Strategies for Sustainable Wood fuel Production in Kenya

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Abstract

Wood energy provides 70% of Kenya's national energy needs and it is expected to continue as the country's main source of energy for the foreseeable future. Wood is the standard cooking fuel for the majority of Kenyan households and also an important energy source for small-scale rural industries. Past studies on supply demand balance of woodfuel have shown a deficit. To address this deficit there is need for a comprehensive wood energy plan with implementation strategies which ensure its sustainable production. This paper outlines some of the strategies that need to be put in place for a sustainable woodfuel production. The strategies are both supply and demand oriented which are aimed at either increasing the supply or reducing the demand. The supply strategies include; enhancing on-farm tree planting, efficient management of rangelands and woodlands, development of fuelwood plantations by Kenya Forest Service. The demand oriented strategies include ; reducing demand through promotion of more efficient cooking stoves and charcoal conversion kilns, use of alternative sources of energy other than wood. Other strategies include formulation of woodfuel policies that enhances decentralized sustainable wood energy planning at all levels. The later can only be achieved if the wood energy institutional framework is strengthened and facilitated to collect wood energy data to be used in national energy planning alongside the conventional fuels that are currently given more emphasis. The decentralized wood energy planning is important as the strategies to be used for sustainable woodfuel production may vary from one region to the other.

Key words; woodfuel sustainability, wood energy planning, woodfuel demand and supply

Introduction

Woodfuel is the major form of biomass energy in Kenya, contributing 70% of the National energy demand while about 90% of Kenyan rural households use woodfuel either as firewood or charcoal(MoE, 2002). Woodfuel meets over 93% of rural household energy needs whilst charcoal is the dominant fuel in urban households (Theuri, 2002; Kituyi, 2008). Besides being the standard cooking fuel for the majority of Kenyan households, fuel wood is also an important energy source for small-scale rural industries. Woodfuel is not only an important source of energy, but its use relates to public sector interests such as environment, public health, rural development, employment and even foreign exchange (Githiomi, 2010). Despite the importance of wood energy in the country's economic development, woodfuel data on supply and demand are scarce and characterized by a high degree of uncertainty that makes it difficult to undertake relevant wood energy planning and policy formulation. This has led to lack of integration of wood energy into national level planning exercises which are important in formulating national policies that are used in allocation of government investment and resources and prioritization of development objectives and targets. The scarcity and uncertainty of wood energy data is due to the fact that it is mainly handled in the informal sector and does not pass through monetized economy like in the case of liquefied petroleum gas (LPG), kerosene and electricity which are alternatives to wood energy. The national energy planning by ministry of energy concentrates more on these conventional fuels while forestry planning by Ministry of Wildlife and Forestry focus more on supply of commercial wood and conservation of protected areas (Republic of Kenya, 2002). These two key sectors deny biomass energy the comprehensive consideration it deserves due to the role it plays in supply of energy to majority of Kenyans.

Lack of sustainable wood energy production planning has lead to scarcity and over-exploitation of natural resources and environmental degradation as supported by past studies by Akinga (1980) and Ministry of Energy (2002), which despite being two decades apart showed a widening gap between supply and demand in woodfuel. The deficit in woodfuel was due to higher tree cutting rate than replenishment. Strategies need to be put in place to ensure sustainability of wood fuel production.

A comprehensive biomass study undertaken in Kenya in 2000 revealed that the principal sources of fuel wood are the farm lands with a production of 84% of the total woodfuel requirement (NEMA, 2004) . Kenya has 3.467 million ha of forest cover which is equivalent to 5.9% of land area out of which 1.417 million ha comprises of indigenous closed canopy forests, mangroves and plantations (Kenya Forest Service Strategic Plan, 2009). Much of the closed canopy forest has been depleted due to internal and external influences. Continued losses of forests and associated resources have had far reaching negative effects on the country's economy and welfare of Kenyans. Some of the consequences include inadequate supply of woodfuel and timber which lead to overharvesting of trees leading to environmental degradation and loss of biodiversity among others (Nellie and Githiomi, 2009). The Kenya Forest Service (KFS) strategic plan indicates that 10.385 million ha of land is covered with trees on farmlands with wood stocking of about 9.7 m3/ha. The moratorium on tree harvesting from public forests in Kenya was imposed in 1999 and complete ban in 2002 which precipitated a shortage of sawn timber and wood products. This shortage lead to increase of timber prices which encouraged farm tree planting. The integration of trees in agriculture systems is a road map to follow to enhance sustainability (Schuren and Snelder, 2008). This integration has been made easier through research on farm forestry systems which are more diverse, efficient and easily adopted to the local condition (Adensinu and Chianu, 2002). The Government of Kenya has been involved in promoting tree planting at the farm level with the aim of increasing tree cover to 10% by the year 2030 (Republic of Kenya, 2007). There have been successful tree planting programs involving rural communities in Kenya led by government rural forest extension services and various non-governmental organizations (Githiomi et al., 2012).

Wood energy consumption in Kenya

Firewood is mainly used for cooking, water heating, house heating, lighting and other home businesses. Households are the most important category in wood energy consumption with an estimated consumption of 6.5 tonnes per household per year (Mugo, 2001). The second highest consumer of woodfuel are the cottage industries which include brick making, tobacco curing, fish smoking, jaggaries and bakeries. Others include small restaurants/hotels and kiosks and learning institutions. In view of the importance of cottage industries in income and employment generation and wealth creation at the rural population, their energy requirements need specific attention to ensure their sustainability. On average, most cottage industries use between 20-30% of the total operation costs on energy which is mainly from wood (MoE, 2002).

Tea industries are some of the most important fuel wood consumers in rural areas with over 50 small-scale tea factories spread in most Kenyan districts and run by Kenya Tea Development Agency (KTDA). Over 70% of these factories have boilers that can use both furnace oil and firewood in curing tea. Most of these tea factories are using wood-fired steam boilers to generate heat in order to reduce cost in tea production. The average cost of processing tea using furnace oil is significantly higher as compared to using the wood energy with a saving of up to 60% in the cost of fuel.

Other rural small-scale industries include curing of tobacco, firing of lime and brick making which also consume substantial amount of fuelwood. Table 1 below which was taken from Kamfor MOE 2002 report indicates national energy consumption where about 31 million tonnes of wood were used for firewood and as charcoal raw material. This figure is expected to be higher today due to the population increase. The consumption of charcoal and other cleaner fuels like kerosene, LPG and electricity are relatively higher in urban households as compared to rural households.

Table 1: Annual Consumption of Various Energy Types (Year 2000)

Fuels **Category**	**Firewood** **Tonnes/yr**	**Wood for Charcoal** **Tonnes/yr**	**Wood Wastes** **Tonnes/yr**	**Farm Residue/** **Tonnes/yr**	**Kerosene** **Litres/yr**	**LPG** **Kg/yr**	**Electricity** **Kwh/yr**
Rural Household	14,065,004	7,624,935	136,459	2,649,981	172,761,463	1,406,270	93,376,810
Urban Household	358,709	6,020,663	83,863	12,832	150,707,171	16,883,884	723,013,990
Cottages industry	467,145	2,860,900	-	-	2,142,950	7,021,875	353,558,397
Total	**14,890,858**	**16,506,498**	**220,321**	**2,662,813**	**325,611,584**	**25,312,028**	**1,169,949,197**

Source; MOE, 2002 report

Supply/demand balance

Energy analysis and forecasting are essential activities in energy planning. They involve analysis and evaluation of data to assess the present and future energy situations. This is used in developing energy plan that provide basis for formulating energy policies. Past wood energy studies in Kenya have shown that the country is not able to match demand and supply leading to deficit in wood energy (Barnes, 1984; KFMP, 1994; MoE, 2002). Table 2 which was taken from MOE, 2002 Kamfor report outlines the major changes in biomass consumption, supply and deficit/balances for the years 2000 to 2020 as far as households and cottage industries are concerned. The sustainable supply is computed using average annual increment. If the total annual woodfuel consumption is higher than the total average annual increment, then a deficit is created as observed in Table 2.

Table 2: Projections of Biomass Consumption/Supply

Years	**Yr. 2000**	**Yr. 2005**	**Yr. 2010**	**Yr. 2015**	**Yr. 2020**
Population	28,686,607	32,694,444	36,810,671	40,941,673	44,981,767
Consumption tonnes/yr	35,119,615	39,896,632	44,599,347	49,164,960	53,416,327
Sustainable supply tonnes/yr	15,024,510	15,488,936	16,634,550	17,984,406	19,559,738
Deficit tonnes/yr	(20,095,105)	(24,407,696)	(27,964,797)	(31,180,555)	(33,856,589)
Deficit (%)	-57.2	-61.2	-62.7	-63.4	-63.4
Deficit (tonnes/person)	-0.701	-0.747	-0.760	-0.762	-0.753

Source; MOE, 2002 report

A major observation in Table 2 is that the biomass deficit will increase to 33.9 million tonnes in the year 2020 if no significant policy measures are taken. This is as a result of the increase in population that largely relies on firewood and charcoal. The continuation of unsustainable woodfuel production might render to lose in environmental services offered by forests besides giving rise to severe soil erosion and land degradation. However, the deficit in national supply/demand balance can be reduced to surplus through woodfuel policy intervention strategies aimed at improving management and conversion efficiencies as discussed below;

Strategies for sustainable wood fuel production

1) **Allocation of gazetted plantation area for fuelwood production**

Kenya Forest Service should develop plantations for woodfuel as a national priority along the same line followed for timber production. The firewood plantations should be established with appropriate fast growing tree species which match specific environmental and ecological conditions for maximum productivity. Other available land for fuelwood plantations can be leased within the municipalities (peri-urban plantations), trustlands, rangelands and community land areas.

2) Woodlot development/increase of tree planting in farmlands

This strategy considers integrating woodfuel into local farming systems as the agricultural sector has a key role to play in supplementing woodfuel through wood production**.** Fuelwood can be commercialized through development of woodlots in private farms where land is idle and/or unsustainable for agriculture.

This effort is supported by government policy which intends to increase the forest cover to 10% by 2030 (Republic of Kenya, 2007) and the legal notice no. 166 of November 2009 on agricultural act which requires the farmers to maintain 10% of tree cover in agricultural holdings. This intervention strategy is supply oriented as it aims to increase woodfuel supply from farmlands. The major constraint to this strategy is the small pieces of land ownership by famers and the competition of trees with the agricultural crops (Githiomi et.al., 2011). Outgrower tree schemes are other possible options which can be used in increasing the tree area cover in farmlands where tea factories and other service industries can develop contractual partnership between the partners (land owners and the tea factories/service institutions). The scheme can be arranged such that the growers are provided with technical advice on forestry practices and planting material which are essential to the success of outgrower schemes. Following a contractual agreement, a clear management plan is essential to ensure effective implementation aimed at achieving the target for long-term viability. This will ensure guaranteed market for the farmers and stable source of woodfuel by the tea factories and service institutions.

3) Efficient management of woodlands and rangelands

A strategy on efficient management of rangelands and woodlands through enrichment planting and controlled harvesting for charcoal, can improve charcoal supply greatly especially as most charcoal in Kenya comes from these areas . The resources in these areas are utilized unsustainably but this can be improved through application of the recently introduced charcoal rules and ensuring the tree harvesting for charcoal production is done sustainably. This can be achieved through proper management plans for woodlands and rangelands.

4) Increase adoption of efficient technology devices

This strategy aims at increasing adoption of improved charcoal kilns with efficiency of over 25% to replace traditional charcoal earth kilns with efficiency as low as 10%. The technologies to be used should be simple, cheap and easily adopted by charcoal producers like the improved earth kiln developed by KEFRI and Casamance kiln. This would lead to a reduction of wood needed for charcoal making significantly. The conservation of wood energy should be given a priority through promotion of improved stoves with higher efficiency. Majority of the households use 3 stone stoves which are very inefficient. The improved stoves to be promoted for adoption should consider users needs which include cooking comfort, convenience, health, safety and their affordability as these factors influence adoption of improved cooking devices.

5) Increase use of other alternative sources of energy like LPG, kerosene and electricity

This strategy assumes that with the government policy of promoting cleaner energy use and rural electrification, the households will slowly substitute woodfuels to alternative cleaner fuels. This will reduce pressure on woodfuel for domestic use leading to its decrease in demand. The use of alternative energy strategy is supported by the energy policy of 2004, which promotes the use of cleaner fuels like LPG through subsidies (MoE, 2004). As an example the government removed Value Added Tax on LPG and kerosene in the Kenya Government budget of June 2011 to encourage their use. The government has also enforced harmonization of different types of LPG regulators, which previously reduced competition in the market by restricting a customer to using one brand of LPG. While the use of alternative fuels sounds fairly realistic, it's likely to be faced with difficulties in price fluctuations of LPG, kerosene and electricity bills, which have been on the increase in the recent times. Other constraints that hinder their wider use include supply distribution, high initial cost of appliances among others. For an effective woodfuels substitution, subsidy is recommended for initial procurement of the appliances.

6) Use of alternative biomass energy technologies

Other forms of biomass energy include gasification which is a thermal treatment of solid fuel into gaseous form while retaining most of the energy in original fuel. Biodiesel is also another type of biomass energy from tree seed oil like *Croton megalocarpus, Jatropha curcas* among others. Biomass energy can also be generated from wood wastes like briquettes which are made from sawdust or charcoal dust and can be alternative option for charcoal. These are biomass energy sources which are gaining recognition in Kenya and their potential need to be explored.

7) Strengthen wood energy institutional framework

Wood energy systems have multi-disciplinary characteristics with many stakeholders strongly integrated between the socio-economic layers of rural areas, all requiring technical agencies from forestry, agriculture and industry sectors. Therefore, wood energy development strategies should be pursued as common task by all the relevant sectors. The coordination and linkages among the sectors concerned has been weak and need to be strengthened.

8) Enabling wood energy policy and planning

Woodfuel production strategy should be developed with prime objective of making each district self-sufficient. Decentralized area based wood energy planning is the most suitable in Kenya as wood energy situation and problems are site-specific and vary from one region to the other. Therefore, the implementation strategies in the decentralized woodenergy plan should be site specific depending on the prevailing problems. The woodenergy plans should be integrated with other decentralized planning activities at district development committees (DDCs. There is need for clear charcoal policy guidelines which would encourage investments on improved charcoal processing technologies. Charcoal production should be like any other cash crop farming and it should be taxed and reflected as a potential revenue earner for government. The 2009 charcoal regulations rules which are meant to establish sustainable charcoal production, transportation and marketing need to be put into operation.

9) Improvement of wood energy database

To improve wood energy data within the country, wood energy databases should be established at regional and national levels. These can be achieved through establishing regular field surveys for wood energy, supply, demand and data analyses to monitor the changes over time. Regular surveys need to be undertaken in future preferably at five year intervals to enable updating the data for future wood energy plans and policy formulations.

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