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Future prospect and sustainability of wood fuel resources in Tanzania

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ABSTRACT

Tanzania is among the lowest income countries with the majority of the people living below a poverty line of less than US$ 2/day. Its energy sector is dominated by wood fuel, mainly charcoal and firewood with over 75% dependency. Wood resources for charcoal and firewood production are collected from a wide variety of tree species. The country has no formal biofuel policies thus leaving biofuel producers (including charcoal and firewood producers) without a reliable framework. This poses a danger to the forest resources and the environment. Little is known about the empirical findings on future prospect and sustainability of charcoal and firewood resources. This study reviewed over 100 articles on the state of the art of wood fuel resources in Tanzania, and the extent and degree of forest resource utilization and sustainability is assessed. Forest loss is estimated at 0.4 million ha per year. Results suggest that it would take about 85 years for all forest resources to be destroyed completely. Assuming year 2005 as a reference year, generations from year 2090 would be left with no forest resources to meet their needs. The study concludes that future prospect and sustainability of charcoal production and firewood harvesting in the country is at stake. Before any irreversible changes occur, it is therefore necessary to protecting forest resources using proper management strategies such as the use of alternative fuel resources, improved conversion technologies and deployment of participatory forest management.

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1. Introduction

Like in the rest of Africa [1], Sub-Saharan Africa has biomass energy sources accounting for over 75% of the total energy consumption [2], mainly for cooking [3–5], Tanzania is no exception. Most countries in Africa are rich in hydropower, natural gas, coal, solar and wind energy resources, however, most of these resources are not tapped. In Tanzania, development of hydropower is estimated at 470–564 MW which is 10–12% of the hydropower potential which is estimated at 4700 MW. The country also has reserves of about 304 million tonnes of coal and 45 billion m^3 of natural gas [6–8]. The underdevelopment of these vast resources has lead to the over dependency on indigenous energy resources (e.g. cow dung) as well as wood fuel (e.g. charcoal, firewood) [9].

Tanzania is among the lowest income countries with a 2013 GDP of US$ 33.23 billion and a population of about 51 million, with more than half of the population living in poverty [10]; i.e. below a poverty line of less than US$ 2/day [11]. The country has a land area (Fig. 1) of about

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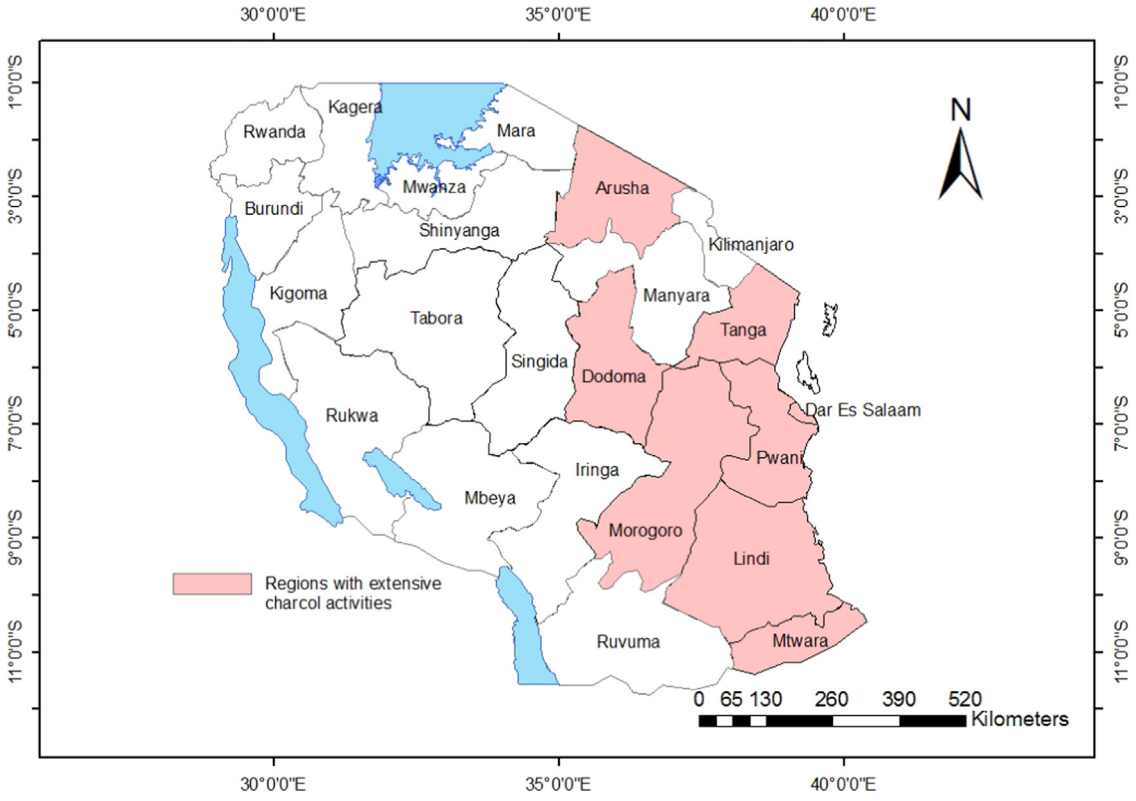

Fig. 1. Map of Tanzania showing some of the regions with extensive charcoal activities (created by Saidi Hussein Ibrahim, May 3, 2015).

885,800 km^2 which is approximately 88.58 million ha [12,13], and a population density of about 51 people/km^2 [14]. Many households depend on charcoal and firewood as their main source of energy [15,16]. About 95% and 4% of the population used firewood and charcoal for cooking while only 2% of the population used firewood for lighting [14]. Trees are widely used for production of charcoal, firewood, timber and burning of bricks [17] as well as for construction materials, building-poles [18–20], and construction of houses [21]. Charcoal and firewood are produced from a wide variety of tree species [22].

The country has no formal biofuel policies thus leaving biofuel producers (including charcoal and firewood producers) without a reliable framework [23]. This poses a danger to the forest resources and the environment i.e. overexploitation of forests, forest degradation and deforestation [24] mainly because unsustainable human activities [25] among others wood logging and charcoal production e.g. illegal charcoal burning [26] could destroy forests [27].

Since the process of making charcoal and firewood is continuing, forest resources could be diminished year by year [28] and the prospect for the future generation to meet their needs through charcoal and firewood production could be lost forever. The empirical findings [29] on future prospect and sustainability of charcoal and firewood use in Tanzania is not well studied [30] but little is known [31]. Before any irreversible change occurs, it is therefore important to access the extent and degree of forest resource utilization with the aim to protecting these resources using proper management strategies. This is why this review is presented. The knowledge of charcoal production and its properties is beyond the scope of this study, however, a substantial review is presented by Antal and Grønli [32].

2. Forest area

Forest area (in % of land area) (Table 1) has decreased from 41.6 million ha (47%) in year 1990 to about 34 million ha in 2005, and about 32.8 million ha (37%) in year 2012 [13] mainly because that these forests and woodlands are often openly accessed [33]. The loss is estimated at about 8.8 million ha of forests in 22 years, 0.4 million ha per year. In year 2005 the country had a total of about 34 million ha of the forests and woodlands, which was about 38% of the total land area. Miombo woodlands (*Zambezian savanna*) covered about 30.6 million ha i.e. 90% of the forest cover (increased from 25.5 million ha in year 2000 i.e. 75%, see Madoffe [34]) while mangroves and other forests covered 3.4 million ha which was about 10% of the total forests and woodlands [35]. Forest loss is also estimated at about 0.34 million ha (1% of the forest area) per year from 1990 to 2005 which is about 5.1 million ha in 15 years, with an annual average loss of 4122 km^2 or 0.41 million ha [36]. If these forests continue to be utilized with this rate (Table 2), it would take about 85 years for all forest resources to be destroyed completely. Assuming year 2005 as a reference year, generations from year 2090 would be left with no forest resources to meet their needs (Table 3).

Table 1
Forest type and forest area.

Type of forest	Forest area (million ha)	Year	Reference
Total (miombo, mangrove, other)	41.6	1990	[13]
Miombo	25.5	2000	[34]
Miombo	30.6	2005	[35]
Mangroove, other	3.4	2005	[35]
Total (miombo, mangrove, other)	34	2005	[35]
Total (miombo, mangrove, other)	32.8	2012	[13]

3. Status of the energy sector

Tanzania has a low electricity connectivity, of about 14–17% [6,14], as compared to that of Sub-Saharan Africa electricity