Tree Diversity along elevation in Gangotri Valley of Uttarakhand, India

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Abstract: The study was conducted to determine the forest tree species in Gangotri valley of Uttarkashi district of Uttarakhand, India along elevation during 2016 to 2017. The survey was carried out along three elevations, viz. lower (1000-1500 m), middle (1500-2000 m) and higher (2000-2500 m). A total of 54 species were documented in the selected study area comprised of 26 families, out of which three families were of gymnosperms (6 species) and 23 families of angiosperms (48 species). In the lower elevation 27 species were observed of which 17 were restricted to this elevation, in middle elevation 30 species were recorded of which 12 being confined to this elevation and in higher elevation there were 18 species of which 6 being restricted to this height. Some of the species were recorded in more than two zones. Among important tree species there were 19 edibles, 5 fibre, 27 fodder, 29 fuel-wood, 28 medicinal, 8 ornamentals, 30 timber yielding species and some species have miscellaneous uses were observed. Many of the tree species recorded of multipurpose uses thus the use of one tree species were overlapped with another. It was observed that preserving the forest flora from indiscriminate use, these species should be promoted for plantation purpose and simultaneously avoiding the monoculture of particular species.
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1. Introduction

The Uttarakshi district is a part of Uttarakhand state of India falls in the Central-Western Himalayan region has got luxuriant vegetation and tree cover which is linking to the livelihood and daily domestic need of local people. Trees form major part of forest and provide different types of non-timber forest products (NTFP). Studies on medicinal plants (Bisht and Badoni, 2009), vegetation diversity (Bijalwan and Singh, 2013) are generally available but, there are few studies available in relation to multipurpose forest tree species in this region, thus the main objective of this study was to document the tree diversity of forest tree species in relation to their uses.

2. Materials and Methods

The study was conducted to determine the trees in three altitudinal ranges (near to the forest in six villages from Netala to Sukhi) in Gangotri Valley of Uttarkashi districts of Uttarakhand, India during 2016 to 2017. The elevation ranges spared in low hills (600-1000 m), mid hills (1000 – 1500 m) and high hills (1500 – 2400 m). The elevation and topography influence the climate of the micro region which ultimately alter the vegetation and tree diversity in changing elevation.

3. Results and Discussion

The study revealed that in lower elevation consists of chir-pine forest and oak-pine forest, middle elevation oak-rhododendron forest and broad leaved mixed forest and higher elevation consist of coniferous forest, broad leaved mixed forest and pastures. The study narrated that, a total of 54 tree species were recorded encompassing 26 families, of which 3 families were of gymnosperms and 23 families of angiosperms. Out of the 54 species, 48 species were of angiosperms (89%) (Table 1; Figure 1). The middle elevation (30) region harbours highest number of tree species followed by lower (27) and higher (18) elevation region. The higher elevation region contained the minimum (6) number of species restricted to particular zone followed by middle (12) and maximum number of restricted species being confined in lower (17) elevation zone (Table 1; Figure 2).

Some of the species recorded in two elevation zones such as: *Alnus nepalensis*, *Cedrus deodara*, *Daphniphyllum himalayense, Ficus auriculata, F. neriifolia, F. palmata, Fraxinus micrantha, Grewia optiva, Lyonia ovalifolia, Melia azedarach, Prunus cerasoides, Querucs floribunda, Q. leucotrichophora, Q. semecarpifolia, Rhododendron arboreum and Toona ciliata.* Only 3 species were found in all the three zones viz. *Celtis australis, Pinus roxburghii,* and *Populus ciliate* (Table 1).

In the economic usefulness of the species, 19 species are edible, five yield fibre, 27 yield fodder, 29 are used as fuel-wood, 28 species have medicinal importance, 30 have average or good quality timber and nine have ornamental significance (Figure 3). From the 54 species, 6 species have one use only.

Among the edible species, the economically important part is flower bud (1 species), leaves (1), seed (3), and fruit (14). In the fibre yielding species, the fibre is derived from fruit wall (1 species) and bark (4). Among the families the highest number of species was found in moraceae (8 species) followed by fabaceae and lauraceae (5 each), pinaceae (4), fagaceae and tiliaceae (3) and two species each in families ancardiaceae, betulaceae, ericaceae, meliaceae, salicaceae, and sapindaceae rest of the families contained only one species (Table 1).

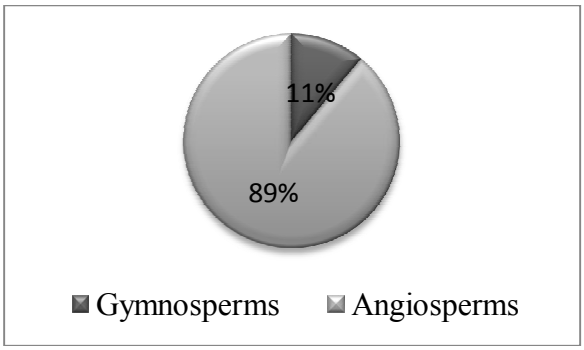

Fig.1. Presence of Gymnosperms and Angiosperms in study area

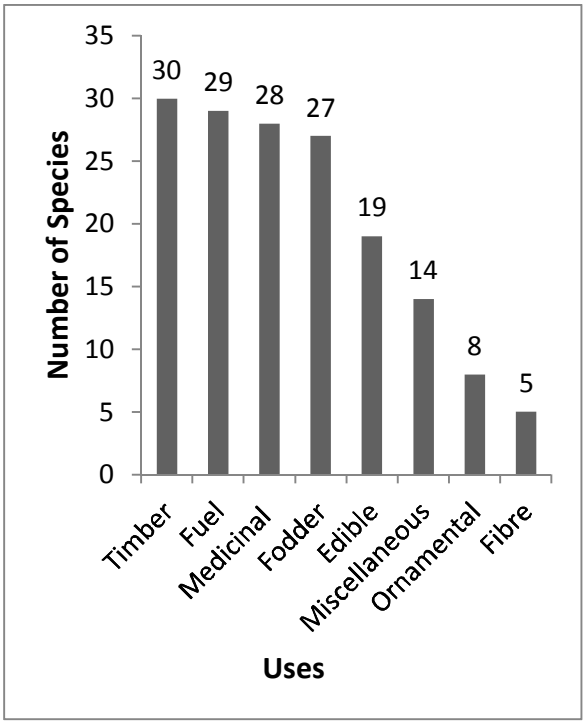

Fig.2. Uses of trees species present in study area

The study documented 54 multipurpose tree species found in the forest of Gangotri valley along different elevation zone in India. These tree species were observed to be useful to the local community. The maximum trees were observed in middle elevation, the reason behind maximum number of species found in middle elevation is that the middle elevation represents a transition zone between lower and higher elevation thus, there is less fluctuation in climatic condition as compared between lower and higher elevation zone. In higher elevation zone there are three types of trees: a) trees which have wide ecological amplitude e.g. *Pinus roxburghii*, *Populus ciliata* and *Celtis australis* b) trees which are adapted to higher elevation environmental condition e.g. *Picea smithiana, Pinus wallichiana, Taxus wallichiana, Pistacia integerrima, Betula alnoides* and *Acer acuminatum* and c) trees which shows good growth in middle elevation zone but can thrive in higher elevation zone e.g. *Alnus nepalensis, Daphniphyllum himalayense, Rhododendron arboreum, Querucs floribunda, Q. semecarpifolia, F. neriifolia, Fraxinus micrantha* and *Prunus cerasoides* (Table 1).

The decline in number of species from lower to higher elevation was also reported from upper Yamuna forest division of Uttarkashi district (Bijalwan and Singh, 2013). Some species were restricted to particular elevation zone because of following reasons: a) the environmental conditions are favourable for the species to grow luxuriantly in these conditions, b) they are not able to migrate to other zone due to limitation of dispersal agents, c) in other elevation zone there may be increase in inter-specific competition. In the Himalayan region there is increasing in temperature (Bhutiyani et al. 2007) thus, there is forest degradation (Pandit et al. 2007) and tree line shift and plant range expansion (Schickhoff et al. 2015). Most of the species have multiple economic values and thus, can be used in forest plantation programs. The trees present in different elevation are important to provide different produces, help in ground water recharge, improving pollinator diversity, provide food and shelter to wildlife, reducing soil erosion through slope stabilization, act as carbon sinks etc. It was observed that if these trees are recommended for farmers' field then the livelihood condition of the village people can be improved, reduce the burden on forest, save the time and energy spent by the people when going to forest and also decrease the chance of human-wildlife conflict.

4. Conclusion

The present study revealed that trees constitute an important part in human life in terms of providing important produces and numerous ecosystem services. In increasing global environmental changes and anthropogenic pressure it is important to conserve and maintain these forest tree scientifically and judiciously.

Table 1: Presence of Forest Trees along elevation in Gangotri valley in study area

Family	Species	Vernacular Name	English Name	Uses	Elevation
Gymnosperms					
Cupressaceae	*Cupressus torulosa* D.Don ex Lamb.	Surai	Himalayan Cypress	Fu, Ti	L
Pinaceae	*Cedrus deodara* (Roxb.) G. Don	Devdar	Deodar Cedar	Ti, wood used in altar making for Homa (Havan) in religious ceremonies/rituals	M, H
	Picea smithiana (Wall.) Boiss.	Rai	West Himalayan spruce	Ti, O	H
	Pinus roxburghii Sarg.	Chir	Chir-Pine	Ed (seeds), Fu, Ti, Turpentine obtained from sapwood, Leaf Needles used to make organic manure	L, M, H
	P. wallichiana A. B. Jacks.	Kail	Himalayan Blue Pine	Ed (seeds), Fu, Ti, Turpentine obtained from sapwood, leaves used as animal bedding	H
Taxaceae	*Taxus wallichiana* Zucc.	Thuner	Himalayan yew	Fu, Me, Incense	H
Angiosperms					
Anacardiaceae	*Pistacia integerrima* J.L. Stewart ex Brandis	Kathkankad	Zebrawood	Fu, Fo, Me, Ti	H
	Pistacia khinjuk Stocks	Kakra/Kakad		Me	M
Apocynaceae	*Holarrhena pubescens* Wall. ex G.Don	KadwaIndrajaw	Bitter Oleander	Me	L
Arecaceae	*Phoenix humilis* Royle ex Becc	JharKhajur	Mediterranean Fan Palm	Me, O	M
Betulaceae	*Alnus nepalensis* D. Don.	Utis	Alder	Fo, Fu, Ti, Fix N_2	M, H
	Betula alnoides Buch.-Ham. ex D.Don			Fo, Me, Ti	H
Boraginaceae	*Cordia dichotoma* G.Forst.	Kendal	Indian cherry	Ed (Fruit), Fo, Me, Ti, Handles for agriculture Implements	M
Cornaceae	*Alangium chinense* (Lour.) Harms	Kimu		Me, Ti	M
Daphniphyllaceae	*Daphniphyllum himalayense* (Benth.) Müll.Arg.	Ratendu, Ratneyli		O	M, H
Ericaceae	*Lyonia ovalifolia* (Wall.) Drude	Ainyaar	Oval Leaved Lyonia	Fu, Ti	L, M
	Rhododendron arboreum Sm.	Buransh	Tree Rhododendron	Fu, Me, Flowers used to make squash, jams, pickles and offered to deities	M, H
Euphorbiaceae	*Phyllanthus* emblica L.	Amla	Indian gooseberry	Ed (Fruit), Me	L
Fabaceae	*Bauhinia purpurea* L.	Guriyal	Purple Bauhinia	Fo, Fu, O, Ti,	L
	B. vahlii Wight &	Mahul	Camel's Foot	Fo, O, Me, leaves used	L

	Arn.		Climber	to make eating plates	
	B. variegata (L.) Benth.	Kachnar	Orchid tree	Fo, Fu, O, Ti, leaves used to make eating plates	L
	Casssia fistula L.	Amaltas	Indian Laburnum	Fu, Me, O, Ti	L
	Erythrina variegata L.	Pangar	Indian coral tree	Me, O	M
Fagaceae	*Querucs floribunda* Lindl. ex A. Camus	Moru	Green Oak	Fo, Fu, Ti, Handles for agriculture Implements	M, H
	Q. leucotrichophora A. Camus	Banjh	White Oak	Fo, Fu, Ti, Handles of Agriculture Implements	L, M
	Q. semecarpifolia Sm.	Kharsu	Brown Oak	Fo, Fu, Ti	M, H
Juglandaceae	*Juglans regia* L.	Akhrot	Walnut	Ed (seed), Me, Ti	M
Lauraceae	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & C.H.Eberm.	Tejpatta	Indian Bay Leaf	Ed (leaves), Me	L
	Litsea monopetala (Roxb.) Pers.	Meda Gwa		Fo, Me, Ti	L
	Machilus odoratissima Nees	Kawla	Fragrant Bay Tree	Fu, Me	M
	Neolitsea cuipala (D. Don) Kosterm.			Me	M
	Neolitsea pallens (D. Don) Momiy. & Hara			Me	M
Malvaceae	*Bombax ceiba* L.	Semal	Kapok, Red Silk Cotton	Ed (Flower bud), Fi (fruit wall)	L
Meliaceae	*Melia azedarach* L.	Dainkan, Bakain	China Berry	Fo, Fu, Ti,	L, M
	Toona ciliata M. Roem.	Toon	Red Cedar	Fo, Fu, Me, Ti	L, M
Moraceae	*Artocarpus lacucha* Buch.-Ham.	Barhar	Monkey fruit	Ed (Fruit), Fo, Fu, Me, Ti	L
	Ficus auriculata Lour.	Timla	Roxburgh Fig	Ed (Fruit), Fo	L, M
	F. glomerata Roxb.	Goolar	Cluster Fig	Ed (Fruit), Fo, Fu, Ti	L
	F. neriifolia Sm.	Doodhla		Ed (Fruit), Fo, Fu, Me	M, H
	F. palmata Forssk.	Bedu	Wild Himalayan Fig	Ed (Fruit), Fo,	L, M
	F. religiosa L.	Peepal	Sacred Fig	Ed (Fruit), Fo, Fu, leaves used in religious rituals	L
	F. semicordata Buch.-Ham. ex Sm.	Khaina//khanu/khanai	Drooping fig	Ed (Fruit), Fi, Fo, Me,	L
	Morus nigra L.	Shetoot	Black Mulberry	Ed (Fruit), Fo, Fu, Ti	L
Myricaceae	*Myrica esculenta* Buch.-Ham. ex D.Don	Kaphal	Box Myrtle	Ed (Fruit), Fu, Me	M
Oleaceae	*Fraxinus micrantha* Lingelsh	Angu	Himalayan Ash	Fo, Fu, Ti	M, H
Rosaceae	*Prunus cerasoides* D.Don	Painya	Wild Himalayan cherry	Ed (Fruit), Fu, Ti	M, H
Salicaceae	*Casearia tomentosa* Roxb.	Chhila	Toothed Leaf Chilla	Me	M
	Populus ciliata	Van Peepal	Himalayan	Fo, Fu, Ti	L, M, H

	Wall. ex Royle		Poplar		
Sapindaceae	*Acer acuminatum* Wall. ex D.Don	Kanjal	Tapering Leaf Maple	Me, Leaves used as tea, Handles of Agriculture Implements	H
	Sapindus mukorossi Gaertn	Reetha	Indian Soapberry	Fo, Fu, Fruit used as soap	L
Tiliaceae	*G. asiatica* L.	Phalsa		Ed (Fruit), Fi, Me,	L
	Grewia optiva J. R. Drumm. ex Burret	Bhimal		Fi, Fo, Fu, Ti, Handles of agriculture implements, bark used as hair wash, wood as torchlight ('Muchala')	L, M
	G. tillifolia Vahl	Dhamani		Ed (Fruit), Fo, Me, Ti, Fi	M
Ulmaceae	*Celtis australis* L.	Khadik	European Hackberry	Fo, Fu, Ti	L, M, H

Abbreviations: Fo – Fodder, Fu – Fuel, Fi – Fibre (Bark), O – Ornamental, Me – Medicinal, Ed – Edible, L – lower elevation (1000-1500 m, a.m.s.l.), M – middle elevation (1500-2000 m, a.m.s.l.), H – higher elevation (2000-2500 m, a.m.s.l.), m, a.m.s.l. – meters, above mean sea level

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References

1. Bhutiyani, M. R., Kale, V.S. and Pawar, N.J. (2007). Long-term trends in maximum, minimum and mean annual air temperatures across the Northwestern Himalaya during the twentieth century. Climatic Change, 85: 159 – 177. [doi 10.1007/s10584-006-9196-1].
2. Bijalwan, A. and Singh, S. (2013). Vegetational diversity along altitudinal gradients in the upper Yamuna forest division of Uttarakhand, India. Asian Journal of Science and Technology, 4(03): 028-032.
3. Bisht, C. and Badoni, A. (2009). Distribution and indigenous uses of some medicinal plants in district Uttarkashi, Uttarakhand, India. Researcher, 1(6): 38-40.
4. Pandit, M. K., Sodhi, N.S., Koh, L.P., Bhaskar, A. and Brook, B.W. (2007). Unreported yet massive deforestation driving loss of endemic biodiversity in Indian Himalaya. Biodiversity and Conservation, 16(1): 153 – 163. [doi 10.1007/s10531-006-9038-5].
5. Schickhoff, U., Bobrowski, M., Böhner, J., Bürzle, B., Chaudhary, R. P., Gerlitz, L., Heyken, H., Lange, J., Müller, M., Scholten, T., Schwab, N., Wedegärtner, R. (2015). Do Himalayan treelines respond to recent climate change? An evaluation of sensitivity indicators. Earth System Dynamics, 6: 245 – 265. [doi:10.5194/esd-6-245-2015, 2015].

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