Assessing Households' Fuel Wood Sources and Tree Species Preference in Foot Hills of North-Western Himalayas

Abstract

The present investigation **"**Assessing Households' Fuel Wood Sources and Tree Species Preference in Foot Hills of North-Western Himalayas" was carried out, during the year 2019-2021 to investigate the primary sources and preferred species for fuelwood consumption among the local people of Kashmir Himalayas, India. The sample of study area was drawn by multi-stage random sampling technique. The data were collected through personal interviews of respondents using well-structured pre-tested interview schedule and non-participant observations. The study revealed that people extract enormous quantity of fuelwood mostly from forests and utilize maximum portion of extracted fuelwood for cooking and heating. Fuelwood collection was mainly done by women along with children. Winter season consumption was more than summer season consumption. Consumption of fuelwood was maximum at high elevation (>2000m) and minimum at middle and low elevation (1900-2000m and <1900m) respectively. Forests were the primary source of fuelwood resulting in huge pressure on forests thereby creating deforestation and degradation. A total of 12 species belonging to 8 families were found preferred species for fuelwood. *Cedrus deodara, Salix spp., Populus spp.* and *Robinia pseudoacacia* was the most preferred species while the *Picea smithiana, Ailanthus altissima* and *Aesculus indica* was the least preferred species.

Keywords**:** Fuelwood; Species; Himalayas; Households; Consumption

Introduction

Fuelwood, fodder and timber are the most common forest products used by rural people in different countries like India (Sharma *et al.*, 1989). Fuelwood is the universal source of rural domestic energy in most developing countries and accounts for 60 percent of the total fuel requirement (Pandey, 2002). It meets the basic energy requirement in both domestic and traditional industrial sectors in rural areas and composes a basic input for efficient economic activities. Wood energy remains the primary source of energy throughout the world and has been used for cooking and heating since thousands of years (FAO, 2009). Besides wood, other important sources of energy are agricultural residues including rice husks, straw, bagasse, corn cobs and other forms of biomass. Fuelwood extraction does not indubitably lead to forest degradation (FAO, 2009). Besides that, it generally prompt forest deterioration where fuelwood demand are high, forest resources are limited (particularly high elevation and arid environments where plant growth is constrained by climate), and alternative energy resources such as kerosene or Liquefied Petroleum Gas (LPG) are unavailable (Rai and Chakrabarti, 2001). A primary effect of scarce supply of fuelwood is the burning of agricultural residue and animal dung, which otherwise would have been used for rejuvenation of soil fertility and booming food production.

Fuelwood is one of the most important sources of energy in the developing and under developed countries. Modern man needs energy for lot of activities. Energy generated from fuelwood is the main component of the domestic energy systems of the world, mainly in the developing countries. Fuelwood is the primary energy sources for cooking and heating used by rural households (70%) in developing countries (Parikh, 1980). Fuelwood is pre-eminently, a renewable source of energy whose decentralized nature is particularly suited to the scattered nature of rural habitation and usually makes it possible to obtain the fuel at a very low cost. In communities where fuelwood is used for residential cooking, it is replaced by other technologies reluctantly, driven by cost differentials (Rao, 1985).

Fuelwood is a non-timber forest product (NTFP) that constitute the primary energy sources for cooking and space heating used by rural households (70%) in developing countries (Mishra, 2008). The reliability of a considerable proportion (40%) of people world-wide on fuelwood energy for cooking and heating has given rise to serious concerns that harvesting of fuelwood could be depleting the forest resources (Anonymous, 2010). Continual growth of human population on the earth, increasing demand for food and living space led to the increase of energy demands as well. In order to meet the energy demands man utilised different natural resources often to such an extent that some of them are likely to become extinct. The consumption of biomass as fuel has been identified as one of the most important causes of forest decline in many developing countries. The fuelwood accounts for over 54 percent of all global wood harvest per annum, leading to a significant loss of forest biomass (Wahab *et al.,* 2008). A heavy and growing reliance on forest and other plant species as a source of fuel has become unsustainable. The heavy dependence of rural households on fuelwood and the anticipated depletion of available stocks present a real threat to economic welfare and growth (Marenya and Barrett, 2007). The declining forests results in serious repercussions of all kinds. The rural people have to devote an increasing proportion of limited time and money for obtaining the supply of fuelwood they need (Sood and Tahir, 2019). This results in accelerated over-cutting of the remaining vegetation which causes irreparable damage to the fragile ecosystem. When trees disappear from the countryside, the people have recourse to agricultural residues and animal waste, the only fuel to which they still have access. Diversion of this organic matter from the fields to the rural hearths causes significant decrease in food production (Mortan, 2007). Thus, it is implicit that food is being burnt to cook food due to wood famine.

A high dependency of large number of human population on forest biomass for running their livelihoods and meeting their household needs of fuelwood demand is age old practice in Kashmir (Tahir *et al*, 2012). The extent and quality of forest cover governs the perennial water supply including ground water recharge and health of soils in Kashmir. In addition, for meeting their fuelwood requirement, people of the Kashmir lean heavily on forests. Therefore, forests are intrinsic to the sustainability of primary sectors like agriculture, horticulture and animal husbandry, particularly in hilly regions. Sheikh Noor- ud-din Wali (1377-1440 CE), the famous sufi saint within this reference has opportunely stated, “ann poshi teli, yeli wann poshi, i.e., food will last as long as forests last.” The major sources for fuelwood accessibility are forests, farm forestry, social forestry, homestead forestry and pastures and the main areas of consumption are cooking, heating, cottage industries, community functions and others in Kashmir (Islam, 2008).

As in other parts of India, fuelwood is a source of domestic energy for majority of households in Jammu and Kashmir. Ganderbal is one of the districts of Kashmir division of Indian union territory of Jammu and Kashmir where people have colossal dependence on fuelwood. Out of various biofuels, fuelwood is considered as major source of domestic energy in the district. A majority (84.18 %) of the population of the district is rural.

MATERIALS AND METHODS

Study Area Description

The proposed study has been conducted in district Ganderbal of union territory of Jammu and Kashmir, India (Fig.1). The district is situated on the bank of river Sindh at a distance of 20 km from Srinagar. The district is located between 34°23`N latitude and 74°78`E longitude at an altitude of 1,619 metres (5312 feet) above mean sea level in the undulated surface of Kashmir valley. The district is predominantly rainfed but some areas of the district are irrigated through Sind irrigation canal network. The climate of the district is temperate which remains hot and dry in summer and cold and snowy in winter. The summer season sets in from April and ends up to June. The rainy season starts from July and continues up to September. The winter season begins from October and continues up to March. The mean minimum and maximum temperatures are 5°C to 20°C respectively with average annual precipitation of 700mm. The district has total geographical area of 39304 ha, out of which area under forest, non-agricultural use, barren and uncultivable land, permanent pastures and other grazing land, cultivable waste land and net area sown are 10949 ha, 5758 ha,3161ha, 1790 ha, 973 ha and 16673 ha respectively (Anon., 2011 b). The total human population of the district is 297446 (158,720 males and 138,726 females, sex ratio of 874 females per 1000 males, family size of 6.62, population density of 1148 per Km^2 and literacy rate of 59.98%)among which the urban population is 47,039 (15.81%) and the rural population is 250,407 (84.19%) according to census of India, 2011. A majority (84.19%) of the population of the district is rural and is dependent on agriculture for their livelihood. The district consists of six tehsils (Ganderbal, Kangan, Lar, Tullmulla, Wakura and Gund) and seven blocks (Ganderbal, Gund, Lar, Kangan, Wakoora, Safapora and Sherpathri) with 146 villages and 44831 households (www.ganderbal.gov.in/ganderbalestablish.asp).

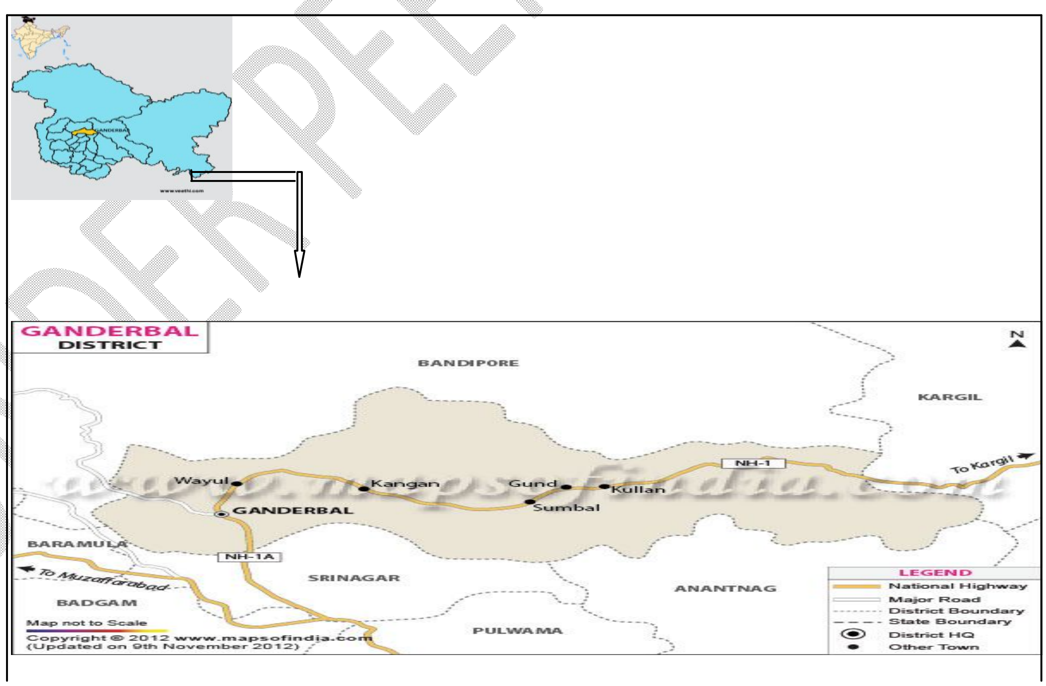

Fig.1. Location map of study area

Sampling Procedure

A multi-stage, random sampling design was adapted to select the villages and respondents for the household survey. In the first stage, two sample blocks out of the total of seven blocks of the Ganderbal district have been selected randomly. The sample blocks selected were Ganderbal and Gund. In the second stage, a complete list of villages was prepared in both the respective blocks in consultation with tehsil and block officials. The total number of eight sample villages was selected from sample blocks using simple random sampling with 15 percent sampling intensity. The sample villages selected were Babosipora, Sadrabagh, Hardomardabagh, Babadariyadin, Chappergund and Gotlibagh from Ganderbal block; Sonamarg and Nilgrar from Gund block. In the selected villages, a complete list of households was prepared in consultation with panchayat secretaries and village elders. In the third stage, selection of sample households having sample size of 20 percent of the total number of households in each selected village using proportionate allocation and simple random sampling with replacement method. The final sample size has been 146 households.

Data Collection

The present research includes both qualitative and quantitative methods for achieving the study objectives (Ray and Mondol, 2004). The collection of data has been done by using both primary field survey and secondary sources.

Primary Data

Primary sources include structured interviews with selected respondents and non-participant observations (Mukherjee, 1993). The collection of primary data has been done at individual/household and village level whereas the collection of secondary data has been done for block, village and household/individual level.

Secondary Data

Secondary sources include data from various journals, research reports, forest department records, village records, internet, previous researches, annual reports and other related documents of different governmental and non-governmental agencies.

Primary Sources and Preferred Species for Domestic Fuelwood Consumption

Primary Sources

The data regarding fuelwood extraction from various sources and consumption for various purposes among the sample households were collected using interview schedule. The fuelwood extracted from various primary sources namely, forests, agroforestry, social/community forestry, homestead forestry and purchase from the market.

Species Preference

To find out the species preference for fuelwood use, Species Preference Index (SPI) has been calculated by using the methodology of Singh (1996). The heads of households were asked to indicate preference of species for fuelwood use from 1-3. Preferences from 1-3 have been assigned numeral values from 3-1 respectively. The numbers of the preferences for each species have been counted. The preference total has been obtained for each species and village by multiplying the number of different preferences by corresponding preference numeral and summing them. The species getting the highest total are the most preferred species in the village and vice-versa. In order to calculate the species preference for the whole study area, preferences weights has been determined and the preference index has been calculated which represented the order of the preference for the species in the study area.

$$\text{The preference weight } (pw_{ij}) = \frac{\text{Preference total for } i^{th} \text{ species from } j^{th} \text{ village}}{\text{Number of sample households in the village}}$$

$$\text{Preference index for } i^{th} \text{ species for the study area} = \frac{\sum pw_{ij}}{N \times 3}$$

Where,

Pw_{ij} is preference weight for i^{th} species from j^{th} village

N is the number of study villages in the study area.

Results and discussion

Primary Sources and Preferred Species for Fuelwood Consumption

Primary Sources

The depiction of data in Fig.2 revealed that out of all available primary sources of fuelwood, 38.35% households was secured fuelwood from forests, 29.45% households from homestead, 27.39% households from own-farm, 2.73% households purchase from the market and rest 2.05% households from other sources such as community forestry, avenue plantation, etc. For 56 households, primary source of fuelwood was forests followed by homestead for 43 households, own-farm for 40 households, purchase for 4 households and other sources for rest 3 households among 146 sample households. The reason for maximum collection from forests can be attributed to easy access to forests, unavailability of alternate fuels and availability of labor.

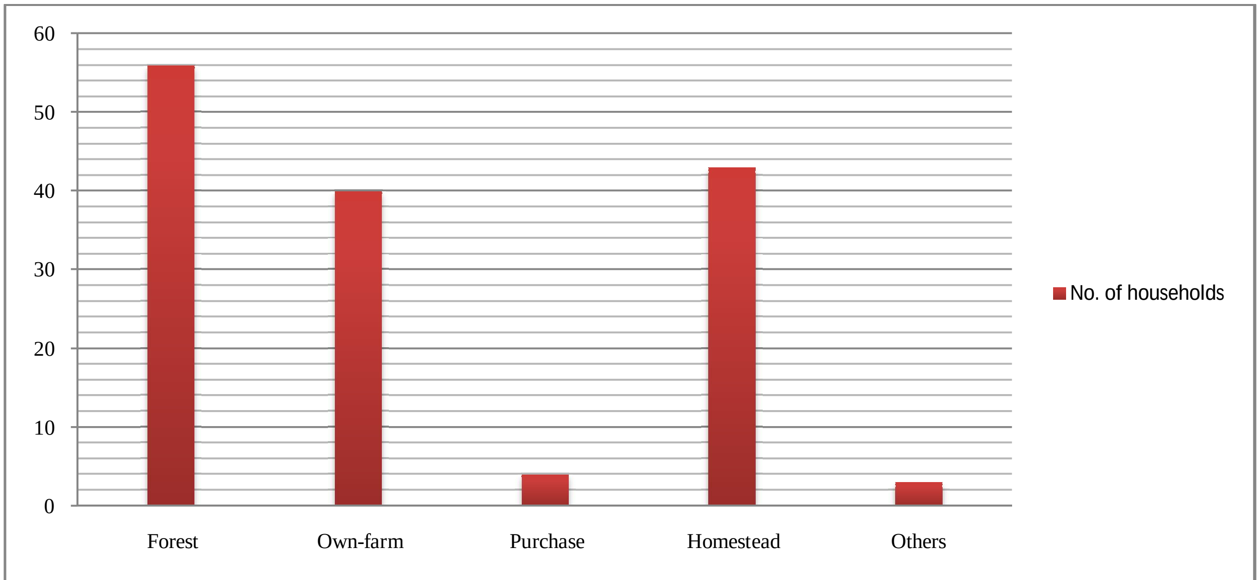

Fig.2: Proportion of primary sources of fuelwood by number of households

Preferred species for fuelwood consumption

The fig. 3 represents the village-wise preference of species for fuelwood consumption in the sample villages by preference total (Pt) and preference weight (Pw). *Salix spp*., *Populus spp., Robinia pseudoacacia*, *Ailanthus altissima*, *Morus alba* and *Ulmus villosa* were found important for fuelwood consumption in the first sample village(V_1), *Salix spp., Populus spp., Robinia pseudoacacia, Ulmus villosa* and *Aesculus indica* in the second sample village (V_2), *Salix spp., Populus spp., Cedrus deodara, Morus alba, Ulmus villosa* and *Aesculus indica* in the third sample village (V_3), *Salix spp., Populus spp., Robinia pseudoacacia, Morus alba, Ulmus villosa* and *Aesculus indica* in fourth sample village (V_4), *Salix spp., Populus spp., Robinia pseudoacacia, Morus alba, Ulmus villosa* and *Aesculus indica* in fifth sample village (V_5), *Salix spp., Populus spp., Robinia pseudoacacia, Morus alba, Ulmus villosa* and *Aesculus indica* in sixth sample village (V_6), *Abies pindrow, Betula utilis, Pinus wallichiana* and *Picea smithiana* in seventh sample village (V_7) and *Abies pindrow, Betula utilis, Pinus wallichiana* and *Picea smithiana* in last sample village (V_8). This could be due to the village-wise variation in the vegetation owing to the variability in locality factors (soil, topographic, climatic and biotic).

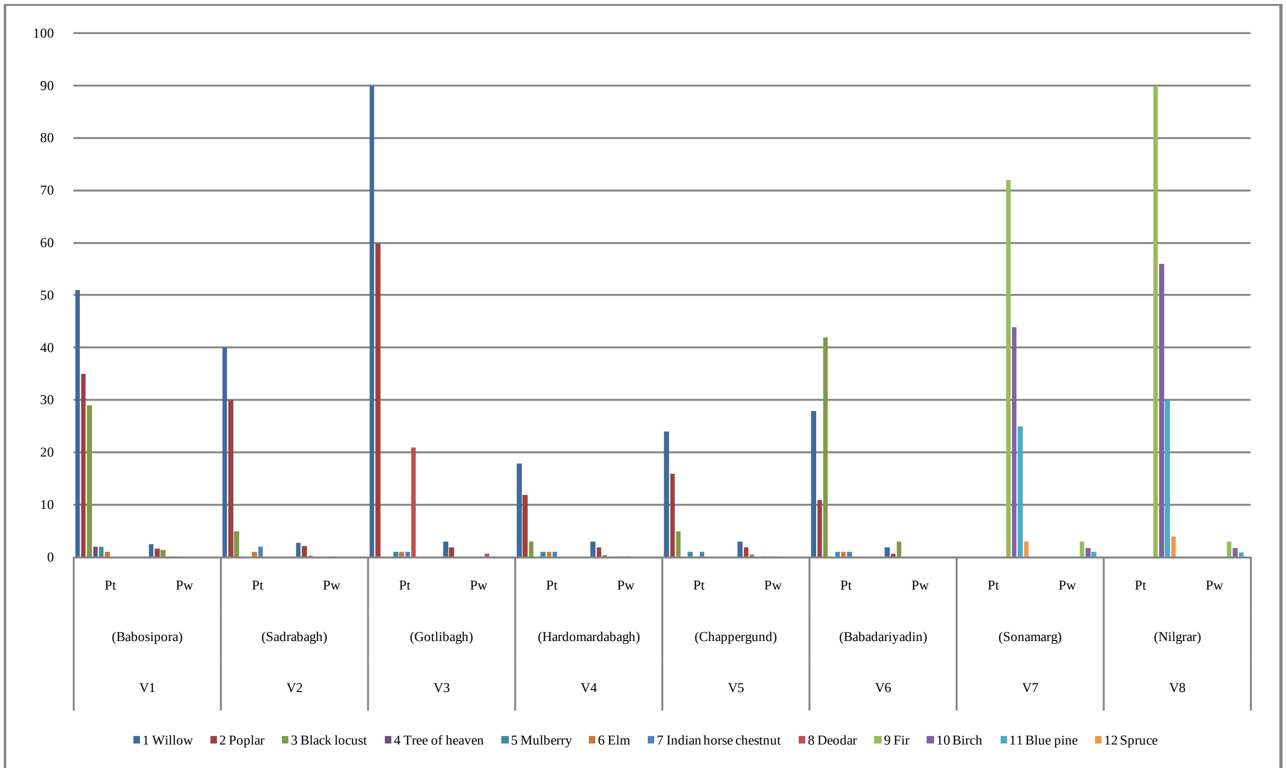

Fig.3: Proportion of species preference in the sample villages by preference total and preference weight

The fig. 4 represents the preference of plant species for fuelwood consumption in the whole study area by Species Preference Index (SPI). A total of 12 species was mainly preferred for fuelwood consumption in the study area viz. willow (*Salix spp*.), Poplar (*Populus spp*.), Black locust (*Robinia pseudoacacia*), Tree of heaven (*Ailanthus altissima*), Mulberry (*Morus alba*), Elm (*Ulmus villosa*), Deodar (*Cedrus deodara*), Silver fir (*Abies pindrow*), Birch (*Betula utilis*), Blue pine (*Pinus wallichiana*), Spruce (*Picea smithiana*) and Indian horse chestnut (*Aesculus indica*). Out of the preferred plant species for fuelwood consumption, the most preferred was *Cedrus deodara* (SPI=0.70) followed by *Salix spp.* (0.68), *Populus spp.* (0.44), *Robinia pseudoacacia* (0.25), *Abies pindrow* (0.25) and *Betula utilis* (0.15). The least preferred was *Picea smithiana* (0.01) followed by *Ailanthus altissima* (0.01), *Aesculus indica* (0.02), *Ulmus villosa* (0.02), *Morus alba* (0.02) and *Pinus wallichiana* (0.08). This can be generally attributed to the selection of those trees by villagers that are available in their areas, possessed good fuel characteristics such as high calorific value, low smoke emission, long-lasting flame and durable timber.

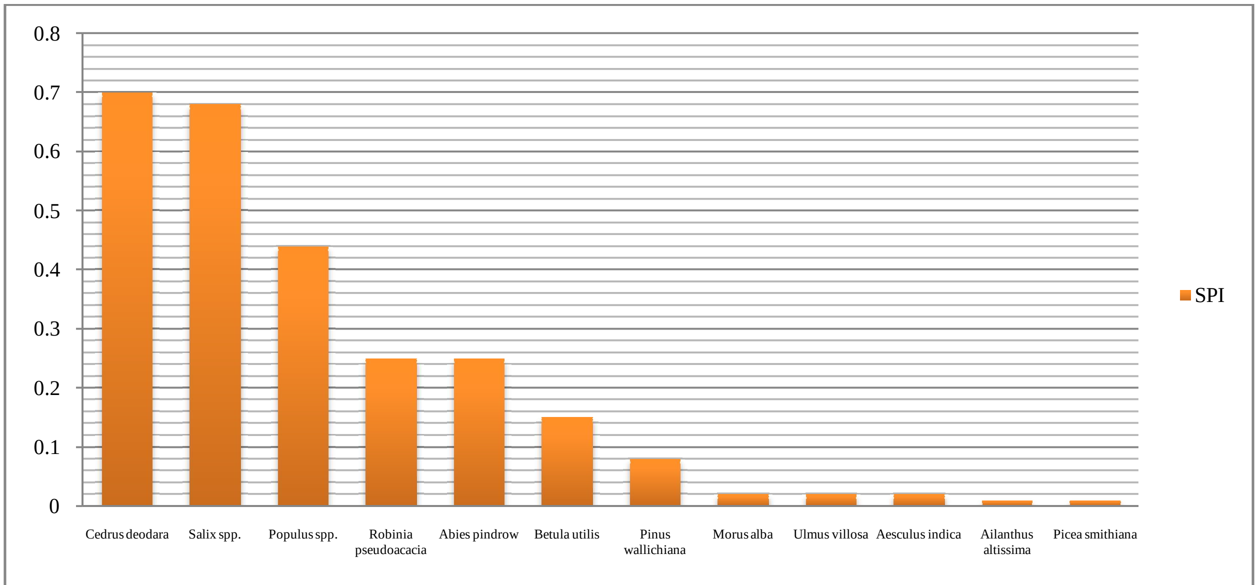

Fig. 4: Representative value of SPI of tree species preferred for fuelwood in the study area

Conclusion

Forests are the primary source of fuelwood for majority (38.35%) of the households followed by homestead (29.45%), own-farm (27.39%), purchase (2.73%) and others (2.05%). A total of 12 species belonging to 8 families were found preferred plant species in the sample villages. *Cedrus deodara*, *Salix spp.*, *Populus spp.*, *Robinia pseudoacacia*, *Abies pindrow* and *Betula utilis* were found most preferred species with their SPI value of 0.70, 0.68, 0.44, 0.25, 0.25 and 0.15 respectively in the study area. *Picea smithiana, Ailanthus altissima, Aesculus indica, Ulmus villosa, Morus alba* and *Pinus wallichiana* were found least preferred species with their SPI value of 0.01, 0.01, 0.02, 0.02, 0.02 and 0.08 respectively in the study area.

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