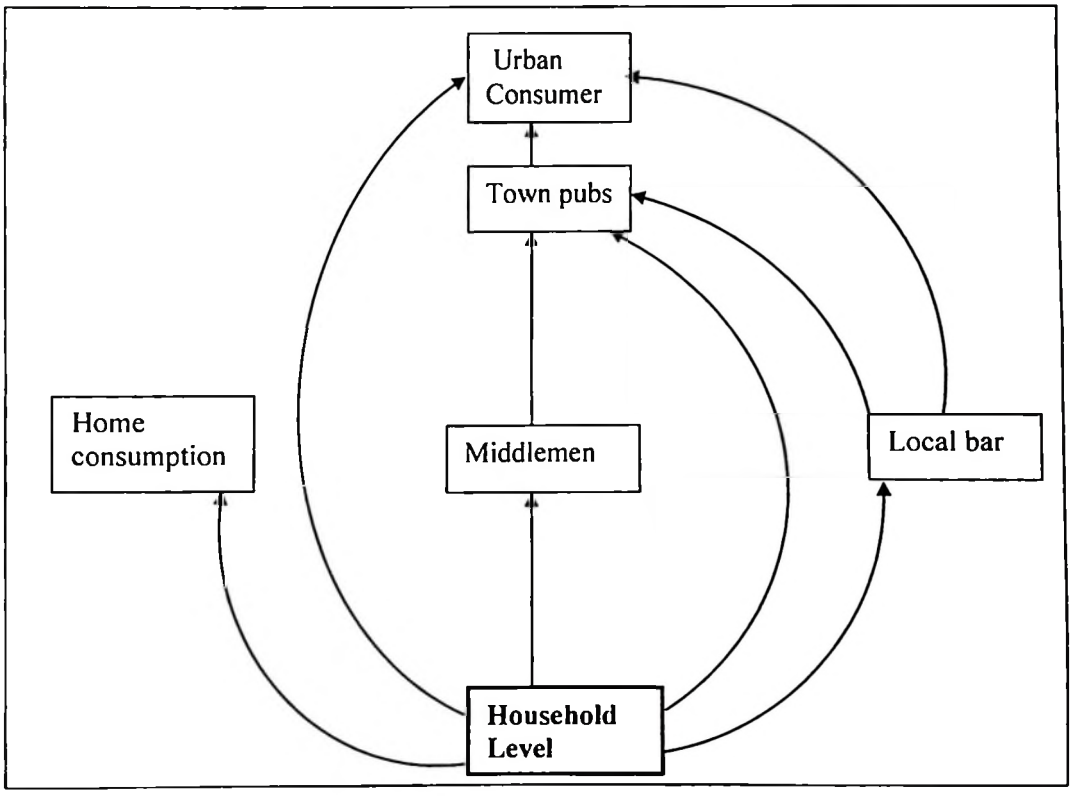

Figure 5: Marketing channels of bamboo in Njombe District, Tanzania

4.6.3.2 Marketing bamboo wine at household level

The amount of bamboo wine at household level produced and distributed differed from one household to another with an average of 62 litres per household per day during rainy season and 12 litres during dry season. After taping bamboo wine an average of five litres (during rain season) and two litres (during dry season) are kept at home for home consumption as beverage and the remaining proportion is sold in the market. The farmer received about 26% of the final market price (TAS 4 166.50/tin of 20 litres) while the remain goes to middlemen and business men (Fig.5). A study by Jayasanker and Muraleedharam (2000), reported that Indian farmers selling bamboo products received about 47.5% of the market price. Bangu et al. (2006) when studying processing of bamboo juice in Iringa town he found that price of Ulanzi in December and May was about TAS 500 per litter but in glut season around March the price slid down to about TAS 50 .

The market for bamboo wine was informal and most bamboo wine tapers were the most disadvantaged as they received the minimum payment in the whole market chain. Similar situation was reported by Duraisamy (2003) when studying Bamboo resources, enterprises and trade development opportunities for livelihood development and poverty reduction in Mozambique, that the trade was informal in rural, urban markets and along roadsides where many entrepreneurs have small enterprises selling raw bamboo, utilitarian items and furniture. Similar experience was reported by Makonda (2003) when studying production and economic potentials of gum Arabic. The system of brokers who earmark households willing to sell the products at a certain price as reported in India (Jayasanker and Muraleedharam, 2000) is not common in Njombe district.

4.6.3.3 Marketing bamboo wine by middlemen and town pubs

Middle men carried bamboo wine to whole sellers and various pubs in town (Njombe and Makambako) using bicycles as the major means of transport. It was noted that each bicycle has the capacity to carry 100 litres per trip. The exercise was usually done once per day. The wine is collected from an average distance of 7.7 ± 1.56(SE) km from different bamboo farmers. Middlemen collect bamboo wine from households at what was known as farm gate price which was about TAS 4 166.50/tin. This price depends on many factors including distance from the market, season, volumes and quantity of the product and the bargaining power of the household and the sub-trader. The average cost of transporting 100 litres of bamboo using bicycle was TAS 1 000.

Having obtained the wine, the pubs sold the product to retail customers. The average sales in Njombe and Makambako divisions were 193 ± 81.02 (S.E.) litres per business man per day and 123 ± 21.52 (SE) litres per business man per day respectively. The average annual gross income of a businessmen was TAS 1 126 679 and 584 769 in Njombe and Makambako respectively. Results of t-test showed that there was significant difference ($t = 2.868$, $df = 39$, $p = 0.007$) of bamboo wine incomes between the two divisions (Njombe and Makambako). Although the test shows significant deferent but still the livelihoods in Makambako town depend on bamboo wine as source of income. Furthermore it implies that Njome business man makes more money from bamboo wine as compared to Makambako town. Income between two towns differ due to different sale price, in Njombe town the price of wine is higher than Makambako town another reason is the formation of association in Njombe town which control price of wine.

4.6.3.4 Marketing bamboo wine by local bars

The local bars played a very important role in consuming the wine. An average of 45 liters of bamboo wine is being sold to consumers in a local bar during dry season and 53 liters during the rain season at a price of TAS 4 000/tin and TAS 1 000/tin respectively. Prices were much lower during rain season as the commodity was abundant.

4.6.3.5 Selling prices

Prices of bamboo wine in different seasons in Njombe and Makambako towns are summarised Figures 5 and 6. The average selling price of bamboo wine in Njombe and Makambako towns differ from one season to another due to availability of wine as during high production (wet season), there is no competition in purchasing bamboo wine in both towns.. The average whole sale price of bamboo wine ranges from TAS 1 000/tin to TAS 5 333/tin in rainy season and dry season respectively (fig. 6). The price of wine in Makambako town was lower than that of Njombe town and wine increases from rainy to dry seasons in both towns (Fig. 7). This was due to strong association of bamboo business men in Njombe town which plays a big role in price control.

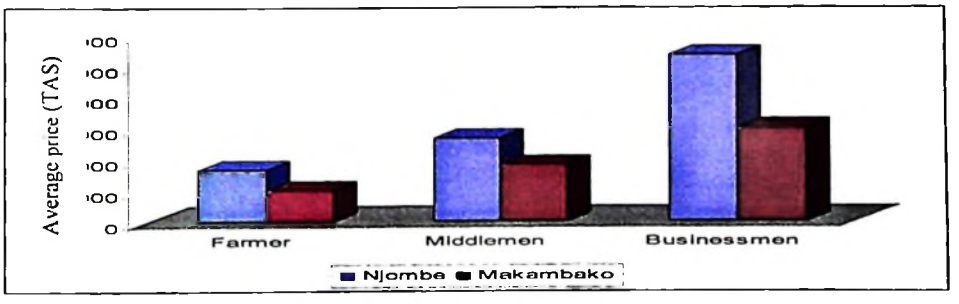

Figure 6: Average price of bamboo wine for different customers in Njombe and Makambako towns at Njombe District, Tanzania

Compared to farm gate price the bulk profit goes to the middle men and final sellers in both towns (Fig. 6).A study done by Krishnankutty (2004) on Marketing of bamboo in South India showed that the wholesale price of bamboo during 2002 was USD 73 per

tonne green weight. He further showed that, of the wholesale price, farm price accounted for 40%, harvesting and other marketing costs 46%, and net margins of the intermediary and wholesaler 14%. The farm price of USD 29 per tonne, which is the net income received by an average bamboo grower, indicates relatively fair returns even from poorly managed clumps. In this study the average yearly household income was TAS 583 900 which is 40% of whole household income.

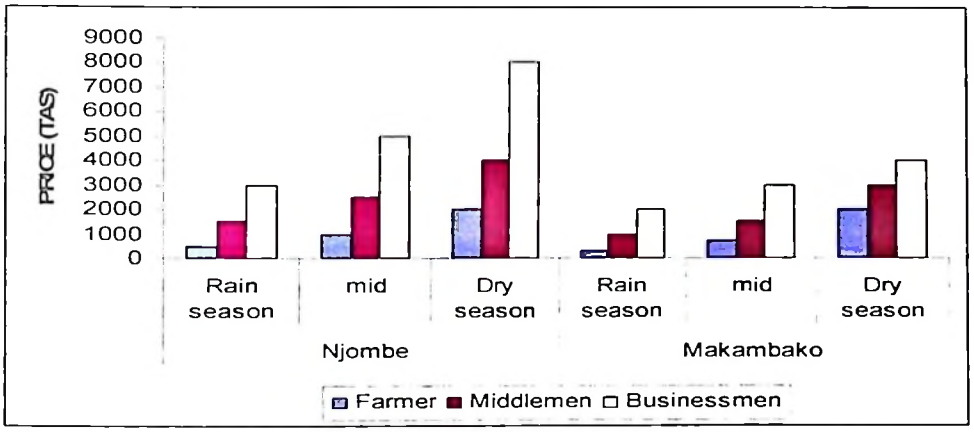

Figure 7: Selling price of bamboo wine for Njombe and Makambako towns in different seasons in the study area Njombe District, Tanzania

4.6.3.6 Price determination of bamboo wine

There are various ways used in determining prices of the product. About 88% of the people dealing with bamboo wine selling determined price by looking/calculating cost and profit margin. The rest sell according to the market situation. All respondents businessmen in Njombe have associations which take part in determining selling prices. There are no associations at Makambako for that purpose because they don't have any idea of how to form such an association. Those in the association get a number of profits as a resulted the average gross income from bamboo wine at Makambako was almost half of Njombe town (chapter 4.3.3). The association helps to make the price stable and ensures increase in

profit margin. Similar situation is reported by Jayasanker and Muralecdharam (2000) that farmers belonging to the union get more development, conservation and financial benefits compared to those who are outside.

4.6.3.7 Local market promotion of bamboo wine

The results showed that about 65% of respondents do not advertise the business. For those who advertise they use place cards (14%), good customer service (72%) and the rest just do it by convincing customers face to face (7%). Having permanent stalls or rooms where a seller giving the service customers can be easily reach was an added advantage. This is done through numbering of doors especially to the place where there are a number of rooms in the same house doing the same business. The exercise enables the customer to locate the room with good service in the following days (personal communication with business man.). It was further revealed that, no cost is being incurred in the promotion of wine.

4.7 SWOC (Strength, Weaknesses, Opportunities and Challenges) to bamboo business

This study identified the Strengths, Weaknesses, Opportunities and Challenges (SWOC) of a bamboo business. A SWOC analysis shows a mirror to oneself and tells where the business stands. All strengths, weaknesses, opportunities and challenges on bamboo farming were analyzed. From the study area it was found that strengths and opportunities for bamboo wine business outweighed weaknesses and challenges (Table 15).There were good number of strengths and opportunities which could be explored in order to make bamboo farming a major source of income in the study area (Table 15). Furthermore, bamboo could be grown sustainably in the study area without any environmental impact or degradation if enough market is ensured.

Table 14: SWOC analysis of bamboo wine in Njombe District

No.	Strengths	Weaknesses	Opportunities	Challenges
(i)	The area is suitable for growth of wine producing bamboo.	Transport facilities do not allow for bamboo wine to be transported to further destination.	Very big market outside Njombe district which has not yet been tapped.	Relating to land-use practices (e.g. change to tomato farming) is considered as a critical challenge.
(ii)	Does not involve costly inputs as other agricultural crops, thus high LEV.	Bamboo wine is the best within 17 hours at 30°C. This does not allow for bulky production short shelf life.	Accessible Government support for the business through farmers groups and SACCOS.	Religious believes that taking wine is a sin.
(iii)	Wine price is low and can be afforded by many customers.	lack of commercialization and marketing skills.	Possibilities of introducing bamboo wine industry which can cane bamboo wine.	Problem of pest which attack bamboo.
(iv)	Minimal management requirements.	Poor sanitation during tapping and storage.	The area is accessible.	
(v)	Multiple use soil conservation, boundary and household incomes.			
(vi)	No processing of bamboo wine involved.			

4.8 Problems in bamboo farming and marketing

4.8.1 Problems at household level

More than half of respondents (52%) indicated that low price of bamboo wine was the main problem. This problem goes hand with that of unavailability of markets (Fig.8) Other problem of, lack of capital for expansion of cultivated land and land security were mentioned by 22% and 18% of respondents respectively. As a reaction to these problems most farmers 65% had replaced bamboo with other tree species. Other 35% have left bamboo culms unattended and ultimately used for fuel, fodder and building materials.

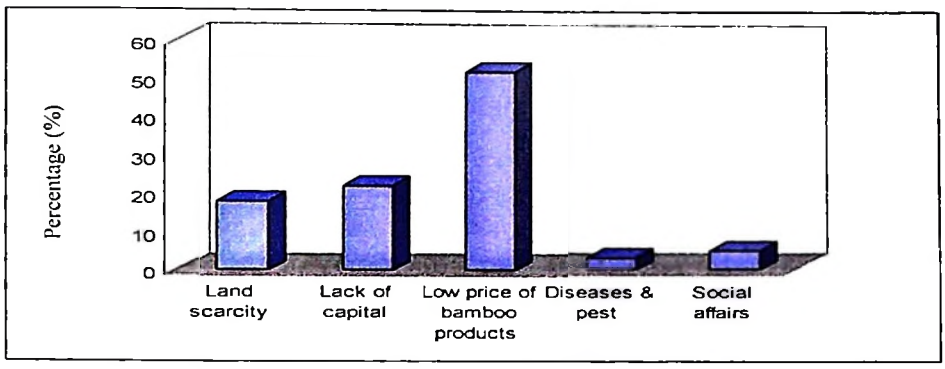

Figure 8: Percentage respondents on main problems limiting household bamboo production in Njombe District, Tanzania

About 71% of the respondents reported that demand for bamboo wine was decreasing resulting into low household income. One of the reasons was that production of bamboo wine has saturated the present market. This was reported as from the fact that people are changing habit or status by preferring bottled beer which was considered cleaner and much safer than bamboo wine.

4.8.2 Problems faced by middlemen and business men

Majority of respondents (69%) indicated low selling price as compared to running costs (Table 16). Most of middlemen use bicycles in transporting the wine sometimes cycling more than 40 kilometers of hilly terrain. Sometimes they hire people to help them to push the bicycles in hilly terrain. Poor qualities of bamboo wine (19%) occur mainly during the tapping of wine particularly when containers are not well covered the wine will mix with water especially during the rainy season. The poor quality has been associated with running away of customers. The problems of increasing capital requirement were reported by 12% of respondents.

Table 15: Problems faced by bamboo wine businessmen in Njombe district, Tanzania

Problems	Frequency
Selling price is too low	11(69)
Increasing capital requirement	2(12)
Low quality	3(19)
Total	**16(100)**

The above problems are being solved by reducing the quantity of wine. For the case of Njombe division those who formed associations, just use association to solve the problems.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Bamboo was found to be a very important crop in household economies of the local and urban communities in Njombe district. Therefore, contribution of bamboo to household livelihood cannot be overemphasized. It was very significant, very valuable and well distributed amongst populations from farmers to final retailers. It served during peak times and times of difficulties. There were various uses of bamboo in the study area. These included production of wine, building materials, water pipes, food, furniture making, fodder, soil conservation, land demarcation, fuel wood, local drums, whistles, pesticide and ornamentals. However, the main one was wine production. The marketing of bamboo wine was informal through the local market. Returns was inadequate especially during rainy season when production was very high and price was very low. Bamboo wine had a big potential in the household economy, it contributed 49% of household income. Presently, the government does not have much to do with improvement of bamboo wine production hence leaving the business to private traders who also control the price. Bamboo farming was possibly feasible in all the four villages in the study area. Furthermore opportunities for bamboo wine business outweighed its weaknesses and challenges. On these grounds, promotion on bamboo farming could be done to Njombe district.

5.2 Recommendations

From the results it is recommended that;-

(i) Since the area is very suitable for bamboo farming, local communities need to be encouraged to plant more bamboo so as to get themselves out of the poverty cycle.

(ii) There has to be a mechanism of controlling bamboo wine price. This can be done through formation of farmers' cooperatives which farmers can use to bargain prices collectively.

(iii) There is an urgent need to formalize markets for the bamboo products. The present informal market does not allow for expansion of the business.

(iv) More research need be done on silvicultural management of bamboo colonies, pest control, harvesting and preservation of bamboo products.

(v) Further study on the effect of bamboo farming on soils need be conducted.

REFERENCES

Arnord, M. and Townson, I. (1998). Assessing the potential of forest Products activities to contribute to Rural Incomes in Africa. Natural Resource Perspective. No. 37 ODI/DFID. 56pp.

Azzini, A., Leme, P. R., Carvalho, C. R. L., Salgado, A. L., de Barros and Ferreira, V.L.P. (1995). Mineral and Bromatologic characterization of Bamboo shoot residues as animal food. *Bragantia Campinas* 54 (2): 257 – 261.

Bangu, N., Chove, B., Sawala, G., Mgombela, J. and Waduma, J. (2006). A short note on processing of bamboo juice. *Journal of Agriculture Science* 7(2): 133-136.

Banik, R. L. (1995). A manual for Vegetative Propagation of Bamboos. International Network for Bamboo and Rattan Technical Report No. 6. Scenario Publishers, India. 66pp.

Bansal, A. K., Arun, K. and Zoolagud, S. S. (2002). Bamboo composites: Material of the future. *Journal of Bamboo and Rattan* 1(2): 119-130.

Baqui, M. A. (1994). Construction, operation and test of a bamboo drip irrigation. *Agricultural Mechanization in Asia, Africa and Latin America* 25(2): 41 – 44.

Basunia, M. A., Abe, T. and Hikida, Y. (1997). A comparative study of the quality of rough rice stored in bamboo wooden and metal bins. *Agricultural Mechanization in Asia, Africa and Latin America* 28(2): 41-47.

Bhatt, B. P., Singha, L. B., Sachan, M. S. and Singh, K. (2004). Commercial edible bamboo species of the North-Easter Himalayan Region, India. Part I: young shoot sales. *Journal of Bamboo and Rattan* 3(4): 337-364.

Bhatt B. P., Singha, L. B.,Sachan, M. S. and Singh, K. (2005). Commercial edible bamboo species of the North-Eastern Himalayan region, India. Part II: fermented, roasted and boiled bamboo shoots sales. *Journal of Bamboo and Rattan* 4(1): 13-31.

Boyd, H. K. R., Westfall, E. and Stasch, S. F. (1981). *Marketing Research, Text and Case.* Illinois, Richard, D. Publisher. London. 813pp.

Cardwell, H. K., Setamou, K. F. and Poehling, H. M. (2000). The influence of storage practices on flatoxin contamination in maize in four agroecological zones of Benin, West Africa. *Journal of Stored Products Research* 36(4): 365 – 382.

Carney, D. (1998). Implementing the Sustainable Rural Livelihoods Approach. Sustainable Rural Livelihoods: What contribution can we make? D. Carney DFID, London. pp 3-23.

Castaneda, M. A. H. J., Gormez, G. A. V. H. J. I. and Vaguera, H. H. (2005). Carbon accumulation in the above ground biomass of a Bambusa oldhamii plantation, Mexico. *Agrociencia (Montecillo)* 39(1): 107 – 116.

Chambers, R. (1992). Rural appraisal: rapid, relaxed and participatory. IDS Discussion Paper, 311, IDS, Brighton. 72pp.

Chamber, R. and Conway, G. R. (1992). Sustainable rural livelihoods: practical concepts for the 21st century. IDS Discussion Paper No. 296, IDS, Brighton. 37pp.

Chandel, B. S. and Jain, S. P. (1998). Do Panchayati Raj Institutions (PRIs) Harbiger Grassroots Level Growth in Agricultural R & D Process : An Enquiry through SWOT Analysis. *India Journal of Agriculture Economics* 53(3): 465-477.

Chihongo, A. W., Kishimbo, S. I., Kachwele, M. D. and Ngaga, Y. M. (2000). Bamboo Production to – Consumption systems in Tanzania. Report submitted to The International Network Bamboo and Rattan (INBAR), Unpublished report, Beijing. 32pp.

Christanty, L., Kimmins, J. P and Mailly, D. (1997). Without bamboo the land dies: A conceptual model of the biogeochemical role of bamboo in an Indonesian agroforestry system. *Forest Ecology and Management* 91(1): 83 – 91.

Davis, L. S., and Johnson, K. N. (1987). *Forest Management*, Third Edition. Mc Graw-Hill Book Company, New York. 790pp.

Dawees, A. P. and. Saxena, C.N. (1995). Tree planting and household land and labour allocation. In: *Tree Management in Farmer Perspectives.* (Edited by Arnold, M. E. J. and Dawees, A. P.), Oxford University Press, Oxford. pp. 76-197.

Dixon, J. A., and Hufschmidt, M. M. (Eds.) (1986). *Economic Valuation Techniques for the Environment.* A case study workbook. The John Hopkins University Press, London. 203pp.

Dubois, O. (2002). Forest-based Poverty Reduction: A Brief Review of Facts, Figures, Challenges and Possible Ways Forward. Forestry Policy and Institutions Branch, FAO, Rome. 21pp.

Duraisamy, J. (2003). Bamboo resources, enterprises and trade development opportunities for livelihood development and poverty reduction in Mozambique. *Journal of Bamboo and Rattan* 2(4): 429-439.

Ellis, F. (1998). Livelihood Diversification and Sustainable Rural Livelihoods. Sustainable Rural Livelihoods: What contribution can we make? D. Carney DFID, London. pp. 53-65.

FAO, (1989). *The major significance of Minor forest products.* Local people uses and values of forest in the West Africa Humid Forest zone. FAO Forest Paper No. 47/7 FAO, Rome. 59pp.

FAO, (1995). Non-wood Forest Products for rural income and sustainable forestry. Non-wood Forest Products Paper No. 7. FAO, Rome, Italy. 127pp.

FAO, (1999). Non-wood Forest products and income generation. Unasylva. *An International Journal of Industries* 50: 27 – 33.

FAO, (2001a). State of the World's Forest. Draft Report. FAO, Rome. 73pp.

FAO/DFID, (2001). *How Forests Can Reduce Poverty*. Policy Brief, November 2001 [http://www.lfccs.net/bgkp3.htm] site visited on 24/2/2007.

FAO, (2003). State of the Worlds Forests 2003, Draft Report. FAO, Rome. 73pp.

Gregersen, H. and Contreras, A. (1992). Economic Assessment of forestry project impacts. FAO Forestry Paper No. 106, FAO, Rome. 134pp.

Gregory, G. B. (1972). *Forest Resource Economics*. John Wiley $ Sons. Inc., New York. 548pp.

Hanley, N and Spash, C. L. (1995). *Cost-Benefit Analysis and the Environment*. Edward Edger Publishing Limited , England. 278 pp.

Hufschmidt, M. M., James, D. E., Bower, B. T. and Dixon,J. A. (1983). *Enviromental, Natural Systems and Development: An Economic Valuation Guideto Project Analysis*. John Hopkins University Press, Baltimore. 338pp.

Hunter, I. R. (2003). Bamboo resources, uses and trade: the future?. *Journal of Bamboo and Rattan* 2(4): 319-326.

Idris, M. A. M. and Mohamad, A. (2002). Bamboo shoot utilization in peninsular Malaysia: a case study in Pahang. *Journal of Bamboo and Rattan* 1(2): 141-155.

INBAR, (1997). Domestication and Improvement of Bamboos. Working paper No. 10. Scenario Publishers, India. 53pp.

Jayasanker, B. and Muraleedharam, P. K. (2000). Efficiency of Agroforestry Product Markets in India: A Comparative Study of Bamboo and Wood Markets. *Indian Journal of Agriculture Economics* 55(2): 194 – 208.

Kajembe, G. C. and Luoga, E. J. (1996). Socio-economic aspects of tree farming in Njombe District. Consultancy report to HIMA-Njombe conducted by, Faculty of Forestry Consultancy Unit (FORCONSULT), SUA, Morogoro. 99pp.

Kangas, J., Kurttila, M., Kajanus, M. and Kangas, A. (2003). Evaluating the management strategies of a forestland estate the S-O-S approach. *Journal of Environmental Management* 69: 349–358.

Kant, S. and Chiu, M. (2000). Bamboo sector reforms and the local economy of Linan country, Zhejiang Province, PRC. *Forest Policy and Economics* 1: 283-299.

Kigomo, B. N. (1995). Guidelines for establishment and managing plantations of Bamboo in Kenya. Kenya Forestry Research Institute (KEFRI). Occasional Paper No. 1. 25pp.

Krishnankutty, C. N. (2004). Marketing of bamboo (*Bambusa bambos*) in South India. *Journal of Bamboo and Rattan* 3(3): 203-215.

Kumar, S., Shukla, K. S., Dev, I. and Dobriyal, P. B. (1994). *Bamboo Preservation techniques: A Review.* INBAR Technical Report No. 3. 59pp.

Kweyuh, H. (1993). Bamboo brings green gold. *Africa Farming and Food Processing*: 39pp.

Lawrence, S. and Norman, J. K. (1987). *Forest Management and Economics: a primer in qualitative methods*. Macmillan, New York. 285pp.

Lehman and Richard, S. (1991). *Statistics and Research Design in the Behavioral Scinces.* Belmont, Wadsworth. 571pp.

Lema,T. A. (2003). The role of non trees forest product in household food security and women income in Morogoro Rural District. Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 109pp.

Leuschner, W. (1984). *Introduction to Forest Resource Management*. John Wiley & Sons CANADA. 265pp.

Li, R. S., Yin, G., Xu, H., Shi, Z. and Yang, J. (2002). The role of *Phyllostachys heterocycla* var. *pubescens* in the life of local residents in Guilin Township, Shaowu, P. R. China. *Journal of Bamboo and Rattan* 1(4): 351-360.

Lipangile, T. N. (1990). Bamboo and woodstave technology. Printpack Tanzania Ltd. 175pp.

Little, I. M. and Mirrlees, J. A. (1992). *Project Appraisal and Planning for Developing Countries*. Gower Publishing company, Great Britain. 387pp.

Liu, J. X., Wang, X. Q. and Ye, H. W. (2000). Nutritional evaluation of bamboo shoot shell and its effect as supplementary feed on performance of heifers offered ammoniated rice straw diets. *Asian-Australian Journal of Animal Sciences* 13(10): 1388 – 1393.

Luoga, E. J. (1994). An Economic analysis of Forest production alternatives in Njombe district, Tanzania: Case study of the Tanganyika Wattle Company (TANWAT) and surrounding villages. Dissertation for Award of MSc Degree at Agricultural University of Norway, 120pp.

MaCein, J. (2202). *Introduction to Statistics*. Washington, DC. 330pp.

Makonda, F.B.S. (2003). Gum Arabica studies in Tanzania: production utilization and economic potentials. Thesis for awarding of PhD degree at School of Agriculture and Forest Sciences, University of Wales, Bangor, United Kingdom. 323pp.

Mapolu, M. H. (2002). Contribution of Non-Wood forest products to the household food security: A case of Tabora District, Tabora, Tanzania. Dissertation for award of MSc Degree at Sokoine University of Agriculture. Morogoro, Tanzania, 157pp.

Marshall, G. (2001). A Perspective on Molecular-based Research: Integration and Utility in Weed Science. *Weed Science* 49: 273-275

Mbuya, L. P., Msanga, H., Ruffo, C. R., Birnie, A. and Tengnas, B. O. (1994). *Useful trees and shrubs for Tanzania.* SIDA Regional Conservation Unit. 542pp.

MNRT (1989). Tanzania Forestry Action Plan 1990/91 – 2007/08. Dar es Salaam. 79pp.

MNRT (1998). National Forest Policy. Ministry of Natural Resource and Tourism. Gorvernment Printers, Dar-es-salaam, Tanzania. 59 pp.

MNRT (2001). *National Forest Programme in Tanzania for 2001-2010.* Forestry and Beekeeping Division, MNRT, Gorvernment Printers, Dar es Salaam. 77pp.

Mohamed, H.A., Haron, N. and Razali, W.M. Wan (1997). Management guidelines and Economics of Natural bamboo stands. FRIM Technical Information. Handbook No. 15. 40pp.

Monela, G. C., Kajembe, G. C., Kaoneka, A. R. S. and Kowero, G. (2000). Household Livelihood strategies in the Miombo woodlands Of Tanzania: Emerging Trends. *Tanzania Journal of Forestry and Nature Conservation* 73: 17-33.

Mosha, D., Wangabo, J., and Mhinzi, G. (1996). African traditional brews: how safe are they?. *Food chemistry* 57(2): 205-209.

Munasinghe, M. (1992). Environmental Economics and Valuation in Development Decision making: Environmental working paper No 51. The World Bank, Washington D.C. Unpublished paper. 129pp.

Munishi, P. K. T., Oktingati, A., Monela, G. C. and Kingazi, S. P. (2004). Small holder forestry for employment, income generation and rural development in Tanzania. *Journal of Tanzania Association of Foresters* 10: 49-63.

Muraleedharan, P. K., Anitha, V. and Simon, T. D. (2004). Present status and socio-cultural acceptability of traditional bamboo houses: a study in Kerala and Karnataka states of India. *Journal of Bamboo and Rattan* 3(3): 283-296(14).

Neumann, R. P. and Hirsch, E. (2000). *Commercialisation of non-Timber Forest Products: Review and Analysis of Research.* SMT Grafika Desa PUTERA, Indonesia. 176pp.

Nyingili, R. B. (2003). Contribution of non-wood forest products to household food security in Mbozi District, Tanzania. Dissertation for award of MSc Degree at Sokoine University of Agriculture. Morogoro, Tanzania. 118pp.

Othman, A. R. and Mohamed, A. H. (2003). Rehabilitation of Malaysian forests. *Malaysian Forester* 14: 99-105.

Pabuayon, I. M. (2004). Consumption value and income potential of bamboo in the Philippines. *Journal of Bamboo and Rattan.* 3(3): 249-263.

Parikesit, T. K., Tsunekawa, A. and Abdoellah, O. S. (2001). Non – forest fuelwood acquisition and transition in type of energy for domestic uses in the changing agricultural landscape of the Upper Citarum Watershed, Indonesia. *Agriculture, Ecosystems and Environment* 84: 245 – 258.

Paudel, S. K. and Lobovikov, M. (2003). Bamboo housing: market potential for low-income groups. *Journal of Bamboo and Rattan* 2(4): 381-396.

Pérez, M. R., Maogong, Z., Belcher, B., Chen, X., Maonyi, F. and Jinzhong, X. (1999). The role of Bamboo plantations in Rural Development: The Case of Anji County, Zhejiang. *World Developmen* 27(1): 101 – 114.

Shanmughavel, P. and Peddappaiah, R. S. (2000). Bamboo for Agro-forestry in India. *Malaysian Forester* 63(4): 147-158.

Sharma, R. A. (1993). Agroforestry vs forestry for the rural poor: a socio-economic evaluation. *Agroforestry Systems* 22: 131-141.

Shiva, M. P. (1993). Solutions to overcome impediments in forest development through MFP based management. [http://scholar.google.com/scholar?q=Shiva,+M.P.htm] site visited on 12/5/2007.

Shrestha, R. K., Janaki, R. R., Alavalapatia, and Kalmbacher, R. S (2004). Exploring the potential for silvopasture adoption in south-central Florida: an application of SWOT–AHP method. *Agricultural Systems* 81: 185–199.

Simons, A. J. (1996). Perspectives and delimitation of planting bamboo as a commercial species. RAP Publication. ICRAFs strategy for domestication of Indegenous tree species. In: Leakey, R.R.B., A.B. Temu, M. Melny and P.Vantomme (Eds) . *Domestication and commercialisation of non timber forest products in Agroforestry systems*. Non-wood Forest Products 9 FAO, Rome, Italy. 82pp.

Singh, H. B., Kumar, B. and Singh, R. S. (2003). Bamboo resources of Manipur: an overview for management and conservation. *Journal of Bamboo and Rattan* 2(1): 43-55.

Soderbaum, P. (1990). Economics in Relation to the Environment, Agriculture and rural Development; A Non Traditional Approach to Project Evaluation. Swedish University of Agricultural Sciences, Uppsala, Sweden. 67pp.

Sosola-Banda B. G. and Johnsen F. H. (2005). Rural livelihoods on bamboo handicraft making and culm vending in Mvera, Malawi. *Journal of Bamboo and Rattan* 44(1): 93-107.

TAFORI, (2004). Socio-economic survey and Baseline studies In Ruvu Fuelwood Pilot Project (RFPP) and HASHI?ICRAF Agroforestry Project . A Consultancy report (Final). TAFORI, Morogoro. 48pp.

UN, (2005). The millennium Development Goals Report. [http://www.unfpa.org/icpd/docs/mdgrept2005.pdf.htm] site visited on 25/9/2006

URT, (1997). *Iringa Region Socio-economic profile*. United Republic of Tanzania. Government Printer, Dar-es-salaam. 145pp.

URT, (2003c). Population and Housing census, General Report. Central Census Office, National Bureau of Statistics, Vice President's Office-Planning and Privatization, Dar-es-Salaam. 203pp.

URT, (2006). Tanzania Inflation Rate. [http://www.indexmundi.com/tanzania.htm] site visited on 23/7/2007

USAID, 1992. *United State Agency for International Development. Definition of Food Security . Policy determination.* PNNA V 468. Washington DC. 150pp.

Van der Lugt, P. (2005). The bamboo sector in Colombia and Ecuador: a state of the art analysis of opportunities and constraints. *Journal of Bamboo and Rattan* 4 (4): 421-440.

Vantomme, P., Braulin, N., Chioetto, V. and Liese, W. (2003). Public constructions made with bamboo: lessons learnt from the 'Vergiate bamboo pavilion' in Northern Italy. *Journal of Bamboo and Rattan* 2(4): 369-380.

Walter, S. (2001). Non wood forest products in Africa: A regional and national overview. FAO Forestry paper No. 140. FAO, Rome. 53pp.

Wang, K., Hong, L. T. and Rao, R. V. (2002). Diversity and indigenous utilization of bamboo in Xishuangbanna, Yunnan Province, Southwest China. *Journal of Bamboo and Rattan* 1(3): 263-273.

Wong, K. M (1995). *The Bamboo of Peninsular Malaysia.* Malindo Printers Sdn.Bnd. Malaysia. 200pp.

World Bank, (1986). *Poverty and hunger: Issues and options for food security in Developing Countries. A world Bank Policy Study.* Washington, D,C. International Bank for Reconstruction and Development. 115pp.

World Bank, (2002). World Development Report, Washington DC. [http://www.worldbank.org/wdr/2001/fulltex2002.htm] site visited on 15/8/2006.

Yang, E and Sucuiwei, Y. (2004). A Gender Assessment Study on Bamboo-based Rural Development and Utilization Activities. A Case Study in Yunnan, China [http://www.inbar.int/publication/txt/INBAR_Working_Paper_No53.htm] site visited on 23/5/2007.

Zinyama, L. M., Matiza, T. and Campbell, D. J. (1990). The use of Wild foods during period of food shortage in rural Zimbabwe. *Ecology of food and nutrition* 34: 251–256.

APPENDICES

Appendix 1: Household questionnaire

A: GENERAL INFORMATION

1. Date ..... Name of enumerator .....
2. Division.....Ward..... Village.....

   Name of respondent..... Sex.....(M/ F) Age.....
3. Marital status
   a. Single (....)
   b. Married (....)
   c. Divorced (....)
   d. Widowed (....)

4. Household composition (...)

Age in Years	Males	Females
0 - < 18 years		
18 - < 55 years		
> 55 years		

5. Household income (per annum)
   a. < Tshs. 150 000.00 (....)
   b. between Tshs. 150 000.00 and Tshs.400 000.00 (....)
   c. between Tshs.401 000.00 and Tshs.1 000 000.00 (....)
   d. > Tshs. 1 000 000.00 (....)
6. Education level of respondents (years).
   a. No formal education (....)
   b. Primary education (....)
   c. Secondary education (....)
   d. High school education (....)
   e. Collage (....)
7. Ethnicity/tribe.....

8. Duration of residence (years) if not native.....

   a. 0 to 5 years (....)
   b. 6- 10 years (....)
   c. 11 – 20 years (...)
   d. 21 – 30 years (....)
   e. 31 – 50 years (....)
   f. More than 50years (....)

9. Reasons for moving to the village

   a. .....
   b. .....
   c. .....

10. What is your main occupation?

   a. Farming ( )
   b. Livestock keeping ( )
   c. Petty business ( )
   d. Employment ( )

12. How much arable land do you own in total? .....

13. How did you get this land?

   a. Inheritance ( )
   b. Purchased ( )
   c. Leased ( )
   d. given by village government ( )

14. For how long have you been farming in this particular land?

   .....

15. How much of this land is cultivated? .....

16. How did you mainly demarcate your land?

   a. By planted trees ( )
   b. By planted bamboo ( )
   c. By planted sisal ( )
   d. Others (specify) ( )
   e. Not demarcated ( )

   If not demarcated why? .....

B: MAIN SOURCES OF INCOME

What are the main source of income generating activities do you engage yourself?

a. Agriculture ( )
b. Livestock ( )
c. Bamboo cultivation ( )
d. Pet business ( )
e. Others (identify) ( )

Agriculture crops

1. What are the main crops did you raise in your farm in year 2006?

Crop	Production /harvest(Bags)	Amount sold	Sales price at household	Amount reserved for food

2. Do you supplement staple food by buying food every year? Yes/No
3. Do you practice soil conservation in your farm Yes/No?
   If yes what type of material do you use.....
   If No, why.....
4. How much do you get from agricultural crops per year?.....TAS

Livestock

1. What type of livestock do you own?

Type	Number	Uses	Price

2. How many shillings do you get per year from livestock sells.....Tshs

3. What type of livestock management system do you use?
   a. Free range ( )
   b. Indoor/Zero grazing ( )
   c. Others (specify) ( )
4. If zero grazing does you use bamboo as fodder.....

Pet business

1. What type of pet business do you practice

.....

2 What amount do you get per year

.....

C: BAMBOO CULTIVATION

1. Do you use bamboo products? Yes/No

   If yes;

Species	Uses	Quantity used per item	Market value of the product at household level

2. Do you own bamboo in your farmland? (Yes/No)

   If yes, how much of your land has been planted with bamboo? ..... acres.
3. Where do you obtain planting stock .....
6. Can you give the number of bamboo culms you own at Present? .....
7. Did you establish the bamboo culms yourself or inherited from parents or other relatives?

8. Are there any costs you incur in cultivation/management of bamboo culms

Year	Activity	Man days/ha/culms	Total cost	Total Revenue
	Establishment (planting stock)			
	Land preparation			
	Tending operations - Weeding - Thinning - others			
	Harvesting			

9. When do you replace bamboo culms? .....

10. For how long have you been in bamboo activity? .....years

11. Who owns the bamboo plots/bamboo business within your house? .....

Husband

Wife

Children

12. Is there any division of work on bamboo farming/production in your household?

Activities	**Sex**

D: PRODUCTION OF SECONDARY PRODUCTS

1. How are you engaged in bamboo business?

a. Farming ( )

b. Wine production ( )

c. Handcrafts ( )

d. Furniture making ( )

e. Soil conservation ( )

f. Others (Specify) ( )

Type of product	Cost of raw materials	Man days	Total cost	Total revenue	Net revenue

2. How much do you sell per annum?.....
3. What is the market channel? .....
4. To whom do you sell your product?
   a. Private traders ( )
   b. Cooperative ( )
   c. Neighbours ( )
   d. Others (specify ( )
5. Why selling to the one selected.....
6. How do you get information on market price
   a. Direct visit to the market place ( )
   b. Cross-check with several middlemen ( )
   c. Hear from friends ( )
   d. Radio ( )
   e. Others (specify) ( )
7. Which time of the year do you make more sales?
   a. Dry season ( )
   b. Wet season ( )
   c. Constant throughout the year ( )
8. How much are you selling during dry season (average}..... litres and how much in wet season..... litres
9. Why do you think are reasons for selling more on the season selected above?
   .....
10. Where do you usually grow bamboo for wine production?
    a. In wet valleys ( )
    b. In drier areas ( )
    c. Others (specify) ( )

11. What is the production trend between wet and dry seasons?

Year	Production in wet season (liter)	Production in dry season (liter)	Income per liter

12. Who owns the money received from bamboo business? (Men/women/both)
Others (specify.....

13. Do you need a license/permission to sell bamboo wine and other bamboo products? (Yes/No)
If Yes, how much do you pay .....TAS per liter

14. Do you receive any directives/services on farming and marketing of bamboo products from either Forest department or Agriculture department (Yes/No?)
If Yes, what kind of directives/services (Specify).....

15. Do you pay any tax when selling bamboo products? (Yes/No)
If yes, how much is the tax.....TAS.

16. Have you received any assistance from the government related to bamboo farming? (Yes/No)
If yes, what was it? .....

17. What assistance would you like to acquire from the government regarding bamboo production from your village?
.....

18. What are the main problems which limit bamboo production?
    a. Land scarcity ( )
    b. Lack of capital ( )
    c. Price of bamboo product ( )
    d. Labour charges ( )
    e. Others (Specify).....

19. Do you face any problems in marketing your products? Yes/No

20. If yes what are the major problems
    a. Production is not sufficient ( )
    b. Price is too low ( )

c. Transport problems ( )

d. Others (specify) ( )

21. How are you doing to solve the problem selected above.....

22. How do you spend money from bamboo product?

.....

a. For buying food (amount).....

b. Buying cloth (amount).....

c. Paying school fees (amount).....

23. What do you consider to be the best way of improving or sustaining the availability of bamboo?

.....

Appendix 2: Questionnaire for bamboo middlemen and businessmen (Market survey)

1. Name of the respondent.....
2. Region .....3.District .....4.Division.....
5. Ward.....6.Village.....
7. Gender: Male/Female.....
8. Education level
   a. No formal education (....)
   b. Primary education (....)
   c. Secondary education (....)
   d. High school education (....)
   e. Collage

9. Which bamboo products do you sell? .....
10. How long have you been selling bamboo products? .....
11. Where do you buy the bamboo product you sell
    a. From the farmers
    b. From wholesalers
    c. Others
12. How are you getting link to producer to .....
13. What are the constraints of getting linked to producers?.....
14. From which place does your bamboo product come from.....
15. How many kilometres is the buying place far from the selling place?.....
16. What was the buying price?.....
17. Which means of transport do you use in transporting your product to local market.....
18. Do you export the product.....
19. How much does transport cost you? (Transportation cost and quantity) .....

20. Do you face any competition when you are buying? Yes/No
    If yes who are you competitors?. .....

21. How do you determine price

    a. Market price

    b. Total cost plus profit margin

    c. Just bellow the market price

    d. Above the market price

    e. I am not sure

22. Why using the above methods for determining the price----------

23. To whom do you sell your product?

    a. To your permanent customer

    b. Any individual customers

    c. Tourist

    d. Others (specify)

24. How are you getting linked to the customers .....

25. How much bamboo product do you sell per day?

    a. Less than 10 litres

    b. between 10-50

26. Which season of the year do you make more sales?

    a. Dry season

    b. Wet season

    c. Constant throughout the year

27. How much are you selling during dry season (average}..... litres and how much in wet season..... litres

28. Why do you think are reasons for selling more on the season selected above?

    .....

29. Sales/revenue of bamboo product:

Product	Quantity sold	Type of buyer (bulk, business, household, tourist)	Sales price product	Revenue from product	Comment

30. Annual income from bamboo resource product sales .....

31. Do you face any competition in selling your product? If yes who is your competitors.....

32. What trends have you observed in:

Demand for bamboo products .....

Cost.....

Type of bamboo product being made .....

33. Do you face any problems in marketing your product Yes/No?

If yes what are the major problems

a. Production is not sufficient

b. Price is too low

c. Transport problem

d. Others (specify)

34. What are you doing to solve the problem selected above .....

35. Do you promote your product? Yes/No

If yes how.....

36. What comments do you have on the quality of bamboo products? .....

Appendix 3: Checklists for key informants

1. Village extension foresters/ agricultural workers:

a) How long have you been in this village/district?..... years

b) What are the general conditions of bamboo production? .....

c) What can you comment on the availability of bamboo products.....

d) What do people collect/use from bamboo? .....

e) What are the common species of bamboo found in this area and their uses

f) Is there any licensing system that is used to control bamboo products? .....

g) What do you think should be done for sustainable availability of bamboo .....

2. Village government leaders:

a) What is the village population?.....

b) Social services and infrastructure in the village.....

c) What are the main economic activities in the village.....

d) What is the average income from each activity?.....

e) What kind of benefits are obtained from the bamboo.....

f) What are types of bamboo products available in the village? .....

g) Are there any by-laws controlling the use of bamboo products. What are they?.....

h) Do you collect any revenue from bamboo products? Yes/No

If yes, how much? .....

i) What are the village strategies in ensuring sustainable availability of bamboo products?.....

j) How can you relate bamboo, agricultural crop and livestock production in this village? .....

k) What is the contribution of bamboo in social-economy of the village? .....

l) What do you think will happen if the government bans the bamboo wine trade in your village? .....

m) Is there any small scale industries using bamboo as raw material in your village? (Yes/ No)

If yes, what are type of industries .....