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Diversity and Indigenous uses of Tree species in the Vicinity of Srinagar Hydroelectric Power Project in Alaknanda valley of Garhwal Himalaya, India

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Abstract

The present study has been carried out in the vicinity of Srinagar Hydroelectric Power Project in Alaknanda valley of Garhwal Himalaya (India) to document the indigenous uses of tree species and their status of availability in the area. In the present investigation a total of 81 tree species belonging to 58 Genera and 31 families have been recorded from the study area. Among these 12 species were abundant, 47 common and 22 uncommon to this area. A list of tree species along with their local names, availability status and their indigenous uses has been given. The recorded indigenous uses of tree species as made by local people for medicine, fuel-wood, timber, food, fodder, etc. can be utilized in the future for technological advancement, economic prosperity and providing employment opportunity to the local people.

Keywords: Tree species diversity, availability status, indigenous uses, Hydroelectric Power Project, Garhwal Himalaya.

Introduction

The Mountain regions, covering about one-fifth of the earth's land surface, are the important sources of water, energy, minerals, forests, and agricultural products as well as of recreation. The Indian Himalayan region occupies a special position in the mountain ecosystems of the world. The Himalaya represents a diverse and characteristics vegetation distributed over a wide range of topographical variation. Its valleys, rivers and streams offer a perennial source of water. The catchment area of rivers supports a large number of plants species of human use and scientific interest[1-2]. The occurrence of 21 forest types[3-5], 18,440 species of plants; 816 tree species; 1748 species of medicinal plants; 675 species of wild edibles; 279 species of fodder and 118 species of essential oil yielding medicinal plants[6-9], justifies the diversity and uniqueness of the Indian Himalaya.

The diversity of trees is fundamental to total forest biodiversity, because trees provide resources and habitat for almost all other forest species[10]. Tree species diversity varies greatly from place to place mainly due to variation in biogeography, habitat and disturbances[11], which has also been considered as the important factor for structuring the forest communities[12].

Biodiversity is essential for human survival and economic well being of the people and for the ecosystem function and stability[13]. The diversity of trees is being used by the local inhabitants of Alaknanda valley in Garhwal Himalaya for fodder, fuel wood, timber, in making agricultural implements, fiber, apiculture, medicine and several non-timber forest products. The world vegetation cover under the natural forests has been depleting fast and a significant portion of such areas is being converted to man-made plantation forests mainly of timber trees to meet the growing need of the ever increasing human population[14]. The degradation of biodiversity in the Himalayan region has reached dangerously at alarming state[15-17]. In the Garhwal Himalayan region, the plant diversity is declining rapidly due to various anthropogenic activities including forest fire, hill road construction, and execution of large river valley projects coupled with the natural calamities leading to degradation of natural habitats of many species to a great extent.

The anthropogenic disturbances such as construction of hydroelectric power projects play an important role in determining the change, loss or maintenance of plant diversity in a forest. Exploitation of fuel wood and timber has profound effects on the biodiversity of the forest ecosystem[18], often leading to the change in species composition and vegetation structure[19]. Keeping this in view the present study has been undertaken in and around Srinagar Hydroelectric Power Project in Alaknanda valley of Garhwal Himalaya to assess the diversity and distribution pattern of tree species, and to record the indigenous uses of tree species within the study area.

Material and Methods

The study was conducted between 30°13'9" - 30°14'22" N latitudes and 78°45'47"- 78°51'59" E longitudes covering an area of approximately 100 km^2. Regular field study was made in the construction phase of the Srinagar Hydroelectric Power Project during the years 2008 -2010 for the survey of the vegetation and indigenous uses. The information on plants was collected through interviewing local communities. The informants were medicine-men (*Vaidhyas*), peasants, shepherds, priests and elderly women. To determine the authenticity of information collected during field work, repeated verification of data from

different informants was done. Thus, only the specific and reliable information, cross-checked with informants has been incorporated in the present study. A structured questionnaire was used to collect data on local plant names, uses, parts used, and mode of administration. Recorded trees were identified with the help of Garhwal University Herbarium (GUH), local floras and previous works[17, 20-23]. The plants were divided into categories of abundant, common and uncommon based on their occurrence in the study area.

Results and Discussion

As a result of present study 81 tree species belonging to 31 families have been recorded in the Alaknanda valley around Srinagar Hydroelectric Power Project. Among these 12 species were abundant, 47 common and 22 uncommon to this area. The availability status and indigenous uses of the tree species have been presented in table-1. The families such as Moraceae (9 species), Mimosaceae (8), Rutaceae (6), Caesalpiniaceae (5), Salicaceae (5), Combretaceae (5), Fabaceae (4), Myrtaceae (4), Meliaceae (3) and Ulmaceae (3) were represented by higher number of species, respectively (figure-1). *Ficus* (7 species), *Citrus* (4), *Acacia* (4), *Albizia* (3), *Bauhinia* (3), *Salix* (3), *Terminalia* (3), *Celtis* (2), *Grewia* (2) and *Phoenix* (2) were the genera with more than one species being used by local inhabitants (table-1).

As per indigenous uses maximum 35 species are used as medicinal, followed by edible and fodder 31 each (figure-2). The study indicates that the area harbors a high diversity of tree species but due to construction of hydroelectric power project many of these species are under severe threat. The inhabitants reveal rich presence of many of these species in the area in the past, which has restricted now to mere patches.

The tree species of this area have been grouped in Northern Mixed Deciduous Forest Type[4]. This type occurs throughout the outer hill ranges where soil is very poor and moisture content is not favorable for growth of Sal forests. These forests are found below the Chir forest zone[4]. It is evident from the vegetational study that the common tree species are *Pinus roxburghii*, *Acacia catechu*, *Mallotus philippensis*, *Lannea coromendelica*, *Holoptelea integrifolia*, *Haldina cordifolia*, *Mangifera indica*, etc.

Table-1
Diversity, availability status and indigenous uses of the tree species in the vicinity of Srinagar Hydroelectric Power Project in Alaknanda valley of Garhwal Himalaya

S. No	Botanical names	Local Name	Family	Availability Status[1]	Indigenous Uses[2]
1	*Acacia auriculiformis* Cunning. ex Benth.	------	Mimosaceae	+	------
2	*A. catechu* (L.f.) Willd.	Khair	Mimosaceae	+++	Fl, Md, Api, Ag, Tm
3	*A. farnesiana* (L.) Willd.	Vilayati kikar	Mimosaceae	++	Fl, Md, Api, Ag
4	*A. nilotica* (L.) Willd. ex Delile	------	Mimosaceae	++	Md, Fd
5	*Aegle marmelos* (L.) Correa	Bel	Rutaceae	+++	Ed, Md, Api
6	*Albizia julibrissin* Durazz.	Kaunesa	Mimosaceae	++	Fd, Api
7	*A. lebbeck* (L.) Benth.	Siris	Mimosaceae	++	Tm, Agi
8	*A. odoratissima* (L.f.) Benth.	Bansa	Mimosaceae	++	Fd, Tm
9	*Anogeissus latifolius* (Roxb.ex.DC.) Wallich ex Richard	Dhauda	Combretaceae	+++	Tm, Agi
10	*Artocarpus heterophyllus* Lam.	Kathal	Moraceae	++	Ed, Tm
11	*Azadirachta indica* A. Juss.	Neem	Meliaceae	+	Md
12	*Bauhinia purpurea* L.	Guiral	Caesalpiniaceae	++	Ed, Dy, Md, Or
13	*B. semla* Wunder	Semla	Caesalpiniaceae	++	Fd
14	*B. variegata* L.	Kanli	Caesalpiniaceae	++	------
15	*Boehmeria rugulosa* L.	Genthi	Urticaceae	++	Fd, Fl
16	*Bombax ceiba* L.	Semal	Bombaceae	++	Ed, Fbr, Md
17	*Butea monosperma* (Lam.) Kuntze	Dhak	Fabaceae	+	Md, Fd
18	*Callistemone citrinus* Curtis	Bottle-brush	Myrtaceae	+	Or
19	*Carica papaya* L.	Papeeta	Caricaceae	+++	Ed, Md
20	*Cassia fistula* L.	Amaltas	Caesalpiniaceae	+++	Md, Fl
21	*Cassine glauca* (Rottboell) Kuntze	Dhebri	Celastraceae	+	-------
22	*Celastrus paniculatus* Willd.	Kaunya	Celastraceae	++	Md
23	*Celtis australis* L.	Khareek	Ulmaceae	++	Ed, Fd, Fl
24	*C. eriocarpa* Decne	Khareek	Ulmaceae	+	Ed, Fd
25	*Citrus aurantifolia* (Christ.) Swing	Kagjee	Rutaceae	++	Ed, Md
26	*C. grandis* (L.) Osbeck.	Chakotra	Rutaceae	++	Ed
27	*C. medica* L.	Nimbu	Rutaceae	++	Ed
28	*C. pseudolimon* Tanaka	Nimbu	Rutaceae	+	Ed
29	*Cordia dichotoma* Forst.	Lisora	Rutaceae	+	Ed, Agi

30	*Dalbergia sissoo* Roxb.	Sisham	Fabaceae	+++	Tm, Fd, Fl
31	*Delonix regia* (Bojer ex Hook.) Rafinesque-Schmaltz	Gulmohar	Caesalpiniaceae	+	Or
32	*Dendrocalamus strictus* (Roxb.) Nees	Baans	Poaceae	++	Fd, Tm
33	*Diospyros montana* Roxb.	Pinna	Ebenaceae	++	Md, Agi
34	*Erythrina variegata* L.	Dhaul dhak	Fabaceae	+	Md
35	*Eucalyptus tereticornis* Smith	Safeda	Myrtaceae	++	Tm, Agi
36	*Ficus auriculata* Lour.	Timla	Moraceae	++	Ed, Fd, Fl
37	*F. benghalensis* L.	Bargad	Moraceae	++	Md, Fd
38	*F. hispida* L.f.	Ghogsa	Moraceae	+	Fd, Ed
39	*F. palmata* Forsk.	Bedu	Moraceae	++	Md, Ed, Fd
40	*F. racemosa* L.	Gular	Moraceae	+	Ed, Fd
41	*F. religiosa* L.	Peepal	Moraceae	++	Md
42	*F. semicordata* Buch.-Ham. ex J.E. Smith	------	Moraceae	++	Md, Fd, Fbr, Ed
43	*Flacourtia indica* (Burm.f.) Merrill.	Kangh	Flacourtiaceae	+	Ed, Fd, Md
44	*Grevillea robusta* A. Cunningham ex R. Br.	Silver Oak	Proteaceae	++	Orn.
45	*Grewia asiatica* L.	Pharsain	Tiliaceae	++	Md, Fd, Fbr, Ed
46	*G. optiva* J. R. Drummond ex Burret	Bheemal	Tiliaceae	++	Md, Fd, Fbr, Ed
47	*Haldinia cordifolia* (Roxb.) Ridsdale	Haldu	Rubiaceae	+++	Tm, Fd, Fl
48	*Helicteres isora* L.	Bhendu	Sterculiaceae	+	Md, Fbr
49	*Holoptelea integrifolia* (Roxb.) Planchon	Papari	Ulmaceae	+++	Tm, Fl
50	*Jacaranda mimosifolia* D.Don	Padeli	Bignoniaceae	++	-----
51	*Juglans regia* L.	Akhrot	Juglandaceae	+	Ed, Md, Dy
52	*Lannea coromandelica* (Houttuyn) Merrill	Kalmina	Anacardiaceae	+++	Fd, Fl
53	*Leucaena leucocephala* (Lam.) De Wit.	Subabul	Mimosaceae	+	-----
54	*Litchi chinensis* Sonner.	Litchi	Sapindaceae	++	Ed
55	*Madhuca longifolia* (Koenig) Mac Bride	Maoa	Sapotaceae	++	Fd, Fl
56	*Mallotus philippensis* (Lam.) Muell.-Arg.	Ruina	Euphorbiaceae	+++	Md, Fl, Api, Dy
57	*Mangifera indica* L.	Aam	Anacardiaceae	++	Ed, Tm, Md
58	*Melia azedarach* L.	Dainkan	Meliaceae	++	Md, Fd,Ag
59	*Moringa oleifera* Lam.	Sunara	Moringaceae	++	Ed, Md
60	*Morus alba* L.	Sahtoot	Moraceae	++	Ed, Fd
61	*Oroxylum indicum* (L.) Vent.		Bignoniaceae	+	------
62	*Ougeinia oojeinensis* (Roxb.) Hochreutiner	Sandar	Fabaceae	++	Tm, Fd, Md
63	*Phoenix humilis* Royle.	Khajoor	Arecaceae	++	Ed, Fbr
64	*P. sylvestris* (L.) Roxb.	------	Arecaceae	++	Ed, Fbr
65	*Phyllanthus emblica* L.	Aunmla	Euphorbiaceae	++	Ed, Md
66	*Pinus roxburghii* Sargent	Chir	Pinaceae	+++	Tm, Fl, Md
67	*Populus nigra* L.	------	Salicaceae	++	Tm
68	*Premna barbata* Wallich ex Schauer	------	Verbenaceae	++	Md, Fd, Fl
69	*Prunus cerasoides* D. Don	Payya	Rosaceae	++	Api, Fd
70	*Psidium guajava* L.	Amrood	Myrtaceae	++	Ed
71	*Pyrus pashia* Buch.-Ham.ex D.Don	Melu	Rosaceae	++	Md, Ed, Fd, Fl, Api
72	*Salix acemophylla* Boiss.	Garbains	Salicaceae	++	Fd
73	*S. babylonica* L.	------	Salicaceae	+	------
74	*S. tetrasperma* Roxb.	Garbains	Salicaceae	+	------
75	*Sapindus mukorossi* Gaertner	Reetha	Sapindaceae	+	Md
76	*Sapium insigne* (Royle) Benth. ex Trimen	Khinna	Euphorbiaceae	++	------
77	*Syzygium cumini* (L.) Skeels	Jamun	Myrtaceae	++	Ed, Tm, Md
78	*Terminalia alata* Heyne ex Roth	Asin	Combretaceae	+++	Fd, Fl, Agi
79	*T. bellirica* (Gaertn.) Roxb.	Bahera	Combretaceae	+	Md, Tm
80	*T. chebula* Retz.	Heda	Combretaceae	+	Tm, Md
81	*Toona hexandra* (Wallich ex Roxb.) M. Romer	Pahari-tun	Meliaceae	++	Tm, Fd, Api

Abbreviations used: +++ = Abundant, ++ = Common, + = Uncommon.

Ag imp = Agricultural implements, Ed = Edible, Fbr = Fiber, Fd = Fodder, Fl = Fuel- wood, Dy = Dye, Md = Medicinal, Or = Ornamental, Tm = Timber

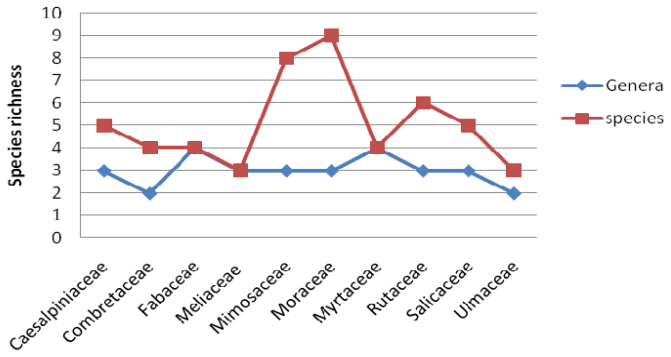

Figure-1
Families represented by more than two species in the study area

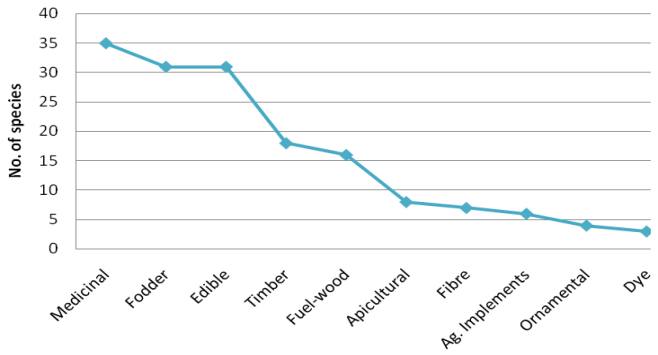

Figure-2
Indigenous uses of tree species made by local inhabitants in the study area

Figure-3
Anthropogenic pressures on plant diversity in Alaknanda valley of Garhwal Himalaya, India
(A). Disturbance due to construction activities in the downstream site of Srinagar Hydroelectric Power Project
(B). Vegetation loss due to construction of roads at the dam axis in Alaknanda valley
(C). Loss of vegetation due to uncontrolled forest fire
(D). Over grazing by cattle (goats and sheep)

The habitat destruction, over exploitation and invasion by alien species has been identified as major causes of biodiversity loss[24]. The day -to- day need of forest resources particularly medicine, fuel-wood, timber, food and fodder species has increased the pressure on forest trees to a great extent. Furthermore, the construction of hydroelectric power project and hill roads, forest fire, over-grazing (figure-3) and over-exploitation of species for fuel, fodder, medicine, food (wild edibles), and house building may lead to reduction of these species from the area. The disturbances created by these factors determine the forest dynamics and tree diversity at local and regional scales[25]. The change in plant diversity and general community attributes along a disturbance gradient are needed to be assessed at the threshold level of disturbance to maintain maximum biodiversity and to formulate a strategy for effective conservation[14].

Conclusion

Thus, the present study provides comprehensive information on diversity, availability status and indigenous uses of tree species. Based on the results, it can be concluded that the area has high potential in terms of number of species. Therefore, there is a need to develop adequate strategy and action plan for the conservation and management of habitats, species, and communities, so that sustainable utilization of these species could be ensured.

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