Wood Utilization Pattern in Kashmir Region, Western Himalaya

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Abstract

The remoteness of the Qazi Nag Range in the western Himalayas has resulted in complete dependence of local people on woody plants for socioeconomic development. The present study aimed to evaluate utilization of woody plants in the Kashmir region. Information was collected through questionnaires and interviews during field surveys. A total of 40 tree species belonging to 29 genera and 18 families were recorded, being used locally as fence and fuel, hedging, thatching, roofing, construction, decoration, furniture, and agricultural tool making. The predominant plant families included Pinaceae and Moraceae, with five species each, followed by Fagaceae and Salicaceae, represented by four species each. Twenty-seven species were used as fence, 25 as fuel in the study area, and 14 species were used for agricultural tool formation, fodder, and fruit production. Nine species were used for furniture, eight tree species were recorded with medicinal values, and only four species were used in construction as structure wood. *Cedrus deodara, Taxus wallichiana, Juglans regia*, *Pinus wallichiana, Celtis eriocarpa*, and *Betula utilis* had multiple uses, being widely used in manufacturing furniture, decoration pieces, and tool handles; in construction; and as fuel, fence, and medicines. *J. regia* and *C. deodara* were also used to create artistic decorative masterpieces. Local inhabitants used *T. wallichiana*, *Aesculus indica, J. regia, C. deodara, P. wallichiana*, and *Quercus* species for cooking and heating homes during the winter season.

Forest ecosystem–based products have always played a key role in life-support systems such as energy requirements, food, fodder, shelter, clothing, and medicine (Murphy et al. 2008). This people–plant relationship contributes a great deal to human welfare. People of rural areas and forest fringe communities in Pakistan obtain their livelihood from forest products (Sher et al. 2010), resulting in continued reliance on natural forest resources. Human–forest interactions have changed as the world undergoes huge human population pressure, which has deteriorated the natural commodities and degraded natural resources. People have traditional knowledge of the relationship between living organisms and their surroundings. It is more necessary than ever to understand and document the socioeconomic services nature provides to human beings (Ahmad and Husain 2008).

Socioeconomic parameters of a society affect the usage of forest resources. Wood is considered one of nature's commodities to man as an energy source, in construction, and in agricultural tool formation (Shah et al. 2007). This stress is manifold in developing countries where the forests experience ruthless cutting of woody species, providing 50 percent of energy sources for cooking and heating homes (Shanley and Luz 2003). Regular unchecked harvesting of woody plants for construction, fuel, and agricultural tool formation has resulted in the decline of natural populations of trees.

Qazi Nag Range was targeted in the present study because the inhabitants had a different socioeconomic status and were involved either in primary economic activities (farmers, hunters, and loggers) or in processing primary activity products as construction workers, dealers/traders, and carpenters. It is a matter of great concern to document the traditional information about woody plants. The aim of the present study was to collect information on timber-yielding plants used in construction, fuel, fence, furniture,

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and agricultural tool formation from the western Himalayan Qazi Nag Range, Azad Kashmir.

Materials and Methods

The study was performed in rural areas adjoining the Qazi Nag Range, District Hattian, Azad Jammu and Kashmir. The Qazi Nag Range is in the western Himalayan Kashmir region, situated between 34°15′ and 34°45′N latitude and 73°45′ and 74°35′ E longitude. The altitudinal gradient varies from 1,700 to 3,400 m, with Khara Maru forming its highest peak (Fig. 1). The climate of the area is sub-Mediterranean and receives heavy snowfall during the winter season. In snowy periods, the area remains isolated from the rest of the world. It lacks the basic necessities of life because of its remoteness, which results in a lack of facilities such as roads that give access to a nearby city and alternative sources of fuel and construction materials. The inhabitants use forest products for various purposes such as heating the home, cooking, fences, thatching, construction, furniture, food, fodder, and medicines. This widespread use of plants is attributed to their acceptability, accessibility, affordability, and efficacy.

Ethnobotanical data

Ethnobotanical data were acquired by using a questionnaire with open-ended structured questions. The questionnaires were focused on the locality; sociodemographic details including age, gender, and education; wood use categories; preference ranking of species; vernacular names; and threats to the medicinal plants mentioned. A total of 85 randomly selected households were interviewed in the local language, Hindko and Kashmiri, to facilitate the locals' expression. In each household, persons having maximum ethnobotanical knowledge were selected for interview from each age and education class. The plants recorded in interviews were collected from the forest stands surrounding the surveyed populations through random walks with the help of informants. The collected specimens were transported to the herbarium of the Botany Department, University of Azad Jammu and Kashmir, for proper identification with the help of experts and literature available. The plants were allocated accession numbers and were deposited in the herbarium.

Quantitative analysis

The collected data were represented systematically in tabular form. The information such as botanical name, voucher specimen number, and family names were provided for each species. Use value (UV) was calculated by following the formula of Phillips et al. (1994). Informants consensus factor (ICF) and preference ranking (PR) threats were calculated according to Martin (1995) and Alexiades and Sheldon (1996).

Multivariate analyses technique (Principal component analysis [PCA]) was performed by present/absent data against each use category to identify the similarities among the most preferred use categories of the tree species (Hill 1979).

Results

The questionnaire respondents represented a diverse array of people including farmers, government servants, literate, illiterate, young, elders, men, and women. Among the 150 informants, 61 were male and 89 were female. The largest proportion of the respondents was of the elderly, older than 50 years old (48%). More than half of the respondents had primary education or were illiterate (62%). These basic results also reflect the reality that indigenous knowledge is

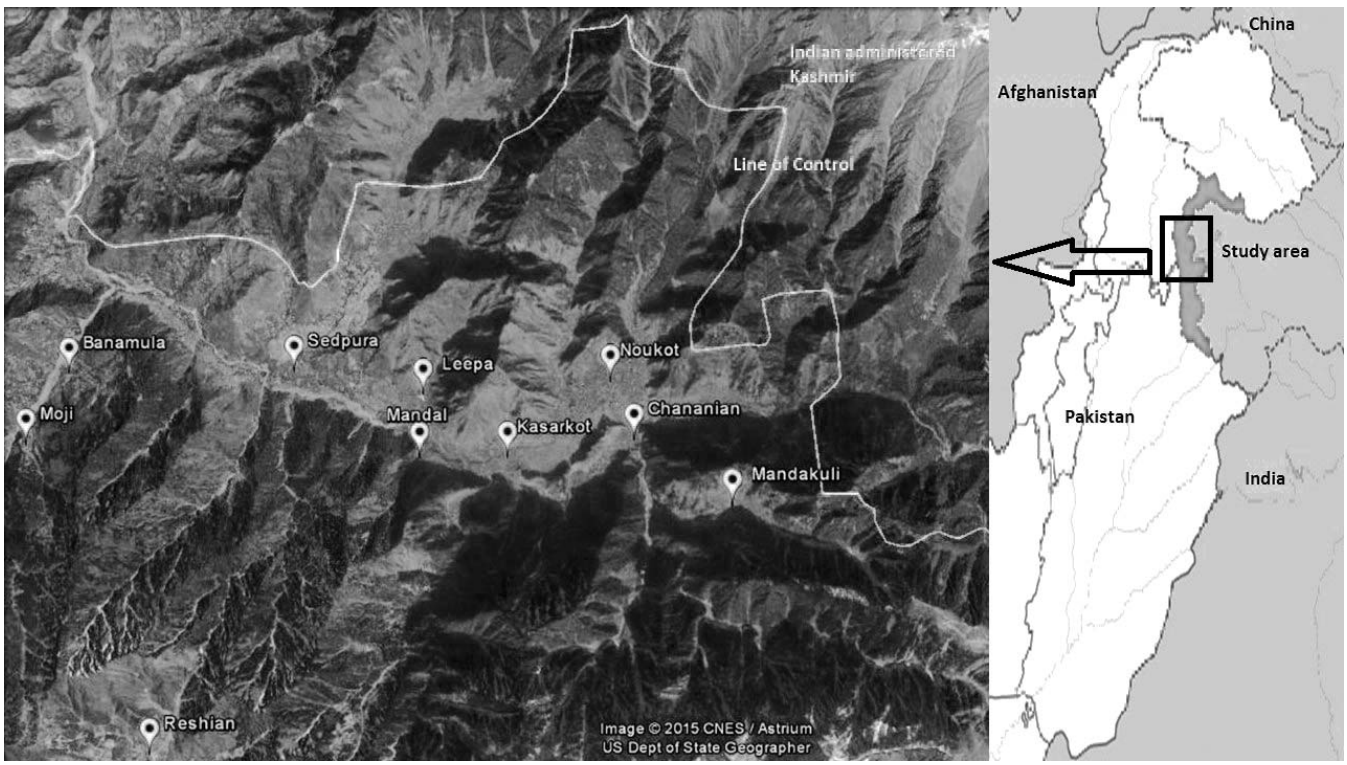

Figure 1.—Map of study area: Qazi Nag Range, Azad Kashmir region, Pakistan, western Himalaya.

Table 1.—Percentage of respondents of different age groups and genders of the interviewed people recorded at Qazi Nag Range.

No.	Age group (yr)	Respondents (no.)		Respondents (%)		Total (%)
		Male	Female	Male	Female	
1	<25	11	6	7.33	4.00	11.33
2	26–50	23	38	15.33	25.33	40.66
3	>50	27	45	18.00	30.00	48.00
	Total	61	89	40.66	59.33	99.99

well established but seems to be decreasing in the younger generation (Table 1).

A total of 40 tree species belonging to 29 genera and 18 families were recorded from Qazi Nag Range, Kashmir region, western Himalayas. The predominant plant families were Pinaceae and Moraceae, with five species each, followed by Fagaceae and Salicaceae, represented by four species each. The remaining families were represented by three or fewer species each (Table 2).

UVs were calculated for all the species, and a single use by a single informant was not considered for analysis. The tree species *J. regia* scored a high UV (1.87), followed by *Morus alba* (1.45) and *Quercus incana* (1.42) (Table 2).

The different uses of the tree species were classified into eight categories and the ICF values for each category were obtained. The highest ICF score (ICF = 1) was recorded for *Rheus cotonus* and was cited by 64 informants. Construction scored the second highest value of ICF (0.98). *Cedrus deodara*, *Pinus wallichiana*, *Picea smithiana*, and *Abies pindrow* were extensively used in construction (240 citations). It was followed by a 0.95 ICF value, with 166 citations recorded for furniture wood extracted from *J. regia*, *C. deodara*, *Fraxinus excelsier*, *Pinus wallichiana*, *Picea smithiana*, and *A. pindrow*. Comparatively low scores

Table 2.—Wood species utilization patterns and their use value (UV) recorded at Qazi Nag Range, western Himalaya.[a]

No.	Botanical name	Family	Local name	Ethnobotanical uses									UV	Acc. no.
				F	C	A	Fu	Fe	Fr	Fo	M	P		
1	*Acer caesium* Wall. ex Brandis	Aceraceae	Trekana	—	—	0	0	0	—	0	—	—	0.42	193
2	*Acer pictum* Wall. ex D. Don	Aceraceae	Trekana	—	—	0	0	0	—	0	—	—	0.68	194
3	*Rhus chinensis* Mill.	Anacardiaceae	Arkhar	—	—	—	—	—	—	—	—	+	0.40	195
4	*Alnus nitida* (Spach) Endl.	Betulaceae	Sharol	—	—	—	0	0	0	—	—	—	0.60	196
5	*Betula utilis* D. Don	Betulaceae	Bhuraj	—	—	+	0	—	—	0	—	—	0.74	197
6	*Corylus colurna* L.	Corylaceae	Urni	+	+	—	+	—	+	—	+	—	1.21	198
7	*Diospyrus lotus* L.	Ebenaceae	Amlook	—	—	—	—	—	+	—	—	—	0.53	199
8	*Bauhinia variegata* L.	Fabaceae	Kachnar	—	—	—	—	0	—	—	—	—	0.07	200
9	*Dalbergia sissoo* Roxb.	Fabaceae	Shisham	—	—	—	—	0	—	—	—	—	0.07	201
10	*Quercus dilatata* Royle	Fagaceae	Brachar	—	—	+	+	+	—	+	—	—	1.20	202
11	*Quercus glauca* L.	Fagaceae	Reen	—	—	—	+	+	—	+	—	—	0.72	203
12	*Quercus incana* Roxb.	Fagaceae	Reen	—	—	—	+	+	—	+	—	—	1.42	204
13	*Quercus semecarpifolia* Sm.	Fagaceae	Choor	—	—	+	+	+	—	+	—	—	1.26	205
14	*Aesculus indica* (Wall. ex Camb.) Hook.f.	Hippocastanaceae	Bankhoor	—	—	0	+	—	—	0	—	—	1.22	206
15	*Juglans regia* L.	Juglandaceae	Akhroot	+	—	+	0	0	+	—	+	—	1.87	207
16	*Acacia nilotica* (L.) Delile	Juglandaceae	Babool	—	—	—	+	+	—	—	—	—	0.95	208
17	*Morus alba* L.	Moraceae	Toot	—	—	+	—	—	+	+	0	—	1.45	209
18	*Morus nigra* L.	Moraceae	Shahtoot	—	—	+	—	—	+	+	—	—	1.13	210
19	*Broussonetia papyrifera* (L.) Vent.	Moraceae	Jangli toot	—	—	—	0	0	—	—	—	—	0.39	211
20	*Ficus palmata* Forssk.	Moraceae	Phagwar	—	—	—	—	0	0	—	+	—	0.95	212
21	*Ficus carica* L.	Moraceae	Anjeer	—	—	—	—	—	—	—	+	—	0.40	213
22	*Fraxinus excelsior* C. B. Clarke	Oleaceae	Som	+	—	0	—	—	—	—	—	—	0.84	214
23	*Olea cuspidata* Wall. ex DC.	Oleaceae	Kao	—	—	—	0	0	0	—	+	—	0.74	215
24	*Rubinia pseudo-acacia* L.	Papilionaceae	Kikr	—	—	—	+	+	—	0	—	—	1.31	216
25	*Abies pindrow* Royle	Pinaceae	Tung	0	0	—	—	0	—	—	—	—	0.42	217
26	*Cedrus deodara* (Roxb. ex D. Don) G. Don	Pinaceae	Deodar	+	+	—	+	—	—	—	0	—	0.91	218
27	*Picea smithiana* (Wall.) Boiss.	Pinaceae	Chachar	0	—	—	—	0	—	—	—	—	0.26	219
28	*Pinus roxburghii* Royl. ex Benth.	Pinaceae	Chir	—	+	—	0	0	—	—	—	—	0.38	220
29	*Pinus wallichiana* A. B. Jackson	Pinaceae	Biar	0	+	—	0	0	—	—	—	—	0.89	221
30	*Punica granatum* L.	Punicaceae	Annar	—	—	—	—	0	—	0	0	—	1.07	222
31	*Prunus padis* L.	Rosaceae	Hari	—	—	—	0	0	—	—	—	—	0.92	223
32	*Pyrus pashia* Buch.	Rosaceae	Tanchi	—	—	—	0	0	0	—	—	—	0.76	224
33	*Prunus persica* (L.) Stokes	Rosaceae	Aroo	—	—	—	0	0	0	—	—	—	0.47	225
34	*Populus alba* L.	Salicaceae	Safida	0	—	—	0	0	—	—	—	—	0.49	226
35	*Populus ciliata* L.	Salicaceae	Safida	0	—	—	0	0	—	—	—	—	0.38	227
36	*Salix acmophylla* Boiss.	Salicaceae	Beensi	—	—	0	0	0	—	—	—	—	0.54	228
37	*Salix alba* L.	Salicaceae	Beens	—	—	0	0	0	—	—	—	—	0.59	229
38	*Taxus wallichiana* (Zucc.) Pilger.	Taxaceae	Parongi	—	—	0	0	0	—	—	+	—	0.98	230
39	*Celtis eriocarpa* Decne.	Ulmaceae	Bremaj	—	—	0	0	0	0	0	0	—	0.61	231
40	*Ulmus wallichiana* Planchon	Ulmaceae	Mannu	—	—	0	0	0	—	0	—	—	0.73	232

[a] Acc. = herbarium accession number; F = furniture; C = construction; A = agricultural tool; Fu = fuel; Fe = fence; Fr = fruit; Fo = fodder; M = medicinal; P = poisonous ; — = not used; 0 = less important; + = very important.

Table 3.—Informant census factor (ICF), number of species, their use frequency, and preference ranks (PR) of threats to tree species recorded from Qazi Nag Range, western Himalaya.

Use categories	No. of use citations	No. of species	% of species	Frequency	ICF	PR by respondents[a]						Total no.	Percentage	PR rank
						R1	R2	R3	R4	R5	R6			
Construction	240	5	3.68	18.2	0.98	3	2	1	0	5	6	17	12.41	5th
Furniture	166	9	6.61	12.6	0.95	3	1	1	2	3	4	14	9.49	6th
Fodder	118	14	10.29	8.93	0.89	4	3	4	5	4	2	22	16.06	3rd
Fruit	96	12	8.82	7.27	0.88	0	0	0	0	0	0	0	0.00	No
Medicinal	82	11	8.09	6.2	0.88	4	2	1	0	0	2	9	6.57	7th
Agricultural tool	114	16	11.76	8.62	0.87	4	5	3	2	6	1	21	15.33	4th
Fence	208	30	22.06	15.7	0.86	3	4	5	3	3	5	23	16.79	2nd
Fuel	233	38	27.94	17.6	0.84	6	7	4	3	5	7	32	23.36	1st

[a] R1 through R6 = six key respondents.

were for fruit and medicine, agricultural tools, fences, and fuel wood (Table 3).

The PR on the degree of threats to trees was conducted using six key respondents. Respondents ranked fuel (23.36%) as the leading threat to the tree species. It was followed by fence (16.79%), fodder (16.06%), agricultural tool formation (15.33%), construction (12.41%), furniture (9.49%), and medicinal (6.57%). Fruit was recorded with no threat to ethnoflora of trees in the investigated area (Table 3).

Woody species were recorded with different usage patterns. Twenty-seven species were used for fencing, 25 species for fuel, 14 for agricultural tool formation, and 14 for fodder and fruit yield in the investigated area. Furniture was prepared from nine species, eight trees were recorded with medicinal values, only four species were used in construction as structure wood, and a single species was recorded as poisonous from the investigated area (Table 2).

A majority of the trees, *C. deodara*, *Taxus wallichiana*, *J. regia*, *Pinus wallichiana*, *Celtis eriocarpa*, and *Betula utilis*, were found with multiple uses. The local inhabitants protect their crops from animals by fencing the fields. Plant species having branching, thorns, and spines were preferred for fencing. Some of the plants grown permanently around fields were *Acacia nilotica* and *Salix tetrasperma*, whereas some were harvested and temporarily placed as a barrier for cattle, wind, and erosion. Heterogeneous fencing based on multiple species usage was one of the common practices around the crop fields to prevent entry of cows, buffalos, sheep, and goats, etc., in the villages of the Qazi Nag Range.

The most preferred plant species used as fuel for cooking and warmth were *A. nilotica*, *Cedrus deodara*, *T. wallichiana*, *Aesculus indica*, *Celtis eriocarpa*, *Quercus* species, *Salix* species, and *J. regia*. Even *Pinus wallichiana* and *Abies pindrow* were also used as fuel during fuel wood shortage (Table 2). Plant species were preferred because of their durability and quality of burning.

Agricultural practices are traditional in the study area. Agricultural tools such as ploughs, sticks, sickle handles, knife handles, pulleys, and axe handles were made from plants such as *J. regia*, *C. eriocarpa*, *B. utilis*, *Q. incana*, *Q. dilatata*, *Q. semecarpifolia*, *Cotoneaster roseus*, *Aesculus indica*, and *Acacia nilotica* (Table 2).

In the villages around the Qazi Nag Range, wooden houses were built because of severe winter weather. *Abies pindrow*, *Cedrus deodara*, *Picea smithiana*, and *Pinus wallichiana* were used in construction.

Wild plants were of great importance for fruits, as 14 trees were recorded for their edible fruit, e.g., *M. alba*, *M. nigra*, *Celtis eriocarpa*, *Pyrus peshia*, *Prunus persica*, *J. regia*, *Diospyrus lotus*, *Ficus palmata*, and *F. carica*.

Acacia nilotica, *Acer caesium*, *A. pictum*, *Aesculus indica*, *B. utilis*, *Celtis eriocarpa*, *Q. incana*, *Q. dilatata*, and *Q. semecarpifolia* were used as fodder species during early spring, autumn, and winter seasons.

Cedrus deodara, *J. regia*, *T. wallichiana*, *Olea cuspidata*, *M. alba*, *M. nigra*, *F. carica*, and *F. palmata* were the tree species with medicinal values recorded in the study area.

The multivariate analysis technique PCA was used to compare the use categories from the data of 40 different tree species to reveal trends in utilization pattern. The first two axes of PCA explained 75 percent of the total variance in the data, which shows statistical strength of the result.

Several important correlations are revealed by PCA. *J. regia* is represented as an outlier. *Cedrus deodara* and *Pinus wallichiana* showed strong correlation with furniture and construction on the *x* axis. Four species of *Quercus* were grouped together because of the very same UVs and weightage. The rest of the species having lower UVs were clustered close to each other on the *y* axis without showing any significant correlation with any specific use (Fig. 2).

Discussion

The whole population of the Qazi Nag Range is dependent on forest resources as it experiences snowfall with a harsh winter season. This lifestyle and housing varied accordingly, consuming a lot of timber wood in construction. Cedar and pine are preferred because of durability of timber in the investigated area. Fuel wood is a dire need of local inhabitants in the investigated area. A majority of the trees were used as fuel depending on their availability. The local community is very selective when choosing plants for fuel wood, because the burning properties varied widely among plants. Wood that burns without smoke or sparking and undergoes an easy and quick burn is considered as good-quality fuel wood. Local inhabitants use *T. wallichiana*, *Aesculus indica*, *J. regia*, *Cedrus deodara*, *Pinus wallichiana*, and *Quercus* species for cooking and heating homes during the winter season. Ruthless and wasteful burning in a traditional way of cooking and heating during cold and snowfall periods may affect the forest ecosystem in ways that may not be immediately visible.

In the higher altitudes, fuel wood is not available easily and is collected from the temperate and subalpine forests. At present, consumption of fuel wood is higher and some of the preferred species such as *Rhododendron*, *Salix grandiflorum*, *B. utilis*, and *Juniperus communis* face the danger of local

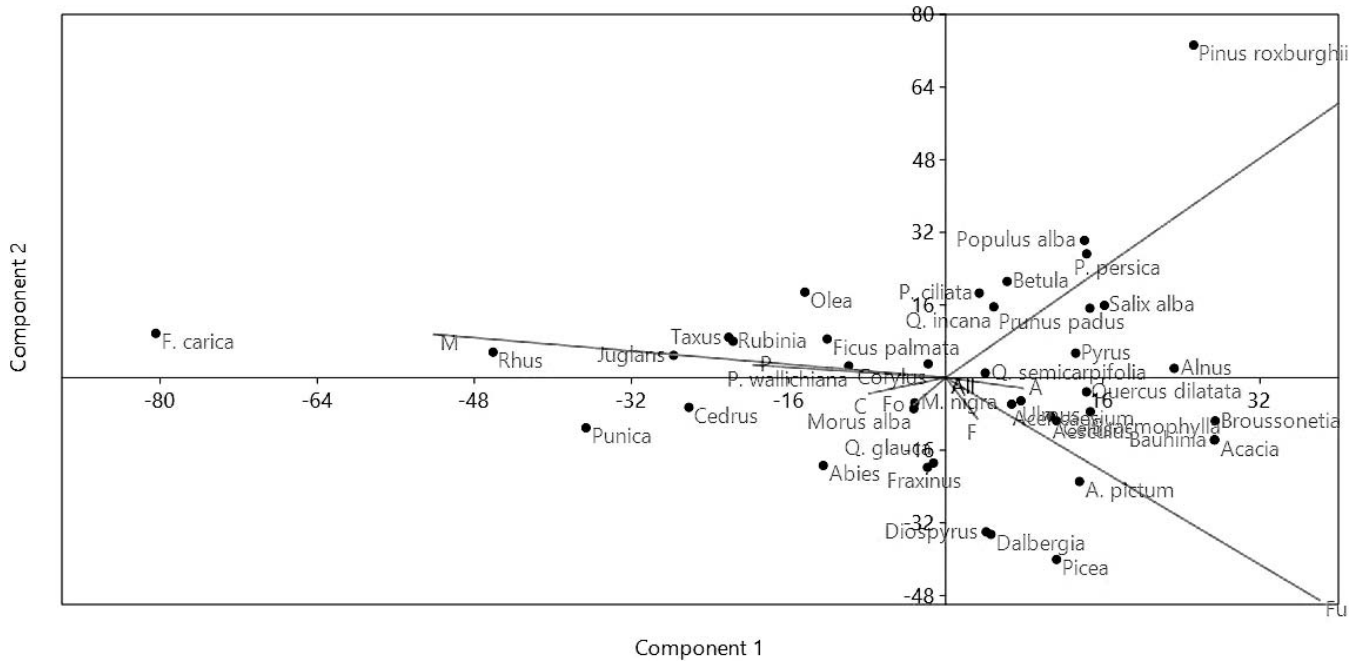

Figure 2.—Principal components analysis ordination of first two axes of tree species usage categories recorded from Qazi Nag Range, western Himalaya.

extinction. Branches of *Aesculus indica*, *Acer ceasium*, *A. pictum*, and oaks, viz. *Q. semecarpifolia, Q. glauca, Q. incana*, and *Q. dilatata,* were collected during autumn and winter seasons to feed livestock. Fodder collection takes place for winter months when there is scarcity of green fodder.

Free grazing during summer and fodder harvesting before the onset of cold winter to feed livestock is a common practice in the snowy areas. Palatable trees like willows, oak, and aesculus are harvested to feed livestock during winter months when the area remains covered by heavy snowfall. Human settlements, summer pasturing, nomadic herds, and grazing inside the forests are common practices in this area. Migratory grazers use Qazi Nag Range forestland extensively during summer months.

In the investigated area, anthropogenic pressures including heavy grazing coupled with fuel and timber harvesting were the common forest usage patterns as reported by other workers who assessed plant conservation priorities in the Himalaya region (Dickoré and Nüsser 2000, Pant and Samant 2007, Khan et al. 2011).

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