

## Forest management and Woodfuel use in Tanzania: Current status and the potential for biomass briquetting

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**Abstract:** As forest dependence for energy production continues to rise due to increasing biomass energy demands, woodfuel production has been reported to be one of the main drivers of forest loss in Tanzania. The aim of the current study is to provide an overview and understanding on the status of Tanzania forests and the biomass energy dependence from forests (woodfuel). The study further investigates the need for biomass briquettes production (biomass briquetting) by highlighting the benefits and related constraints on briquettes production in the country. Developing alternatives that can be used in the same manner as woodfuel such as biomass briquettes is important not only in reducing forest loss due to unsustainable woodfuel production but also in an efficient way to utilize the biomass residues, which are currently under-utilized. Despite the constraints on briquettes production, there are still notable benefits of briquettes including reduction in forest loss, reduction in firewood usage, emission reduction, employment and hence income generation. Thus, biomass briquetting should be a national agenda to facilitate awareness creation, product promotion and wider adoption of briquettes use while regulating charcoal production industry.

**Key-word:** Biomass briquettes, Woodfuel, Charcoal, Tanzania

### I Introduction

Like for most developing countries, the utilization of wood based fuels (charcoal and firewood) in Tanzania is much higher, being the only source of energy available to a large part of society (11). An increasing demand for forestry energy negatively affects forest status and availability because of weak governance and coordination, making it difficult to regulate the industry due to its informal nature.

As little attention is paid to efficient fuel use, scant research is undertaken to assess whether biomass energy is sustainably produced and utilized (15). Promotion of biomass energy in the form of densified solid fuels (briquettes) is gaining an importance, sought as an alternative to charcoal which can eventually contribute to sustainable forest management. This is mainly by improving the state of forests through decreasing the risk of fire and by indirect incidence in perception of the forest as a source of jobs and wealth creation (12). Thus, the current study presents an overview of the forestry energy dependence and the potential for biomass briquettes in Tanzania.

### II Materials and methods

**1. Study area** This subsection presents the study area (Tanzania) description and its location. Tanzania (figure 1) is located in East Africa and lies between the latitude 1° S and 11° 45' south of the Equator and the longitude 29° 20'E and

40° 38' east of Greenwich. It borders Kenya and Uganda in the north; the Democratic Republic of Congo, Rwanda and Burundi in the west; Zambia, Malawi and Mozambique in the south and the Indian Ocean in the east (9). It has a total area of 945,749 km<sup>2</sup> with a population of 44.9 million and a population growth rate of 2.9% per annum (according to the National Population and Housing Census of 2012).

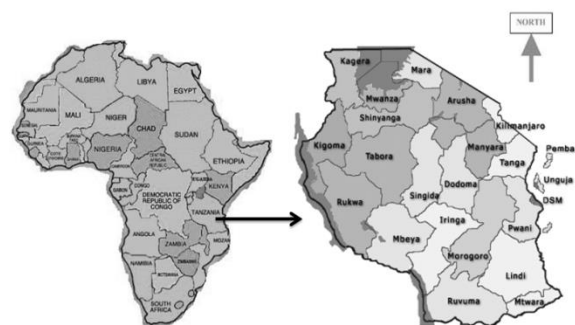


Fig.1 Tanzania, its location and main regions (adopted from Google maps)

**2. Study item** This study presents a review on the forest resources, forestry energy and the potential for biomass briquettes production and utilization as an alternative to woodfuel in Tanzania. Information and data is from published articles and reports on the relevant topic.

### III Tanzania forest resources and ownership

Forests resources are categorized by type, usage and legal status (6), of which the total forest area is estimated at 48 million ha (55 per cent of the total area (table 1).

Table 1 Status and categories of forest resources

Category	Forest resource	Total area	
		million ha	%
Type	Woodlands	44.6	93
	Forests*	3.4	7
Use	Productive forest	-	60.3
	Protected forest	-	39.7
Ownership	Central government	15.84	35
	Local government	3.36	7
	Village governments	21.6	45
	Private sector	3.36	7
	General land	2.4	5
	Mixed**	0.48	1
Total		48	100

\* Mangroves, coastal forests, humid montane forest and plantations

\*\* Unspecified forests with less known ownership; example sacred forests

### IV Forestry energy in Tanzania

**1. Energy status, demand and supply** About 90% of energy use in Tanzania is wood based fuels (charcoal and fuelwood) while kerosene and electricity account for 8.8%, with non-wood fuels accounting to about 1.2%. Only 24% of the population is connected to electricity (9), thus a continuous reliance on woodfuel, with lack of relevant policies ultimately contributing to deforestation and forest degradation (3). While Tanzania consumes an estimated 1.6 million tons of charcoal annually, approximately 15 million cubic meters of wood are required to meet this demand (14).

With the total annual supply (growth) of wood at national level

being about 83.7 million cubic metres, only 42.8 million cubic metres are available for harvesting at a sustainable level (9). This indicates that consumption exceeds the sustainable supply, overwhelming the capacity of forests to sustainably supply wood resources for a diverse range of needs. To cite an example, annual estimates of 100,000 – 125,000 hectares of forests are lost due to charcoal production. On the other hand, an annual forest loss of 100,000 – 400,000 hectares is attributed to unsustainable woodfuel production (14).

Despite the fact most of the charcoal is produced unsustainably with inefficient technologies, the proportion at which charcoal contributes to deforestation in Tanzania is not well established. This may be due to the informal nature of charcoal industry, unorganized available data and lack of countrywide studies to establish the relative contribution of charcoal in driving deforestation. Under inadequate alternatives and weak strategies to regulate woodfuel use, high reliance on woodfuel will continue to exert pressure and hence threaten the existence of forest resources.

**2. Necessity of Briquettes** Biomass remains and shall continue to be the main energy source for both rural and urban residents. Alternatives such as kerosene, Liquefied petroleum gas (LPG) and electricity are less utilized as cooking energy due to decreased demand as a result of high cost of kerosene, high start up cost for LPG while cooking with electricity is perceived too expensive.

Several years ago, plantations targeted to supply fuelwood were established to address challenges on future availability of woodfuel. However, fuelwood plantations have largely failed in Tanzania, partly due to management challenges, lack of financial viability, little follow up and monitoring plans. Likewise, more charcoal solutions to date are targeted on the supply side (consumers i.e. big towns and cities, mainly Dar es Salaam) than on the demand side (production), at which unsustainable charcoal practices start thus leaving the entire charcoal system largely not addressed.

The inefficiencies in wood industry associated with low wood conversion technologies results in large quantities of wood wastes (sawdust, slabs and offcuts) which are normally left accumulated in harvesting sites and eventually burnt, with those on processing facilities being minimally used as direct source of energy. Direct use of biomass for energy results into low energy output, with the piles of wood wastes in logging sites accelerating the occurrence of forest fire, production of smokes and hence environmental pollution.

Densification of wood residues into briquettes is more advantageous than direct burning of wood wastes as a fuel due to having low bulk density, high moisture content and low energy content.

Briquetting (figure 2) involves the production of an energy-dense solid fuel source (briquettes) through the process of densification under a high compaction pressure or low compaction pressure (7). Biomass briquetting (bio-briquetting) involves conversion of low bulk density biomass into high density and energy-concentrated fuel through densification to form briquettes (5) mainly used for cooking and heating applications.

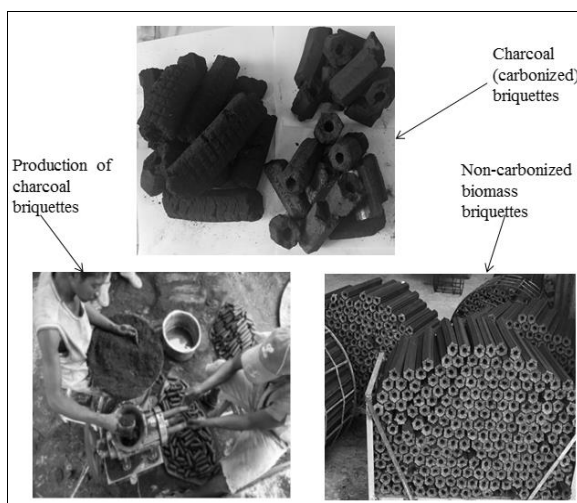


Fig.2 Briquettes production from biomass wastes

The use of charcoal briquettes (carbonized briquettes) from sawmill residues is a viable option to reduce the pressure on forest resources and presents a renewable energy resource as an alternative to fossil fuels (7). The production of briquettes from sawdust exemplifies the potential of appropriate technology for wood waste utilization to minimize the Greenhouse gases (GHGs) emissions and reduce deforestation by providing a substitute for woodfuel (13). Since more charcoal are used than briquettes especially in long duration heating (1), briquetting saves trees that can prevent soil erosion and desertification by providing an alternative to burning wood for cooking energy (2).

**3. Constraints on briquettes production** While firstly piloted in the late 1980s, briquettes production ended unsuccessful due to various reasons, among them being inappropriate briquetting machinery, unavailability and high cost of the briquetting machines' spare parts, poor projects'

planning and implementation as free supply of raw materials was assumed (4). From 2005 to date, various community based organizations and private sectors are engaging in biomass briquettes production in Tanzania.

However, a number of issues constrain the successfulness of briquettes production to realize their benefits over woodfuel. These includes unknown production capacity, lack of information on volume estimates of produced briquettes and sales volumes compounded by few marketing studies due to low community awareness on briquettes (10). Likewise, access to technology, production bottlenecks, access to finance, low business and marketing skills, supply limitations and low adoption rate to utilizing biomass briquettes (4) hinders scaling up of briquetting interventions.

As biomass briquettes have been demonstrated to be cheaper than wood charcoal in some countries (1), the higher prices in Tanzania limits their adoption and hence lack of public acceptance (4). Furthermore, spatially dispersed feedstock, short briquetting project span and lack of government intervention makes it difficult for biomass briquetting to become a successful venture. Poor quality briquettes as indicated by low-energy density, high moisture content from hand operated machine (8) limits the scaling up of biomass briquettes. In order to overcome these challenges, it is thus important to devote much effort on promoting briquettes use by proper planning and fully investment in high efficient technologies for high quality products and hence wider market penetration.

## V Conclusion and Way forward

Despite the constraints on briquettes production, there are still notable benefits of briquettes including reduction in forest loss, reduction in woodfuel usage, emission reduction, employment and hence income generation. Thus, awareness creation, product promotion and mass production are necessary for wider adoption of briquettes use while regulating charcoal production industry. Tree planting coupled with effective forest management are the only solutions to meeting such high wood demands for energy purposes.

Generally, if the continuous high charcoal dependence is to be addressed, there is need to ensure adequate and affordable availability of alternatives energy sources with the appropriate technology to meet consumer expectations.

More efforts are needed to understand the energy demands of potential consumers and the factors that will drive mass

briquettes consumption in order to make briquettes more desirable to a wider range of users. Likewise, learning from successful countries in terms of bio-briquetting such as Nepal and China is necessary to stimulate a change in the briquetting scenario by establishing research and promotional institutions.

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