

**PRESENT CONSUMPTION AND FORECASTING OF SAWNWOOD
IN ARUSHA AND MOSHI MUNICIPALITIES**

BY

RAPHAEL MUSOMI MACHUMU



**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
FORESTRY OF SOKOINE UNIVERSITY OF AGRICULTURE.
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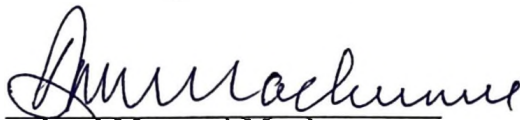
ABSTRACT

The study on Present Consumption and Forecasting of sawnwood Consumption was carried out in Arusha and Moshi Municipalities for the year 2007, 2012 and 2017 to determine the consumption of sawnwood in the target years. The sampling units were obtained from a sampling frame of a list of Wards in each municipality by random selection. A sampling intensity of 30 % of the population was applied in all cases. From the selected wards the interviewees were selected randomly. Questionnaire on specially prepared forms were used to obtain data from the interviewees and data from secondary sources were collected from registers in respective public offices. The analysis of data was done using SPSS and MS excel programmes. The results of consumed timber in 2006 show that 30 156.20 m³ in Arusha Municipality and 4 904.50m³ of sawnwood in Moshi Municipality were consumed in 2006. In Arusha Municipality softwood consumed was 24 848.70 m³ and the remaining 5 307.49 m³ was hardwood, representing 82.40% and 17 .60% respectively of sawnwood. In Moshi Municipality about 100% of sawnwood consumed was hardwood. The per 1000 capita consumptions for timber in Arusha and Moshi Municipalities were 86.44 m³ and 33.98 m³ indicating that Arusha consumed nearly 2.50 times more sawnwood than Moshi Municipality. The high incomes in the area influenced the greater consumption of sawnwood in Arusha Municipality than in Moshi Municipality. Forecasted consumptions for Arusha Municipality are 108.05m³ for 2007, 329.724m³ for 2012 and 1006.29m³ in 2017. While in Moshi the consumption forecasts are 41.80 m³ in 2007, 200.70 for 2012 and 331.30m³ in 2017. From these results the consumption of timber in the two Municipalities shows to be increasing, all types of hardwood timber species consumed included the lesser known. There is a large demand of sawntimber in both

Municipalities and that their sources were too far, about 1000 km away. It is recommended that more efforts are needed through afforestation by increasing areas under forests and by following sustainable forest management procedures.

DECLARATION

I, Raphael Musomi Machumu, do hereby declare to the Senate of Sokoine University of Agriculture that this Dissertation is my own original work and has not been submitted for a higher degree award in any other University.


Raphael Musomi Machumu

18/11/2008
Date

Msc Student

The above deceleration is confirmed


Professor Y.M. Ngaga

Professor Y.M. Ngaga

(Supervisor)

18.11.2008

Date

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LIST OF ABBREVIATIONS

AfDB/OECD	Africa Development Bank
AICC	Arusha International Conference centre
DPG	Development Partners Group
FAO	Food and Agricultural Organisation
FTE	Full Time Equivalent
GDP	Gross domestic Product
Ha	Hectares
HIV/AIDS	Human Immunodeficiency Virus /Acquired Immune Deficiency Syndrome.
IED	Income Elasticity of Demand
IEDs	Income Elasticities of Demand
km	kilometers
m ³	Cubic metres
MDF	Medium Density Fibreboards
MNRT	Ministry of Natural Resources and Tourism
MPEE	Ministry of Planning Economy and Empowerment
NBS	National Bureau of Statistics
NDC	National Development Corporation
NGOs	Non Governmental Organisations
NWFPs	Non wood Forest Products
RFO	Regional Forest Officer
SMP	Sustainable Moshi Programme
SPSS	Statistical Package for Social Sciences
TAS	Tanzanian Shillings

TFAP	Tanzania Forestry Action Plan
TWICO	Tanzania Wood Industries Corporation
UNEP	United Nations Environmental Project
UNPD	United Nations Population Division
USD	United States Dollar
WB	World Bank

CHAPTER ONE

1.0 INTRODUCTION

1.1 Industrial Forests

In Tanzania mainland the area under forest cover comprise different types of forests namely miombo woodlands (374 356 km²), natural closed forests (24 313 km²), mangroves (1 569 km²) and plantations (1 349 km²) together totaling 401 587 km². Forest plantations were established to form a base for future forest industries and to cover the expected future forest wood deficit from the natural forest resource base. About 70% of the total forest area is suitable for production of wood products and the other 30% is more suitable for production of Non-Wood Forest Products (Catchment / Protection areas) (FBD, 2000). The average growing stock is estimated at 41 m³/ha with potential sustained yield from the net production area of about 16.70 million per year or 0.70 m³/ha/yr. The forests produce sawnwood and logs, which are used in forest industries to produce paper, matchboxes, poles, chipboard, fibreboard and tannin (FBD, 2000).

The forest industry has changed from using only the indigenous hardwood from natural forests to using softwood from plantation. Current estimates indicate that 70–80% of the total log consumption is from softwood plantations with a large surplus of softwood (FBD, 2000).

1.1 Forest industries in Tanzania

The growth and sustainability of forest-based industries in Tanzania is influenced by factors that include the type and distribution of indigenous forest resources, local demand, transportation systems and availability of raw materials (Shayo, 2004).

Forest based industries include pitsawyers and sawmills of diverse capacities. There are 426 small to medium sawmills in the country and 28 large mills that derive their products from both plantation and natural forests (MNRT, 2005). Arusha and Moshi towns depend chiefly on raw materials from the plantation forests which rose to the quantity of 72 723 m³ in 2005. The utilised capacity of sawmills in Arusha and Kilimanjaro regions is 95 254 m³ for soft woods and 37 301 m³ for hardwood. The uses of these sawnwood products are mainly for construction, building and businesses (MNRT, 2005). The socioeconomic development activities presently taking place promoted by the high national economic growth of 6.80 percent (Ngasongwa, 2006) prompt higher consumption of these products.

1.2 Dependency on forest resources

Forest industries contribute to the improvement of livelihoods of rural communities and to the reduction of poverty while providing inputs to other sectors of the economy (Ngaga, 1990). Forest industries depend on forest resources to transform wood into usable forms for various activities. Yet many people in the world to support their livelihoods depend upon the forests. It is estimated that hundreds of millions of people depend on forests for subsistence production and environmental services such as watersheds, soil erosion control, microclimate, biodiversity and cultural services, and contributing to poverty reduction. An additional 350 million people are directly dependent on forest resources for subsistence or income, and 1.20 billion people in developing countries use trees on farms to generate food and cash.

1.3 Population pressures on decreasing forest resources base

When population increases the pressure on demand for resources also increases. Population growth broadly acts to increase the demand for forest products. It has been reported that most growth is expected to occur in less developed countries, led by African countries where population is expected to grow by over 40% or over twice the world average by natural means as well as migration (Whiteman *et al.*, 1999). In Tanzania population increase is projected to take place at a rate of 2.90% annually (NBS, 2002), figures which presuppose that negative impacts on the limited forests and resources are obvious. (Whiteman *et al.*, 1999) explains that increase in population has the effect of converting forestland into other uses and that higher incomes tend to result in higher demands for environmental services from forests and reduce the areas vital for the production of timber, fibres and other non wood goods and services.

Population growth poses a threat to the future of wood and other fibre supplies, as these will be affected by forest loss and forest change. Forest loss has the impact of reducing the area available for wood supply through pressure from forestry policy makers to place forest areas under protection, or to prevent harvesting through imposition of logging bans.

Forest change implies gradual degradation of the forest by loss of site fertility; soil erosion, reduction in biological diversity, and fragmentation of forest areas, but probably the single most important indicator of degradation (and one of the most important in terms of future timber supply) is the gradual loss of standing biomass (FAO, 1999).

Current forest loss is estimated at 91 000 ha annually (FBD, 2002) and average degradation level weighted by area was 18.50 % in catchment forest reserves in Arusha, Kilimanjaro, Morogoro and Tanga regions (MNRT 2003) and Chome. Efforts to remedy this situation are low due to poor economy and uncoordinated efforts of land users on activities such as agriculture, forestry, livestock and mining causing non sustainability of the forest resources (FBD, 2000).

1.4 Problem statement and justification

The production and consumption of sawnwood in Tanzania has been increasing from 122 m³ per annum in 1980 to 210 m³ per annum in 1988 (Kowero, 1989 and MLNRT, 1989b). There is a rising demand for the sawn wood that has been attributed to by the increase in development activities in Arusha and Kilimanjaro as urban growth and commercialisation have increasingly been putting pressure on forest resources. The process of supplying sawn timber to urban users and the ways in which the system responds to economic and political changes as well as government attempts to make actors in the wood chain to operate legally have received little attention to date (Shayo, 2004). There is lack of reliable information on sawnwood consumed from sawmillers. Reliable data are inevitable for accurate estimates of future requirements of the sawnwood. The National Forest Policy directs that information and availability of raw materials have to be secured through periodical forest resource assessment and to provide all relevant data to potential users (NFP, 1998). There is, therefore, a great need to conduct assessment of sawnwood consumption and forecast for Arusha and Moshi municipalities for the period 2007 - 2017. The study is important in giving an insight of the consumption

levels and estimates in the two municipalities and in laying out the basis for sustainable forest management planning in the area.

1.5 Objectives

1.5.1 To determine the consumption and estimates of sawn wood in Arusha and Moshi Municipalities for the period 2007- 2017.

1.5.2 Specific objectives

- (i) To carry out survey of all timber traders, furniture marts and end users of sawnwood in the study area and determine their consumption rate per year.
- (ii) To determine factors that affect sawnwood consumption behaviour.
- (iii) To estimate future consumption of sawnwood in the area for 2007, 2012, 2017.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Tanzania forestry outlooks

2.1.1 Forest resources

Tanzania is endowed with a wide variety of natural resources including forest resources. As mentioned in section 1.1 above, the various forest types cover approximately 46% of the total land area. The various types of forests are as shown in Table 1.

Table 1: Tanzania forest cover, type and area expressed in percent

Type of Forest	Area covered (km ²)	Proportion (%)
Miombo woodlands	374 356	93.50
Natural Closed Forests	24 313	6.10
Mangroves	1 569	0.40
Total	400 238	100.00

Source: FBD 2000

If the bushland is included (as some areas are already protected as forest reserves); the percentage will increase to 66% of the total land area. Out of this, 125 170 km² have been set aside as forest reserves including 83.80 km² of nature forest reserve and 20,000 km² protected as game reserves and national parks.

The area of woodlands in public land is 13 million ha gazetted as forest reserves that include about 80 000 hectares of plantations and 1.60 million ha of catchment forests. About 6 percent of the forest area is within national parks (MNRT, 1998).

2.1.2 Threats to Forest resources

According to the MNRT (2006) these forests face high threats of deforestation and degradation. Around ten million hectares of forest land were lost between 1970 and 1998; the harvest rates experienced during 2003 and 2004 and based on official forest inventories, it is apparent that all harvestable class I and II trees (i.e. trees that are large enough for timber exports) in Rufiji and Kilwa districts will have been felled within 20 years, where some key timber tree species will have disappeared well before this time.

Given the rate of population growth the forests succumb to enormous pressure due to the expansion of agricultural activities, livestock grazing, fires, charcoal burning and other human activities. And according to the Vice President's Office (1998) other causes of deforestation include poverty, loss of traditional knowledge in forest management, population dynamics, and poor agricultural practices.

Furthermore the resettlement of refugees in western and southern Tanzania has necessitated the clearing of large areas of land for human settlements and over-exploitation of forest and game resources for fuel and food. Other threats include unclear boundaries; lack of systematic management, illegal logging and insufficient revenue collection (FBD, 2000) and thus causing the sustainable supply of hardwood timber from natural forest to diminish rapidly. Existing data show that indigenous hardwoods from natural forest account for about 300 000m³/year roundwood, whereas plantations contribute about 600 000 m³ of roundwood per year (MLNRT, 1989).

2.2 Importance of forest resources

2.2.1 Source of energy

It is estimated that more than 90% of the population in Tanzania, both in urban and rural areas, use biomass energy for cooking and heating. Hence, bio-energy is the main source of fuel for the country's population, and accounts for approximately 90% of the total energy consumption (FBD, 2000). Though wood energy is the main source of energy, the government has formulated plans to reduce the impact it has on deforestation by increasing local wood supplies through afforestation and, reducing wood energy needs through greater efficiencies of wood conversion and utilization and the substitution of wood fuels by alternative energy sources. The last alternative or strategy is limited by prohibitive costs that consumers cannot afford. In addition sound wood energy plans are hampered by poor information on demand and consumption levels and sustainable supply.

2.2.2 Employment

Poschen (1997) estimated that industrial forestry accounts for approximately 1 million full-time equivalent (FTE) jobs in developed countries and 2.70 million FTE jobs in developing countries. Furthermore an additional 350 million people are directly dependent on forest resources for subsistence or income. Of this, 1.20 billion people in developing countries use trees on farms to generate food and cash. It is against this background that trade in forest products and services are vital for economic growth as well as for safeguarding sustainable livelihoods in rural areas in the whole of the developing world (FAO, 2007). It is estimated that Tanzania's forests employ approximately 1 million mainly rural people officially and about 5 to 10 times more unofficially (DPG, 2007). Employment figures for 2000 by FBD,

(2000) showed employment of over 800 000 people half of them women emanating from forest-based enterprises. In southern Tanzania, following the recent harvests from the natural forests, some 16% (and up to 60% seasonally) of households from villages located near forests benefited from logging and timber trade during 2005 (Milledge *et. al.*, 2006).

2.2.3 Non-Wood Forest Products and Services (NWFPs)

There is an extensive documentation of the many products that are used for food, fibre, medicine and other purposes (Neumann and Hirsch, 2000). The NWFP category includes roots, fruits and (sometimes) fish and game or ‘bushmeat’ used for foods, a range of medicinal plants, resins and essential oils valuable for their chemical components, fibres such as bamboos, rattans and other palms used for weaving and structural applications (Belcher, 2003). FAO estimated that 80 percent of the rural poor depend on NWFPs for subsistence (FAO, 2004b). Trade in NWFPs is an important commercial factor at the national level. Reliable data on international and domestic trade of NWFPs are only available for a few countries and a few products such as brazil nuts, vanilla, natural rubber and shea nut. As the resource base has diminished and the demands on the resource have increased, the environmental services, recreation and non-timber products of forests have come to be appreciated as being equal to or more important than industrial timber and fibre, particularly in developed countries. Whereas broader commercialization of most NWFPs carries the risk of overexploitation, NWFPs are used as safety nets to meet emergency shortfalls and to keep from getting worse in times of need (Belcher, 2003). In Tanzania the NWFPs include fruits, nuts, traditional medicine, honey,

beeswax, tannins and gum arabic (MNRT, 1998). Other NWFPs are tourism and beekeeping.

Most importantly, there is a high level of actual use of NWFP by the rural poor. Many studies report that rural households use a wide range of forest products, and some have attempted to measure the quantities in absolute and relative terms. In an overview of case studies, Vedeld *et al.* (2004) found out that forest products contribute between 20% and 40% of total income of households in forest areas, and that poor households tend to be disproportionately dependent on forest resources. Also according to Belcher, (2003) NWFPs are important to poor people, and that their uses have low environmental impact and are cheap in improving livelihoods.

2.2.4 Protective function

Twenty nine percent of the forest area in Tanzania is categorized as protection forest. Forests, especially those on steep slopes, have been reserved as catchment forests to protect land from erosion as well as water sources vital for human and animal populations and hydroelectricity. For example, the Eastern Arc mountain forests are essential to urban populations as they are sources of rivers supplying water to Dar es Salaam, Tanga and Morogoro (Mugabe and Clark, 1998; VPO, 1998).

2.2.5 Productive function

About 71% of the forest area in Tanzania is used for productive purposes. Besides fuel wood, forests are sources of logs for timber, paper products, wood based panels and poles. Forests provide various non-wood products (NWFPs), which are

important to the livelihoods of many Tanzanians. The NWFPs include fruits, nuts, traditional medicine, honey, beeswax, tannins and gum arabic (MNRT 1998). Forests also provide shelter for wild animals, which are the bases of tourism industry. The beekeeping industry is also very important.

2.2.6 Provision of fodder

Forests are the major sources of fodder for livestock and wild animals because most farmers in the country practice free grazing most of which is carried out in the woodlands and is the source of food to grazing animals (MNRT 1998).

2.3 Economic Benefits of forest and resources

Besides the products from forests that are used or traded, other benefits to national economy cannot be over emphasized. The contribution of the forest sector to the national economy is estimated at 3-4% (FBD, 2000). The figure included only tangible and marketed products like sawnwood and carvings and excluded wood consumed as fuelwood and charcoal. The other excluded products involve the role of forests as source of water for electricity generation, agriculture and fisheries, the provision of pasture land, wildlife habitat hence tourism, medicinal values, contribution to the carbon pool and general environmental values.

From a social point of view, forestry provides direct employment to a considerable number of people in both primary, secondary and artisan wood industries notably sawmills, carpentry and joinery and weaving. Forests contribute 10-15% of the country's registered export earnings, 95% of Tanzania's energy supply through fuel wood and charcoal with the amount of unaccounted wood fuels being estimated over

30 million m³ per year. Forests provide approximately 75% of construction materials used in the country. The construction sector was the second fastest growing sector after mining in the national economy by 2003. Forests are key to Tanzanian livelihoods in providing 100% indigenous medicinal and supplementary food products especially to poor rural family households thereby improving their livelihoods. The contribution to the national economy of other forest benefits such as the forest ecosystem, water services, biodiversity, climate regulation, eco-tourism and cultural values remain completely unaccounted for (MNRT, 2006).

2.4 Wood industry

2.4.1 Forest industries

The wood industry in Tanzania started more than 100 years ago, when Indian settlers and some missionaries owned and operated the mills which mainly utilized hardwoods while the first softwood sawmills utilized thinnings. Between 1967 and 1990, the mills were under the state ownership after the nationalization policies of 1967. However some mills were left under private hands. The nationalized large mills were put under TWICO, a government organization that was formed to run and develop wood industries. A number of new mills were established including Fibre-board Limited in Arusha, Tembo chipboard at Mkumbara and Sao-Hill sawmills in Mufindi Iringa. In the late 1990's, all the mills under the TWICO and NDC had insurmountable operational problems, most of the mills halting operations and finally collapsing. This situation was later followed by divestiture of the parastatals and privatization though again some mills and especially those in the miombo woodlands had not yet started production or had been closed and or had wound up operations. To date, forest-based industries in Tanzania are dominated by some 367

sawmills (MNRT, 2005 pp 6) with a total installed capacity of 2 203 703 m³ of softwood logs and 458 482 m³ of hardwoods per year but with a total utilization capacity of 16% of the total installed capacity (MNRT, 2005).

Production from Tanzania's wood industries is low in quantity and quality and thus has a low share in the world market. Obsolete machinery, the levels of technology employed in the production of the panel products, lack of fresh investments in the industry sector and poor financing, scarcity of logs appropriate for the production of panels and competition arising from free trade environment and weak market development are among the factors that contribute to low production in the wood industries (FBD, 1998). Some of the factors to low production as outlined by FBD (2000) include lack of data on raw materials availability, degraded resource base and conservation requirement of natural forests, poor utilization and wastage of raw materials and low recovery rates, and the inefficient management of plantations causing raw material deterioration. Others include poor transport and communication infrastructure as well as inaccessibility to and within forests and mills located far from the actual resource base. Performance and efficiency of the forestry industry plants are poor because of old machinery and inadequately trained staff. MNRT, (1999) had projected hardboard exports of 1 000 tons per year but the realization of estimated quantities was doubtful due to low product quality and market uncertainties.

There are two veneer and plywood industries, one hardboard industry in Arusha, one Chipboard industry at Mkumbura in Korogwe district in Tanga Region and three major mills producing pulp and paper in Moshi, Iringa and Dar es Salaam (BET,

2000). Products from these wood industries are plywood, fiberboard, pulp and paper, poles, flooring strips, clarinet sets, matchboxes, tannin and essential oils (MNRT, 2005). The industries are located near sources of raw material, infrastructure and market channels. The hardwood supply represents 20.80% of total wood supply but the rate is declining compared to softwoods (MNRT, 2005). Sawn wood production in Arusha and Moshi put together stands at 49 011 m³ where soft woods accounted for 41 882 m³ on annual average between 2002 and 2004 (MNRT, 2005). The situation where production from the wood based industries is seen to be declining has necessitated importation of the same products to cater for the internal deficit (FAO, 2007).

2.4.2 Market of sawnwood products

The global value of roundwood, sawnwood, pulp and paper, was estimated at approximately US\$150 billion in 2003 (FAO, 2004a), with paper accounting for nearly half. Trade in secondary processed wood products added approximately US\$40 billion to the total. The trade in all product categories of tropical timber accounted for only US\$16 billion in 2002 – roughly 10 percent of the total (Rytkönen, 2003). While most of the international trade in forest products takes place between developed countries and rapidly emerging markets such as China and India, exports from developing countries offer much-needed opportunities for income. In 2000, planted forests were estimated to supply about 35 percent of the global industrial roundwood, with a further increase to 44 percent expected by 2020 (Carle *et al.*, 2002). Much of the wood that is not sourced from plantations is from semi-natural forests, with the share of roundwood from natural forests in

international trade becoming increasingly small despite an increase in the share of tropical round wood in the global market (FAO, 2004a).

Global demand for industrial wood and wood products is expected to increase by 25% to 1.90 billion m³ approximately per year by 2010. By far, the greatest increase in the demand is expected to occur in less developed countries, where the demand is expected to rise by about 40% to 0.70 billion m³ approximately. Net trade from developing to developed countries is expected to increase very slightly to around 0.10 billion m³ approximately. However, with greater market opportunities at home, some developing countries with currently high exports may reduce their levels of exports in the future.

During the period 1996 to 2010, the annual global industrial forest product production and consumption are projected to increase at the rate of about 1.70% per year, giving a total increase of 26% over the whole period. Growth in production and consumption in Africa will be slightly less than the global average due to the fact that most forest-based production is for consumption in the domestic markets of producing countries. This may occur for two reasons. Firstly, because countries will continue to develop value-added industries in their own countries (e.g. to process rather than export roundwood and pulp); and secondly in the development of significant domestic markets of their own due to strong economic growth export (FAO, 1999).

In many developing countries, domestic forest products trade is important for economic development and the livelihoods of rural communities, even if it may

and Beekeeping Division amounted to USD 58 million annually due to under-collection of natural forest product royalties in the districts (Milledge *et al*, 2006).

For local consumption, the prominent sawnwood markets, which offer competitive prices, are Dar es Salaam as well as neighbouring regions (Ngaga and Kowero, 1992; FBD, 2000). A substantial amount of the sawnwood is also consumed in Arusha, and Kilimanjaro and some exported to Somalia and Kenya (FBD, 2000) though a good proportion is exported without record or illegally (MNRT, 2005). The growing market for softwood as well as forest conservation is expected to trigger growth in private forest estate development though there are limiting factors in forestry investments. The 2006 list of exports of forest products shows market prospects found outside the country. Table 2 shows the list of forest product exports for 2006.

Table 2: Forest products exported in 2006

Product	Number of Pieces	Weight (kg)	Volume (m ³)	Value TAS (,000)
Carvings	26 332	86 626.3 0		22 996.40
Blackwood	49 924	2197.5.00	81.43	2871.12
Blackwood clarinet sets			5.71	200.00
Blackwood sawnwood			8.72	300.00
Flooring strips			107.75	464.1 8
Treated Poles (Eucalyptus and Wattle)	12 618		-	400.00
Furniture	17 713	6 126.00	-	4 026.24
Handcrafts	4 889	5 209.00	-	3 791.04
Logs (Teak and Paurosa)			5 984	15 266.92
Sandalwood billets			465 000	1 562.50
Sandalwood oil			19 700	2 988 925.00
Sawn hardwood			2 869.09	2 350.00
Sawn softwood			5 917.17	16 942.61
Wattle extracts		171000.00		750.00
Total				3 060 846.00

Source: MNRT 2006

Forest industrial products have been being exported for nearly a decade ago. In Table 3 the value of exports of panel products from 1997 to 2004.

Table 3: Panel products exports from 1997-2004 in million USD

Product	1997	1998	1999	2000	2001	2002	2003	2004
Fibreboard	-	-	-	-	5	-	157	-
Particleboard	-	-	343	343	-	-	1801	1194
Plywood	-	-	-	-	-	-	4450	2
Veneer sheets	5	24	7	7	-	1	24	125
Total	5	24	350	350	5	1	6432	1321

Source: Compiled from FAOSTAT 2005

2.5 Determinants of consumption

In forecasting, different terminologies have been used to describe consumption and or demand. In 1940's in one of the Forest services study, the estimates were called 'potential timber requirements' In the TRR (Timber Resources for Americas Future) they were called 'projected timber demand' and in FAO's European timber trends and prospects they were called 'estimated requirements'. All of these terms have the concept of estimating future wood consumption under set assumptions such as regarding levels of economic activity and population. Gregory (1955) elaborates the intersection point of the curves of demand and supply as the equilibrium price at which the quantity demanded will be equal to that supplied. In the market economies, consumption is usually assumed to be synonymous with the equilibrium market quantity supplied or sales. But in specifying the use of consumption, Gregory limits its application to the quantity that is actually used (consumed).

A range of factors affect the demand for wood and wood products and these include: the price of the products themselves; the price of substitute products; population and income levels; and trends in consumer preferences. In addition to these factors, most forest products are intermediate goods. They are used in other industrial processes or commercial activities (e.g. construction), such that technological changes in these processing or end-use sectors can have a major impact on the demand for forest products through the efficiency with which they are transformed into other products. Substitute products from the metals, plastics, agricultural, cement, and chemical industries will continue to challenge the use of wood products in the future (FAO, 1999).

2.5.1 Population growth

Population growth broadly acts to increase the demand for forest products by increasing the number of forest product consumers (FAO, 1999). Population factors impinge on development and the welfare of individuals, families, and communities at the micro level, and the district, regional and the national level as whole at the macro level by tending to increase outlays on private and public consumption (URT, 1992). People have different needs for their various development activities. These different development activities become the basis for demand of particular items, and to accomplish their demand levels, their economic activities become the basis that facilitates their purchasing powers. With population growth, the forests are to succumb to enormous pressure from expansion of agricultural activities, livestock grazing, fires, charcoal burning and other human activities.

Population growth poses a threat to the future of wood and other fibre supplies that will be affected by causing forest loss and forest change (FAO, 1999). Forest loss has the impact of reducing the area available for wood supply, increasing the pressure by forestry policy makers to place forest areas under protection, or prevent harvesting by imposing logging bans and cause further wood unavailability. Forest change implies the gradual degradation of the forest by loss of site fertility; soil erosion, reduction in biological diversity, and fragmentation of forest areas, but probably the single most important indicator of degradation (and one of the most important in terms of future timber supply) is the gradual loss of standing biomass (FAO, 1999).

Population and income growth may not only affect the demand for forest products, but may also affect the supply of wood raw materials. For example, increasing population density increases the pressure of converting forestland into other uses and higher incomes tend to result into higher demands for environmental services from forests (FAO, 1999). Thus, the changes outlined above are likely to put pressure on forest resources both in terms of the wood and fibre products that will be desired from them and the other non wood goods and services that they will be expected to produce (which may consequently reduce their availability for timber supply).

A report from the global social change project for the period 1960 to 2003 on population changes and trends shows that population growth is faster among the less developed countries. The report also shows that population growth is slowing down for both more and less developed countries with sub-Saharan Africa, the Near East and Northern Africa being the fastest growing regions. Growth rates for the regions in the year 2000 were 2.4% 1.8% 2.2% for sub Saharan Africa, The Near East and North Africa respectively. The slow trend in population growth is also expected to apply in Tanzania. In 2002, the country had a population growth rate of 2.9 and a population of 34.4 million (URT, 2006). The population growth rate for Kilimanjaro region will decrease from 1.7 for 2003 to 1.0 in 2025. A slow population growth is also anticipated in Arusha region. Population growth trends for Arusha have been fluctuating from 5.9%, 4.5% and 5.4% for 1967/1978, 1978/88 and 1988/2002 respectively; and that the population growth projections for 2012 are set at 5.5% per year (URT, 1992).



2.5.2 Increase in income

The Gross Domestic Product or GDP measures the economy. The GDP is commonly used to measure the economy and economic growth (BOC, 2007). This is a measure of all products and services produced in a country (CIA, 2006), and which is also known as income or wealth (Whiteman *et al.*, 1999). It can be used along with other variables like infant mortality rate, freedom and literacy, to give a reasonable picture of national wealth and progress. Though it is the best measure of aggregate economic activity that is available, there are some measurement problems that make economic growth often underestimated. GDP only measures products and services that are bought or sold, but does not take into account things that are bartered or traded with neighbors, or friends (Schenk, 2004). Such an economic activity that is not reported to the government was termed as an underground economy by Braguinsky, Doepke and Schenk (Braguinsky, 2005; Doepke, 2003; Schenk, 2004).

People who work for cash but don't report this income are part of the underground economy. Other activities not considered by GDP for measurement include subsistence farming, household production of meals cooked, caretaking, and related activities, which are certainly valuable and externalities which include pollution from factories (Braguinsky, 2005). GDP does not account for changes in quality of products. For example, when computers become more powerful, they are still counted as the same product, even though they can do much more. Thus, economic growth is often underestimated (Doepke, 2003). The underground economy could be as large as the officially measured economy in some countries (USDS, 2004).

Globally there are sharp contrasts in world GDP distribution. About 80% of world GDP is share among only 29 countries, which have a low share of the world population of 20%. In contrast to this distribution, the Asian and other less developed countries, which have 80% of the world population, share only the remaining 20% of world GDP among themselves. Despite the poor distribution of world GDP, many less developed countries are expected to have their GDP growths at over 3% per annum (and some much higher than this), while that of the developed will grow at 2% to 3% in most developed countries. Thus, by 2010, the share of world GDP produced in less developed countries is expected to increase from 20% to around 35% and double the sizes of their economies by year 2010 (FAO, 1999). These developments may have a profound effect on the demand for forest products.

2.6 Recent economic developments

Despite the prolonged drought that caused food shortages and a scarcity of water for electricity generation over the past three years, Tanzania's economy continued to perform well. In 2006, real GDP growth remained resilient at 5.70 per cent, just below the annual average of about 6 per cent over the 2000-05 period (AEO, 2007). Growth is expected to pick up strongly to 6.8 per cent in 2007 and further to 7 per cent in 2008. Economic growth in 2006 was constrained by drought, and agricultural output expanded by an estimated 4.50 per cent compared with 5.20 per cent in 2005. Measures have been taken by the government as from 2006 to avert the unending food crisis and to enhance agricultural productivity (AEO, 2007).

In the external trade arena, however, performance was not good, as the external trade quarterly statistics released by the National Bureau of Statistics showed total

international trade deficit for 2005. In the 4th quarter of 2005 the total exports valued at 1 400 340 million TAS being an increase of 21.80% over the previous quarter. and 17.10 % higher than that of the same quarter for the previous year. In the same year of 2005 the total exports reached 550 396 million TAS and imports reached 849 944 million TAS, which showed a trade deficit of 299 548 million TAS and whose gap continued to grow ((AEO, 2007).

The industrial sector in 2006 grew by 7.40 per cent, albeit below that of 2005 of 10.60 per cent. The industrial sector's contribution to GDP share in GDP rose to 16.90 per cent in 2005. The industrial sector's rapid growth was due to strong performances in manufacturing, construction, and especially mining and quarrying. The growth in the construction sector rose to 11.90 per cent after remaining at around 11 per cent for three years in a row, while growth in manufacturing output rose to 9 per cent from 8.60 per cent in 2005 (AEO, 2007). Other sectors that contribute to economic growth include Public administration and other services, Finance and Business services, Transport and communications, Trade, hotels and restaurants, Construction, Electricity and Water, Manufacturing, Mining, Quarrying and Agriculture.

Tanzania's services sector continues to achieve healthy growth rise of an estimated 7 per cent in 2006. The tourism and hotel/restaurant sub-sectors were in the lead of this growth. These sub-sectors are still promising as their future prospects are still healthy. Tanzania continues to enjoy the preference by tourists as their priority destination in East Africa. Their preference being contributed by improved tourist services in the country. In 2006 the number of tourists rose by an estimated 7.10 per

cent with tourists' receipts also increasing by an estimated 6.70%. Table 4 shows the number of tourists and the revenues collected for the period from 2000 to 2005.

Table 4: Number of tourists and revenue for 2000 to 2005

Year	Number of tourists	Changes (%)	Revenue in million USD	Revenue in million TAS
2000	501 669	-20.03	739. 00	628 201
2001	525 000	4.65	725. 00	665 115
2002	575 000	9.52	730. 00	705 618
2003	576 000	0.17	731. 00	759 070.40
2004	582 807	1.18	746 .02	812 676.89
2005	624 020	7.07	1 083.50	1 318 156.06

Source: URT, 2006.

In 2005, a total of 465 991 foreign tourists visited the National parks out of this figure 282 585 of them (60.64%) visited the Arusha region National parks (URT, 2006).

The expenditure composition of Tanzania's GDP reveals investment from the public and private sectors beginning to grow significantly, and this is expected to underpin faster growth in 2007 and 2008. The share of gross capital formation in GDP has grown in recent years, mainly because of rising public investment.

2.7 Employment in forest based activities

It is estimated that 1.60 billion people on varying degrees depend on forests for their livelihoods, with 350 million living in or, near dense forests, on which they depend "to a high degree, Belcher (2005) and Poschens' (1997) estimated that industrial

forestry accounted for approximately 1 million full-time equivalent (FTE) jobs in developed countries and 2.70 million FTE jobs in developing countries, while an additional 350 million people are directly dependent on forest resources for subsistence or income. Moreover 1.20 billion people in the developing countries use trees on farms to generate food and cash. It is against this background that trade in forest products and services is vital for economic growth as well as for safeguarding sustainable livelihoods in rural areas throughout the developing world (www.fao.org/forestry/site/9608/en).

Forest based enterprises provide direct and indirect employment in a variety of ways. In some countries forest industries make up nearly one-fifth of total manufacturing employment. Rural small-scale forest industries provide the principal employment for between 20 and 30 percent of the rural labour force in many developing countries (FAO, 1986). In Tanzania forests employ approximately 1 million mainly rural people officially and about 5 to 10 times more unofficially (DPG, 2005). Additionally, FBD (2000) reported that wood forest based activities generate employment to over 800 000 people half of them being women.

2.8 Forecasting and sampling

Forecasting can be explained as quantitative estimates of some specified future conditions or events made as a result of a rational study and analysis of available pertinent data (Wheelright and Makridakis, 1985). Forecasting reduces uncertainty on assessment of future conditions like marketing and production. Thus for any type of consumption survey of wood product, sampling is required (Ngaga, 1990).

2.8.1 Forecasting techniques

2.8.1.1 Smoothing techniques

Smoothing methods use historical data to obtain a smoothed value for the series. Smoothing methods have two subclasses which are averaging methods that conform to the conventional definition of an average, equal weighting or smoothing, and exponential smoothing methods which apply an unequal set of weights to past data that decay in an exponential manner from the most recent data value to the most distant value (Wheelright and Makridakis, 1985).

2.8.1.2 Single moving average

Forecasts for period t are given by:

$$F_{t+1} = \frac{X_t}{N} - \frac{X_{t-N+1}}{N} + F_t$$

Where F_{t+1} = Forecast for time $t + 1$

X_t = the most recent observation

N = the number of values included in the average

F_t = previous moving average.

In applying moving averages, only a limited amount of historical data N is needed to compute forecasts for future periods. Single Moving Average (SMA) allows flexibility, since N can vary from 1 to n . Computational and data requirements for applying moving average to a single time series are minimal. The method can be used as a forecasting tool when the data is stationary.

There are limitations that pertain to this method. Among them is the need to save the last N values and additionally there is the application of equal weights to last N observations. Since the accuracy of moving averages is low, the method is not used extensively.

2.8.1.3 Single exponential smoothing

This method has advantages over the single moving averages. To compute a moving average the past N observations must be available and the data take considerable storage space if forecasts for a large number of items are required. Equal weighting is given to each of the past N observations and no weight is given to the observation prior to period $t - N + 1$. It is agreed that in many cases, the most recent observations contain more information than the older ones about what will happen in future, and therefore recent values are given relatively more weight in forecasting than the older observations.

Exponential smoothing satisfies this argument. It requires only two data points to forecast a future value. Exponential smoothing can be developed starting from the single moving average equation. Forecast for period t is given by:

$$F_{t+1} = F_t + \alpha(X_t - F_t)$$

Where α is the smoothing coefficient and lies between 0 and 1.

The accuracy of moving averages is low and hence not used extensively (Wheelright and Makridakis, 1985).

2.8.1.4 Linear moving averages

Linear moving averages method has been developed to avoid systematic error that occurs if moving averages are applied to data with trend. This is a moving average of the moving averages based on the actual data and is also known as double moving averages.

The double moving averages are going to lag behind the single moving averages by the same amount that single moving averages lag behind the actual data. Thus the difference between the actual and the single moving averages will be the same as the differences between the single and double moving averages. The method calculates a second moving average.

To forecast with no systematic error, the difference between actual and single moving average is added to the difference between single moving averages and double moving averages. This brings the forecast to the level of actual data. The basis of this method is to calculate a second (double) moving average as in the formula below;

The forecast is given by formula: $F_{t+m} = \alpha + b_t M$ (Wheelright and Makridakis, 1985).

Where:

S_t = Single moving average

$S_{t''}$ = Double moving average

α_t = Base adjustment to a starting point for a forecast

b_t = Trend in the data at time t .

m = Number of periods ahead to the forecast.

2.8.1.5 Brown's one parameter linear exponential smoothing

The underlying concept is similar to that of Linear moving averages. Both the single and double smoothed values lag the actual data when a trend exists. The difference between the single and double smoothed values can be added to the single smoothed values and adjusted for trend (Wheelright and Makridakis, 1985). Forecasts are made using the following formulae;

$$F_{t+m} = a_t + b_t M$$

Where:

S_t = Single exponential smoothed value

S_t'' = Double exponential smoothed value

2.8.1.6 Holt's two -parameter linear exponential smoothing

Holt's two -parameter linear exponential smoothing is similar to Brown's except that it does not apply the double smoothing formula. It smoothes the trend values directly since it allows the trend to be smoothed using a different parameter. Forecasts are found by using two smoothing constants with values between 0 and 1, and 3 equations.

$$S_t = \alpha X_t + (1 - \alpha)(S_{t-1} + b_{t-1})$$

$$B_t = \gamma(S_t - S_{t-1}) + (1 - \gamma)b_{t-1}$$

$$F_{t+m} = S_t + b_t m$$

The equation adjusts S_t directly for the trend of the previous period b_{t-1} by adding it to the last smoothed value. This eliminates the lag and brings S_t to the approximate base of the current data value.

2.8.1.7 Winter's Linear and seasonal exponential smoothing

The basic equations for winter's methods are as follows;

$$S_t = a \frac{X_t}{I_{t-L}} + (1-a)(S_{t-1} + b_{t-1})$$

$$b_t = \gamma (S_t - S_{t-1}) + (1-\gamma) b_{t-1}$$

$$I_t = b - \frac{X_t}{S_t} + (1-b) I_{t-L}$$

The method is based on three equations in which each one smoothes a parameter associated with one of the three components of the pattern, i.e. stationary, linear, and seasonal. It includes three smoothing constants (with values between 0 and 1) and an additional equation to deal with seasonality.

The basic equation for winter's method is as follows;

$$F_{t+m} = (S_t + b_t m T_t) I_{t-L+m}$$

Where

S is a smoothed value of the deseasonalised series,

T is the smoothed value of the trend,

L is the length of seasonality (e.g. number of months or quarters in a year), and

I is smoothed value of the seasonal factor.

2.8.2 Moving average models (MA)

In moving average models (MA) sawnwood consumption is described completely by a weighted sum of current and lagged random disturbances. The equation is represented as;

$$SC_t = \mu + e_t - \Phi_1 e_{t-1} - \Phi_2 e_{t-2} - \dots - \Phi_q e_{t-q}$$

Where:

$\Phi_1 \dots \Phi_q$ = Moving average coefficients

μ = Mean of the time series

e = Random disturbance

q = Number of periods ahead to the forecast

2.8.2.1 Autoregressive models (AR)

Autoregressive models (AR) are classified according to the time period one goes back. AR (p) Means that the current observation SC_t is generated by a weighted average of past observation going back p periods. Therefore;

$$AR_{(p)} \text{ is } SC = \alpha + Q_1 SC_{t-1} + Q_2 SC_{t-2} + \dots + Q_p SC_{t-p} + e_t$$

α = Constant term relating to the mean

$Q_1 \dots Q_p$ = autoregressive coefficients

e_t = an error term at time t.

2.8.2.2 Mixed autoregressive- moving average models (ARMA)

The ARMA models have the qualities of both AR and MA. They deal with many stationary random processes that cannot be modeled either by AR or MA, and the model is also known as ARMA (p, q) (Wheelright and Makridakis, 1985).

$$SC_t = Q_1 SC_{t-1} + \dots + Q_p SC_{t-p} + e_t - \Phi_2 SC_{t-2} - \dots - \Phi_p SC_{t-p}$$

2.8.3 Causal forecasting methods

Causal forecasting methods include simple regression, multiple regression and econometric models.

2.8.3.1 Simple regression methods

The technique finds out the relationship that exists between two variables e.g. the variable to be forecasted (the dependent variable) and another variable (independent variable) and can be represented in a functional form, expressed as; $Y = f(x)$, which states that the value of Y (dependent variable) is a function of the value of X (independent variable), and is assumed to be a linear relationship and therefore represented by the function;

$$Y = a + bX + \mu$$

Where,

Y = dependent variable

X = predictor (independent variable)

a, b = regression coefficients or parameters to be estimated

μ = disturbance term.

2.8.3.2 Multiple regression

Multiple regression is an analytical method that is applied where forecasts require two or more independent variables and takes the form of;

$$Y = a + b_1 X_1 + b_2 X_2 + \dots + b_n X_n + u$$

$$SC_t = Q_1 SC_{t-1} + \dots + Q_p SC_{t-p} + e_t - \Phi_2 SC_{t-2} - \Phi_p SC_{t-q}$$

2.8.3 Causal forecasting methods

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2.8.3.2 Multiple regression

Multiple regression is an analytical method that is applied where forecasts require two or more independent variables and takes the form of;

$$Y = a + b_1 X_1 + b_2 X_2 + \dots + b_n X_n + u$$

Where;

$a, b_1 \dots b_n =$ regression coefficients (parameters to be estimated)

$X_1 \dots X_n =$ Independent variables

$n =$ number of variables in the equation

$u =$ disturbance term.

CHAPTER THREE

3.0 METHODOLOGY

3.1. Introduction

This chapter describes the study area, the methods used to estimate sawnwood consumption, the research design, sampling procedure and data collection materials.

Data were collected from sellers, and endusers.

3.2 Description of the study area

The study area was Arusha and Moshi municipalities in Arusha and Kilimanjaro regions respectively, in northern Tanzania. The two urban areas are located in one of the high density population areas in the Northern highlands of Tanzania, where the famous mountain Kilimanjaro and mount Meru are situated.

3.2.1 Arusha

Arusha is located at longitude $3^{\circ} 20' S$ and $36^{\circ} 4'E$ on the southern slopes of mount Meru. The area has a cool climate owing to the high altitudes and has an average rainfall of between 500 mm and 1100 mm per annum (ARP, 2004). Arusha has a well structured roads and is connected to other towns and the rest of the country. A railway terminal connects the city to the country's chief ports of Dar es Salaam and Tanga in Tanzania and Mombasa in Kenya. It is served with Kilimanjaro International airport located 45 km from Arusha, as well as a municipal airport in the outskirts of the city that links the city with other towns and national parks. Several tourist hotels, shops and industries operate to stimulate the business activities of the city and in the zone.

Mount Meru slopes provide sites on which the natural forests and plantation are located. Due to the fertility of the soils, the forests flourish well and act as cover and protect the soils from possible erodibility. The forests too provide water catchment values that serve the city with abundant water supplies. The city is rapidly expanding with a population of 282 712 (URT, 2002) and a good business climate that is supported by high population in neighbouring Arumeru district and other districts.

The manufacturing sectors involve industries for various products including saw mills and a fibre industry. Arusha city facilities include private and government hospitals, shops and supermarkets, hotels banking and financial institutions. There are several academic institutions including Universities, adequate electricity supply and telephone facilities in the municipality. As stated earlier the business climate in the municipality is supported by the high population density in the surrounding districts and regions (URT, 2002).

3.2.2 Moshi

Moshi is located in Kilimanjaro region to the North Eastern part of the country between latitude $3^{\circ} 18'$ south and longitude $37^{\circ} 20'$ East. Moshi urban has a population of 144 336 and is surrounded by Moshi rural district with a population of 402 431. The area receives two rainy seasons with rainfall amounts varying between 500 mm in the lowlands and 2000 mm in the mountain areas. The mean annual temperature is 25°C with the coolest month being July where the temperatures fall to 17°C . December is normally the hottest month with temperatures reaching 34°C . The town is endowed with good communication infrastructure of well-planned

surfaced roads, a railway line, and an airstrip (SMP, 1999). The town is linked to other parts of the country by roads, railway and air. There are several industries operating in the town to activate the business life of the town and neighbouring districts. Wood based industry is the second most important sector in the region. The manufacturing sector contributed about 3 % of the region's gross domestic product (NBS, 2002) with a total of 1 388 economic establishments where wood based industries are ranked as major industries of the region. Important service sectors in the town include an airport, electricity supply plants, a referral hospital (KCMC), a regional hospital, secondary schools, vocational training centres, a University and colleges and communications.

3.3 Methods of estimating sawnwood consumption

Several methods for estimating sawnwood consumption are outlined in this section. It was necessary to make literature survey on the Methods of estimating sawnwood consumption in the study area in order to expose the techniques available before selecting a method appropriate for making sawnwood consumption estimates in Arusha and Moshi towns for the target years.

3.3.1 Apparent consumption

Apparent consumption method is based on data for domestic consumption and imports less exports with necessary adjustments for stock changes for both categories of consumption. If the data from domestic production and trade statistics are true the method provides real estimation to the forecasts (Ngaga, 1992).

Domestic consumption statistics are compiled from records in the registers of the primary wood using industries. Import and export data may be obtained from monthly, quarterly or annual trade reports if available from the country or region of origin together with those from FAO year book of forest products. Also, the data may be used to determine trade balance and the significance of exports or imports as the percentage of consumption. The method is commonly used in estimating the consumption of wood products. Presently method is not considered feasible in estimating sawnwood consumption in Tanzania because records for consumption data are rarely available and are only a fraction of actual production. In addition, there are no reliable statistics on some sawnwood sources such as pitsawn timber whose operators operate illegally. Pitsawn timber accounts for a great percentage of the wood consumed in the country (Ngaga, 1998; Kowero, 1989).

3.3.2 Survey of end use manufactures, industrial users and timber traders

The survey of end use manufactures, industrial users and timber traders is undertaken to give an end use pattern of wood raw material as well as giving consumption estimates. The endusers include joinery works, furniture shops, motor-body builders and building and construction industry. There are many enduse manufactures and timber traders, thus their sample survey is used to obtain consumption of wood raw material. Some end users who consume woodfuel, poles and sawnwood found in the subsistence sector are not recorded since they produce and consume directly. To obtain reliable estimates of their consumption, visiting them and making on the spot assessment is important. The survey is important in determining wood consumption in the cash economy in urban areas. The survey is also useful for industrial development reasons, marketing and for urban and regional

planning. The method also acts as a cross-check in other wood consumption surveys. This method was adopted in this study to estimate the sawnwood consumed in furniture industry and building contractors (Ngaga, 1991).

3.3.3 Using cross sectional data

When in the country of study, there is no statistics that exists to enhance the estimates, such data may be taken from other countries of similar economic development. Though cheaper it is less accurate in arriving at realistic estimates, since its rationale depends on reliability of the records in the country concerned and the similarities in economic development of the two countries. It is difficult to find two countries with similar economic development like Tanzania and with similar wood consumption habits. Also, data for some wood products in Tanzania are available at different degrees of abundance (Ngaga, 1992). The restrictions mentioned above made it difficult to use the method and was dropped.

3.3.4 Wood consumption survey

Wood consumption survey is a method that is concerned with the survey of wood based commodities used in a particular area at a particular period of time, with the aim of estimating the quantity of wood products used by the end-users. For consumption surveys that take place at one particular time, a resurvey of a small percentage of the sample should be taken a little latter to check the accuracy of the main survey. The method is important only if there are many surveyors. It is similar to apparent consumption survey in estimating wood products consumed. It is a reliable method for estimating consumption of products like sawnwood, since some of the products are produced illegally by pitsawyers and are not recorded while part

of the products are self produced and consumed directly without record (Ngaga 1992).. The method takes into account these abnormalities because the survey is done to the end-users to provide the estimates of their sawnwood consumption.

In this study, self produced sawnwood consumption by the household sector was not taken into account except that it was determined indirectly from the survey of end-use manufacturers, industrial users and timber traders. In Tanzania, there is insignificant number of individuals who own and operate sawing facilities of self-produced sawnwood and that their omission from the survey could not affect estimates for a particular area. In this study, only the survey of end-use manufacturers, industrial users and timber traders were carried out to determine their suitability in the area of study.

3.4 Research design

The study was on sawnwood consumption in Arusha and Moshi towns of Tanzania. Urban sawnwood consumption includes all timber used in or by urban based enterprises (public or private) and households. Two major sectors have been considered namely households (residential) and non-households (industrial) sectors.

In the industrial sector there were three major sub-sectors considered and these are the furniture industry, the building industry and the public sector. The public sector includes government offices and government owned institutions or organizations.

During this survey the household sector consumption was not determined. Instead, the subtraction of the quantities of the industrial sector consumed from the total urban consumption derived the household consumption. The quantity of sawnwood sold outside the Municipalities was deducted from the total urban consumption. The

remainder or residue was regarded as the household consumption. The household sector is a group of individuals, private, low cost house builders and other wood consuming activities that are mainly industries that use wood incidentally (Ngaga, 1998).

3.5 Data collection

Data collection was aimed at obtaining both primary data and secondary data.

Primary data were obtained from the interviewees, who were the sellers, consumers and end users by the use of questionnaires and quantities of sawnwood used or sold and in stock (available at the time of the survey) were recorded.

Sources for secondary data were the Municipality and Forestry offices and Regional administration offices. Here information on factors that affected the consumption of sawnwood like population growth rates, urbanization, and other socio-economic information and future plans on the municipality were sought from the various offices under the Municipalities.

Additional information sought included the business office regarding licensing and where possible the number of dealers in sawnwood and the number of registered engineers. However the information regarding the list of licensees and registered engineers was older by two years back and was not found useful for the survey. The regional forest office was able to provide reliable information through recorded statistics on timber brought into the Municipality. This was possible in Arusha City where such records exist starting from August 2003. In the Moshi, Municipality

such records were obtained from the Moshi district council forest office where registered information of all timber brought into the town by businessmen is kept.

3.6 Sampling procedure

Spot survey procedure was used in this study. The procedure is similar to that used by Ngaga (1998); and Openshaw, 1971. Thus the researcher visited the end-use manufacturers, timber traders and sawmillers in the study area. The procedure is considered as one of the most effective in obtaining consumption estimates since the survey is done at the spot. Nevertheless, the procedure has its own problems as were found from the survey. Most interviewees had no records of the data for their businesses, and only a few managed to keep data by not more than two years back. Most of the information was based on memory and not records. Even if some could have data recorded for longer periods back, they were not willing to produce that data on claims that the owner did not permit them to release such information, or that the owner has gone away with the register. Albeit others were willing to give but untrue information that usually underestimated their real uses or sales.

Before the survey was undertaken permission was sought from the Municipal authorities, in order for the ward to be accessed. The wards are the basic units of administration in the local governments. Upon introduction to the ward officer, wherever possible, himself or any other officer was chosen to accompany the researcher in the ward area. Also the presence of the assisting officer offered security to the researcher and reduced fears from respondents and created a conducive environment for the participants to cooperate.

The municipal administration is made of Divisions which are themselves comprised of wards. There are several wards in each division with a total of 17 wards in Arusha municipality and 15 wards in Moshi municipality. During the study, all wards were visited and from each ward a count of all end-users and timber sellers was done and acted as a sampling frame from which samples were drawn. In this study 10 wards were randomly selected in Arusha municipality and 7 in Moshi municipality, where in both areas a sample size of 30% was adopted. In his study, Openshaw (1971) recommended a sample size of 30%, while Ngaga (1998) adopted a sample size of 42%. The sample sizes used by Openshaw and Ngaga therefore lead the researcher to adopt a sample size of 30%. The limitation of time and resources forced the adoption of the sample size of 30% in Arusha and Moshi Municipalities.

3.7 Questionnaire design

The questionnaires were prepared for industrial end-users and timber sellers to extract the quantitative and qualitative information in their businesses for both Municipalities. In each Municipality a random selection of wards from where the survey would be conducted was made. A sampling intensity of 30% was assumed for all wards in both Municipalities to obtain sampling units out of which spot surveys were carried using questionnaires. The questionnaire design was based on the one used by Openshaw (1971) in the Gambia, Tanzania and Thailand, and Ngaga in Tanzania at different periods (Ngaga, 1998). When performing the interview, care was taken to make sure that the questions were answered properly to meet the objectives of the survey. Sometimes the same question was asked in different forms in order for the researcher to get the same answer as the other question without

deviating from the main theme. This approach was used to obtain answers which at first seemed ambiguous to respondents.

3.8 Data analysis

The analyses of both quantitative and qualitative data were done using computer programmes of Statistical Package for Social Sciences (SPSS). The statistical analysis category of descriptive statistics was adopted under which the analysis procedures of frequencies and multiple responses were performed to produce results in frequencies. The SPSS is compatible with Microsoft excel program, and data from the SPSS were exported for further analysis. This helped to calculate the quantities for sales, consumption, existing stock, number of workers, employees and traders and other statistics. The analyses produced figures for sawnwood consumption by traders, and industrial sectors.

Further analysis was undertaken to examine uses or production, consumption and sales of other industrial wood products both within and outside the country. Trends of sawnwood consumption, and forecasts for 2007, 2012 and 2017 were determined. In addition, total present sawnwood consumption by each sector was determined. From the present total sawnwood consumption in each municipality, the per 1000 capita consumption of sawnwood for each municipality was determined. The per 1000 capita consumption of sawnwood for each municipality is the rate of sawnwood consumption per 1 000 people. The rate was the base for the calculation of future estimates of sawn wood consumption in both municipalities.

3.8.1 Analysis of consumption by end-uses and tree species

Evaluation of consumption by end-uses with preference to specific species was carried out in order to determine if there were preferred species and for what uses. The significance of the evaluation was to establish validity of information about potentially specific tree species for use by each sector. In this study sawnwood has been grouped into three major clusters namely softwood species, which are *Pinus patula* and *Cypress species*, fine hardwoods which are high value hardwoods and preferred mostly for use in high class furniture and joinery including. *Milicia excelsa*(mvule), *Pterocarpus angolensis* (Mninga), *Ocotea usambarensis* (Camphor) and *Olea africana* (Loliondo), an general utility hardwoods which refer to general-purpose hardwoods that are commonly used in construction works and in low class furniture. These are *Khaya spp* (Mahogany), *Cordia africana* (Mringaringa), *Grevillea robusta* (Mgrevilia) *Azalia quanzensis* (Mkola), *Albizia spp* (Mkingu). However, during the survey more species that were lesser known or least preferred were found in the market in large quantities and these include *Eucalyptus species* (Mkaratusi), *Persea americana* (Mparachichi), *Rauvolfia spp*, *Mangifera spp* (Mwembe) and *Jacaranda mimosfolia* (Mkrismasi)

3.9 Sawnwood consumption forecasting models

The future sawnwood consumption forecasts to the targeted years were done on the basis of the model that best fit the data. The models that were considered for forecasting were time series forecasting models, and income elasticity of demand model. The types of models that were considered for forecasting were single equation model, time series forecasting models, and income elasticity of demand model.

(ii) Time series models

The time series models use historical information extending back for a long period of observations and therefore require many data points to justify their uses that produce sound results. The data collected in this survey pertained to six years only, where as data for a long period extending back for at least 20 years or more was needed. Data for such a long time was not found as most end users rarely keep such data even for three years. This problem forced the use of the time series models for forecasting to be abandoned.

(iii) Income elasticity of demand model

Forecasting using income elasticity of demand relates consumption of sawnwood to the size of the population, income (per capita GDP of the area/town) and the rate of urbanization. Many wood consumption studies use few principle independent variables of population, income and urbanization rate due to lack of or difficulties in getting the data (Openshaw, 1971)

To determine the future consumption of sawnwood using the model for each municipality, the calculation of Income Elasticity of Demand (IED) was done. The independent variables were obtained after extrapolating the population sizes, incomes and rates of urbanization to the target years and then insert new variables in the basic relationship. Population changes were extrapolated using the formula obtained from the National Bureau of Statistics (1978) as follows;

$$P_t = P_o e^{rt}.$$

Where:

P_t = Previous population size.

P_o = Present population size

r = Average annual population growth

t = Time interval in years between the two censuses

e = Base of natural logarithm with value of 2.71828183

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter presents results and discussion of the research centred on the present consumption and forecasting of future consumption of sawnwood in Arusha and Moshi Municipalities in Northern Tanzania. The results and discussion are based on the sales of sawnwood by timber traders and sawmillers in each Municipality. Also consumption data by endusers were collected and presented. In both cases questions of sales and end-uses are presented in cubic metres of timber sold or used and the tree species involved for various end-uses. Moreover, the chapter examines the sources of sawnwood, availability and employment opportunities in the sales, furniture, and building industry. The results from the sales of sawnwood are used to estimate future sawnwood consumption in both Municipalities for the period 2007 to 2017.

4.1 Present consumption of sawnwood

(i) Arusha Municipality

The results in Table 5 indicate that a total of 38 028 m³ of machine sawn sawnwood was consumed in 2006. To find out the actual consumption for Arusha municipality, the volume of timber that was exported to other districts in the form of furniture had to be deducted. The volume of sawnwood exported to other districts was found to be 7871.80 m³. The remaining 30 156.20 m³ was considered as consumed within the municipality and gave a per 1 000 capita consumption of 86.44 m³ of sawnwood. Softwood consumed was 24 848.70 m³ and the remaining 5 307.49 m³ was

hardwood where when both figures were expressed in percentage they represented 82.40% and 17.60% respectively.

Table 5: Total sawnwood consumption for Arusha and Moshi Municipalities in 2006

Sector wise consumption	Arusha		Moshi	
	Volume (m ³)	As percent (%)	Volume (m ³)	As percent (%)
Furniture industry	21 470	56.50	1 374	20.00
Construction industry	2 251	6.00	982	14.3
Household sector	5 719	15.00	2 548	37.1
Public building	8 588	22.50	1 965	28.60
Total sawnwood consumed				
	38 028	100	6 869	100
Population 2006	348 858	100	144 336	100
Per 1000 capita consumption	109		47.59	

(ii) Moshi Municipality

In 2006, Moshi Municipality consumed a total of 4 904.50m³ of sawnwood. Moshi municipality has a population of 144 336 (NBS, 2002), while the surrounding district of Moshi rural has a population of 402 431. This makes the per 1000 capita sawnwood consumption of Moshi to be 33.98 m³ of sawnwood. If the consumption levels of the two municipalities are compared, Arusha would be found to consume nearly 2.50 times more sawnwood than Moshi did in 2006. In other words, Moshi municipality consumed about 16.30 % of sawnwood consumed in Arusha municipality. The difference in consumption inherent in the two Municipalities is

big indicating great timber business that is taking place in Arusha than in Moshi. The per 1000 capita consumption results for Arusha municipality is greater than that forecasted by Openshaw (1971). The per 1000 capita consumption forecasts made by Openshaw for large towns for 1980 and 2000 was 49m^3 and 65.20m^3 respectively.

In this study the per 1000 capita consumption of sawnwood for Arusha and Moshi Municipalities were found to be 86.44 m^3 and 33.98 m^3 respectively in 2006. For Arusha Municipality the results are higher than forecasts made either by Openshaw in 1970s or Ngaga in 1988 indicating that more sawn wood was consumed in Arusha Municipality and that the former forecasts are far below than what has been observed from this study. There was no existing information on previous sawnwood consumption in Moshi Municipality such that there was no basis for comparison of sawnwood consumption trends there.

On the other hand the high consumption of sawnwood in Arusha must not be surprising since Arusha has a high population compared to Moshi. The 2002 population census showed Arusha to have a population of 282 712 with an intercensal growth rate of 5.50. The neighbouring district of Arumeru that embodies the Municipality had a population of 514,651 with an intercensal growth rate of 3.30 (NBS, 2002). The populations of the two districts together contribute to the common wood market in the Municipality. The factors that favour the high population in the area can be revealed by the features characteristic to the neighbouring districts and the Region as a whole. Arusha town has been developing as the capital of the East African Community with the Arusha International Conference Centre (AICC) where

gatherings for local, National and International, sports and various other conferences are held, thus attracting visitors and tourists who due to their stay are obliged to spend and contribute to the economy of the Municipality. The Municipality ranks second in industrial establishments after Dar es Salaam. Altogether, Arusha municipality has a total number of 5,827 establishments related to manufacturing, building and trade. The commercial, industrial and tourist sectors together with agricultural might make the region the fourth largest regional economy after Dar es Salaam, Mwanza and Shinyanga. Arusha region has the highest per capita GDP of T. Shs 277,367 equivalent to USD 308 that was only exceeded by Dar es Salaam TAS 554,287 and Shinyanga at TAS 285,053 (NBS, 2002). The good climate with bimodal rainfall patterns of mean annual rainfall of 800 mm to 1200 mm, a cool climate with mean annual temperatures of 24° C together with the fertile volcanic soils to favour agriculture in the region all contribute to the high urbanization status of 31.3 in 2001 as was reported in the 2002 census. The agricultural sector takes a lead in contribution to economic growth as a source of cash income in Arusha region. By and large the effect of all economic activities is to improve the peoples' cash incomes, which augment in raising their living standards and hence compel them to undertake among other things, the construction of buildings and their furnishings, activities that need the consumption of sawnwood.

4.2. Sales of sawnwood

The sales of sawnwood in volumes (m³) sold in each Municipality are shown in Table 6. The sales data were collected from salesmen or timber traders and sawmillers. The timber traders buy the timber from sawmillers within and outside the region. There were only four sawmills located in the Arusha Municipality and

six in Moshi Municipality. The few sawmillers in these two towns produce and use their factory premises to sell the produced sawnwood.

Table 6: Sawnwood sold in Arusha and Moshi Municipalities from 2001-2006

Year	Arusha	Moshi
	Volume (m ³)	Volume (m ³)
2001	9 932	5 684
2002	10 070	7 437
2003	9 571	7 145
2004	13 203	6 837
2005	15 263	7 635
2006	31 369	10 989

4.2.1 Sales of sawnwood in Arusha Municipality

Sales of sawnwood for Arusha Municipality in 2006 were 31 369m³. The sales exceeded those of 2005 by 16 106 m³. Among the sold timber, softwood accounted for 86.40%, equivalent to 27 103 m³, while hardwoods accounted for 13.60% equivalent to 4 266 m³ of sawnwood. The trends of sales for sawnwood increased at an annual average rate of 0.43 from 2001 to 2006. The increases in sales of sawnwood during that period can be linked to factors that prevailed including timber availability situation in the region or country as a whole, population increase and the effects of population on the use of resources (URT, 2006), the rise in the general national and regional GDPs, the greater industrial base, and high per capita income levels in the municipality. Of the total timber sales in the municipality, 15.60 % were sold to Manyara while 28.10% were sold to districts of Arusha region. These results show that 56.30% of timber was sold within the Municipality. Timber sellers

in the Municipality were 123 in total, a significant increase compared to what Ngaga (1990) established in 1988 of only 17 traders. The number of traders is an indication that timber business has increased probably due to a number of factors. The high population growth rate of Arusha, the increase in GDP and urbanization create situations that result in the increase of timber demand for development activities such as construction and furniture which in turn result from the demand for essential social services, such as education, health, water, transport and housing (URT. 2006). Timber sellers distinguished themselves by type of species they sell. There were those who sold softwood only, some softwood and hardwood and others hardwood only. Table 7 below shows the types of species sold in percents.

Table 7: Sales of sawnwood by species in Arusha Municipality in 2006

Species type	Volume m ³	% sold
<i>Pinus spp</i>	19 919	63.50
<i>Cupressus spp</i>	7 184	22.90
<i>Albizia spp</i>	543	1.73
<i>Cordia africana</i>	465	1.48
<i>Grevillea robusta</i>	853	2.72
<i>Terminalia</i>	311	0.99
<i>Eucalyptus spp</i>	775	2.47
<i>Rauvolfia</i>	543	1.73
<i>Persea americana</i>	388	1.24
<i>Jacaranda mimosfolia</i>	388	1.24
Total	31 369	100

According to Table 7, species that are sold in Arusha Municipality are dominated by softwood species of *Pinus patula* (63.50%) and also *Cupressus lusitanica* (22.90%). Arusha Municipality is situated near the softwood plantations of Meru-Usa, West

Kilimanjaro and North Kilimanjaro Forest Projects. From the table it is seen that hardwood species found being sold in the Municipality did not include the famous and highly preferred traditional species of *Pterocarpus angolensis*, *Milicia excelsa*, *Olea Africana* and *Khaya nyasica* and *Podocarpus usambarensis*. As it is shown in Table 7 species that previously had low or no preference for use as timber were found sold in Arusha municipality. The scarcity of the traditionally preferred species is said to be caused by restrictions imposed by the government on harvesting timber species from restricted areas especially natural forests for protective and conservation purposes. Since 2003, the government has been introducing periodic bans on harvesting from natural forests (WWF, 2007). In addition the scarcity is caused by the controls on harvesting (for most hardwood-producing forests) for the preservation of biodiversity and watershed values. Currently, harvesting in catchment forest reserves is banned despite the on going illegal tree cutting for hand sawing (FBD, 2000). This situation has caused the scarcity of the traditional hardwood species and as such species like *Albizia gumifera*, *Grevillea robusta*, *Eucalyptus spp*, *Jacaranda mimosfolia*, *Persea americana*, *Rauvolfia spp* are now found in timber Markets in Arusha.

In the study to evaluate sawmills and other primary wood industries in Tanzania, some new non-traditional species for sawmilling in various regions of country were reported. The report included species of *Mangifera indica*, *Cocos nucifera*, *Syzigium spp*, *Araucaria spp*, *Jacaranda spp*, *Senna siamea*, *Persea americana*, and *Eucalyptus spp* (URT, 2005). Most of these trees were planted by farmers and individuals to act as windbreaks in coffee farms in Kilimanjaro and Arusha regions. The owners sell them to sawmillers who collect and saw the logs to obtain

sawnwood. On the question of whether timber traders obtained any timber from outside Arusha region, 25% of the traders said they obtained timber from Kilimanjaro, 64% indicated Iringa and 11% indicated Tanga region. Arusha, Tanga and Kilimanjaro regions mainly supply hardwood while sawnwood from Iringa region mainly comprises pines. The previously unpreferred wood species have now substituted the highly favoured fine hardwoods in the timber markets in Arusha. Hardwood sold in the Municipality comes from the districts of Arumeru in Arusha Region, Moshi, Hai, Same, Mwanga and Rombo in Kilimanjaro region, and Lushoto, Muheza (Longuza), and Kilindi districts of Tanga region.

When timber traders were interviewed on the state of the market, 6.30% of the traders said the market was easily available, while 37.50% said it was good, 9.40% indicated the market being stable and 46.90% said the market was difficult. From the results it can be deduced that the sawnwood market is good. According to responses by timber traders on customers for sawnwood 34.10% of timber traders mentioned builders, while 47.70% of them said carpenters and 18.20% mentioned domestic users as major customers. The timber market was not restricted to the Municipality alone, as 31.30% of the timber traders said they sold timber to other districts or regions. From the survey results, 15.60% sold their timber to the districts of Manyara region and 28.10% to the districts of Arusha region. Sellers were not selective on the species of timber they would want to sell to customers. This was shown by about 69 % of the timber traders who said they did not make any preference on the species of timber they sold, and 97% of them were satisfied with the quality of goods they sold. Also on the level of satisfaction on goods they sold, 62.50% of traders were satisfied with the quantity and 37.50% of them were

satisfied with the quality. On the other hand, responses given by traders on whether their customers were satisfied with the goods they received 100 % of traders said customers were satisfied with the quality of the goods and 93.80% said customers were satisfied with quantity.

The judgments of customer satisfaction by traders may not give a true picture of satisfaction because customers bought what they found in the market irrespective of their preferences since the traditionally favoured timber species are not available in the market. On the other hand, the dissatisfaction suggested by the few traders from this study may have been caused by lack of choice of species. The reported causes for attraction to sawntimber by customers include favourable prices (15.30%), quality of goods (21%) and customer care (19.40%). Meanwhile 44.40% of customers disagreed with the existence of attraction in any of the three aspects of price, quality and quantity. Whether there was attraction or not the market situation existing at that particular time had greater influence on the demand of sawnwood in Arusha.

4.2.2 Sales of sawnwood in Moshi Municipality

In the Municipality of Moshi, there are 40 timber traders selling sawnwood. Out of the 40 traders about 79% sell hardwood and the rest 21% sell softwood of which *Pinus patula* was sold by 7% and *Cupressus lusitanica* by 14% of the respondents. The sales of sawnwood for the year 2005 amounted to 10 989 m³ being a 193% increase over the 2001 sales totaling 5 684 m³. However, the trends of sawnwood sales for Moshi during the reviewed period fluctuated, as there were periods of fall and rise of sales (Table 8). Sales for 2002 reached nearly 31 % increase over the

sales of 2001, while in the two consecutive years (of 2003 and 2004) the dropped by about 4%. Timber sales increased again in the following years of 2004 and 2005 where there were increases of 11.70% and 43.90% respectively. Conditions that caused the fall possibly could be associated with timber availability. General increases of sales of sawnwood are a proof that the demand for sawnwood in the Municipality has been increasing progressively. Sawnwood sold in Moshi was mainly hardwood species of general utility timber of which 73.10% of the sawnwood was sold in Moshi, while the districts of Kilimanjaro region consumed 19.20% and the districts of Manyara region consumed 7.70%. The Municipality consumed much of the sawnwood sold in the municipality. Table.8 shows sawnwood sold in Moshi Municipality by species in 2006. The results in Table 10 show that Moshi municipality sold more hardwood than softwood compared to Arusha municipality. The source and timber availability for the Municipality of Moshi could explain this situation. Softwood plantations in Kilimanjaro region have deteriorated in production of softwood. There are only various hardwood species planted in farmlands as windbreaks in coffee farms and plantations that now act as the source of the hardwood. The timber sold in Moshi Municipality was sourced from the districts in the region. Each district supplied timber to the Municipality amounting to 34.80% from Moshi, 30.40% from Hai, 13% from Rombo, 4.30% from Same and 10.90% from Mwanga.

Table 8: Quantity of sawnwood species sold in Moshi municipality in 2006

Species type	Volume m ³	% sold
<i>Eucalyptus spp</i>	1 989.00	18.10
<i>Grevillea robusta</i>	1 857.00	16.9.00
<i>Cupressus lustanica</i>	1 538.50	14.00
<i>Cordia africana</i>	1 483.50	13.50
<i>Albizia spp</i>	1 363.00	12.40
<i>Pinus patula</i>	769.00	7.00
<i>Rauvolfia</i>	747.25	6.80
<i>Jacaranda mimosfolia</i>	747.25	6.80
<i>Persea americana</i>	494.50	4.50
Total	10 989.00	100.00

4.3 Sawnwood prices

4.3.1 Arusha Municipality

Selling prices of sawnwood in Arusha Municipality are set differently by traders according to species. Softwood species have different prices depending on the type of species, for example *Cupressus lustanica* usually sells at a higher price than *Pinus patula*. The same applies to hardwood species that also sell at different prices. In free trade, price setting of timber depends on the value the buyers put on the species and the market forces of demand and supply of the commodity. The various selling prices per species types are shown in Table 9.

Table 9: Retail prices for sawnwood by species in Arusha Municipality in 2006

Species	Ex-mill prices/m ³ (TAS)	Retail prices / m ³ (TAS)
<i>Terminalia spp</i>		292 500
<i>Rauvolfia spp</i>		295 000
<i>Pinus patula</i>	144 000	190 000
<i>Persea americana</i>		360 000
<i>Jacaranda mimosfolia</i>		330 000
<i>Eucalyptus spp</i>		285 000
<i>Cupressus lusitanica</i>		220 000
<i>Cordia africana</i>		300 000
<i>Albizia spp</i>		330 000

Table 9 indicates that different hardwood species have different price values attached to them. The lowest hardwood selling price was 228 000 TAS per m³ as against the highest of 288,000 TAS per m³ in 2006. Sawn softwood prices were the lowest compared to hardwood prices. Prices vary from TAS 285 000 to TAS 360 000 for hardwood species. The selling price for *P.patula* was 63.15% lower than hardwood price. Prices of timber fluctuate almost frequently causing continuous price rises. One hundred percent of the interviewees who were asked about the stability of timber prices responded positively on the continued price rises. Frequent price changes are caused by timber availability and some other economic factors that influence the change.

Table 10: Responses on instability of sawnwood prices in Arusha

Item	Timber traders		Timber endusers	
	No.	as %	No.	as %
Number sampled	98	100	75	100
Price fluctuates?				
Yes	32	100	29	100
No	0	0	0	0
Reasons				
Transportation	15	15.30	13	17.30
Rise in price of logs	24	24.50	13	17.30
Rise in price of diesel fuel	27	27.60	18	24.00
Long distance from source	23	23.50	14	18.70
Export of sawnwood to Kenya	5	5.10	6	8.00
Price rises in other				
General trade items	5	4.10	11	14.70

Table 10 shows responses of timber traders and endusers on the fluctuation of timber prices. All interviewees in both groups agreed that sawnwood prices fluctuated and thus they were unstable. However, the frequencies at which prices fluctuate were not identified by the survey. There are obvious reasons that influence the changes in prices of sawnwood in Arusha. Both groups agreed on the common causes that instigated the rises. Some of the causes according to respondents include rise in price of diesel, rise in prices of logs and long distances from timber source ranked high as causes of timber price rises.

Scarcity of timber in the region was another reason that caused rises in price of timber. Five percent of timber traders and 8% of endusers indicated that export of the sawnwood to Kenya cause prices to rise. The diversion of sawnwood from the internal market to the external market is caused by the great overseas demand

especially from China, where Tanzanian hardwood commands high prices, compared to timber from West and Central Africa (Guardian, 2007). This situation contributes to scarcity and therefore denies local consumers of the commodity. Another cause for price rise was the inflationary trend as was stated by 4.10% of the timber traders and 14.70 % of the endusers.

None of the timber sellers knew the quantity per type of species that was sold be it for soft wood or hardwood. Lack of such data indicates that timber traders do not record quantities of sawntimber by species they sell. In view of the frequently sold species, for both softwood and hardwood, 75.80% of the traders mentioned *P.patula* and 24.20 % mentioned *C. lustanica* for softwood. In the case of hardwood species the frequently sold species, with respective respondents percent in parentheses include: *Albizia spp* 13.80%, *Cordia Africana* (15.50%), *Grevillea robusta* (20.70%), *Terminalia spp* (3.40%), *Eucalyptus spp* (15.50%), *Rauvolfia caffra* (13.80%), *Persea americana* (6.90%) and *Jacaranda mimosfolia* (10.30%). Sellers were able to identify the different uses by suitability to which each species is put to. The most suitable species were found to be *P. patula* reported by 27.30% of the respondents, *Grevillea robusta* and *Cordia Africana* by 13.60% of the respondents in each case, and *Albizia spp* and *Eucalyptus spp* reported by 10.60% of the respondents in each case. *Cupressus lustanica* suitability was ranked by 9.10% of the respondents, *Rauvolfia caffra* reported by 7.60%, and *Jacaranda mimosfolia* 6.10% of the respondents in each case. Usually *C.Lustanica* is normally highly preferred for its suitability in furniture making. The low ranking that is observed here is due to scarcity in the market such that it is quite often forgotten to be mentioned. The species of *Jacaranda mimosfolia*, was found to produce high quality

furniture, though its supply to the market is very low. Finding Jacaranda trees with fine logs to produce timber is difficult.

The traders mentioned the traditional species that used to be preferred for various types of furniture as *Olea africana* (32.60%), *Milicia excelsa* (26.10%), Camphor (21.70%) and *Podocarpus usambarensis* (19.60%), though the species were scarce as was indicated by 75% of the timber traders. Most of the hardwood species are scarce, as they are brought to the market in small quantities. Timber availability was reported by 100% of timber traders interviewed as difficult. Most of the softwoods are obtained from Iringa, which is a very long distance from Arusha. Therefore, there are implications of distance; transport costs and the time taken that are involved to get the timber consignment to Arusha and Moshi. Mostly the timber traders had to wait for a long period of time to get the sawn timber dried to reduce moisture content and hence weight with the objective of avoiding transporting unwanted moisture present in the wet timber. This environment makes the timber availability situation be termed as difficult and the one, which causes extra costs of timber in the market. The total existing stock of sawnwood at the time of the survey was found to be 2 149 m³ with an average of 17.46 m³ per trader. Timber traders prefer to create buffer stocks of commodities that will take care of any deficit before they bring in a new stock.

4.3.2 Sawnwood prices in Moshi Municipality

Sawnwood prices in Moshi are shown in the Table 11 below.

Table 11: Prices of sawnwood species per m3 sold in Moshi municipality in 2006

Species	Price per m ³ (TAS '000)	Ex- mill prices (TAS '000)	Last year's prices (TAS '000)
<i>Pinus patula</i>	190	150	150
<i>Cupressus lusitanica</i>	230	190	190
<i>Albizzia sp</i>	300	260	260
<i>Cordia africana</i>	420	380	380
<i>Grevillea robusta</i>	420	380	380
<i>Terminalia spp</i>	300	260	260
<i>Eucalyptus spp</i>	450	410	410
<i>Rauvolfia spp</i>	315	275	275
<i>Persea americana</i>	300	260	260
<i>Jacaranda mimosfolia</i>	300	260	260
<i>Milicia excelsa</i>	1,110	1,070	1,070
<i>Ocotea usambarensis</i>	450	410	410

The prices of timber shown in Table 11 are averages for each species since the prices vary from one selling post to another and among traders themselves. The variations in prices for the same species are due to the costs incurred in the extraction of the timber species together with the value consumers put to a particular species. Some species are assigned higher value and are therefore cost more in the market and sell at high prices. The differences in the prices of different species may be caused by the values inherent among the traders and customers on particular species. Here the main reasons for differences in prices may be associated with

timber availability, which influence costs of extraction and transportation, incurred by each trader.

Timber availability in Moshi is relatively difficult than usual because the sources of timber are from individual farms spread everywhere in the districts. Prices in Moshi have not been stable like those of Arusha Municipality. Timber traders interviewed in Moshi with their percentage responses in brackets, mentioned reasons for the rise in prices as transportation (35.10%), rise in the price of logs (32.40%) and rise in the price of diesel (32.40%).

Trends of timber sales in both municipalities show swift increases. Arusha has had higher increases compared to Moshi. The increases can be qualified to prominent factors prevailing in Arusha as they are distinguishable from those found in Moshi. The highlighted economic status of the Municipality prompts business transactions that at the end reward the population with high incomes that compel them to engage in development activities that demand sawnwood.

The geography, climate and ecology of the regions influence the species that are found in the zone. Timber sold in Arusha and Moshi with an exception of softwood are brought from nearly the same sources for the two regions. The species that are sold are *Pinus patula*, *Cupressus lusitanica*, *Albizia spp*, *Cordia africana*, *Grevillea robusta*, *Eucalyptus spp*, *Rauwolfia spp*, *Persea americana*, *Jacaranda mimosfolia* and *Terminalia spp*. Though the list shows dominance of hardwood species the quantity sold is quite small especially in Arusha. In Moshi, the sales of hardwood dominate the market.

With the exception of the softwood species, the hardwood species sold in the two towns are rather new species in the timber market of the two towns. Ngaga, (1998) found different hardwood species in the timber market in Arusha. These were the traditionally adored hardwood species that best suited furniture manufacturing. The same writer observed the factors that caused preferences of the species in furniture production as stability in the wood and did not check or split. Also other reasons include appearance, attractiveness, natural durability and easiness to work. The species of *Pterocarpus angolensis*, *Chlorophora excelsa*, *Khaya nyasica*, *Olea africana*, *Ocotea usambarensis* and *Podocarpus usambarensis* no longer access the timber market and if they do, they would be in very small quantities.

Large quantities of softwood species of *Pinus patula* are sold in Arusha compared to Moshi. Almost all pine that is sold in Arusha is imported from Iringa in southern Tanzania. Softwood plantations in the northern zone that used to supply and satisfy the timber market in Arusha have run out of harvestable stock. Most of the sawmills that used to process the logs into timber have been moved to Iringa. The preferences for *Cupressus spp* wood by customers in Arusha have changed to *Pinus patula* indicating changes in consumer behaviour of preference.

4.4 Sawnwood consumption by the furniture industry

The data collected in Arusha and Moshi Municipalities show the quantities of sawnwood consumed by the furniture industry in each Municipality beginning from 2001. This section indicates sawnwood quantities consumed by the furniture industry in both Municipalities from 2001 to 2006.

4.4.1 Arusha Municipality

Table 12 below shows the involvement of different subsectors in the furniture industry in Arusha in 2006, while the total quantities consumed by the furniture industry from 2001 to 2006 are shown in Table 13.

Table 12: Consumption of sawnwood in the furniture industry by trade/skill 2006.

Item	Trade/skill	Frequency	Percent
1	Workshop	7	24.10
2	Carpentry	8	27.60
3	Furniture mart	14	48.30
4	Total	29	100.00

The total consumption of sawnwood in the furniture industry in Arusha is shown to be dominated by furniture production at 48.30% and workshops and carpentry share the remaining 51.70%.

Table 13: Annual sawnwood consumption figures for Arusha from 2001 to 2006

Item	Year	Volume(m ³)	Increases in %
1	2001	11 269	
2	2002	13 790	22.40
3	2003	14 234	3.20
4	2004	13 108	-7.90
5	2005	14 679	12.00
6	2006	21 470	46.30

The consumption pattern of sawnwood was seen to be rising sharply, especially for the years of 2003 and 2006 where there were sharp increases of 22.40% and 46.30% respectively. Timber availability and changes in consumer spending, and the rises in the per capita incomes may probably explain such increased consumptions. In general, there was a rise in the consumption of sawnwood from 11 269 m³ in 2001 to 21 470m³ in 2006. The species of trees and their quantities consumed are summarised in Table 14.

Table 14: Hardwood species used in Arusha Municipality in 2006

Species	%age use
<i>Afzelia</i>	2.70
<i>Terminalia</i>	3.60
<i>Albizia</i>	11.60
<i>Grevillea</i>	20.50
<i>Eucalyptus</i>	16.10
<i>Rauvolfia</i>	12.50
<i>Persea</i>	6.30
<i>Cordia</i>	16.10
<i>Milicia</i>	2.70
<i>Jacaranda</i>	8.00

When asked on the species of softwood used, nearly 53% of the respondents used *Pinus patula* and 42.30% reported to have used *Cupressus lusitanica*. Hardwood species used in Arusha, are general utility timber. The traditional fine hardwoods like Camphor (*Ocotea usambarensis*), Loliondo (*Olea africana*) and Mninga

(*Pterocarpus angolensis*) have been replaced by other tree species that had low priority to the consumers for furniture production. Ngaga (1998), mentioned selected fine hardwood species like (Mninga and Mvule) as preferred for furniture making but were scarce and were selling at high prices, a phenomenon that forced consumers to turn to other tree species (camphor and Loliondo). In fact, every tree species that can produce timber is now brought into the market. The protection and conservation of certain tree species have contributed towards the scarcity and therefore changes in the consumption behaviour of customers. Carpenters obtain most of the wood from within the Municipality area. Responses from the carpenters regarding their sources of sawnwood show that 48.30% of them got their timber from the timber yards, 21% from sawmills and 31% from private sources Sawnwood from private sources is usually taken to carpenters or workshops for the sake of manufacturing the furniture the customers want. In the opinion of the furniture manufacturers, the prices of wood were not stable as 100% of the respondents agreed on the existence of fluctuation. The causes of the price rise were said to be transportation reported by 17.30%, the rise in the prices of logs reported by 17.3%, rise in the price of diesel fuel reported by 24%, and long distance of transportation reported by 18.70%. Other reasons included timber export especially to Kenya (8%) and the rise in the prices of other goods (14.70%). When the prices of daily consumer goods that are necessary for daily uses rise, the extra expenses incurred on them reduces the individual's purchasing power. According to the survey results, customers in the furniture market are divided into builders who consumed 26.60% of the sawnwood in the form of furniture, carpenters comprising 46.7%, and domestic users comprising 26.70%. Some furniture is exported outside of the Municipality in

the districts of Arusha and Manyara regions. A total of about 21 % of the furniture was exported in 2006.

4.4.2 Sawnwood consumption by furniture industry in Moshi Municipality

In Moshi Municipality, there are 52 carpenters out of whom 21 were sampled from seven out of 15 wards comprising Moshi Municipality. A total of 6 869 m³ of sawnwood were consumed by the carpenters in the municipality in 2006. The volumes increased from 2 162 in 2001 to 6 869 in 2006 with annual increases of 44.40% for (2002), 27.20% for (2003) 24.10% for (2004), 11.30 for (2005) and 25.20% for (2006). The increases were attributed to population increase and high GDP that provoked the demand for other products including sawnwood. Moshi has an intercensal population growth rate of 24.60% and an average annual growth rate of 1.90%. The total sawnwood sold by the furniture industry amounts to 1 374 m³ of the total sawnwood consumed in the municipality. Various timber species were consumed. Table 15 shows the tree species consumed and their ratios expressed in %.

Table 15: Sawnwood consumption in Moshi Municipality 2006

Species consumed	% age consumed
<i>Albizzia sp</i>	13.90
<i>Cordia sp</i>	16.50
<i>Grevillea sp</i>	21.50
<i>Terminali sp</i>	7.60
<i>Eucalyptus sp</i>	11.40
<i>Rauvolfia sp</i>	10.10
<i>Persea</i>	11.40
<i>Jacaranda</i>	3.80
<i>Milicia</i>	3.80

Almost all species consumed are hardwoods, though only a small fraction of sawn softwood was consumed. The data from Moshi District Council did not show any sawn softwood that was recorded. All forest products that are brought into the municipality for sale must be registered by the Moshi District Council and any payments such as royalty, are made to the government, where a royalty of 600 TAS per m³ is charged. District councils under-collect the royalties and consequently cause a loss of the most important revenue for development programmes. It has been observed (Milledge *et.al.*, 2006) that revenue lost by central and district governments due to the under-collection of royalties reached up to 96% of the total amount of potential revenue due. A further estimated nation wide loss of revenue to the Forestry and Beekeeping Division amounted to USD 58 million annually due to under-collection of royalty in the districts (Milledge *et al.*, 2006).

Carpenters in Moshi obtain sawnwood they use to manufacture furniture from sawmills, timber yards and private sources. These are the results given by carpenter respondents who 21% of them reported to have sourced agreed to source timber from sawmills, 48.30% reported to have obtained timber from timber yards, and 31% reported to have gotten the product from private sources. According to the respondents most of their products are bought by builders who take 44.40%, domestic users who consume 44.40% and construction works that use 11.20% respectively. Of the respondents asked about the market situation of their products only 4.80 % conceded that the market for their products was easily available, while 52.40 % complaining about the difficulty of the market for their products and 33.30% admitted that the market condition was good. However, 9.50% of the respondents considered the market situation as being poor. Most of the products are

within the districts of Kilimanjaro region, with 85.70% and Manyara region with 14.30% of the total products. The districts of Kilimanjaro have market shares of 14.30% for Moshi rural district, Hai has 9.50%, Rombo has 4.80%, Same has 9.50% and the Municipality has 61.90% of the market shares.

Regarding the prices, sawnwood is usually sold per running foot in Moshi, and therefore to get the actual prices per cubic metre, mathematical conversion into metric units were done. Ex-mill prices and previous year's prices differed from the selling prices by 200 TAS per metre. The higher prices of sawnwood caused the availability of sawnwood in the region to be considered as scarce by 57.10% of the respondents and very scarce by 4.80% while 38.10% said timber was abundant. However among the opinions given in addition to the causes of high prices for sawnwood included difficult wood availability (12.50%), few customers (25%), high prices of sawnwood (18.80%), lack of tools (9.40%), small capital (15.60%), competition within business (6.30%) and transport (12.50%).

The sawnwood consumed by the furniture industry in the two Municipalities is used for making cupboards, tables shelves and drawers, beds sofas and chairs. Other works for which sawnwood is used are joinery items like doors, windows or frames and other structural works.

4. 5 Sawnwood consumption by building industry

4. 5.1 Arusha Municipality

There were about 56 contractors in Arusha, out of whom only seven were interviewed. It was difficult to access these contractors to obtain data for the

sawnwood consumed because of the locations of their business premises. Therefore only seven of the contractors were interviewed and the data they provided acted as a basis for estimating sawnwood consumption in Arusha Municipality. Altogether consumed 9 959 m³ of sawnwood in 2006. This figure is only an estimation and is based on the data provided by contractors interviewed. It is likely that the data provided were understated probably for fear that revealing their business secrets or information may cause them to be heavily taxed. It can also be explained here that some of the contractors may not have been registered, and may have been operating illegally and are therefore not willing to give true data. Table 16 shows sawn hardwood tree species consumed in the building industry in Arusha in 2006.

Table 16: Hardwood species consumed by the building industry in Arusha in 2006

Species	Volume m ³	% consumption
<i>Pinus Patula</i>	7 469.30	75.00
<i>Terminalia spp</i>	89.60	0.90
<i>Albizia spp</i>	288.80	2.90
<i>Grevillea robusta</i>	507.90	5.10
<i>Eucalyptus spp</i>	398.40	4.00
<i>Rainvolfia spp</i>	308.70	3.10
<i>Persea Americana</i>	229.00	2.30
<i>Cordia Africana</i>	398.40	4.00
<i>Milicia excelsa</i>	69.70	0.70
<i>Jacaranda mimosfolia</i>	199.20	2.00
Total	9 959.00	100.00

Table 16 indicates that 75% of the sawnwood consumed by the building industry in 2006 was *Pinus patula*. The rest of the hardwood species altogether accounted for 25% of all the timber consumed by the same industry in Arusha. The dominant hardwood species consumed are *Grevillea robusta* (5.10%), *Cordia* spp (4%), *Rauvolfia* spp (3.10%), *Albizia* spp (2.90 %), *Persea americana* (2.30%). These are the species, which are supplied to the timber market in Arusha from the farms in Arumeru and Kilimanjaro region. Fine hardwoods and camphor, *Ocotea* species and *Olea* do not appear in the table because of harvesting restrictions imposed by the government. Sawn softwoods' consumption level of 75% indicates that softwoods are used more extensively in building possibly due to their availability and are relatively cheap compared to hardwoods. *Pinus patula* has dominated other tree species because it is available in large quantities.

4. 5.2 Sawnwood consumption by building Industry in Moshi Municipality

The building industry in Moshi Municipality consumed 28.60% of sawnwood consumed in the municipality in 2006. A total of 1965 m³ of sawnwood was used by the building industry. The supply level of *Pinus patula* to the timber market in Moshi is very low, and thus rendering the species' availability for consumption difficult. Sawnwood consumption by species in the building industry in Moshi Municipality is shown in Table 17.

Table 17: Sawnwood consumption by species in Moshi Municipality in 2006

Species	Volume m ³	% Consumption
Softwood spp	413	21
<i>Terminalia spp</i>	118	6
<i>Albizia spp</i>	216	11
<i>Grevillea robusta</i>	334	17
<i>Eucalyptus spp</i>	236	12
<i>Rauvolfia spp</i>	157	8
<i>Persea Americana</i>	118	6
<i>Cordia Africana</i>	255	13
<i>Milicia excelsa</i>	59	3
<i>Jacaranda mimosfolia</i>	59	3
Total	1965	100

About 79% of the sawnwood consumed by the building industry in Moshi was in the form of hardwood species as shown in Table 17. This shows that building activities in Moshi Municipality depend heavily on sawn hardwoods. The most preferred hardwood species are *Grevillea spp*, *cordial spp*, *Eucalyptus spp* and *Albizzia spp*. Building contractors in joinery works prefer hardwoods. Comparing the building industries in both Municipalities, Arusha had more building activities than Moshi. The differences in quantities of sawnwood used in building in the two Municipalities are a clear indication of the differences. There are many building contractors in Arusha than in Moshi Municipality. Arusha Municipality consumed 36.10% of all sawnwood, while Moshi Municipality consumed 28.60%. Also the quantities of timber that are brought to Arusha are many times higher than those brought to Moshi. The trend of consumption for Arusha can be explained by the economic

activities that take place in Arusha being relatively higher than those of Moshi Municipality.

Population sizes broadly increase the demand for forest products by increasing the number of forest product consumers (FAO, 1999). Population factors impinge on development and the welfare of individuals, families and communities at the micro-economic level and tending to increase outlays on private and public consumption at the macro-economic level (URT, 1992). The other reason that has contributed to the attractive timber industry in Arusha, is income. The GDP for Arusha is higher than that for Moshi, which reflects the fact that people in Arusha are richer than those in Moshi. This makes many people in Arusha to have greater purchasing power for wood products than those in Moshi.

4.6 Sawnwood consumption by the public sector

There were no public organizations that consumed sawnwood in Arusha and Moshi Municipalities in 2006. Following trade liberalization and its adoption in the country, many public organizations ran out of business and or were privatized. The contracts that formerly were being tendered to such public organizations are now given to private companies. Public organizations that used to exist were established as Government parastatals, which therefore used and followed government procurement procedures. The sawnwood consumption in the two municipalities for the public sector was not determined. Most of the public construction activities are done by contractors whose consumption is already accounted for. There are mini repairs and maintenances, which some public institutions or organizations do them by themselves and can, therefore register a small amount of sawnwood consumed.

4. 6.1 Arusha Municipality

The public sector in Arusha consumed 13.90% of the total sawnwood consumption in the Municipality in 2006. The consumption was due to the construction of primary and secondary school classes, Wards offices dispensary rooms and staff houses.

4.6.2 Moshi Municipality

A total of 984 m³ of sawnwood was consumed in Moshi by public organization in 2006 for the construction of school classrooms, dispensary and hospital wards, and Ward offices and staff houses.

4. 7 Sources and availability of sawnwood

4. 7.1 Arusha Municipality

The findings indicate that the sawnwood consumed in Arusha municipality is obtained from Iringa, Kilimanjaro and Tanga regions. Iringa region supplies almost all sawn softwood of *Pinus patula* from Sao Hill forest plantations. Very small quantities of softwood are obtained from private farms/plantations in Njombe and Makete districts. However, there are other sources of pine from forest plantations in Morogoro and Ruvuma regions, which also supply sawnwood to Arusha market though in very small quantities. Little quantities of sawn softwood are still obtained from the forest plantations in Arusha and Kilimanjaro regions. Timber production from these plantations has declined following mismanagement.

All hardwood consumed in Arusha is obtained from Tanga, Kilimanjaro and Arusha Regions. They are obtained from private farmlands in these regions, where sawmillers search and find the trees to harvest. In Arusha, Kilimanjaro and Tanga

regions tree species of different kinds are planted in the farmlands for marking borders and for use as wind breakers especially in coffee farms. Following the scarcity of sawnwood in the Municipalities, sawmillers have resorted to harvesting trees in the farms in the districts. The people with farm trees in the districts also find this practice as an alternative or a supplementally source of income. The income that is gained from tree harvesting motivation (Kajembe and Mgeni, 1996) to the farmers or local communities to plant more trees in their farmsteads. The districts that supply the hardwoods are Arumeru in Arusha Region, Moshi and Hai districts in Kilimanjaro region. Same, Mwanga and Rombo have little supplies compared to the two districts of Hai and Moshi. In Tanga region, Muheza and Lushoto districts are the chief sources of hardwood. Handeni district supplies hardwood though to a much less extent than the two districts. Though Arusha has a rich natural forests base that could act as a source of hard woods, harvesting has so far been prohibited for conservation and protection reasons.

Though timber imported in Arusha is adequate to satisfy the local demand, its availability is said to be difficult according to how it is accessed and brought to Arusha. In the cross interviews with timber traders, 100% of them reported that timber was scarce; on part of carpenters, 72.4 0% of them said that timber was scarce, and 27.60% said timber was abundant. As an observation from carpenters, those few who said it was abundant reflected the way timber was obtained. The element of scarcity thus reflects the distance and costs involved to obtain the timber (Ngaga 1990). Sunderlin, *et al.* (2005), elaborate among others, the factors of difficult access, steep topography and long distance to the markets, as limiting to the development opportunities for the local people. As already observed in this

discussion, timber is imported from distant sources such as Iringa (1200km), Tanga (526km). Kilimanjaro, which is the nearest source is 100 km away. Table 18 shows the quantities of sawn wood imported into Arusha from other regions between 2003 and 2006.

Table 18: Sawnwood supply into Arusha Municipality from 2003 to 2006.

Product	Year			
	2003	2004	2005	2006
Softwood (m ³)	2 640	9 059	11 405	30 954
Hardwood (m ³)	700	7 041	4 408	4 403
Total (m ³)	3 340	16 100	15 813	35 356

Source: Regional Forest Office Arusha (2007).

4. 7.2 Moshi Municipality

Unlike in Arusha municipality, timber consumed in Moshi municipality comes from within the region's districts. The sawnwood that is consumed in the Municipality of Moshi is mainly hardwood. The chief sources of timber for the municipality, according to timber traders interviewed, are districts of Kilimanjaro region. Moshi contributes about 41.30% followed by Hai (30.40%) and Mwanga by 15% of the timber supplied into the municipality. Rombo district contributes little while Same contributes (4.30%). A monthly timber supply into Moshi from 2001 is shown in Table 22.

Table 19: Monthly sawnwood import into Moshi municipality from 2001 to 2006 in m3

Month	Period					
	2001	2002	2003	2004	2005	2006
January	73	91	313	141	156	408
February	44.2	117	241	261	136	313
March	31	145.5	252.5	354	479	491
April	67.5	105	199	281	287	115.5
May	17	62	145	324	355	458
June	18	149.5	314	270.1	420	264
July	158	198	189	298	405.1	465
August	139	140	180	383	623	386
September	79	120	175	250	664	354.3
October	65.5	181	289	298	507	223.5
November	69.2	850	251.5	280	520	426
December	111	233	321	237	459	333.3
Total	872.4	2392	2870	3317.1	5008.1	4237.6

Source: Moshi District Council Forest Products Register 2006.

The situation of harvesting timber from farms in the region is an indication of scarcity of timber. Timber supply especially of softwood from forest plantations has not satisfied the demand since supplies from these plantations are very low. The reasons for low supplies from the industrial plantations include management plans, irregular replanting of clear-felled areas and low allowable cut and actual removals and poor stand conditions. One other factor that has contributed to low supply from industrial plantations especially of Cypress is the emergence of aphids (*Cinara cupressii*) that caused death of *Cupressus lusitanica* plantations in the country (FBD,

2000). The loss of *Cupressus lusitanica* added to timber scarcity in the country. The loss of the species through disease agents is among a complex set of biological, social and economic pressures that result into deforestation and forest degradation by conversion of forests to farmland and poor forest management, including over-logging, forest fires, and increased harvesting of wood fuels and other forest products for household use (FAO, 2000 and UNEP, 2001).

4.8 Employment involved in sawnwood activities

4.8.1 Wood based employees in Arusha Municipality

The sawnwood sales and utilisation business involves provision of jobs and therefore create incomes to employees. In Arusha people employed in this business were evaluated in the sales and furniture sectors as shown in Table 20.

Table 20: Estimates of wood based employees in Arusha municipality in 2006.

Item	Timber selling posts	Percentage	Carpentry	%age	Total
Number of employment units	126	57	221	43	347
Employment units sampled	32		29		61
Average of employees per unit	4		6		10
Total number of employees	504	27.54	1326	72.46	1830

The results in Table 20 indicate that the total number of employment created from sales and usage of sawnwood in Arusha Municipality in 2006 amounts to 1 830, out

of which timber sales offered 504 employments equivalent to 27.60% while carpentry and allied jobs created 72.40% of all the jobs. It appears therefore that carpentry employs many people per business unit (6) compared to an average of four to timber sales. The presence of many carpentry units in the Municipality compared to timber selling can be explained by the zeal for many a young people to find self-employment. Carpentry manipulates and renders wood to be turned into a structure as required by customers. This is where timber is put to one of the enduses, like furniture and joinery and therefore requires a broader base of carpentry shops to absorb all the demands. Carpentry is attractive to many people who seek employment, since it requires few simple hand tools to work with.

4.8.2 Wood based employees in Moshi Municipality

As for Moshi municipality the estimates for the numbers of employees in wood based activities is shown in Table 21.

Table 21: Estimates of wood based employees in Moshi Municipality in 2006.

Item	Timber sales posts	As %	Carpentry shops	As %	Total	As %
Total number of employment units	40	43.5	52	56.5	92	100
Number of employment units sampled	19		21		40	
Average number of employees per unit	3		5		8	
Total number of employees	120	31.6	260	68.4	380	100

Moshi Municipality has 92 employment units of which timber selling posts account for 43.50% and carpentry 56.50%. The units altogether employ 380 people where carpentry employs 68.40% and the rest about 31.60% are employed in timber selling business. The average number of employees per business unit is 3 for timber sellers and 5 for carpentry. Carpentry business employs many people compared to timber selling, because timber selling requires more cash inputs than does the to carpentry. Wunder, (2001) observes that, among other reasons, timber is typically unavailable to the poor rural people for several reasons including the costs of entry that are typically very high, and as such delimit most people to operate the business. Besides the high capital involved in timber business, carpentry itself requires artisanal skills that are essential for manufacturing of various items and requires a little capital to start the business. Many people with carpentry skills are attracted to carpentry business as a kind of self-employment. On the other hand those without skills find it easy to join the enterprise to start learning and acquire the skills. The results of the two Municipalities show that Arusha has many carpenters than Moshi. Therefore a lot many employment opportunities associated with timber industry have been created in Arusha Municipality than in Moshi Municipality. Further, it can be explained that the attractive environment for the timber industry in Arusha as compared with Moshi is due to the high population size found there.

4.9 Future sawnwood consumption

4.9.1 Methodology of forecasting

Sawnwood consumption forecasts were done for the years 2007 through 2012 to 2017. The consumption data collected in each of the municipality surveyed were used to extrapolate the future sawnwood consumption after identifying the factors

that affect sawn wood consumption in both municipalities. The forecasting models proposed for the estimate were tested for their suitability with the field data obtained and the best one was chosen.

4.9.2 Factors considered in determining of future sawnwood consumption

In determining future sawnwood consumption, there are economic and social factors that are considered and used in forecasting. Some of these factors, i.e. population, income and urbanization that were be used for the forecasting of future sawnwood consumption in the two Municipalities are discussed in this section.

4.9.2.1 Arusha Municipality

Population attributes in Arusha Municipality is discussed because demands for commodities arise from the population (URT, 2006). This is because population factors impinge on development and the welfare of individuals, families, communities to the national level since population growth broadly increases the number of forest products consumers (FAO, 1999). People have different needs for their various development activities. These different development activities become the bases for the demand of particular items, and to accomplish their demand levels, their economic activities become the basis for their purchasing powers. Therefore the factors of population, economic attributes and urbanization rates are discussed here.

(a) Population

The Municipality of Arusha has a total area of 82.50 km² about 0.20 % of the total land area of the region. It has an average population of 16 565 people per ward.

(RCO, 2004). The municipality's population has been increasing remarkably. The population is an important resource for development, as it is a resource for labour supply for production as well as consumption of various products. Hence, the size of a population is one of the important parameters for economic development. As population increases demands for food, water, energy and other natural resources, also increase (URT, 2006). In the 1967 census the population in the municipality was 46 362 and grew to 281 605 people in 2002 census. While the population growth projected for 2002/2012 is 5.50%, Arusha has throughout the period maintained a higher growth rate than the Mainland average and is expected to soar to 483 000 by 2012 a size about one quarter of the regions population. Perhaps, there are reasons for the increases of the population in Arusha municipality and the region as a whole. Fertility, low mortality levels and net migration components have high influence on population growth (URT, 1992). One of the contributing factors that influence population growth in the Municipality and the region is land fertile, which is suitable for producing agricultural cash crops and food to the town dwellers.

The international status that the Municipality enjoys enables it to compete with other major towns in the country in attracting business. The commercial, peasantry farming, tourism and livestock subsectors create a conducive environment that attracts people to migrate into Arusha. The existing trade liberalization policy encourages and creates a suitable business atmosphere that attracts many people to invest and works in the municipality.

(b) Economic attributes

Economic activities present in an area encourage and attract people to work and produce. As for Arusha municipality, her economic environment is greatly influenced by the regional economic perspective. Arusha's economy is dominated by the agricultural sector that contributes 45% of the region's GDP. Tourism and livestock subsectors contribute 20% each, while manufacturing and mining sectors contribute 5% and 2% respectively. The region ranks second in the number of cattle available in the country and has a comparatively well developed dairy industry.

The per capita income for the region stood at 314 USD in the year 2000 and was one of the highest in the country. The region's better than average per capita income was a result of many factors: It has the most dynamic tourism industry in the country; the region plays the central role as the Headquarter for the unique gemstone trade Tanzanite; it also has a broad industrial base second only to Dar es Salaam.

The region is well connected to other regions and the outside world by land, rail and air. The industrial sector and the trade and hotel/restaurants sector each contributed to the national Gross Domestic Products 8.30 percent and 16.50percent respectively in 2002. Trade, both wholesale and retail in the region is a dominant economic activity and is one of the major sources of personal incomes and employment after agriculture. The volume of trading activities is determined by the output of the agricultural and industrial sectors. Arusha region has a total number of 5,827 establishments out of which 327 are related to manufacturing, 16 to building construction and 5 484 establishments for general trade. (RCO, 2004)

There are small-scale industries in the region operating under different capacities and producing various products. These include metal works, wood works, milling, sawmills, garages, tailoring marts and many others. These small-scale industries include grain milling 167, Carpentry, timber and furniture workshops 96 and other small industries 33. The concentration of industries in this municipality is higher than in most other regions in the country as noted by MNRT (1986) and Ngaga (1998),

Commercial activities in this municipality vary from small and simple retail shops to large trading, financial and tourist services enterprises. Formal employment provided by the commercial sector together with transport and communication was 28% in 1985. This figure could have grown higher with the current economic liberalization in the country.

(c) Rate of urbanization

The number of people living under urban conditions in Arusha municipality continued to increase. As reported by Ngaga (1998), the urbanization rate was 12.4 0% for 1967 and though there was a decline to 7% in 1967/78, the rate of urbanization was expected to increase basing on economic growth in the Municipality.

Urbanization is chiefly determined by rural-urban migration, while fertility and mortality add to population increase in a given area thus increasing the rate of urbanization (URT, 1992). In 1978/88, the rate of urbanization was 8% for the whole region. Arusha municipality has had an urbanization rate of 64.50 % and

74.90% for the periods of 1978 and 1988 respectively. The regional figure was 12.40 %. It was expected (Ngaga, 1998) that the urbanization rate of 8% per year would persist up to year 2000, after which 9% was expected for years up to 2015. In the 1988 census, the urbanization rate for the region was put at 12.40%, which is greater than what Ngaga had expected of 9% for year 2000-2015. According to the current economic growth in the municipality and immigration trends, the rate of urbanization for the Arusha municipality is expected to increase. Therefore, for a better forecast, an urbanization rate of 12.40 was adopted.

4.9.2.2 Moshi Municipality

(a) Population

The district of Moshi municipality is the regional capital that grew out of a German military camp in what is now known as Old Moshi and was moved to present location in 1911. It was designated as a Municipal council in 1988. By 1948 it was a small urban area with a population of 8 048 people that grew to 96 838 in 1988 (SMP, 1999). The population started to increase continuously and the population growth trend was doubling after every decade.

Certain characteristics have emerged out of the population pressure in the region. Cultivation and housing are very dense, with a cultivation rate of 98% and a correspondingly high density of 650 people per square km. The net agricultural per capita hectare average in Kilimanjaro is 0.66, where over 65% of the small holders are engaged in the cultivation and keeping of stall-fed livestock. The small size of the land, obviously does not sustain these peasants with enough cash for the whole year. Movement toward the town becomes inevitable as an alternative to

subsidize cash income. The industrial establishments in the municipality stand as the sources for jobs and therefore people move Moshi municipality to secure jobs. With sustainable incomes they change their life styles and raise the standards of living.. which include construction of houses and other buildings and acquisitions of furniture of various sorts.

The factors of mortality, fertility, migration and HIV/AIDS were considered in the projections of Kilimanjaro's demographic and socio-economic future trends. The projections show that population growth rate will decrease from 1.70 percent in 2003 to 1.0 percent in 2025. The growth rate will be 1.44 at the end of the forecasting period in 2017 (NBS, 2006). The projected population of 169 927 for the Moshi Municipality for 2006 will be taken as the basis for the estimation of timber consumption.

(b) Economic features

About 75% of Kilimanjaro residents live in rural areas and they depend on agriculture and livestock keeping for their livelihood. Their main cash crops include coffee, wheat, cotton, sugar paddy and sunflower. Sisal, formerly an important cash crop is no longer grown in the region. In recent years, dairy farming has gained popularity. There are other economic activities that include industry and commerce. In the year 2000, the regional GDP had increased at the current rate by 218% from that of 1994. The agricultural sector contributed 69.20% of the region's GDP. Trade contributed 13.80% of the region's GDP and is the second most important after agriculture (KRP, 2002). Public administration contributed 6.20% of the region's GDP. The lower manufacturing sector's contribution of 3.20% to the GDP was due

to the closure of most industries. Despite the decline in industries, employment in the sector increased reflecting the contribution that the current government policy of privatization has in creating employment opportunities (Moshi municipality). In 1995 the manufacturing sector in Kilimanjaro created employment to 16 210 people and reached 19 112 in 2000. There are several small-scale industries in the region, which together contributed between 4% and 4.35% to the regional GDP between 1994 and 2000. The number of economic establishments signifies the regions large economy, which makes Kilimanjaro the third in industrial establishment after Dar es Salaam and Mwanza.

The data available for the Moshi Municipality GDP are for the year 2000 where a per capita GDP was 147 015 TAS in the whole region. However the National GDP was 5.70 % in 2006 and was expected to rise to 6.80% in 2007 and to 7 per cent in 2008 (URT, 2006). The GDP for Moshi is low compared to that of Arusha and, since the economy is expected to be growing the National rate of economic growth for 2007 will be taken for use in calculating the IED for estimates of future sawnwood consumption in Moshi.

(c) Rate of urbanization

Factors that influence urbanization trends include demographic changes, concentration of economic and commercial activities within limited geographic space triggered by industrialization, spatial expansion of settlements and changes in people's life styles. In non- industrialized countries, rapid population increase is due to natural increase and migration as well as the uncontrolled expansion of towns with limited economic opportunities and narrow productive bases. Some of the

features that characterized urbanization in these countries include growth and expansion of informal settlements (URT, 2006). The world urbanization trends show that most of the population increase expected during 2000-2030 will be absorbed by the urban areas of the less developed regions, whose population will likely rise from 1.90 billion in 2000 to 3.90 billion in 2030. The urban population of the more developed regions is expected to increase very slowly, passing from 0.90 billion in 2000 to 1 billion in 2030 (UNPD, 1999).

Rural-urban migration and rural transformation into cities are important determinants to the high urban populations of the less developed world. The urbanization rate for Moshi bears direct relationships to these characteristics. The general migration of people from rural to urban areas to upgrade their lifestyles influences population growth in the municipality. Industrial concentration in Moshi favours in-migration into the municipality, for people will move to secure jobs.

Rural to urban migration is expected to continue for Moshi Municipality as is the case for other towns in the country. The urbanization rate for Moshi Municipality was not available. However, the urbanization rate for Kilimanjaro region was adopted for use in the timber consumption forecast 7.50% and 15.40% for 1978 and 1988 respectively. The 2006 urbanization data was used for the forecasting of timber consumption in Moshi.

4.10 Forecasting models chosen

The types of models that were considered for forecasting were time series forecasting models, and income elasticity of demand model.

4.10.1. Time series models

The time series models use historical information extending back for a long period of observations and therefore require many data points to justify their uses that produce sound results. The data collected in this survey pertained to six years only, where as data for a long period extending back for at least 20 years or more was needed. Data for such along a time was not found as most end users rarely keep such data even for three years. This problem forced the use of the models for forecasting to be abandoned.

Time series models are divided into two categories: smoothing methods and linear time series methods. Linear time series methods require data with trend and systematic differences, or lag, i.e., the difference between the actual and the forecast is the same. It is significant in removing that systematic error from the data to be used for forecast. This model did not fit the characteristics of the forecasting conditions of the historical data already at hand, and was therefore abandoned in the forecasting of the future consumption of sawnwood.

4.10.2 Income elasticity of demand model

The model depends on the relationship between the present sawnwood consumption, income and population growth using income elasticity of demand. Sawnwood consumption data in Table 21 was used to calculate the income elasticities of demand. And the forecasts for varied population and income growth rates for the forecast periods are given in Table 22.

Table 22: Income and per capita sawnwood consumption in Arusha and Moshi

Town	Year	GDP change (%) ¹	Per 1000 capita consumption	Population ¹	Volume Consumed m ³	Demand rate
Arusha	2001	14	43.14	266924	11269	0.35
	2002	14	44.70	281605	13790	0.35
	2003	14	92.9	297093	24771	0.35
	2004	14	94.63	313433	23525	0.35
	2005	14	94.46	330672	24771	0.35
	2006	14	109	348859	30156	0.35
Moshi	2001	3.2	15.03	143798	3225	0.104
	2002	3.2	21.13	147824	3124	0.104
	2003	3.2	26.15	151963	3974	0.104
	2004	3.2	31.57	156218	4932	0.104
	2005	3.2	34.17	160593	5488	0.104
	2006	5.7	41.60	165089	6869	0.104

Source: National Bureau of Statistics 2002¹

Income Elasticity of demand for Arusha town was found to be 2.50, while that for Moshi stood at 3.25. Sawnwood projections for Arusha and Moshi are made for the years 2007, 2012 and 2017. Using the figures for changes of rates of demand for each of the two municipalities of 0.35 for Arusha and 0.104 for Moshi and the per 1000 capita consumptions for the year 2006. The results shown in Table 21 were obtained for the target years of 2007, 2012 and 2017. Ngaga, (1998) projected the forecasts varying population growth rates and income growth rates. FAO and Openshaw through their various studies found out that the income elasticities of demand for sawn wood are 1.00 and 0.80 respectively. Table 23 shows the forecast results for the target years when the FAO, Openshaw, Ngaga and own Income Elasticities of demand are used.

Table 23: Forecasts of sawnwood consumption for Arusha Municipality for the target years

	IED	GDP%	Demand	Estimator	Per 1000	capita	Consumption
			%		forecasts for target years (m ³)		
Forecast period					2007	2012	2017
FAO	1	14	0.14	(1.14)	98.54	189.73	365.30
Openshaw	0.8	14	0.112	(1.112)	96.12	163.40	277.90
Ngaga	1.4	14	0.196	(1.196)	103.40	252.99	619.10
Own	2.5	14	0.35	(1.25)	108.05	329.74	1006.29

Source: field data (2007) and Ngaga (1990).

4.11 Forecast results

4.11.1 Arusha

Results for Arusha show that the per 1000 capita estimates for sawnwood consumptions in 2017 will be 1 006.29 m³. By comparing the different IED used by FAO, Openshaw and Ngaga estimates of the consumptions for the year 2017 differ greatly. Using Openshaws IED the forecast for 2007 is 277.9 m³ while using the survey data obtained the figure rises to 1006.29m³. Whilst if the estimates are based on Ngaga's IED the figure rises to 619.10 m³. The results show that the rate of consumption of sawnwood for Arusha municipality has increased by 1.78 times (nearly twice) since 1988 when such a study was conducted for Arusha. The rate of consumption between 1970 and 1988 increased by 1.75 times over that of 1970. These two findings indicate that the rate of increase of timber consumption is nearly the same for each period of 20 years.

If compared to FAO and Openshaws' studies, the rates of consumption exceed their estimates by 2.50 and 3.125 times for FAO and Openshaw observations respectively. The results from this study indicate that the rates of consumption of sawnwood for Arusha Municipality have greatly increased. All the results are lower than the estimates obtained from this study for the year 2017. As it can be seen the IEDs have been increasing with time. Openshaw and FAO each established their IEDs in the 1970s where their IEDs were 0.80 and 1.00 respectively, while Ngaga established an IED of 1.40 in 1988. The IED of 1.40 had high elasticity, showing the influence of income on demand of sawnwood in Arusha.

Changes in income have effects in the demand of sawnwood. Openshaw's IED of 0.8 indicates that elasticity was less than 1.00 and was inelastic. Income did not have any significant effect on the demand of sawn wood and therefore less wood was demanded and consumed. Commodities with IED being less than 1.00 are regarded as inferior goods (<http://www.Investopedia.com/terms/i/incomeelasticityofdemand.asp>). The low IEDs indicate that wood consumption was inelastic by the time the studies were carried out. The economic status of the population, the urbanization rate and the population levels and growth rates were lower compared to either the current one or to that of Ngaga of 1988. As the economy continued to grow its impact on sawnwood consumption increased, as depicted by Ngaga's observation of 1.40 IED for Arusha in 1988. Arusha's economy has always been growing fast compared to other economies in most of the mainland regions. However, it is not expected for the economy to keep falling, but rather an upward growth is expected and especially during the forecast period. FAO, (1999) has indicated that the growth of the economy of the developing countries is expected

to grow to their highest and increase their shares of world GDP from 20% to 35% and also double their sizes of their economies by 2010.

The Tanzanian economy has been performing well though in 2006, real GDP growth remained resilient at 5.70 per cent, just below the annual average rate of about 6 per cent over the 2000-05 period. Growth is expected to pick up strongly to 6.80 per cent in 2007 and pick up further to 7 per cent in 2008, driven mainly by higher investment from both the private and public sectors (AEO, 2007). Economic growth has enabled people to increase their consumptions of sawnwood as observed by Ngaga (1988) when he recorded an IED of 1.40 being higher than those in the previous studies. According to Gregory (1966), in the low-income areas, the effect of income on wood consumption is insignificant, as income will be spent on necessities. This postulate was signified in the Openshaw study where the demand for wood was inelastic. As soon as the elementary needs were met the effect of income would be pronounced and increased income would go to purchase sawnwood. With high income growths the effect has been high IEDs in line with Ngagas's observation and the observation of 2.50 in this study. The high IEDs are an indication that people are spending more of their incomes on activities which demand sawnwood especially on construction (Gregory, 1966), and also show a high responsiveness of changes in income on demand.

Sprawling of the tourist activities contributed 20% to the GDP. In 2005, a total of 465 991 foreign tourists visited the National parks and 282 585 of them (60.64%) visited the Arusha region National parks (MPPEE, 2006). Growth in the construction sector rose to 11.90 per cent after remaining at around 11 per cent for three years in

a row. This is where sawnwood is used and approximately 75% of construction materials used in the country come directly from forests with the construction sector being the fastest growing one after to mining in the national economy in 2003 (MNRT, 2002). Currently, for the past five years, the construction of Primary schools in every village and Secondary Schools in Every ward has significantly increased sawnwood consumption in the country.

High IED is an indication of swift responsiveness of demand due to changes in income. Sawnwood is still an indispensable material for construction in the country yet. Sawn wood consumption will continue to increase since housing establishment and related construction activities increase with the increase in population.

4.11.2 Moshi

The forecasting results for Moshi municipality are as shown in Table 24. The per 1000 capita consumption of sawnwood is 33.98m³ per annum. As was the characteristics for FAO and Openshaw's IEDs, these are less than that observed in this study for Moshi Municipality of 3.38, and also higher than that for Arusha Municipality. The per 1000 capita consumption of sawnwood for Moshi Municipality will be 331.3 in the year 2017. The increase in sawnwood consumption being due to an increase in income from the 1970s to the current forecasting base year. Sawnwood consumption habits and trends are similar to those for Arusha Municipality, though each town has different situations. The catalysts of economic growth include agriculture, manufacturing, trade, tourism and natural resources. Despite the high IED of sawnwood in Moshi, consumption continues to increase because construction activities cannot be separable from development. New private

housing units, building of schools both for primary and Secondary, buildings of hospital wards and ward offices in the villages account for the increased consumption of sawnwood, the material that is vital for construction.

Table 24: Forecasts for Moshi Municipality for the year 2017

Forecast Periods	IED	GDP%	Change in Demand	Estimator	Per 1000 capita consumptions (m ³) For the target years		
					2007	2012	2017
FAO	1	6.8	0.14	(1.14)	38.73	75	144
Openshaw	0.8	6.8	0.112	(1.112)	37.78	64.2	109.23
Ngaga	1.4	6.8	0.196	(1.196)	40.64	99.5	243.364
Own	3.38	6.8	0.23	(1.23)	41.8	20.7	331.3

CHAPTER FIVE

5.0 Conclusions and recommendations

5.1 Conclusion

Based on the findings and discussion the following conclusions are made:

- Total sawnwood consumptions for Arusha and Moshi Municipalities for the year 2006 were 30 156 m³ and 6 869 m³ respectively. The per 1000 capita consumptions are 86.44m³ and 33.98 m³ for Arusha and Moshi municipalities respectively in the base year 2006. The per 1000 capita consumption figures for Arusha exceeds those of Openshaw study of 49 m³ for 1980 and Ngaga,s (1990) study of 65m³ for 1990, by 1.33 and 1.78 times respectively with the consumption trends rising fast for each Municipality. The future forecasts for sawnwood consumption in 2017 for Arusha and Moshi municipalities will be nearly 12 and 10 times
- Prices were higher and kept rising for sawnwood sold due to long distances involved in transportation of sawnwood from their sources to the markets and also due to rising fuel prices.
- There was rising consumption of sawnwood despite rises in the prices of sawnwood in both municipalities due to population pressure and increase in income.
- There was scarcity of sawnwood in both municipalities as the sources for the material consume was mainly Iringa region - from softwood plantations in Sao-Hill and other private ones in the region and other regions such as Ruvuma, Mbeya, Tanga and Morogoro. Supplies from Arusha and

Kilimanjaro were in smaller quantities and could not suffice the market of Arusha.

- Customers have changed the behaviour of making preferences on specific traditional hard wood species like *Pterocarpus angolensis* to consuming any kind of timber species including the lesser known ones that are brought to the market. The change of attitudes towards the consumption of timber is mainly caused by sawnwood scarcity. Other factors which influence the consumption of sawnwood include population demand for finished wood products and furniture.
- Most end users especially in the carpentry or other small scale enterprises, use less efficient tools and machines to process or convert timber for other uses, and that there are less developed forest product processing industries, while the artisans have less or lack skills to produce quality products.
- There was lack of properly kept records regarding the quantities of sawnwood sold or consumed by timber sellers, or end users since most dealers do not have the habit of keeping records for their businesses and afraid of exposing data for fear of taxation.

5.3 Recommendations

- With the rising consumptions of sawnwood due to population increases and demand for more finished wood products in these municipalities there is a need to make sure that future sawnwood demands for both Arusha and Moshi will be met from within the regions and on a sustainable basis to meet the future high demands in the area.
- More efforts are needed in research in the values and properties of indigenous and non indigenous wood species, lesser known forest species unknown agricultural trees and trees out of forests and their evaluation for nationwide sustainability procedures.
- New areas for sources of sawnwood should be identified and or established by new investments in plantation forestry by the government, private companies, NGO's community managed farms and individuals involving all types of species.
- Assistance by the government to development of forest industries in manufacturing and processing capability in order to uplift their technology and skills and improve the quality of (value- adding) products such as furniture is significant since this is the area where most of the sawnwood is converted to other forms, and in addition it creates more employment opportunities.

- The collection and maintenance of forest products data is important. Therefore there is necessity for designing and structuring of the data collection forms to ensure that the reporting mechanism is properly monitored.

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APPENDICES

Appendix i: Questionnaire industrial survey

A. General information

Name of firm or organization..... Date.....

Address

Type of firm.....

Employees.....

B. Consumption of sawnwood

1. What type of species are used
2. What are the recorded quantities of sawnwood used in the previous year?
3. What are the sources of sawn wood used? (Whether sawmill/timber trader/pitsawyer, private sources).
4. What are the prices of sawntimber per m³
5. What the end uses of the sawntimber

C. Timber consumption for year 2001-2006

1. What is the state of availability of sawnwood (abundant, scarce, and very scarce)?
2. Are there any other sources of sawnwood, e.g. outside town?
3. Is there any type of species you prefer?
4. How about the stability of prices, if they fluctuate and how often?
5. Which of your products have high demand?
6. Is the demand of your products steady, increasing or decreasing?
7. Are the changes in demand accompanied with changes in price?

8. Is availability of the sawnwood affected by price changes?
9. What are the types of customers?
10. Suggest the uses to which the bought timber is put.
11. Are there any buyers who originate outside the Municipality?
12. Do you export?

D Timber traders' survey

General information

Name of Dealer/firm/company or organization.....

Date.....

Address

Employees.....

1. What are your sales of sawnwood in terms of species, volume, prices per m³?
2. What the sources of the timber you sell?
3. Do you know the end uses the timber is put to by your customers?
4. Can you give the approximate timber consumption quantities for the period 2001-2006?
5. How do you rate the availability of sawnwood, abundant, scarce or very scarce?
6. Do you experience any changes in stock volumes of different timber sizes?
7. Can you mention a list of your major customer types?
8. What are the timber species mostly preferred?
9. What about the prices of your goods, do they fluctuate, stable, and how often?
10. What are the reasons that cause the fluctuations if any?
11. Do you fetch the timber from far, long or near distances?

12. What are the quantities do you sell per day?
13. How many customers do you handle per day?
14. Is the demand for your products (goods) rising declining or falling?
15. Do you always meet the demand of your customers?
16. Do you sell any amounts of sawn wood outside the town?
17. Are there any exports of sawnwood you undertake, and by how much?
18. What are the prices of the exported wood starting from 2001 -2006?
19. Do you have any stock of sawn wood, by how much (m³)?
20. Do you have any other business other than selling timber?
21. What priorities do you give to the sawnwood you sell?
22. Are there factors that affect your business?
23. What are your future plans?
24. What any other remarks do you have?

Appendix iiA: Questionnaire industrial survey

- 1.0 Glory Macha
- 2.0 Nancy Daud
- 3.0 Pili Shayo
- 4.0 Agnes Temu
- 5.0 T. Kimaro
- 6.0 Sabina Faraja
- 7.0 Matunda timber
- 8.0 Ms Kajuna
- 9.0 Patrick Swai
- 10.0 Pre- market
- 11.0 Olotu Matunga
- 12.0 Esther Kimaro
- 13.0 Ally Mrindoko
- 14.0 V.L. Tarimo
- 15.0 Ms V. Shayo
- 16.0 Nora Temu
- 17.0 Flora Nyiyehe
- 18.0 Castro trans
- 19.0 Elia Rodick
- 20.0 Harold Mfinanga
- 21.0 Celina Mushi
- 22.0 Elly Mrindoko
- 23.0 Herman Kavishe

- 24.0 Cosmas Massawe
- 25.0 Elineema Saro
- 26.0 Revenant Kavishe
- 27.0 Lilian Mboya
- 28.0 E. mwanga
- 29.0 Peter Adrian
- 30.0 Nancy Munuo
- 31.0 Kanje Lucas
- 32.0 Felicia Lyakurwa
- 33.0 Sawe Adam
- 34.0 Suzana Lymo
- 35.0 Onesmo Olotu
- 36.0 Johari Maro
- 37.0 Pilly Mashsmbo
- 38.0 Anna Charles
- 39.0 Eliwanga S. Swai
- 40.0 Mhiddin Mfangavo
- 41.0 Stella Temu
- 42.0 John Akunaay
- 43.0 Herri Mwingi
- 44.0 Peter Adrian

B. List of timber sellers in Moshi

1.0 Lyima	Timber seller
2.0 Karanga Bridge	Timber seller
3.0 Santel Minja	Timber seller
4.0 Joshua Temba	Timber seller
5.0 Julius Tesha	Timber seller
5.0 Salome Moshi	Timber seller
6.0 Family General	Timber seller
7.0 Nahel Auto	Timber seller
8.0 John F. Tarimo	Timber seller
9.0 Mubanyizi Hamadi	Timber seller
10.0 Simon Elia Mrema	Timber seller
11.0 Migambo timber	Timber seller
12.0 Ahmed Saburi	Timber seller
13.0 Gastro Mroso	Timber seller
14.0 Thomas Temu	Timber seller
15.0 Fidelia Kileo	Timber seller
16.0 Thomas Kyara	Timber seller
17.0 Nunu Maulid	Timber seller
18.0 Mariwa Furniture	Timber seller
19.0 Dastan Massawe	Timber seller
20.0 Apesa Samkisha	Timber seller
21.0 FITI sawmill	Timber seller

C. List of carpenters and or workshops/endusers in Arusha

Name	duty
1.0 Kitendaguro trading Co.	Workshop and Furniture
2.0 Minja	Carpentry and furniture
3.0 Daleka timber	Timber seller
4.0 Bernard J. Mahu	Furniture
5.0 Filipo Masha	Furniture
6.0 Kigilagila	Furniture
7.0 Machame quality furniture	Furniture
8.0 Jua Kali Furniture Mart	Furniture
9.0 Wazalendo youth group	Furniture and carpentry
10.0 Flora Timber	Timber seller
11.0 Kwa Roman	Timber seller
12.0 Sabrina Faraji	Timber seller
13.0 Lema Furniture	Furniture
14.0 Kanagwa Furniture	Furniture
15.0 Tillya workshop	carpentry and furniture
16.0 Makaranga furniture	Furniture
17.0 System Builders	Furniture and Joinery
18.0 Magereza Furniture workshop	Furniture
19.0 Kijazi	Carpentry
20.0 Ali timber	Timber seller
21.0 Miyombo furniture	Furniture
22.0 Toofik	Furniture
23.0 Solo Chacha	Furniture

24.0 Maeda Furniture	Furniture
25.0 Corporation sole	Contractor
26.0 Omari William	Contractor
27.0 Wulkan	Contractor
28.0 Panga concrete works	Contractor
29.0 Tumaini Civil works	Contractor
30.0 Elerai construction	Contractor
31.0 Patel Construction	Contractor
32.0 Humphrey Construction	Contractor

D. List of carpenters and or workshops/endusers in Moshi

1.0 FITI	Carpentry and joinery
2.0 Vijana Ufundi Stadi	Carpentry workshop
3.0 Nguvu kazi	Carpenters
4.0 Kwa Gogo	Carpentry and workshop
5.0 Fred furniture construction	Carpentry
6.0 Gogo furniture	Carpentry
7.0 Karanga Bridge	Carpentry
8.0 Santel Minja	Carpentry
9.0 Julius Tesha	Carpentry
10.0 East Vunjo furniture works	Furniture and carpentry
11.0 Mariwa Furniture	Carpentry and furniture

E. List of Sawmillers in Arusha

1.0 Machenje Sawmill	Sawmiller and timber seller
2.0 Sombetini Sawmill	Sawmiller and timber seller
3.0 Magereza sawmiller	Sawmill
4.0 Mshana sawmill	Sawmiiler and timber seller

F. List of Sawmillers in Moshi

1.0 Imara Daima	Sawmiller and furniture
2.0Gastro Mroso	Sawmillers
3.0 Ludovick Mbonika	Sawmiller
4.0 Abnery E. Abnery	Sawmiller
5.0 Azimio Engineering	Sawmiller
6.0 C. R. Kajuna	Sawmiller
7.0 Abdu J. Nasibu	Sawmiller
8.0 Kiborloni sawmill	Sawmiller
9.0 Kilimanjaro sawmills	Sawmiller
10.0 FITI sawmill	Sawmiller
11.0 Patrice Sawmill	Sawmiller

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