8. The analysis of sustainable fuelwood production systems in Tanzania

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EXECUTIVE SUMMARY

According to UBET (Unified Energy Terminology) woodfuels include all types of biofuels derived directly and indirectly from trees and shrubs grown in forests and non forest land. Woodfuels can be divided into four main types of products: charcoal, fuelwood, black liquor and other. Fuelwood is not therefore synonymous with woodfuel as often regarded. Woodfuel constitutes a major source of energy in most countries, both developing and developed. In most cases methods used to extract wood energy are not sustainable, leading to land degradation. This report reviews the status of fuelwood in Tanzania and the potential for sustainable production through certification. In the text, fuelwood is used in the same context as firewood. It should be noted that accurate figures on woodfuel consumption are not readily available. The estimates given in this text are mainly based on literature that could be accessed.

In Tanzania 88 per cent of the total energy consumption is estimated to be fuelwood and 4 per cent charcoal, leaving only 7 per cent for petroleum and 1 per cent for electricity from hydropower. Major fuelwood consumers are household domestic purposes, and small-scale industries related to agriculture such as tobacco and tea curing, brick burning fish smocking, etc. Fuelwood constitutes 96.6% and 4.2%, of cooking and lighting fuel respectively in rural areas in Tanzania. The per capita consumption seems to be dropping from an average of 2 in the 1960s to a range of 1.0–1.5, suggesting improved utilization efficiency. Given that 75% of the Tanzanian population (34 443 603) lives in the rural areas, the domestic fuelwood requirement is more than 25 832 702 $m^3 year^{-1}$.

Tobacco is a major cash crop for export in Tanzania. It is produced in Iringa, Tabora, Ruvuma and Mbeya. It is estimated that to cure a hectare of tobacco requires approximately one hectare of woodland. The magnitude of deforestation caused by unsustainable fuelwood consumption for tobacco curing and brick burning is estimated at around 20 000 ha per annum, the former contributing the most.

Tea is cultivated in most highlands of Tanzania. This includes East and West Usambara in Tanga region, Mbeya and Iringa regions. All these industries use fuelwood for curing tea. Few industries such as the Ubena Tea Company in Njombe grow their own tree plantations while others such as Wakulima Tea Company in Tukuyu outsource wood from individual tree growers. It takes 1 m^3 or 0.65 tons of dry wood to cure 350 kg of tea. Wakulima Company has the capacity to produce up to 3 985 tons of tea per year while Ubena produces 3 500 tons per year. Thus the annual fuelwood requirement for the two companies is 22 000 m^3

Other rural fuelwood consuming industries include fish smoking beer brewing, bread making, salt drying, brick making, lime making. Although these industries are known to consume significant volume of wood, there are hardly any reliable rates of consumption and impact on the environment. It is however known that all sites in Tanzania where fish smoking is practiced are facing fuelwood scarcity.

The major source of fuelwood is the natural forests, plantations and trees outside the forests. It is believed that subsistence fuelwood collection rarely affects the natural miombo woodlands since only the dead wood or wood cut for other purposes is collected. As such in most cases the impact of fuelwood consumption for domestic purposes has little impact to deforestation. Clearing for agriculture, grazing and harvesting of fuelwood from miombo woodlands for tobacco and tea curing, fish smoking, bear brewing, bread baking, salt-drying and brick and lime making without planting trees are the main agents contributing to deforestation.

The potential for woodland to produce fuelwood mainly hinges on the ability of the woody species to regenerate and grow. Harvested miombo woodlands for woodfuel production would normally regenerate by coppicing and recruitment from stunted saplings. Because of regeneration in areas previously cut and if there is no further disturbance, such areas usually revert to woodland, thus increasing the potential of the area to supply fuelwood over a much longer time period.

The stand density of woody plants in dry forests varies widely. For instance, in miombo woodland the stand density of woody species mostly ranges between 380 and 1 400 stems. In most miombo stands, the basal areas range from 7 to 25 m^2 per ha. The mean harvestable volumes in miombo range between 14 m^3 and 117 m^3 per ha depending on rainfall. The mean annual volume increment (MAI) in mature miombo woodland ranges from 0.58 to 3 $m^3ha^{-1}yr^{-1}$.

The total forest plantation area in Tanzania is about 100 000 ha. Most of these are for timber and pulp production. In most of these plantations fuelwood collection of dead branches is done free of charge by women in the surrounding villages. During harvesting the non merchantable (crooked, deformed and smaller ends of the stem) are staked and sold as fuelwood to urban customers for use in bakeries and few households. This is especially so for forest plantations in close proximity to urban centres such as Meru forest project in Arusha. The quantity of fuelwood from the forest plantations is yet to be established.

Few plantations are established purely for the production of fuelwood wood. These include forest plantations established for wood production for curing tea. The Ruvu Fuelwood Pilot Project is a recent initiative to establish forest plantations for commercial fuelwood production. It is not clear whether the end product will be fire wood, charcoal, or both. The Tanganyika Wattle Company (TANWAT) is currently producing wood volumes in excess of 60 000 tones per annum which is used to generate 2.5 mega watts of power connected to national grid system. The company also supplies woodfuel to Kibena Tea Limited, Njombe. These are only a few of the forest plantations that are supplying woodfuel, indicating their tremendous potential if sustainably managed.

There is hardly any data on how much fuelwood is collected from agroforestry home gardens in Tanzania. Observations in Coast region however indicates that farm land trees, mainly old cashew nut mango and occasionally jack fruit trees are also used for fuelwood and charcoal production.

Use of energy saving appliances and practices aim at minimizing consumption and hence achieving sustainable production. Other advantages of energy saving kilns and stoves include providing time for women for other development activities, promoting the utilization of local resources and enhancing environmental sanitation by utilizing

waste products such as sawdust and rice husks whose disposal is sometimes a problem**.** Significant efforts have been made in Tanzania to improve the thermal efficiency from 7–12 of the traditionally used three stone fuelwood stoves to about 20% of the brick or metal stoves designed by several NGOs such as SCAPA (Soil Conservation and Agroforestry Project, Arumeru, CAMATEC (Centre for Agriculture Mechanization and Rural Technology, Arusha), SECAP (Soil Erosion Control and Agroforestry Program Lushoto), TaTEDO (Tanzania Traditional Energy Development Organization, Dar se Salaam) and the Traditional Irrigation and Environmental Development Organization, Moshi. It is not by coincidence that most of these NGOs are Agroforestry/Environment related but rather to emphasize that the primary objective of introducing energy efficient stoves is to save the environment. Adoption of these stoves however is generally low due to lack of skills and technical assistance on how to construct them.

Though its direct cost is negligible, since it is not in most cases traded in the market, the economic and social cost of burning fuelwood is immense. Mostly these costs come in the form of opportunity costs which are not easily quantified by economic statistics – poor health, lost time and human effort expended. In areas with fuelwood scarcity, women and children spend hours each day in the drudgery of collecting fuelwood. Because children are involved in acquiring fuelwood, this means they spend less time, or no time, in school. The time that rural women spend collecting fuelwood and performing other household tasks (which are also largely based on manual labour) leaves little time for productive employment, education and community involvement. For tobacco curing most of the fuelwood is obtained free and its cost is often ignored or omitted in production and processing plans.

In strictly ownership terms, land in Tanzania may be regarded as: general land - administered by the commissioners of lands, reserved land - under statutory or other bodies and village land - administered by the village council. Fuelwood may be extracted from all the three categories of ownership. This is in contrast to charcoal which mostly comes from the general land. Collection of dry fuelwood is allowed even in strictly protected areas such as the Amani Nature Reserve after paying a small fee. The Forest Act states that licences for fuelwood will be issued either by quantity or by time such that: quantity licences are charged at TAS 3 000 per m^3 and time licence whereby the licensee is charged TAS 1 000/= to enter the forest reserve and remove one head load (28 kgs) of dead fallen wood daily for a calendar month. Nothing is mentioned on fees from the general or village land. Fuelwood is therefore regarded as a free commodity. It may therefore be concluded that with the exception of fuelwood production for agricultural industries the influence of land tenure on the availability of fuelwood is small.

Several sectors have reviewed their policies as a response to the Poverty Reduction Strategy Paper popularly known as *Mkukuta* in Kiswahili in Tanzania. Sectors that are related to wood energy include forestry, energy, agriculture and livestock, environment, wildlife, fishery, science and technology, women and gender development. Some of these have been discussed in relation to wood energy.

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Certification provides assurance that people who live

in or close to the forest must benefit from its management and use. Forest certification therefore is a process that leads to the issue of a certificate by an independent party, which verifies that an area of forest is managed to a defined standard.

Relevance of certification of woodfuel in Tanzania is based on the fact that current woodfuel production practices are not sustainable. Woodfuel extraction is the principle factor responsible for deforestation in Tropical countries including Tanzania.

Criteria and indicators are tools which will help guide national policies, regulations and legislation and which will guide monitoring and reporting on status and overall trends in forest management. Desirable developments will be demonstrated by positive aggregate trends in the identified indicators. Based on information on the trends at national level, and on forecasts for the future based on these, policy and decision making can be rationalized and action can be adjusted and improved. Seven common thematic areas of sustainable forest management have emerged based on the regional and international criteria and indicators initiatives. These are: extent of forest resources, biological diversity, forest health and vitality, productive functions and forest resources, protective functions of forest resources, socioeconomic functions, legal, policy and institutional framework.

Although not much explicitly for fuelwood production, the thematic areas have been used in setting the criteria and indicators for charcoal certification in Tanzania, with additions to encompass charcoal from plantations and natural forests.

The following constraints are foreseen in implementing woodfuel certification in Tanzania: lack of proper management plans, insecure land tenure, lack of local certifying agencies, uncertainty of the market for certified woodfuel and lack of awareness among stakeholders.

Policy options necessary to support certified woodfuel production should involve: allowing time for markets to develop for certified products so that risks to investors are reduced, building on local market conditions and opportunities, providing adequate time and space for the development of appropriate local institutions, developing effective partnerships for training, technical assistance, processing and marketing appropriate to local goals and including feedback mechanisms for mutual learning so that local knowledge and wisdom can also inform international trade institutions so they can be more responsive to equity and sustainability issues.

In the light of these strategies the following research areas are proposed: development of standards for woodfuel forests management in Tanzania, development of participatory forest assessment techniques in order to capacitate different forestry practitioners and provide them well appropriate monitoring tools, applied research on efficient woodfuel production, processing (packaging, labelling and branding) and marketing, applied research on efficient woodfuel storage and use, applied research on development of appropriate local institutions to support the certification process and applied research on the development of market for certified wood.

It is concluded that the concept of certification is new to Tanzania. Certified woodfuel is obviously going to be expensive. The question is whether people are willing to buy the clean woodfuel at the new price. This is a research area to be pursued. Research is also needed to take stock of all woodfuels using industries and their views on certification. Otherwise mandatory certification would be possible if it were a

government policy to reinforce the existing policy for sustainable forest management. In this case awareness raising and sensitization to all stakeholders especially policy makers is necessary.

INTRODUCTION

According to UBET (Unified Energy Terminology) woodfuels include all types of biofuels derived directly and indirectly from trees and shrubs grown in forests and non forest land (FAO, 2004). Woodfuels can be divided into four main types of products: charcoal, fuelwood, black liquor and other. Fuelwood is not therefore synonymous with woodfuel as often regarded (Johnsen, 1999). Woodfuel constitutes a major source of energy in most countries, both developing and developed and its contribution is expected to grow in the future as a result of the application of stricter environmental regulations and the use of more competitive sources of locally-available energy. In most cases methods used to extract wood energy are not sustainable, leading to land degradation. Wood energy production has therefore direct consequences on the environment. Other entities that affect production and availability of wood energy are socioeconomic, cultural, institutional and legal aspects.

In Tanzania, around 91% of all energy consumed is woodfuel (CHAPOSA, 2002), miombo woodland being the source of 60–70% of the annual consumption (Monela *et al*., 1993). It accounts for 97.6% of the total wood products consumed in the country (MNRT, 2001). The estimated national annual woodfuel consumption in Tanzania is 44.8 million m^3 (Kaale, 2005). The major consumer centres (Table 1) are households for cooking (95.4%), rural industries (2.8%) and agriculture (1.4%). The rural industries and agriculture use exclusively fuelwood. On the other hand, the rural households use almost fuelwood exclusively while in urban areas charcoal is used.

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Under certification people who live in or close to the forest must benefit from its management and use.

Under proper forest certification schemes, independent auditors issue a certificate to the forest manager after the quality of forest management has been assessed using nationally agreed standards that meet internationally agreed principles. Once a certificate is given, the auditor makes annual follow-up visits to ensure that the forest continues to be managed to the agreed standard. This report reviews the status of fuelwood in Tanzania and the potential for sustainable production through certification. In the text fuelwood is used in the same context as firewood. It should be noted that accurate figures on woodfuel consumption are not readily available. The estimates given in this text are mainly based on literature that could be accessed.

CURRENT FUELWOOD CONSUMPTION IN TANZANIA

In Tanzania, 88 per cent of the total energy consumption is estimated to be fuelwood and 4 per cent charcoal, leaving only 7 per cent for petroleum and 1 per cent for electricity from hydropower (Mnzava, 1990). Surprisingly, the overwhelming importance of fuelwood has not always been well understood (Johnsen, 1999).

Household and domestic purposes

Fuelwood constitutes 96.6% and 4.2% of cooking and lighting fuel respectively in rural areas (Kaale, 2005) in Tanzania. Subsistence fuelwood consumption in the miombo woodlands surrounding Kitulanghalo Forest Reserve in eastern Tanzania is 1.5 $m^3capita^{-1}year^{-1}$ (Luoga *et al*., 2000). Other estimates from sites with a range of climatic conditions and ecosystems showed that the consumption ranges from 1 to 3 $m^3capita^{-1}year^{-1}$ depending on availability, suggesting that people adjust their consumption patterns in response to availability (Johnsen, 1999). Fuelwood scarcity can therefore be viewed as site specific. The per capita consumption seem to be dropping from an average of 2 in the 1960s to a range of 1.0–1.5 (MNRT 2001), suggesting improved utilization efficiency (Kaale, 2005). Given that 75% of the Tanzanian population (34 443 603) (URT 2003) lives in the rural areas the domestic fuelwood requirement is more than 25 832 702 m^3year^{-1}.

Agriculture and small-scale industries

Tobacco Curing

Tobacco is a major cash crop for export in Tanzania. It is produced in Iringa, Tabora, Ruvuma and Mbeya. Mnzava (1981) estimated that to cure a hectare of tobacco requires approximately one hectare of woodland. Similar ratio of 1:1 was also reported by Temu (1979) and Kaaya (1881). It is also estimated that it takes 42 m^3 of wood to cure 1 ton of tobacco (Kaale 2005). These estimates are realistic because the volume of wood in miombo woodlands in Tanzania ranges from 35–70 m^3ha^{-1} (Malimbwi and Mugasha 2001: Kaale 2005). According to Mangora (2002), ninety percent of households in Urambo District (Tanzania) rely on agriculture for income whereby 75% are regular tobacco growers.

Kaale (2005) reported that in Tanzania, the magnitude of deforestation caused by unsustainable fuelwood consumption for tobacco curing and brick burning is estimated at around 20 000 ha per annum, the former contributing the most. This estimate may be on the lower side because according to Mangora (2002) for Urambo district alone on average, a farmer cultivates 1.3 ha of tobacco each growing season and an estimated 42 738 ha of land is annually cleared for tobacco cultivation. Apart from the area cleared for cultivation, another 42 738 ha of more woodland are also cleared annually for tobacco curing. Under this pace of deforestation, the miombo woodlands in the district cannot sustain the high demands for the tobacco industry. Shifting cultivation, being the major farming system provides a fallow period of an average of 4 years and can therefore no longer sustain the tobacco industry since new land must be opened before returning to the original land after the fallow period. In Iringa region, Tanzania, Abdallah (2006) reported an annual deforestation rate of 319 ha between 1959–1978 and 26.6 ha for the period 1978–1999 attributed to tobacco curing and shifting cultivation. He concluded that for the small scale flue cured Virginia tobacco growing in miombo woodlands would not be viable under current practices.

Table 1. Main consumers of woodfuel, estimated quantities consumed and sources

Consumers	Estimated firewood Consumption m^3 in 2003	Main sources of firewood and other biomass fuels to the consumers							Economics	
		Farmland	Unreserved Forests	Forest Reserves	Game Reserves	Forest industries residues	Agriculture residues	Cow dung	Free collection	Purchased
Households for cooking										
a). In rural areas as firewood	25,000,000	****	***	*		*	**	*	****	*
b). In urban areas as charcoal	17,800,000	*	****	***		**			****	**
Sub total	**42,800,000**									
Rural Industries										
Brick burning	344,000	*	****	**			*		**	****
Fish smoking	425,000		****	**			*		****	**
Bread baking	150,000		****	*					****	**
Salt production	350,000		****	*					****	**
Lime production	4,400		****							
Pottery	20,000	*	****	*		*	*	*	****	**
Processing beeswax	1,000		****	**	*				****	
Beer brewing	No data	**	****							
Smithery (use charcoal)	No data		****	*					**	****
Subtotal	**1,294,400**									
Agriculture										
Tobacco curing	630,000	**	****	***	*				****	
Tea Drying	108,000	****	***			*			****	
Sub total	738,000									
TOTAL	**44,832,400**									****

*Source: MNRT 2001, Kaale 2005 (****Main source – preference number one; ***Secondary source – preference number two bases on accessibility; **Complimentary source based on availability; *Use rarely depending on availability or scarcity of fuelwood)*

Tea Curing

Tea is cultivated in most highlands of Tanzania. These include East and West Usambara in Tanga region, Mbeya and Iringa regions. All these industries use fuelwood for curing tea. Few industries such as the Ubena Tea Company in Njombe grow their own tree plantations while others such as Wakulima Tea Company in Tukuyu outsource wood from individual tree growers. It takes 1 m^3 or 0.65 tons of dry wood to cure 350 kg of tea. Wakulima Company has the capacity to produce up to 3 985 tons per year while Ubena produces 3 500 tons per year. The total annual fuelwood requirement for the two companies is 22 000 m^3. Estimates from other companies are necessary to obtain the accurate fuelwood consumption for tea curing.

Fish Smoking

Tanzania has an annual fishing potential of more than 700 000 tons. Due to poor infrastructure in terms of roads, lack of appropriate processing and refrigeration facilities transportation of fresh fish is difficult, often causing a post harvest loss of about 30% of total catch (Kaale 2005). The remaining option of preservation in the rural areas is fish smoking. Fish smoking is usually a household enterprise whereby most of the fuelwood used is obtained free of charge (Mnzava 1981). There are no proper surveys on the amount of fuelwood consumed in fish smoking but it is estimated that about 1 m^3 of wood is enough to smoke 1 ton of fish. It is also known that all sites in Tanzania where fish smoking is practised are facing fuelwood scarcity. A viable solution would be to establish woodlots for fish smoking and introduce efficient fish smoking kilns.

Other Small Industries

Other small-scale industries that use woodfuel are beer brewing, bread making, salt drying, brick making and lime making. Although these industries are known to consume significant volume of wood, there are hardly any reliable rates of consumption and impact on the environment.

FUELWOOD SUPPLY POTENTIAL

The forests

Natural forests

Subsistence fuelwood collection rarely affects the natural miombo woodlands structure (Chidumayo, 1997). Only the dead wood or wood cut for other purposes is collected. As such in most cases the impact of fuelwood consumption for domestic purposes has little impact to deforestation. Main reasons include: most of the fuelwood used for domestic purposes is collected from farm land trees or shrub land close to consumers within a walking distance of about 500 m (Bandeira *et al.,* 1994); women and children who are the main collectors of fuelwood do not possess appropriate tools for cutting big trees that could contribute to deforestation (Figure 1). In Tanzania, however, there are reported incidences where fuelwood is transported over some 55 km on average from a point of production to a point of consumption (Boberg, 1993). Also cutting of live trees for fuelwood in miombo that has been associated with the emergence and growth of urban fuelwood markets affects the structure of woodlands locally (Chidumayo, 1997). Peri-urban deforestation is the main result of fuelwood consumption in the urban areas

(Chambwera, 2004). Hosier *et al.* (1990) compared four different regionalized fuelwood balances for Tanzania. Out of Tanzania's 20 regions, the number of regions that faced a fuelwood deficit varied from 6 to 15 within the four studies. However, the total fuelwood balance for the country was positive (i.e. increment larger than consumption) in two of the studies and negative in the two others.

Regional woodfuel supply situation was analysed and grouped into three categories namely regions with no reports on woodfuel scarcity, regions with moderate woodfuel supply and regions with reported woodfuel scarcity (Kaale, 2005).

Category One – regions with satisfactory biomass fuels supply. Eight regions are included in this category namely: Coast, Kigoma, Lindi, Morogoro, Mtwara, Rukwa, Ruvuma and Tanga. These regions have forest area of more than 1 ha per inhabitant

Category Two – regions with moderate biomass fuels supply. Six regions are included in this category namely: Arusha[6], Dodoma, Iringa, Mbeya, Singida and Tabora. On average the regions forest area per person ranges between 0.5 ha to 1.0 ha

Category Three – regions with reported severe biomass fuels scarcity. Six regions are in included in this category namely: Dar es Salaam, Kagera, Kilimanjaro, Mara, Mwanza and Shinyanga. Average forest area per person in these regions is below 0.5 ha.

The above categories are broad regional wood biomass fuels situation. At lower levels isolated site-specific biomass fuels scarcities or satisfactory supply can exist.

Deforestation rates (annually) differ among countries: Tanzania (0.3%), Zimbabwe (0.4%), Zambia (0.2%), Botswana (0.1%), Mozambique (0.8%), Malawi (3.3%) and Angola (0.2%) (Chambwera, 2004).

Clearing for agriculture, grazing and harvesting of fuelwood from miombo woodlands for tobacco and tea curing, fish smoking, bear brewing, bread baking, salt-drying and brick and lime making without planting trees are the main agents contributing to deforestation. In the absence of these agents it can generally be concluded that domestic fuelwood consumption in the rural areas has little effect on deforestation.

Woodland Regeneration

The potential for woodland to produce fuelwood mainly hinges on the ability of the woody species to regenerate and grow. Woodland regeneration generally involves seed production, seedling development and vegetative regeneration. In the absence of intense disturbance such as frequent late fires and overgrazing, the dominant trend in regenerating woodland is towards the recovery to original state. For example, if a woodland stand cleared for charcoal production is abandoned to regenerate, it will re-grow virtually unchanged in species composition following clearing. Unless the trees have been thoroughly uprooted, most of the subsequent development of woodland will derive from re-growth of coppice from the surviving stems, stump/root sucker shoots and recruitment from old stunted seedlings already present in the grass layer at the time of tree cut, fall or death (Chidumayo, 1993). Thus, one year after clearing a miombo woodland stand, the sapling population in re-growth may consist of one third coppiced stumps and two thirds seedlings recruited from the stunted seedling pool

[6] Arusha region in this report includes Manyara region.

(Chidumayo, 1997). Frost (1996) recognized four phases in regenerating woodland: (1) initial re-growth, just after sprouting and coppicing (most woody plants in the initial re-growth phase are less than 1 m tall), (2) dense coppice, some two to five years after clear felling, (3) tall sapling phase, starting from six to eight years after regeneration and (4) mature woodland.

Figure 1. Fuelwood collection in Miombo woodlands

Source: Udzungwa National Park Office (2006)

Most seedlings and other tree regeneration (e.g. suckers and coppices) experience a prolonged period of successive annual die back during their development phase. Their success to attain the canopy generally depends on their ability to survive fires and to exhibit rapid growth in years without grass fires (Kielland-Lund, 1982). In general, fire and water-stress during the dry season are responsible for the annual shoot die-backs (Ernst, 1988). This is probably why seedlings in miombo woodlands grow very slowly in height as they initially allocate more biomass to root growth. The under ground parts of seedlings of many miombo trees grow faster than shoots during the establishment period (Chidumayo, 1993). Lees (1962) observed that a comparison of growth rings of root stocks and the established shoots revealed that at least eight years may be needed for miombo woodland seedlings to reach the sapling phase.

After removal or death of the above ground parts of the trees, most woodland stumps produce many sucker shoots. However, during the establishment period the number of shoots would decrease as a result of inter-shoot competition and only dominant shoots contribute to the next generation of re-growth woodland. Sucker shoots grow relatively

faster than shoots of stunted old seedlings. This is because stumps retain their well-developed root systems after tree cutting. However, stem height growth in re-growth woodland declines after 5–6 years and remains extremely slow thereafter (Chidumayo, 1993, 1997).

Woodland Productivity

The stand density of woody plants in dry forests varies widely. For instance, in miombo woodland the stand density of woody species mostly ranges between 380 and 1 400 stems per ha (Malaisse, 1978; Nduwamungu and Malimbwi, 1997; Nduwamungu, 2001). In most miombo stands, the basal areas range from 7 to 25 m^2 per ha (Lowore *et al.*, 1994; Nduwamungu, 2001; Malimbwi and Mugasha 2001). Both stand basal area and mean biomass increase with increasing rainfall of a site (Frost, 1996). Stand basal area is linearly related to both harvestable volume and aboveground woody biomass. The mean harvestable volumes in miombo range between 14 m^3 per ha in dry miombo of Malawi (Lowore *et al.,* 1994) and 117 m^3 per ha in Zambian wet miombo (Chidumayo, 1988). In Eastern Tanzania, the volume of harvestable trees for fuelwood in miombo woodland is 35 m^3ha^{-1} (Malimbwi *et al,* 2005). Average aboveground biomass in old growth miombo woodland varies mostly from around 30 tons per ha to about 140 tons per ha (Malaisse, 1978; Malimbwi *et al.*., 1994) generally depending on the amount of annual rainfall and edaphic properties.

The annual increment of girth varies widely depending on species and site conditions. In area protected from fire and human disturbance, the mean growth in girth range from 0.27 cm/year (Grundy, 1995) to 2.2 cm/year (Chidumayo, 1988). The mean annual volume increment (MAI) in mature miombo woodland ranges from 0.58 to 3 $m^3ha^{-1}yr^{-1}$ (Zahabu, 2001; CHAPOSA, 2002). As for the biomass the mean annual increment of biomass in coppice woodland range from 1.2 to 3.4 tons ha-1yr-1, which is about 4-7% of above ground biomass (Chidumayo, 1993). In mature woodlands, the mean annual biomass increment is estimated at 2–3% of the standing stock (CHAPOSA, 2002).

Plantations

The total forest plantation area in Tanzania is about 100 000 ha. Most of these are for timber and pulp production. In most of these plantations fuelwood collection of dead branches is done free of charge by women in the surrounding villages. During harvesting the non-merchantable (crooked, deformed and smaller ends of the stem) are staked and sold as fuelwood to urban customers for use in bakeries and few households. This is especially so for forest plantations in close proximity to urban centres such as Meru forest project in Arusha. The quantity of fuelwood from the forest plantations is yet to be established.

Few plantations are established purely for the production of fuelwood. These include forest plantations established for wood production for curing tea. The Ruvu Fuelwood Pilot Project is a recent initiative to establish forest plantations for commercial fuelwood production. It is not clear whether the end product will be fuelwood, charcoal, or both. The Tanganyika Wattle Company (TANWAT) is currently producing wood volumes in excess of 60 000 tons per annum which is used to generate 2.5 mega watts of power connected to national grid system. The company also supplies woodfuel to Kibena Tea Limited, Njombe. These are only a few of the forest plantations that are supplying woodfuel, indicating their tremendous potential if sustainably managed.

Trees outside the forests

There is hardly any data on how much fuelwood is collected from agroforestry home gardens in Tanzania. Observations in Coast region however indicates that farm land trees, mainly old cashew nut mango and occasionally jack fruit trees are also used for fuelwood and charcoal production (IUCN 2000 in Kaale, 2005). A biomass survey carried out in Zanzibar in 1996 showed that out of the 10.3 million m^3 of wood volume estimated in the islands 40.8% (4.2 million m^3) were coconut trees, 7.5% were cloves, 6.8% were mango trees (Ali *et al.,* 1999). These wood sources are used as fuelwood in most occasions. The forest policy (MNRT 1998) recognizes trees on farmland as the major sources of fuel wood for rural house holds.

Industrial wood waste as source of energy

In most wood-using industries the common wood by-products that may be used as source of energy are sawdust, deformed stems and slabs. Although there are wood industries in Tanzania only few of them utilize wood waste as a source of energy. These include the TANWAT (Tanganyika Wattle Company), Southern Paper Mill, Sao Hill Saw Mill, Tembo Chip Board, and Fibre Board 2000 which burn the waste to provide the power for boilers.

At the TANWAT for example the forest estate comprises 8 000 hectares of wattle trees, 4 000 hectares of pine and 1 000 hectares of eucalyptus. The wattle bark is rich in tannin. The bark is separated from the wood in the field and transported to the factory for processing and manufacture of wattle extract. The wood, which is effectively a waste product, is transported to the power station for use as fuelwood for boilers. At the current wattle extract production levels, wood volumes in excess of 60 000 tons are available per annum. Once the tannin has been boiled out, the (waste) bark provides a further fuel source for the boilers. At current production levels, 10 000 tons of spent bark is available per annum. The eucalyptus in the forest is available in a range of species, some of which are not suitable for conversion into poles. Planting of these species has been discontinued but there is a residual 60 000 tons available in the forest (TaTEDO, 2004).The sawmill produces 3 000 tons sawn timber per annum at a recovery rate of 40% from the pine trees. As such, 4 500 tons of pine waste is produced per annum, comprising off-cuts and sawdust.

In Kilimanjaro region the use of sawdust in brick burning, briquetting and domestic cooking has triggered the demand for sawdust to the extent that there is hardly any sawdust being left in Sawmills (James Sige[7] 2007, personal communication)

ENERGY SAVING APPLIANCES AND PRACTICES

The advantages of energy saving kilns and stoves are:

- minimized consumption of woodfuel,
- provide time for women for other development activities,
- promotion of the utilization of local resources and
- enhanced environmental sanitation by utilizing waste products such as sawdust and rice husks whose disposal is sometimes a problem.

[7] James Sige is the Principal of Tanzania Forestry Industries Training Institute (FITI), Moshi.

Improvement of fuelwood stoves

Significant efforts have been made in Tanzania to improve the thermal efficiency from 7–12 of the traditionally used three stone fuelwood stoves to about 20% of the brick or metal stoves designed by several NGOs such as SCAPA (Soil Conservation and Agroforestry Project, Arumeru, CAMATEC (Centre for Agriculture Mechanization and Rural Technology, Arusha), SECAP (Soil Erosion Control and Agroforestry Program Lushoto), TaTEDO (Tanzania Traditional Energy Development Organization, Dar se Salaam) and the Traditional Irrigation and Environmental Development Organization, Moshi. It is not by coincidence that most of these NGOs are Agroforestry/Environment related but rather to emphasize that the primary objective of introducing energy efficient stoves is to save the environment (TaTEDO 1998, MEM 2003).

Adoption of these stoves however is generally low due to lack of skills and technical assistance on how to construct them (Kaale, 2005). Shortage of extension services on construction and use of efficient fuelwood stoves have been identified as the main causes hindering wide adoption of improved fuelwood stoves in rural areas (MEM 2003). Under the SECAP and SCAPA programs it is common to see village representatives from other districts being trained by farmers under the program on Agriculture and Environmental Conservation issues including improved fuelwood stoves (TARP II, 2004). This is an effective way of technology dissemination as the newly trained farmers become trainers when they return to their villages. Funding the initial training however may be a constraint.

Improvement of kitchen management to save energy

At the household level adoption of improved kitchen management skills is also essential in reducing fuelwood consumption (Kaale, 2005). Such skills include:

- use of dry fuelwood to increase burning efficiency,
- extinguishing fuelwood after cooking,
- pre-treatment of some food stuffs through soaking to reduce cooking time and
- construction of cooking shelters instead of cooking in the open to increase fuelwood utilization efficiency.

SOCIOCULTURAL AND ECONOMIC ASPECTS OF FUELWOOD

Cost of fuelwood

Though its direct cost is negligible, since it is not in most cases traded in the market, the economic and social cost of burning fuelwood is immense. Mostly these costs come in the form of opportunity costs which are not easily quantified by economic statistics – poor health, lost time and human effort expended. In areas with fuelwood scarcity, women and children spend hours each day in the drudgery of collecting fuelwood. Because children are involved in acquiring fuelwood, this means they spend less time, or no time, in school. The time that rural women spend collecting firewood and performing other household tasks (which are also largely based on manual labour) leaves little time for productive employment, education and community involvement.

In urban areas of Kenya, it is the lowest income households who depend on fuelwood the most. Fuelwood is obtained mainly from agroforestry or on-farm sources (84%),

from trust lands (8%) and from gazetted forests (8%). Approximately 76% of households obtain all their fuelwood free, 17% of households regularly purchase it while 7% supplement their free collection by purchasing some fuelwood. Fuelwood is mainly used for cooking and space heating (Daniel, undated). For tobacco curing most of the fuelwood is obtained free and its cost is often ignored or omitted in production and processing plans.

HIV/AIDS and woodfuel

HIV/AIDS are a national and global catastrophe. About 15 per cent of Tanzanians are infected with HIV and AIDS and prevention awareness of the disease is low. Youth are highly vulnerable, with about 60 per cent of new infections in Tanzania occur among those aged 15 to 24 (Thomas, 2007). This is the productive working age which is crippled. The main social and cultural impacts of HIV are: high death rates of the working groups and lowering life expectancy. These have consequences on: reduction in productivity, loss of manpower that has been trained at high investment, increased number of orphans, increased child mortality as well as growing number of orphans (Kaale, 2005). Cross cutting issues of HIV/AIDS and woodfuel supply include:

- loss of income for households which depend on sales of woodfuel,
- raised demand for woodfuel for cooking during funeral ceremonies and
- reduction of growth in GDP and reduction in productivity is eroding consumers ability to switch upwards to advanced energy alternatives which would conserve the environment.

LEGAL ASPECTS AND POLICIES INFLUENCING FIREWOOD SUPPLY AND USE

Land and tree tenure systems in Tanzania

During the colonial period, indigenous peoples' rights to harvest and dispose of trees were significantly restricted. Similarly, after independence, Forest Policies in many developing countries have been characterized by the strong concentration of power over forest resources in the central state apparatus, and the corresponding lack of local participation in forest and tree management. Failure to recognize indigenous systems of forest management and indigenous rights to resources at policy level has led to:

- loss of incentives by the local communities to protect trees-hence indiscriminate tree felling,
- discouragement of local people to engage in tree planting and reforestation projects and
- excessive reliance by the state on punitive measures to enforce the law.

The present land tenure system in Tanzania for example, provides four main possibilities of acquiring land for one’s use as specified in the Land Act 1999 (MLHSD,1999b) as follows:

- government leasehold (33, 66 and 99 years renewable),
- right of occupancy (statutory or deemed),
- customary land tenure and
- village land ownership.

In strictly ownership terms, land in Tanzania may be regarded as:

- general land - administered by the commissioners of lands;
- reserved land - under statutory or other bodies
- village land - administered by the village council.

Despite that the new Land Law in Tanzania recognizes the existence of customary rights of rural communities' ownership still remains strictly under the state. The government as the land owner has the power to revoke customary land rights, creating levels of land insecurity. Insecurity of tenure among others has promoted open access to forests and woodlands. Tenure determines whether local people are willing to participate in the management and protection of forests in terms of rights, ownership and access. If these are not well defined, effective participation of the local people in the management of the miombo woodlands may hardly be achieved. For the case of Tanzania it is therefore stressed that the current Village Land Act of 1999 (MLHSD, 1999b) be put into action to make people own land and trees growing on the land. Thus, their participation in woodland management in public lands would be under the custodian of the Commissioner for Lands.

Whereas charcoal mostly comes from the general land, fuelwood may be extracted from all the three categories of ownership. Collection of dry fuelwood is allowed even in strictly protected areas such as the Amani Nature Reserve after paying a small fee. The Fourteenth Schedule of the Forest act No 14 (URT 2002) states that licences for fuelwood will be issued either by quantity or by time such that quantity licences are charged at TAS 3000 per m^3 and time licence whereby the licensee is charged TAS 1 000/= to enter the forest reserve and remove one head load (28 kgs) of dead fallen wood daily for a calendar month. Nothing is mentioned on fees from the general or village land. Fuelwood is therefore almost free of charge as pointed out by Mnzava (1981). It may therefore be concluded that with the exception of fuelwood production for agricultural industries the influence of land tenure on the availability of fuelwood is small.

Relevant sector policies related to woodfuel production

Several sectors have reviewed their policies as a response to the Poverty Reduction Strategy Paper popularly known as *Mkukuta* in Kiswahili in Tanzania. Sectors that are related to wood energy include forestry, energy, agriculture and livestock, environment, wildlife, fishery, science and technology, women and gender development.

The Forest Policy

The first Forest Policy of Tanzania was published in 1953 and revised after 45 years in 1998 (URT 1998). Salient features of the current forest policy that did not surface in the old policy include:

- the goal to enhance the contribution of the forest sector for the sustainable development of Tanzania and the conservation and management of present and future generations,
- the recognition of farmland trees as a major source of fuelwood for rural communities,
- singling out deforestation due to charcoal production, agriculture expansion, overgrazing, wildfires and overexploitation of other wood resources as the major problem facing the forest sector. Estimates deforestation rate at 130 000 to 500 000 ha per annum,

- the recognition of government failure to protect forest reserves due to inadequate resources and recommends collaborative management initiatives as possible solution and
- the recognition of the contribution of woodfuel to the energy balance and its dwindling supply consequently encourages tree planting for woodfuel, use of efficient conversion technologies and promotion of affordable energy alternatives as strategies to address the woodfuel crisis.

The Energy Policy

The first National Energy Policy was published in 1992 and revised in 2003 (MEM 2003). The policy has the following salient features.

- The vision of the energy sector is to effectively contribute to the growth of the national economy and hereby improve the standards of living for the entire nation in a sustainable and environmentally sound manner.
- The mission of the energy sector is to create conditions for the provision of safe, reliable, efficient, cost-effective and environmentally appropriate energy services to all sectors on a sustainable basis.
- The policy provides a very comprehensive analysis of the energy supply and demand situation in Tanzania, including woodfuel and other renewable energy sources.
- The policy states that *"Woodfuel for the foreseeable future will remain the main energy source"*. To ensure sustainable supply of biomass fuels, the policy emphasizes that *"Biomass, particularly woodfuel should be conserved through efficient conversion and end use technologies which could be complemented by tree growing at household level and beyond"*.

In view of the above, it can be observed that the policy gives high emphasis on the need to sustain rural energy and in particular woodfuel. It also promotes efficient woodfuel conservation and end use technologies in order to save resources: reduce rate of deforestation and land degradation and minimizing threats on climate change. This feature is also observed in the forest policy. Although a Renewable Energy Fund has been provided for in the Energy policy, it is not yet operational. One of its possible uses could be to meet cost of mainstreaming certification of woodfuel.

The Agriculture Policy

The Agriculture Policy calls for timely delivery and efficient use of energy inputs, including renewable energy sources into agriculture. It emphasizes the need for agricultural sector to collaborate with forestry in environmental conservation programs. It specifically singles out tobacco production as a cause of deforestation and encourages tobacco farmers to plant trees to meet their woodfuel requirement for tobacco curing.

The Agricultural Sector Development Strategy (URT 2001) developed to implement the policy advocates the use of animal manure for biogas production and planting of nitrogen fixing trees in agroforestry systems in order to increase agricultural production and provide fuelwood to rural communities.

WOODFUEL PROJECTS IN TANZANIA

The Ruvu Fuelwood Pilot Project

The Ruvu Fuelwood Pilot Project (RFPP) which started in 2000 is located in North Ruvu Forest Reserve, about 60 km west of Dar es Salaam (URT, 2004). Being a production forest, closer and accessible to Dar es Salaam, North Ruvu Forest Reserve which covers a total 67 000 ha is a victim of severe degradation due to woodfuel exploitation for the urban population. About 80% of Dar es Salaam city population depend on wood fuel as a first choice domestic energy. About 1 900 ha has been provided by the government under special agreement with 670 households which have been allocated 3 ha plots each to be planted with agroforestry tree species which potential as woodfuel. The participating villages are Kongowe Msangani, Mkuza, and Mwendapole. The planted tree species *are Acacia crassicarpa, A mangium, Brachystea kirkii, Khaya anthotheca, casuarinas equisetifolia, Senna seamea, and Eucalyptus terreticornis*. Insitu conservation of *Afzelia quanzensis, Dalbergia melanoxylon, Jurbernardia magnistipula* and *Khaya anthotheca* is also practiced. The average production in farmer managed plots is 6.3m^3/ha/yr compared with 0.96 m^3/ha/yr in non-managed areas. The project has trained farmers on growing woodfuel trees how make charcoal kilns and fuelwood stoves. Between 2000 and 2004 a total of 1 240 000 trees of different species have been planted (Kaale, 2005). The approach is essentially a participatory one. The main goal is to promote sustainable forest resources management through increasing forest regeneration and forest products to meet rural and urban primary energy requirements, while providing realistic economic base for the communities surrounding the forest reserve.

The Maseyu Eco-Charcoal

Maseyu is a village 40 km from Morogoro on the Dar es Salaam highway in an area where the production of charcoal is a major business with a long tradition. The production of Maseyu Eco-Charcoal has two goals: The improvement of the livelihood of the producers of charcoal and the sustainable use of wood as an important natural resource. These two goals are achieved by:

- Tree nursing and woodland management: To ensure sustainable production and source of income, trees are being nursed continuously to replace the wood used for charcoal.
- Efficient production. With improved brick kilns, less wood is needed to produce the same amount of charcoal (3–4 tons of wood per tons of charcoal).
- Marketing: Sustainable Eco-Charcoal will be sold directly to big consumers and in special places (e.g. hotels, supermarkets), assuring a better remuneration of the producers. The intent to help shifting charcoal business from the informal to the formal sector of Tanzania's economy is an important additional goal of this initiative.

Since February 2006, 40 villagers from Maseyu organized in two charcoal groups have nursed 80 000 trees, most of them indigenous Mgunga (*Acacia polyacantha*). Burned bricks have been made locally and the first improved half-orange-shaped kiln was built in which carbonization trials have started in October 2006. The project aims at five charcoal groups operating 5–10 kilns. The eventual goal of the project is to certify the charcoal from this project.

To achieve this, Eco-Charcoal has the following stakeholders. The local stakeholders are the Maseyu village and the Wami-Mbiki Society, a CBO of 24 villages with the goals of sustainable wildlife management and improvement of well-being in its

communities, while ESDA (Energy for Sustainable Development Africa) provides the technical backstopping. This pilot is funded by RLDC (Rural Livelihood Development Company) who acts as a facilitator with funds from SDC (Swiss Agency for Development and Cooperation).

TANWAT (Tanganyika Wattle Company)

TANWAT) was founded in 1949, when the Commonwealth Development Corporation (CDC) took responsibility for a forest development project set up two years earlier by the Forest, Land Timber and Railways Company, located in the Southern Highlands of Tanzania with 15 000 hectares of private forest business (TaTEDO, 2004). Production of tannin from wattle was the major source of revenue for the business until late 1960s when a decline in demand for leather goods, brought about by availability of cheaper synthetic alternatives. This resulted in an initiative aimed at exploring new global forestry product opportunities, reducing reliance on tannin products and creating prospects for increased revenue on a long-term basis. The Tanganyika Wattle Company is a fully owned subsidiary of CDC capital fund.

The forest estate comprises 8 000 hectares of wattle trees, 4 000 hectares of pine and 1 000 hectares of eucalyptus. The wattle bark is rich in tannin. The bark is separated from the wood in the field and transported to the factory for processing and manufacture of wattle extract. The wood, which is effectively a waste product, is transported to the power station for use as fuelwood for boilers. At the current wattle extract production levels, wood volumes in excess of 60 000 tons are available per annum. Once the tannin has been boiled out, the (waste) bark provides a further fuel source for the boilers. At current production levels, 10 000 tons of spent bark are available per annum.

The eucalyptus in the forest is available in a range of species, some of which are not suitable for conversion into poles. Planting of these species has been discontinued but there is a residual 60 000 tons available in the forest (TaTEDO, 2004).The sawmill produces 3 000 tons sawn timber per annum at a recovery rate of 40% from the pine trees. As such, 4 500 tons of pine waste are produced per annum, comprising off-cuts and sawdust.

The Tanzania's first commercial wood-fired power plant was commissioned in mid 1995 with an installed capacity of 2.5MW. The plant provides power to the Njombe/TANESCO mini grid. The plant is composed of fuel handling and processing facilities that include a hydraulic feeder or logger, a drum chipper with a capacity of 70m³ loose chips per hour, chip belt conveyor and two silos, each capable of storing 17 tons of chips. Sustainability of raw material supply is achieved by adhering to the annual planting target of 1 200 ha (900 ha Wattle, 100 ha Eucalyptus and 200 ha Pine). At harvesting the wood productivity is 80T/ha Wattle, 400 m^3ha^{-1} Pine and 300T/ha Eucalyptus (Aza Mbaga 2007, personal communication.[8]) The rotation ages are 10 years for Wattle, 20 years for Pine and 10–12 for Eucalyptus. Kibena Tea Ltd, Njombe (Section 7.5 below) meets her fuelwood requirement for curing tea from TANWAT.

Kibena Tea Limited, Njombe

This company produces tea at the rate of 3 500m tons/yr from a 700 ha farm (Miraji Gembe, 2007, personal communication). The tea is steam cured using fuelwood from

[8] Aza Mbaga is the Chief Forest Manager at TANWAT

Eucalyptus and wattle wood. It takes 1 m^3 or 0.65 tons of dry wood to cure 350 kg of tea. With an annual capacity of producing 3.5 kg of tea the total amount of wood needed annually is 10 000 m^3. Kibena Tea Ltd has contracted TANWAT to produce the required fuelwood and have not faced any problems regarding supply of fuelwood. Assuming productivity of 300 m^3ha^{-1} at harvesting, about 35 ha of plantation needs to be harvested annually.

Wakulima Tea Company Ltd, Tukuyu

This company has the capacity to produce up to 3 985 tons per year. The tea is steam cured using fuelwood from Eucalyptus grown by outgrowers. One m^3 of wood costs TAS 7 000 at the factory as it can cure 332 kg of tea. The annual requirement of wood for tea is therefore 12 000 m^3. The factory prefers mature wood which has high calorific value but since the wood comes from different outgrowers, there is high variation in maturity. Availability of fuelwood during the rain season is also a problem due to poor accessibility and increased distance to the resource. The company is considering producing their own fuelwood and they have set aside 80 ha for planting Eucalyptus. Otherwise future fuelwood supply may not be sustainable.

Other Tea Companies in Tanzania

Other tea companies using woodfuel for curing tea but whose details could not be obtained include Mufindi Tea Company - Mufindi, Herkulu Lushoto, East Usambara Tea Company - Tanga (Amani).

WOODFUEL CERTIFICATION

What is certification?

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Certification provides assurance that people who live in or close to the forest must benefit from its management and use.

Under proper forest certification schemes, independent auditors issue a certificate to the forest manager after the quality of forest management has been assessed using nationally agreed standards that meet internationally agreed principles. Once a certificate is given, the auditor makes annual follow-up visits to ensure that the forest continues to be managed to the agreed standard.

Forest certification therefore is a process that leads to the issue of a certificate by an independent party, which verifies that an area of forest is managed to a defined standard.

Requirements for forest certification

The credibility of certification as key to sustainable forest management hinges on the following requirements:

- The standard has been defined and accepted by stakeholders - local people, forest owners, industry, government, consumers.
- The standard is compatible with globally acceptable principles that balance economic, ecological and social objectives.

- There is independent and credible verification with reporting of results to stakeholders, certification and the market place.
- Certified products can carry a label, which verifies that the timber or wood product originates from well-managed forests.
- Companies in the supply chain hold chain of custody certificates so that the label can follow the wood from the forest to the consumer.

Steps in certification process

Preparing for certification

This involves development of certification standards for sustainable forest management based on Principles and Criteria for the national context by supplementing them with relevant indicators. These national standards provide detailed and specific management requirements. In the absence of nationally adopted certification, standards such as guidance will be provided by the certifiers using generic or local interim standards. The certification standards, though not designed as a forest management manual, provide clear objectives. Certification itself adds the incentive to achieve those objectives.

Also at this stage preliminary visit (scoping visit) is carried out by the certifier. Scoping visits identify major strengths and weaknesses based on a briefing with the managers and/or a rough estimation of the applicant performance. This helps the enterprise

Field assessment

Although certifiers have to remain independent of other interests and therefore are not allowed to provide consultancy services to an operation they certify, in practice the field assessment serves as an informal training opportunity concerning how to reach certification standards. When the assessors interview forest managers and operators about the performance of the operation under investigation the discussions provide a lot of useful hints and recommendations to those involved.

Meeting the condition

The third phase starts when certification has been achieved, but conditionally on certain improvements. The summary of field results provided in the certification report identifies strengths and weaknesses of an operation. It indicates to forest managers what needs to be consolidated and what needs to be improved. It normally contains a list of corrective actions, or conditions, that have to be met within a given time frame. If there are major issues, these have to be met (and will be checked) before a certificate can be granted. Minor issues can be dealt with subsequently. Together with specific recommendations it provides a clear guide to what kind of training or other measure might be needed to address any areas of non-compliance with the standards. The regular (at least annual) monitoring visits by the certifier ensure that the corrective actions are followed up.

Production of certified woodfuel in Tanzania

Relevance of certification of woodfuel in Tanzania

About 80 percent of all wood used in the tropics each year is consumed as fuel, mainly as fuelwood, in the country of origin. Fuelwood is the primary source of

energy for hundreds of millions of people who do not have access to fossil fuels, or can not afford them. The remaining 20 per cent of the yearly production of tropical wood is used as industrial timber, of which four-fifths are also consumed in the country of origin (Julio, 1997). Woodfuel extraction is therefore the principle factor responsible for deforestation in Tropical countries including Tanzania.

Tanzania has a total area of about 94.5 million ha out of which 88.6 million ha is covered by landmass and the rest is inland water. Forests cover about 34 million hectares of the total land area. There are 13.9 million hectares of declared forest reserves in a country of which 12.3 million (81.5%) are under central government and the rest under local governments (district/town or city councils) and private ownership. Village Forest Reserves cover about 3 million ha. These are under Collaborative Forests Management (CBFM) an initiative that was introduced in Tanzania in the early 1980s with some experiences of success stories from Nepal and India. The practice is already legitimized by the parliament through the current forest act of 2002. Most of the CBFM forests are demarcated as part of village general land. Thus they are also called village forest reserves. There are more than 9 000 villages in Tanzania but currently CBFM is confined to only a few.

Apart from the aforesaid different forest management regimes in place, current statistics also reveal that the remaining forest area in general land is about 18 million ha. These forests are "open access" characterized with insecure land tenure, shifting cultivation, harvesting for woodfuel, poles and timber and heavy pressure for conversion to other competing land uses, such as agriculture, livestock grazing, settlements, industrial development in addition to wild fires. The rate of deforestation in Tanzania which is estimated at more than 500 000 hectares per annum is mostly impacting such general land forests. On the other hand, reforestation and aforestation activities by private and local communities are also done in general land areas. Therefore there is a room for much more sustainable forest management activities that may alter the observed high rate of deforestation in the country. Forest certification may offer a better control for forest exploitation for both reserved and unreserved forests in the country.

Criteria and indicators of fuelwood certification in Tanzania

Although not much explicitly for fuelwood production, the thematic areas may be used in setting the criteria and indicators for charcoal certification in Tanzania, with additions to encompass charcoal from plantations and natural forests. The proposed C&I for sustainable production of woodfuel in Tanzania are presented as Appendix 1 of this report. The following sources of criteria and indicators were consulted in compiling the criteria and indicators.

- The Analysis of Sustainable Fuelwood and Charcoal Production Systems in Nepal (Bhattarai and Shrestha, 2007)
- The Tarapoto Proposal of Criteria and Indicators for Sustainability of the Amazon Forest (ACT, 1995)
- International Tropical Timber Organization (ITTO) (Anon. 1998 a)
- African Timber Organization (ATO) (Anon, 1998 b)
- The CIFOR Criteria and Indicators Generic Template (CIFOR, 1999)
- Criteria and Indicators for SADC Countries within the Framework of the Dry-Zone Africa Process (Anon, 1999)

Tanzania is a member to the SADC and ATO. Some of the features of these C&I are therefore related to Tanzanian policy. For example the establishment of a Forest Service in charge of the management of all the forests as a necessary indicator in the institutional framework is currently an ongoing process in Tanzania.

The implementation of C&I developed for a particular product and country involves several stakeholders. Similarly rigorous consultations are prerequisite during preparation of C&I. In Malaysia final C&I for woodfuel was compiled by an appointed committee of stakeholders assigned to refine the C&I in addition to identification of activities for each indicator (Tang, 2001). This is a necessary step for the Tanzanian case whereby the current document should form the draft for the final document acceptable to relevant stakeholders.

Constraints for woodfuel certification in Tanzania

Although woodfuel certification is still lacking in Tanzania, the following limitations are foreseen:

Lack of proper management plans

As is the case with most developing countries there is no reliable data on forest extent, characteristics, and growth and yield because national forest inventory is not carried out (FAO, 2006) due to limited capacity in terms of number of staff and finance. This has led to poor forest management because of lack of data for making informed management decisions. The Tanzania forest policy (URT, 1998) and its forest act (URT, 2002) clearly stipulate the need for proper forest management based on specific forest management plans but except for private forests there is hardly a forest reserve with a proper management plan. This could affect the certification process.

Insecure land tenure

Long-term tenure and use rights to the land and forest resources are required for the forest certification. In Tanzania most of the land is under local communities with customary tenure or use right but not formally surveyed and mapped. As such sometimes land may be set aside by the government for other uses including establishment of private forests. When such circumstances happen, disputes of substantial magnitude involving a significant number of interests normally occur. This may affect the certification process unless clear evidence of long-term forestland use rights (e.g. land title, customary rights, or lease agreements) is demonstrated. It is required that local communities with legal or customary tenure or use rights shall maintain control to the extent necessary to protect their rights or resources, over forest operations unless they delegate control with free and informed consent to other agencies.

Lack of local certifying agencies

World-wide certification generally has had support from local and international NGOs, government and bilateral aid organizations. However, in Tanzania currently there are no local supporting organizations for the certification process. Lack of local organizations means additional costs for the certification process, as it has to be carried out by expatriates. The costs of certification include both direct assessment costs as well as indirect costs to improve management practices and to meet certification requirements. Such costs are high and a burden for any small-scale enterprise. In this respect woodland management for fuelwood production will be difficult to cover these costs. This is the case with most community-based forest

management projects and small private forestlands. Economies of scale do not favour any of these operations and appropriate solutions will need to be found for each of them.

Equally important at the national level, certification initiatives and associated standard setting processes facilitate a redefinition of roles and responsibilities with regard to forest management. However, there is so far no clearly developed national or regional forest certification systems based on broad stakeholder consensus and acceptance. This to a greater extent will limit certification process in Tanzania.

Uncertainty of the market for certified woodfuel

Experiences with forest certification show that contrary to expectations frequently raised by NGOs and donors, certification has no mechanism to facilitate consistent access to the market potential for certified products (Irvine, 2002). The certification, as it has been structured to date, reinforces an existing trend which is for forestry products to try to enter international markets. This requires the creation of higher order regional processing and marketing structures, as well as closer links with industry. The lack of domestic markets for certified products is especially problematic for forest enterprises. Because certification is at an early stage in its development as a market tool, certified markets still represent a high risk for most forest enterprises. This could be minimized by developing certification trade networks in different parts of the world and retail companies. However large-scale industrial producers are more likely to be able to provide the needed quantities and qualities to out-compete small scale enterprises.

Lack of awareness among stakeholders

Forest certification is still a new concept in Tanzania. As such effort are needed to raise awareness among different stakeholders including foresters, environmental and conservation organizations, loggers, forest dwellers, research and academic institutions, social and human rights advocacy groups, indigenous communities, development and aid organizations, government representatives, timber trade dealers and associations and concerned individuals. It is also important not to forget groups which are often excluded from decision making processes such as under-represented social and ethnic groups, women, youth, rural communities, land owners and foresters.

Policy options necessary to support certified woodfuel production

The local existing markets in Tanzania offer very low value and therefore low prices for fuelwood. This is because wood for fuelwood has been regarded as a free good that requires just the producer effort to extract. To a great extent this situation is brought about by the fact that forests from which the woodfuel is extracted are not managed. Policy interventions to support sustainable forest management of the fuelwood producing woodlands should therefore be developed. This may be built on woodfuel certification, that among other things ensures that fuelwood in the market is produced from sustainably managed forests.

Increasing stakeholders' awareness in participation, and benefits from forestry certification will require strategies that:

- allow time for markets to develop for certified products so that risks to investors are reduced,
- build on local market conditions and opportunities,

- provide adequate time and space for the development of appropriate local institutions,
- develop effective partnerships for training, technical assistance, processing and marketing appropriate to local goals and
- include feedback mechanisms for mutual learning so that local knowledge and wisdom can also inform international trade institutions so they can be more responsive to equity and sustainability issues.

On the light of these strategies the following research areas are proposed:

- development of standards for woodfuel forests management in Tanzania,
- development of participatory forest assessment techniques in order to capacitate different forestry practitioners and provide them will appropriate monitoring tools,
- applied research on efficient woodfuel production, processing (packaging, labelling and branding) and marketing,
- applied research on efficient woodfuel storage and use,
- applied research on development of appropriate local institutions to support the certification process and
- applied research on the development of market for certified wood.

PROPOSED CRITERIA AND INDICATORS OF FUELWOOD CERTIFICATION IN TANZANIA

PRINCIPLE 1: POLICY, PLANNING AND INSTITUTIONAL FRAMEWORK

This principle involves the government commitment to support sustainable forest management in harmony with national and international laws and policies

Criterion 1.1 Government commitment to support sustainable forest management for woodfuel production

Indicators:

- *Appropriate political and legal framework that stimulates sustainable development*
- *Clear and focused policy statements supporting sustainable forest management*
- *Existence of a forestry service in charge of the management of all the forests, with adequate staffing to fulfil its mandate*

Criterion 1.2 Policy formulation and implementation are carried out in a participatory manner.

Indicators:

- *Existence of a mechanism for enhancing participatory policy formulation*
- *Existence of multi-sectoral interactions during policy formulation and implementation*
- *Regularity of meetings, discussions and other forums for which records of minutes of meetings are prepared and made available.*
- *Policy statements in non-forestry sectors (e.g. Agriculture, Energy, Fisheries) that recognizes and supports sustainable forest management for woodfuel production.*

Criterion 1.3 Recognition of international laws and conventions addressing forestry and other environmental issues

Indicators:

- *Capacity to represent the country to international instruments and conventions to which the country is part of (egg ILO, CITES, ITTO, FAO, ATO, UNCED)*
- *Compliance of government circulars and directives to provisions of international laws*

Criterion 1.4 Extent of the forest resource well defined

Indicators:

- *There exists a map showing the boundaries of the forests.*
- *The boundaries of the forests estate are well marked on the field.*
- *Areas and percentages of forest lands and non forest land that produce woodfuel, in relation to total land area are known.*
- *No evidence of forest encroachment*

Criterion 1.5 Effective structure for the promotion of private forestry and trees outside the forests (ToF)

Indicators:

- *Effective institutional support for commercial production of woodfuel from private forestry and TOF*
- *Existence of inter-sectoral coordination between sectors related to forestry*

PRINCIPLE 2: CONSERVATION OF BIODIVERSITY AND MAINTANANCE OF ECOSYSTEM FOR ENVIRONMENTAL PROTECTION ENHANCED

Criterion 2.1 Conservation of biodiversity in natural and planted forests at all tenure levels (egg government forests, private forests, community forests)

Indicators:

- *Diversity of habitat in terms of flora and fauna maintained.*
- *Identification of endangered, rare and threatened species that should be exempted from woodfuel production.*
- *Identification and zonation of biodiversity hotspots of flora and fauna that should be protected from any disturbance.*
- *Species richness maintained.*
- *Other specific management activities in place to conserve biodiversity of special biological interest, such as seed trees, nesting sites, niches and keystone species.*

Criterion 2.2 Ecosystem and protective functions of the forest maintained

Indicators:

- *Special provisions for the protection of sensitive areas, plains, stream banks, steep slopes should be defined.*

- *Erosion and other forms of soil degradation are minimized (sensitive areas identified and appropriate control measures applied).*
- *Soil and water restoration programs are implemented when necessary.*

Criterion 2.3 Forest health and vitality maintained or improved

Forest condition and health can be affected by a variety of human actions and natural occurrences, from air pollution, fire, flooding and storms to insects and disease.

Indicators:

- *Absence of damaging human activities such as: encroachment, agriculture, roads, mining, dams, unplanned fire, nomadic grazing, illegal exploitation, inappropriate harvesting practices, hunting, and other forms of forest damage such as change in hydrological regime, pollution, introduction of harmful exotic plant and animal species.*
- *Degree of forest damage by natural causes: wild fire, drought, storms or natural catastrophes, pests and diseases, and other natural causes*
- *Existence of procedures to prevent/control: fires, diseases and pests.*

PRINCIPLE 3: SOCIO-ECONOMIC FUNCTIONS ARE SUSTAINED

Criterion 3.1 Improved incomes through sustainable production and consumption of woodfuel

Indicators:

- *Employment generation from woodfuel production activities in relation to total national employment.*
- *Average per capita income in different woodfuel production activities.*
- *Efficiency and competitiveness of woodfuel production and processing systems*
- *This includes improved kiln efficiency and minimization of waste through briquetting in charcoal making.*
- *Economic profitability of management of the forests for woodfuel production.*
- *Sustainable production, consumption and extraction of woodfuel.*

Criterion 3.2 Investment and economic growth in the forest sector

Indicators:

- *Annual investment in woodfuel plantations, sustainable forest management and conservation in relation to total forest sector investment.*
- *Aggregate value of sustainable woodfuel production.*
- *Rate of return on investment on sustainable production of woodfuel, compared with rates of return in other sources of energy, considering all costs and benefits.*

Criterion 3.3 Enhanced cultural and social values

Indicators:

- *Level of reduction of drudgery for women and children as a result of sustainable availability of woodfuel*
- *Level of participation of local populations in the management and in the benefits generated by woodfuel production activities.*
- *Absence of activities that compromise human culture*

PRINCIPLE 4: FOREST (WOOD ENERGY) RESOURCE MANAGEMENT INCREASES BENEFITS THROUGH BETTER FOREST MANAGEMENT

Criterion 4.1 Effective local management in place for maintaining and assessing the forest (wood energy) resources.

Indicators:

- *Ownership and use rights to resources are clear and respected.*
- *Rules and norms of resources use are successfully enforced and monitored (existence of rules and norms, patrolling, incidences of violation of rules, number of forest offence cases registered, etc).*
- *Effective and accepted conflict management mechanisms are in place (number of cases resolved).*
- *Access to forest (wood energy) resources is perceived locally to be fair (deprived and poor users get fair concession, access to woodfuel and NTFP, evidence of discussion in meetings on access to resources, attendance of gender, class, and ethnicity in meetings).*
- *Local people feel secure about their access to forest resources, including woodfuels.*

Criterion 4.2 Stakeholders get equitable share from the benefits of forest (wood energy) resource management.

Indicators:

- *Mechanisms for equitable benefit sharing are developed and implemented (local people express satisfaction on the benefits received)*
- *Employment opportunities exist for poor and deprived users (number of such people involved in carpentry works, livestock raring, and fuelwood collection for trade, charcoal making and other income raising activities).*

Criterion 4.3 All production forests under different systems of management be considered as means of livelihood by rural communities

Indicators:

- *The above people invest significant amount of time and efforts in wood energy resource management.*
- *Destruction of natural resources by the local people is rare.*
- *Maximum utilization of the productive national forests (all types) by local forestry stakeholders.*

PRINCIPLE 5: YIELD AND QUALITY OF DESIRED FORESTRY GOODS AND SERVICES ARE SUSTAINABLE

Criterion 5.1 Forest management units are implemented on the basis of legal ownership, scientific forestry practices and recognized traditional rights.

Indicators:

- *Forest management takes place on the basis of inventory information and relevant silvicultural practices.*
- *Information on the identity, location and population of communities living in the vicinity of the managed forests exist*

Criterion 5.2 Management plans are detailed and clearly documented.

Indicators:

- *Management objectives (both long-and short-term) are clearly stated reflecting the condition of forest, expressed public interest of the forestry goods and services, and the local forest users needs.*
- *Harvesting plans are in place taking into consideration available stock and capacity of forest staff to monitor operations.*
- *Forest Working Plan is comprehensive (identifies boundaries, provide inventory of resources, protection, includes management and utilization plans, biodiversity hot spots and cultural and conservation areas).*
- *Appropriate involvement of stakeholders in Management Plan preparation and takes into account all components and functions of the forest (i.e. timber, woodfuel, NTFP etc).*
- *Yield regulation by area and/or volume is prescribed in Forest Harvesting Plan (allowable cuts, minimum exploitable diameter, number of trees or total volume to be harvested per year etc).*
- *Silvicultural systems are prescribed and are appropriate to forest types.*
- *Prescribed harvesting systems and equipment match the condition of forest in order to reduce impact.*
- *Forest Management/Harvesting Plan is periodically revised and approved by the Director of Forestry and Beekeeping*
- *Programs and estimated costs of forest management activities are covered in the Management Plan on a priority basis.*

Criterion 5.3 Effective monitoring system is implemented.

Indicators:

- *Mechanisms for monitoring and evaluation are clearly described in the Forest Working/Operational Plan, including chain of custody monitoring of products.*
- *Documentation and record of all forest management and forest activities are kept in forms that enable monitoring, also for product tracking during transportation and transformation*

Criterion 5.4 Costs and benefits from all types of forests are properly accounted for, distributed and shared among relevant stakeholders

Indicators:

- *Mechanisms for sale and/or equitable distribution of forest products (including woodfuels) to relevant stakeholders are clearly described in the Harvesting Plan*
- *Re-investment of the benefits from forestry management for forestry development.*

Criterion 5.5 Promotion of user and environment friendly wood energy technologies, government initiatives of R & D on woody and non-woody biomass based modern energy applications

Indicators:

- *List of environment friendly modern wood energy technologies relevant to Tanzania.*
- *Priority R & D areas in modern wood energy applications (i.e. technologies and end-uses).*
- *Priority R & D areas in non-wood biomass based modern energy applications (i.e. technologies and end-uses).*

Criterion 5.6 Guidelines for quality control of fuelwood produced

Indicators:

- Species used
- Size of billets
- Moisture content

CONCLUSIONS

The concept of certification is new to Tanzania. There is evidence of only one project, Kilombero Forest Limited which is striving to develop CDM (Clean Development Mechanism) in the year 2000 whereby certification is one of the basic requirements in order to qualify for carbon credits. To date the goal has not been achieved, probably indicating the complexity of the process. Kilombero Forest Limited is not a fuelwood project but a timber project.

Among the woodfuel projects in chapter 7, it is only the Maseyu Eco-Charcoal, which has a clear objective of achieving certification of her future charcoal, but they also face the obvious uncertainty of market. Certified fuelwood is obviously going to be expensive. In Malaysia it is estimated that the initial cost required to improve harvesting for certified timber is US$ 65.05 ha^{-1} which is equivalent to 65% of total harvesting cost without the improvement (Thang, 2001). Other sources of cost will be packaging, labelling and monitoring. The question is whether people are willing to buy the clean fuelwood at the new price. This is a research area to be pursued.

On the other hand, the tea factories obviously have some mechanism of ensuring continued supply of fuelwood but it is not clear whether the systems are sustainable to meet certification requirements. It is also not known whether they would like to use certified woodfuel. Unless there is pressure from above such business enterprises would like to reduce production cost by using easily available and cheap woodfuel. Research is needed to take stock of all such woodfuel using industries and their views on certification. Otherwise mandatory certification would be possible if it were a government policy to reinforce the existing policy for sustainable forest management. In this case awareness raising and sensitization to all stakeholders especially policy makers is necessary.

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