Energy 85 (2015) 310–316

Contents lists available at ScienceDirect

Energy

journal homepage: www.elsevier.com/locate/energy

Wood energy in India: Status and prospects

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ARTICLE INFO

Article history:
Received 1 June 2014
Received in revised form
10 December 2014
Accepted 16 March 2015
Available online 18 April 2015

Keywords:
Wood
India
Biomass
Fuelwood
Plantation
Clonal plantation

ABSTRACT

Wood plays a key role in meeting energy demand in India, particularly in rural areas; its share in total energy consumption of the country is estimated to be about 18%. Traditionally wood is mostly used as fuel in household cooking; small quantities are also used in other applications such as restaurants, brick and tile manufacturing and agro-processing. The energy crisis of 1973 triggered interest in use of wood in modern applications, initially in gasifiers for pumping water and small-scale electricity generation in rural areas and later in power generation using steam turbines. Although installed capacity of biopower generation has been growing at an annual average rate of about 16% since December 2005, the sector appears to be facing uncertain future because of rising cost and lack of reliable supplies of wood. This paper presents a review of different aspects of wood energy in India and an assessment of wood energy potential in 2050 based on availability and productivity of different types of land for wood production; the potential of biopower capacity based on surplus wood after meeting demands for timber and fuelwood is estimated to be 180–260 GW.

1. Introduction

Traditional fuels, e.g., fuelwood, dung and crop residues, play a key role in meeting energy demands in India, particularly in rural areas. As shown in Fig. 1, the absolute amount of energy from these fuels consumed annually in the country has been growing, although its share in total energy consumption has been declining.

Wood is the most important and sought-after traditional fuel; based on a report of the Planning Commission [1], its share in total traditional energy consumption has been estimated to be 72.6% in 2006–07. According to Planning Commission [2], fuelwood accounted for about 65% of total traditional energy consumption in 1996–97; based on [3], the share of fuelwood in consumption of traditional fuels is estimated to be about 54% in 1975–76. Thus, overall, share of fuelwood in total traditional energy consumption appears to be increasing. In India, the share of traditional biomass fuels in total energy consumption has been slowly falling and amounted to about 24.6% in 2010 [4]; assuming that wood accounts for 72.6% of total traditional energy consumption, the share of wood in total energy consumption of the country is estimated to be about 18%.

Apart from use as a cooking fuel in the households, wood is traditionally used for energy in restaurants, tea shops, brick kilns, tobacco drying and other cottage industries as well as religious rites [5]. A relatively modern application of wood is power generation based on gasifiers and steam power systems.

Sources of fuelwood include forests as well as trees outside forests. To reduce pressure on forest resources and increase supply of fuelwood, the Indian Government has taken several policy measures from time to time. India's NFP (National Forest Policy) of 1952 suggested having at least 33% of the national land area under forest cover; NFP of 1988 reiterated this target [8]. The 10th five year plan of India set a target of having 25% of the country's geographic area under forest and tree cover by 2007 and 33% by 2012. However, even the target for 2007 has not been achieved yet and fuelwood still remains in short supply. This paper reviews different aspects fuelwood in India, e.g., consumption, sources, uses and policy initiatives. An attempt has also been made to estimate the sustainable fuelwood potential of the country in 2050.

2. Fuelwood consumption

Estimates of annual fuelwood consumption have been derived by different national-level studies for different years. Fig. 2 shows values of fuelwood consumption reported in these studies. Fig. 2 also shows values obtained from FAO [20]. The FAO's fuelwood estimates are obtained through annual surveys; in cases where

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http://dx.doi.org/10.1016/j.energy.2015.03.043
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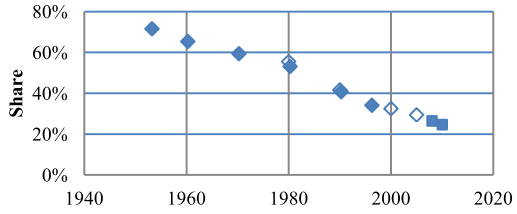
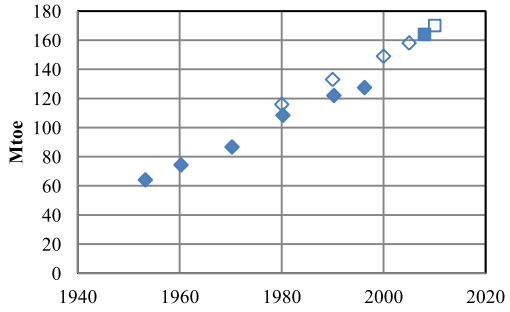


a. Share of Traditional Fuels in Total Energy Consumption, 1953-2011



b. Historical Consumption of Traditional fuels, Mtoe

Fig. 1. Historical variation of a) consumption of traditional fuels and b) their share in total energy consumption; Source: ♦ [2]; ◊ - [6]; ▪ [7]; □ - [4].

such estimates could not be obtained, FAO repeats historical figures until new estimates become available. In Fig. 2, FAO estimates for the years 1997–2001 are simply repetition of the estimate for 1996. The FAO estimates of fuelwood consumption show a gradual rising trend, the growth being quite slow in recent years.

There are significant discrepancies in the reported consumption estimates of the national studies. In rural areas, a lot of fuelwood is collected freely from several sources, e.g., forests, roadside plantations, community land etc. and there are no records of fuelwood freely collected or purchased from local markets; unrecorded collection, trade and consumption of fuelwood make reliability of its total consumption estimates in the country rather low. As pointed out by Pandey [21], estimates of fuelwood consumption are mostly derived from questionnaire survey with limited physical checking; also no institution is exclusively mandated with the task of fuelwood studies. These factors also contribute towards low reliability of fuelwood consumption estimates.

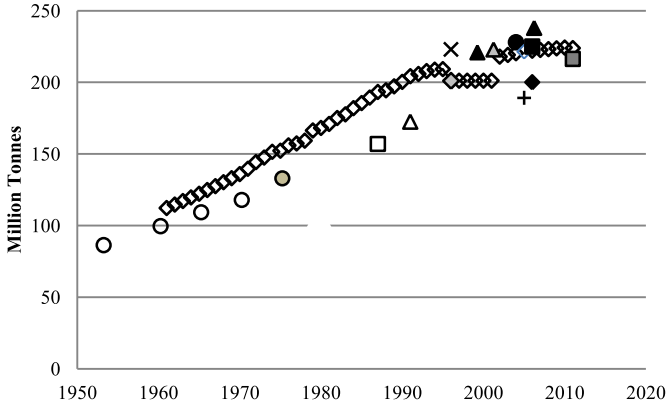


Fig. 2. Historical variation of fuelwood consumption, million tonnes (Sources: ○- [9];● - [3];□- [10]; Δ- [11]; ◆ - [12]; × - [13];▲ - [1];△ - [14];● - [15]; + - [16]; ◆ - [17]; ■ - [18]; ▪ - [19]; ◇ - [20].)

3. Fuelwood sources

The sources of fuelwood in India include natural forests, tree plantations, community forests, village or private woodlots, agro-forestry, trees planted along canal, river banks, and road sides etc. Only a few studies have attempted to assess the shares of different sources of fuelwood supply in the country so far. Ravindranath and Hall [11] estimated the contributions of forests, shrubs on degraded lands/roadside, plantations, and homestead gardens to be 40.9%, 26.7%, 23.2%, and 9.3% respectively. Contribution of the forests towards wood supply has been assessed in several studies; results of these studies are shown in Table 1.

A report of the Ministry of Environment and Forests [13] indicated that annual fuelwood demand was 223 Mt (million tonnes) in 1996, while the availability was 115 Mt suggesting a huge gap met from over-exploitation. Forests of the country are thus under tremendous pressure for meeting demands for fuel, and other products.

4. Uses

4.1. Household

The most important use of fuelwood is for cooking and heating in the households, particularly in rural areas. Table 2 shows the percentage of rural and urban households using wood as the primary fuel for cooking over the period from 1983 to 2011. Although data from the two sources, i.e., NSSO and Census of India, differ quite significantly, it can be seen that the percentage of rural households depending on fuelwood has changed only slightly during this period. However, the percentage has decreased in case of urban households due to availability of LPG.

4.2. Other traditional uses

According to the Planning Commission of India [1], about 80% of total fuelwood is used in the households; the remaining 20% is used in a variety of applications, e.g., manufacturing bricks, tiles and lime, and in agro-processing such as jaggery preparation, tobacco curing and preparation of spices like cardamom. Rai and Chakrabarty [12] estimated that consumption of fuelwood in rural and urban households was 162 Mt and demand for other uses was around 39 Mt in 1996, implying that other uses account for around 19.4% of total fuelwood use in the country. FSRI [16] estimated the total fuelwood consumption in the country in 2010 to be 261 million cubic meter, consisting of 248 and 13 million cubic meter for household use and other uses respectively implying that other uses accounted for only 5% of total fuelwood consumption in the country. Thus, the share of other uses in total fuelwood consumption can be taken to lie in the range 5–20%; the remaining wood is used in the households.

Table 1
Contribution of the forests towards wood supply.

Reference	Contribution of forest, %	Year
NCAER -1985 [22]	53	1978-79
Rai and Chakrabarti [12]	51	1996
SFI [19]	27.1	2011
FSRI [16]	19.9	2005
Ravindranath and Hall [11]	40.8	1991