Conservation prioritization of Agroforestry tree species in District Ganderbal of Jammu and Kashmir, India

ABSTRACT:

The present study entitled "Conservation Prioritization of Agroforestry tree species in District Ganderbal" was conducted in Ganderbal district of Jammu and Kashmir. A total of 89 species were recorded from the study area in which 19 were forest trees, 17 were fruit trees, 29 were crop components and 24 were grasses, belonging to 27 families. Among the families, Poaceae was recorded as dominant family followed by Rosaceae with 18 and 12 species, respectively. Among trees *Salix alba*, was found to be the dominant tree species in the study area. Among fruit trees Punica *granatum,* was found to the dominant. Among the recorded species, notable Endemic species to Indian Himalayan region were *Aesculus indica, Ulmus villosa* and *Cupressus torulosa.* Most of the recorded species were found to be used as multipurpose (fuel, fodder, food, timber, medical etc.) by local communities. *Ailanthus altisimmia* and *Ulmus villosa* were found to be under threat status, while as, all other species were found to be in least concern status as per IUCN Conservation categories.

Keywords: Conservation, Agroforestry, threat status, Ganderbal, Endemic

Introduction

Biodiversity, which is short for biological diversity, is a term which is coined with the aid of Walter G. Rosen in 1986 which is used to describe the big range and richness of life on earth. United Nations Earth Summit 1992 described biodiversity as "the variability amongst dwelling organisms from all sources, including, inter alia, terrestrial, marine and other submarine ecosystems and the ecological complexes of which they are part: this consists of diversity inside species, between species and of ecosystem. The term "biological diversity" encompasses exclusive ecosystems, species, genes and their relative richness and abundance. Alpha, beta and gamma diversity are the three terms described by Whittaker (1972) for measuring biodiversity over spatial scales. Ecologists categorized biodiversity in three primary levels, including genetic diversity (diversity of genes within a species), species diversity (diversity among species in an ecosystem) and ecosystem diversity (diversity at advanced position of association, the ecosystem). We live on a planet with a veritably vast biodiversity. It has been estimated that 3,35,25,435 species to be present on earth with 13,92,485 identified species (Pulliah *et.al*., 2015). Scientists agree with that there are authentically about 13

million species, though as per United Nations Environment Programme (UNEP) estimates 9 to 52 million species are there on earth (Mora *et.al*., 2011). Scientists have estimated that there are 4,80,000 plants species in the world out of which 3,22,331 are identified. Out of them, 3,08,312 are vascular plants, with 2,95,383 flowering plants (Bahadur *et.al.,* 2015). A study reported that there are around 3.04 trillion trees in the world. Out of them, half of the trees can be found in tropical and subtropical forests. In world, there are 36 biodiversity hotspots (Ehrenberg, 2015). Biodiversity hotspot is a biogeographic region with vast degree of biodiversity that is threatened by mortal habitation. The term 'biodiversity hotspot' was given by Norman Myers (1988). The hotspots are veritably pivotal.

Conservation of plant biodiversity are often performed in situ or ex-situ. The upkeep of plant species in their natural habitat, also as the conservation of domesticated and cultivated species on the farm or in the surroundings where they have developed their distinctive characteristics, represent the in-place strategies. However, there is a heavy loss or decline of species, populations, and ecosystem composition, which may lead to a loss of biodiversity, thanks to habitat destruction and the transformations of these natural environments; therefore, in place methods alone are inadequate for saving endangered species. Additional approaches, like storage in seed banks, field gene collections, in vitro collections, and botanical gardens, complement the protection applications for plant biodiversity. They are classified as ex-situ strategies, which suggest maintaining the biological material outside their natural habitats. Ex-situ conservation may be a viable way for saving plants from extinction, and in some cases, it's the only possible strategy to conserve certain species. Ex-situ protection of species is supplied by means of botanical gardens, zoos, and aquaria and of gene pools with the aid of germplasm banks (seed stores, in vitro collections, and subject gene banks), and out of all botanical gardens probably have higher possible involving plant species. Agroforestry, as a component of the multifunctional working landscape, additionally can play a foremost role in conserving and enhancing biodiversity within deforested, fragmented landscapes by providing habitats and resources for plant and animal species, maintaining landscape connectivity, making the panoroma much less harsh for forest-dwelling species by decreasing the frequency and depth of fires, probably reducing edge effects on ultimate woodland fragments and supplying buffer zones to protected areas (Schroth *et al*., 2004). Agroforestry is recognized as an integrated approach to conserving biodiversity and has garnered interest. However, there are rare methods to evaluate this contribution (Huang *et al*., 2002).

Studies over the last 20 years demonstrated that more biologically diverse ecosystems are more productive and a third of all land plants are at threat of extinction, including many who are undescribed, or are described however otherwise data deficient. Threats to biodiversity come from many sources, mostly anthropogenic and a few natural. Anthropogenic activities like deforestation, land degradation, habitat destruction, overexploitation, pollution resulting in climate change, thanks to which over 75 percent of earth's terrestrial biomes have shown alteration. The Impact of those changes on biological systems is manifested as shifts in phenology, interactions, species distributions, morphology, net primary productivity, and losses of biodiversity (Gardner *et al.*, 2009). Loss of biodiversity appears to affect ecosystems the maximum amount as climate change, pollution, and other major sorts of environmental stress, consistent with the results of a new study by an international research team. In view of this loss in biodiversity, it becomes essential to assess and conserve biodiversity, at regional, national and international levels.

The basis for effective plant conservation is a fundamental understanding of plant diversity, abundance, and distribution, as well as how these are changing over time. Some species become extinct before being described by science, especially within tropical locations where substantial financial, human, and infrastructure resources are essential (Vorontsova *et al*., 2020). According to Humphreys *et al*. (2019), at least 571 plant species have become extinct since the 1750s, and 40% of plant species are currently in risk of becoming extinct (Antonelli *et al*., 2020). In order to preserve plant diversity, genetic diversity and ecological and evolutionary processes are equally as crucial as species. These processes give plants and their communities the foundation they need to adapt to local stresses like habitat fragmentation as well as changes in the global environment (Coates *et al*., 2018; Quiroga *et al*., 2019). Distribution, abundance, and genetic diversity data can help prioritise conservation funding and efforts, as well as research focused at improving plant conservation and management and the mechanisms that sustain healthy ecosystems.

Study area

District Ganderbal is situated between 34.2165ºN Latitude and 74.7719ºE Longitude. It has an elevation of 1,619 metres (5,312 feet) to 3000 metres (9842) above sea level. It covers a total area of 39304 thousand hectares. Out of this area, 18.12 thousand hectares is cultivated land, 0.988 thousand under forests, 8.43 is under horticulture, 4.8 thousand hectares comes under barren and marshy lands,1.67 thousand hectares as permanent pastures and 13.23 is under miscellaneous tree crops and

other fallows. The district has a unique agroclimatic conditions pived generally in the form of snow in winter and rains in March to June. The mean temperature of 13.3ºC in summer and may dip to -10ºC is generally experienced. Agriculture in Ganderbal is the foremost occupation as more than 80% of the working populace is engaged with it, consequently making this district as one of the vital districts of Jammu and Kashmir. The district has unique agroclimatic conditions, which allows cultivation of not only major fruit crops like apple, pear, cherry, walnut, but also rare and special fruits like grapes, strawberry etc. Gund, Kangan, Ganderbal, Wakura, Lar, Tulmullah are the six tehsils of district Ganderbal and consists of seven blocks Lar, Ganderbal, Kangan, Wakura, Sheripathri, Safapora. It has been further divided into 126 panchayat halqas comprising 139 townlets.

MATERIALS AND METHODS

Identification of species in different Agroforestry systems

This objective was achieved through stratified random sampling where in a detailed survey at Panchayat level was conducted in various Tehsils of District Ganderbal and observation with regard to different species was recorded on a well devised questionnaire. For collection of data several panchayats were selected randomly in various tehsils of the district. In each panchayat, several households were selected randomly for taking observations. Altitude of all villages was recorded with the help of Global Positioning System (GPS).

During surveys information was collected through following methods:

1. Questionnaire method: A questionnaire prepared for the purpose was filled through on spot interaction with the residents and farmers.

2. Informal interview: Information was also collected during informal interviews with farmers, old respective citizens of the concerned areas. Generally open-ended questions were asked for getting the information.

3. Visit of farm lands: Information was collected during field visit of farm lands. Field visits gave more scope to discuss with farmers in their farm lands while walking through their farms. Problems and prospects of Agroforestry farming were discussed.

4. Collection of Secondary data: The secondary data was collected from the published books and journals, magazines, various related websites etc.

Results

The results obtained in the present investigations have been presented character wise as under:

Identification of different species in Agroforestry systems in various blocks of District Ganderbal.

This objective was achieved by conducting a detailed survey at Panchayat level in various tehsils and observation with regard to different tree species in Agroforestry systems in the area recorded. Surveyed panchayats of District Ganderbal (Table 1).

A detailed survey revealed that different species including forest trees along with fruit trees, crop components and grasses prevelant in various villages of District Ganderbal in different Agroforestry systems which are as under (Table 2).

Native and Endemic species

Amongst the recorded species, notable Endemic species recorded are *Ulmus wallichiana*, *Aesculus indica*, *Ulmus villosa*, *Cupressus torulosa* to Western Himalayas, Himalayas from Kashmir to Nepal, Kashmir, Indo-Himalayas respectively.

Economic Importance

Economic significance of forest trees and fruit trees in different agroforestry structures is in Table 2. Almost all the species have been used as fuel, fodder, timber, ornamental, edibles and few species for other purposes. Morus species has more than one uses. Species is used for fodder, fruits and most importantly silkworm rearing.

Multipurpose trees

The recognized tree species have multipurpose uses. The recorded species are used as fodder, fuel, fit to be eaten(food), medicine, timber, and a number of other functions through the inhabitants. (Table 2).

Status

In the researched area, nearly all recorded species were classified as Least Concern, except for *Ailanthus altissima* and *Ulmus villosa*, which were identified as being under threat.

Crop components

Some crops are grown in Rabi season and some in Kharif season while grasses are grown throughout the year in different agroforestry systems.

DISCUSSION

Several researchers have conducted studies on conservation prioritization of trees throughout the world. Rana and Masoodi (2016) studied threat categorization and conservation prioritization of floristic diversity in the Indian Himalayan region: a state of art approach from Shimla water catchment wildlife sanctuary and prioritized species. at local level using four conservation attributes. Threat categorization of the floristic diversity was undertaken based on Conservation Priority Index. Of the total 476 species of vascular plants recorded, a total of 119 species (15 Trees; 20 Shrubs; and 84 Herbs including 4 Ferns) belonging to 111 genera and 62 families were found to be threatened from Shimla Water Catchment Sanctuary, 10 species were identified as Critically Endangered, 31 species as Endangered, 48 species as Vulnerable and 30 species as Near Threatened. Maximum threatened species were found in altitudinal zones 1850-2350m. Over exploitation and habitat degradation were the two factors identified as major threats to the floristic diversity. Khan *et al.* (2014) assessed the plant diversity and conservation status of the Himalayan region Poonch valley Azad Kashmir (Pakistan) and found that there were 145 threatened, 30 endangered, 68 vulnerable, and 47 rare species. It was observed that extensive grazing, uprooting of plants, and soil slope erosion intensify the environmental problems. They also reported that the principal threat to biodiversity is an expansion of settlement and army installations in the forests of the valley. The study carried by Lokonon *et al*., 2019 in Oueme catchment from central to southern regions of the Republic of Benin showed that most important useful woody species that should be considered as priorities for conservation in each climatic zone of the catchment were *Parkia biglobosa, Pterocarpus erinaceus, Milicia excelsa, Prosopis africana, Afzelia Africana* and *Khaya senegalensis*. Tara (2013) carried out the study on the assessment and conservation prioritization of floristic diversity in Central Himachal Pradesh, North-Western Himalaya for the socio-economic development of the Rissa Khad watershed. 754 species were assessed for the threat categories, 10 were categorized as Critically Endangered, 23 were Endangered, 71 were Vulnerable, and 31 were near threatened. The remaining species were categorized as Least Concern.

Conclusion

The study highlights the diversity of distinctive species within agroforestry systems of District Ganderbal, analyzed for their distribution, nativity, endemism, economic importance, multipurpose utility, and status. Forest species like *Salix, Populus, Ulmus, Robinia pseudoacacia, Ailanthus, Aesculus indica, Morus, Pinus wallichiana, Cedrus deodara, Abies pindrow, Cupressus torulosa,* and

Catalpa bignonoides dominate the region. Key horticultural species include *Punica granatum*, Prunus spp., *Juglans regia*, Pyrus spp., Ficus spp., Malus spp., *Cydonia oblonga*, *Eriobotrya japonica*, *Diospyros kaki*, and *Vitis vinifera*, which are highly productive and significant for income generation. Lar block, especially Repora village, is noted for cultivating *Vitis vinifera*. Farmers grow grasses like *Avena sativa*, Trifolium spp., *Dactylis glomerata*, *Festuca pretense*, and mustard as the main winter crop, alongside vegetables like carrot, radish, turnip, and knoll khol. Some agroforestry species offer high potential as fodder and fuel. Developing propagation protocols through conventional methods will aid large-scale seedling production. Training programs on nursery, plantation, and harvesting techniques for agroforestry species are crucial for skill development. Consolidation of scientific and technological advancements in agroforestry through on-farm testing with farmers is essential for improving productivity and socioeconomic conditions.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Literature cited

Antonelli, A., Fry, C., Smith, R. J., Simmonds, M. S. J., Kersey, P. J., Pritchard, H. W., et al. (2020). State of the World's Plants and Fungi 2020. Kew: Royal Botanic Gardens.

Bir Bahadur et al. (eds.). 2015. Plant Biology and Biotechnology: Volume II: Plant Genomics 1 and Biotechnology, DOI 10.1007/978-81-322-2283-5_1, © Springer India.

Coates, D. J., Byrne, M. and Moritz, C. 2018. Genetic diversity and conservation units: dealing with the species-population continuum in the age of genomics. *Frontiers in Ecology and Evolution* **6**:165. doi: 10.3389/fevo.2018.00165

Ehrenberg, R. Global forest survey finds trillions of trees. *Nature* (2015). https://doi.org/10.1038/nature.2015.18287

Gardner, T. A., Barlow, J., Chazdon, R. L., Ewers, R., Harvey, C. A. and Sodhi, N. 2009. Prospects for tropical forest biodiversity in a human-modified world. *Ecology Letters* **12**: 561-582.

Huang, W., Luukkanen, O., Johanson, S., Kaarakka, V., Räisänen, S. and Vihemäki, H. 2002. Agroforestry for biodiversity conservation of nature reserves: functional group identification and analysis. *Agroforestry systems* **55**:65-72.

Humphreys, A. M., Govaerts, R., Ficinski, S. Z., Lughadha, E. N. and Vorontsova, M. S. 2019. Global dataset shows geography and life form predict modern plant extinction and rediscovery. *Nature Ecology and Evolution* 3: 1043–1047. doi: 10.1038/s41559-019-0906-2

Khan, M. A., Khan, M.A., Hussain, M. and Mujtaba, G. 2014. Plant diversity and conservation status of Himalayan Region Poonch Valley Azad Kashmir (Pakistan). *Pakistan Pharmaceutical Sciences* **27**(5):1215-1239.

Lawrence, W. R. 1895. The Valley of Kashmir (Reprinted). Srinagar: Chinar Publishing House.

Lokonon, B. E., Tchandao Mangamana, E., Gnonlonfoun, I., Akpona, T. J. D., Assogbadjo, A. E., Glèlè Kakaï, R. and Sinsin, B. 2019. Knowledge, valuation and prioritization of 46 woody species for conservation in agroforestry systems along Ouémé catchment in Benin (West Africa). *Environment, Development and Sustainability* **21**:2377-2399.

Mora, C., Tittensor, D.P., Adl, S., Simpson, A.G. and Worm, B., 2011. How many species are there on Earth and in the ocean?. PLOS Biology. 9(8): e1001127. doi:10.1371/journal.pbio.1001127. Retrieved on 26 May 2015.

Pullaiah, T., Bahadur, B. and Krishnamurthy, K.V. 2015. Plant Biology and Biotechnology: Volume 1: Plant Diversity, Organization, Function and Improvement, DOI 10.1007/978-81-322-2286-6_6, Springer India.

Quiroga, M. P., Castello, L., Quipildor, V. and Premoli, A. C. 2019. Biogeographically significant units in conservation: a new integrative concept for conserving ecological and evolutionary processes. *Environment Conservation* **46**: 293–301. doi:10.1017/S0376892919000286

Rana, D. and Masoodi, U.R. 2016. Threat categorization and conservation prioritization of floristic diversity in the Indian Himalayan region: a state of art approach from Shimla water catchment wildlife sanctuary. *Vegetos: An International Journal of Plant Research* **29**: 1-10

Schroth, G., da Fonseca, G.A.B., Harvey, C.A., Gascon, C., Vasconcelos, H.L. and Izac, A.M.N. (eds) 2004a. Agroforestry and Biodiversity Conservation in Tropical Landscapes. Island Press, Washington, DC, USA.

Tara, D. 2014. Assessment and conservation prioritization of floristic diversity in Central Himachal Pradesh, North-Western Himalaya for the socio-economic development of the Rissa Khad watershed. Ph.D. Thesis. Kumaun University, Nainital.

United Nations (1992) Convention on Biological Diversity. Concluded at Rio de Janeiro on 5 June 1992. United Nations Environment Program, Nairobi.

Vorontsova, M. S., Lowry, P. P., Andriambololonera, S. R., Wilmé L., Rasolohery, A., Govaerts, R., Ficinski, S.Z. and Humphreys, A. M. 2020. Inequality in plant diversity knowledge and unrecorded plant extinctions: an example from the grasses of Madagascar. *Plants People Planet* pp:1–16. doi: 10.1002/ppp3.10123

Whittaker, R.H. 1972. Evolution and measurement of species Diversity. Taxon **21**:213–251.

Table 1: List of surveyed sites (panchayats) in District Ganderbal

District	Tehsils	No. of Panchayats in the Tehsil	Panchayats selected randomly	Co-ordinates of the area	Approx. altitude (m) {a.m.s.l}
Ganderbal	Ganderbal	27	1. Arch	Lat.34º14′19″N Lon.74º46′17″E	1581m
			2. Wayil	Lat.34º16′09”N Lon.74º48′09”E	1642m
			3. Gutlibagh	Lat.34º17′44”N Lon.74º50′18”E	1700m
			4. Shuhama	Lat.34º11′18″N Lon.74º49′42″E	1633m
			5. Gadoora	Lat.34º10′56″N Lon.74º46′24″E	1581m
	Tulmulla/ Sherpathri	9	1. Harran	Lat.34º11′19″N Lon.74º46′08″E	1583
			2. Shallabugh	Lat.34º10′22″N Lon.74º43′35″E	1580m
			3. Tulmulla	Lat.34º13′24″N Lon.74º43′50″E	
			4. Hatbura	Lat.34º10′10″N Lon.74º44′19″E	
			5.Sehpora	Lat.34º11′58″N Lon.74º43′39″E	1584m
	Wakura	13	1. Barsoo	Lat.34º14′33”N Lon.74º43′06”E	1594m
			2. Waskura-B	Lat.34º13′50”N Lon.74º41′24”E	1611m

			3. Yangoora	Lat.34º14′30”N Lon.74º42′18”E	1635m
			4.Batwina	Lat.34º14′01”N Lon.74º42′11”E	1610m
			5.Kurhama	Lat.34º14′18″N Lon.74º42′24″E	1597m
	Lar	30	1. Watlar	Lat.34º15′22″N Lon.74º46′04″E	1600m
			2. Haripora	Lat.34º17′44″N Lon.74º50′18″E	1697m
			3.Khranihama	Lat.34º14′42”N Lon.74º44′24”E	1594m
			4. Repora	Lat.34º14′52″N Lon.74º45′34″E	1615m
			5. Wahidpora	Lat.34º13′58″N Lon.74º45′44″E	1587m
	Kangan	32	1. Barwalla	Lat.34º16′54″N Lon.74º53′40″E	1778m
			2. Mammer	Lat.34º16′00″N Lon.75º01′51″E	2130m
			3. Kijpora	Lat.34º16′35″N Lon.74º53′17″E	1774m
			4. Wussan	Lat.34º17′44″N Lon.74º50′18″E	1704m
			5.Preng-A	Lat.34º16′32″N Lon.74º53′01″E	1763m

	Gund	15	1. Gund –A	Lat.34º16′28″N Lon.75º06′02″E	1887m
			2. Kullan-A	Lat.34º15′52″N Lon.75º07′16″E	2230m
			3. Sumbal	Lat.34º14′54″N Lon.75º04′21″E	2015m
			4. Rayil	Lat.34º18′03″N Lon.75º07′06″E	2200m
			5.Ganiwan-A	Lat.34º13′59″N Lon.75º00′49″E	2057m

Table 2: Identified species in Different agroforestry systems

S. no.	Species	Family	Common name	Local name	Native	Endemic	Threatened category	Economic uses	EIP	Altitudinal range (masl)
Forest trees										
1.	*Salix alba*	Salicaceae	White willow	Bot - Vir	Europe,western and central Asia and northern Africa		Least concern	Fuel wood, fodder, timber, bark used as antiseptic for wounds	4	Upto 2000m
2.	*Salix matsudana*	Salicaceae	Peking willow, Tortured willow	Vir	North-eastern China and Korea			Fuel wood, fodder	3	18.46-464.42m
3.	*Populus nigra*	Salicaceae	Black poplar	Fras	Europe, southwest and central Asia and northwest Africa.		Data deficient	Fuel wood, fodder, timber	3	Upto 2000m
4.	*Populus deltoids*	Salicaceae	Cottonwood poplar	Russi Fras	North America		Least concern	Fuel wood, fodder, timber	3	1300-3000m
5.	*Ulmus wallichiana*	Ulmaceae	Himalayan elm, Kashmir elm	Bren, Elm	Eastern Afganistan to Nepal	Western Himalayas	Vulnerable	Dye, fibre, string, wood, leaves- edible, bark-- anti-inflammatory in the gut	5	800-3000m
6.	*Robinia pseudoacacia*	Fabaceae	Black locust	Kikar	Eastern United States		Least concern	Fuel wood, fodder, timber, agricultural implements	4	340-670m
7.	*Ailanthus altissima*	Simoaroubaceae	Tree of Heaven, Ailanthus, Varnish tree	Elmthar	Northeast and central China and Taiwan		Endangered	Fuel wood, fodder, ornamental use	3	20-2400m
8.	*Aesculus indica*	Sapindaceae	Indian horse chestnut, Himalayan horse chestnut	Handoon	Eastern Asia, northwestern Himalaya	Himalayas from Kashmir to Nepal	Least concern	Fuel wood, small timber, seeds – medicinal, bark-tannins, agricultural implements	4	2000-3000m
9.	*Morus alba*	Moraceae	Mulberry	Tuellkul	Central and Eastern China			Fruit, fodder, Fuel wood, timber, used for feeding and rearing of silkworm	5	0-1500m
10.	*Pinus wallichiana*	Pinaceae	Blue pine, Pine , Kail	Kaeur , Yaari-kul			Least concern	Timber, firewood, ornamental, medicinal use	4	1800-4300m
11.	*Cedrus deodara*	Pinaceae	Himalayan cedar, Deodar	Deodar	Himalayas		Least concern	Timber, medicinal, ornamental,	3	1500-3200m
12.	*Abies pindrow*	Pinaceae	Fir, Silver fir	Budul	Himalayas, from Afghanistan to Nepal		Least concern	Timber, ornamental, medicinal,	3	2400-3700m
13.	*Ulmus villosa*	Ulmaceae	Cherry bark elm, Marn elm	Marn	North Pakistan to Western Himalaya	Kashmir	Vulnerable	Fuel, fodder, timber	3	1200-2500m

14.	*Ailanthus excelsa*	Simoaroubaceae	Tree of Heaven	Elm fras	India and Sri Lanka			Medicinal, fodder, ornamental	3	0-900m
15.	*Cupressus torulosa*	Cupressaceae	Himalayan cypress	Sarwa-kul	South Asia, northern regions of Indian subcontinent, primarily Himalayas	Indo-Himalayas	Least concern	Timber, fuel, ornamental	3	300-2800m
16.	*Catalpa bignoniodes*	Bignoniaceae	Indian bean tree, Cigar tree, Southern catalpa	Drath ,	United States of America			Timber, ornamental, fuel, medicinal	4	
17.	*Morus indica*	Moraceae	Mulberry	zagtul	Temperate and subtropical Himalayan region			Fuel, fodder, timber, fruit, silk worm rearing	5	Upto 1000m
18.	*Berberis lycium*	Berberidaceae	Indian Barberry, Indian lycium	Kawdach	Northwestern part of Indian Subcontinent		Least concern	Food, medicinal, ornamental, dye	4	Upto 3000m
19.	*Populus ciliata*	Salicaceae	Himalayan poplar	Kashmirifras	Asia Himalaya		Least concern	Fuel, fodder, medicinal, timber	4	1500-2000m
Fruit trees										
1.	*Punica granatum*	Lythraceae	Pomegranate	Dhaae'n	South Asia, Persia		Least concern	Fruit, timber, fuel,medicinal, ornamental, agricultural implements	6	Upto 1600m
2.	*Prunus persica*	Rosaceae	Peach	Tche'nunn	Northwest China, Persia			Fruit, medicinal, ornamental, fuel ,timber, fodder	6	2067-4492m
3.	*Prunus amygdalus*	Rosaceae	Almond	Badaam	Iran			Fruit, medicinal, fodder, fuel, ornamental, timber	6	
4.	*Vitis vinifera*	Vitaceae	Grapes	Duchh	Europe and southwest Asia		Least concern	Fruit, medicinal, ornamental	3	700-900m
5.	*Prunus avium*	Rosaceae	Cherry	Gilaas	Europe and Asia		Least concern	Fruit, fuel, fodder, medicinal, ornamental, timber	6	
6.	*Juglans regia*	Juglandaceae	Walnut	Doon	Europe to central Asia		Least concern	Timber, fruit, fodder, oils, dyes, agricultural implements	6	1200-2990m
7.	*Pyrus*	Rosaceae	Pear	Tungg	Temperate regions of Europe, North Africa and Asia		Least concern	Fruit, medicinal, ornamental, fodder, fuel, timber,	6	1700-2400m
8.	*Ficus carica*	Moraceae	Fig	Anjeer	Mediterranean and western Asia		Least concern	Fruit, medicinal, fodder, ornamental	4	Upto 1300m
9.	*Diospyros kaki*	Ebanaceae	Persimmon	Amlok,	China		Least concern	Fruit, fodder, medicinal, agricultural	4	0-2500m

				Aamb				implements		
10.	*Prunus domestica*	Rosaceae	Plum	Ollu-bukhara, Aae'rr	Southwest Asia		data deficient	Fruit, medicinal ,dye, agricultural implements, fuel, fodder	6	Upto 1600m
11.	*Prunus armeniaca*	Rosaceae	Apricot	Tcheir	Eastern Europe and western Asia		Data deficient	Fruit, medicinal, ornamental, oil, fodder, fuel, dye, timber, agricultural implements	9	Upto 3500m
12.	*Cydonia oblonga*	Rosaceae	Quince apple	Bum-tchoonth	Southwest Europe and Asia		Least concern	Fruit, fuel, fodder, medicinal, ornamental	5	100-2100m
13.	*Eriobotrya japonica*	Rosaceae	Loquat, Japanese plum	Loquat	Central eastern China			Fruit, medicinal, fodder, fuel, timber, ornamental,	6	Upto 1524m
14.	*Malus pumila*	Rosaceae	Paradise apple	Tsoonth	Southeastern Europe and Western Asia		Data deficient	Fruit, timber, fuel, fodder, medicinal, agricultural implements	6	1500-2700m
15.	*Malus domestica*	Rosaceae	Apple	Tsoonth	Central Asia		Data deficient	Fruit, fuel, fodder, timber, medicinal ,agricultural implements	6	1900-2600m
16.	*Pyrus pyrifolia*	Rosaceae	Asian pear, Itanian pear, Japanese pear, Sand pear.	Kashmiri Nakh	East Asia			Fruit, medicinal, timber, fuel, ornamental	5	1500-2500m
17.	*Prunus cerasifera*	Rosaceae	Cherry plum, Purple leaf plum	Aae'rr	Southeast Europe and Western Asia		Data deficient	Fruit, ornamental, medicinal, dye, oil,	5	800-2000m
					Crop components					
1.	*Spinacia oleracea*	Amaranthaceae	Spanich	Palakh	Central and western Asia			Edible, medicinal,	2	Upto 3200m
2.	*Brassica oleracea gongylodes*	Cruciferae	Knol khol	Monj haakh	Coastal southern and western Europe		Data deficient	Edible, medicinal, fodder	3	Upto 958m
3.	*Daucus carota*	Apiaceae	carrot	Ghahzir	Europe and southwestern Asia		Least concern	Edible, medicinal, fodder	3	Upto 1500m
4.	*Brassica oleracea viridis*	Brassicaceae	Kale, collard greens	Haakh	Southern and western Europe			Edible, medicinal, fodder	3	
5.	*Brassica*	Cruciferae	Cauliflower	Phool	Europe			Edible, medicinal	2	Upto 3000m

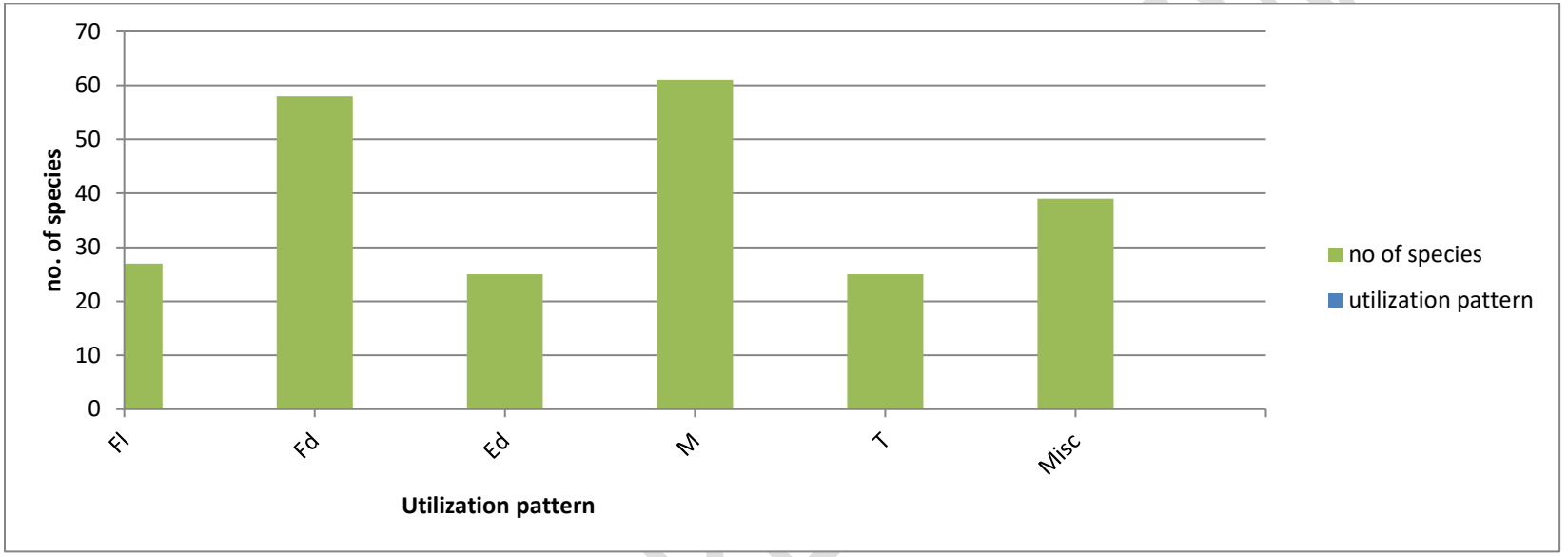
	oleracea botrytis			ghobi						
6.	*Zea mays*	Poaceae	Maize	Makai	Southern Mexico		Least concern	Edible, medicinal, fodder, fuel	4	Upto 3000m
7.	*Solanum melongena*	Solanaceae	Brinjal	Vangun	India			Edible, medicinal,	2	
8.	*Pisum sativum*	Fabaceae	Peas	Matar	Western Asia and North Africa		Least concern	Edible, medicinal, fodder	3	
9.	*Allium cepa*	Amaryllidaceae	Onion	Gande	Southwestern Asia		Least concern	Edible, medicinal	2	3000-4800m
10.	*Allium sativum*	Amaryllidaceae	Garlic	Ruhan	Middle Asia		Least concern	Edible, medicinal	2	
11.	*Avena sativa*	Poaceae	Oat	Khasel	Eurasia and Africa		Least concern	Edible, fodder,	2	
12.	*Brassica rapa*	Brassicaceae	Mustard	Til goggul, Sinzer	Temperate regions of Europe			Edible, medicinal, oil,	3	Upto 1524m
13.	*Brassica rapa rapa*	Brassicaceae	Turnip	Goguj	Europe			Edible, medicinal, fodder	3	
14.	*Raphanus sativus*	Brassicaceae	Radish	Muji	China			Edible, medicinal, fodder	3	
15.	*Brassica oleracea capitata*	Brassicaceae	Cabbage	Band	Southern and western Europe		Data deficient	Edible, medicinal,	2	700-2200m
16.	*Phaseolus vulgaris*	Fabaceae	Beans	Hyambi	North Africa and southwest Asia		Least concern	Edible, medicinal	2	
17.	*Capsicum frutescens*	Solanaceae	Chilli	March e waangun	America		Least concern	Edible, medicinal, ornamental	3	
18.	*Capsicum annum*	Solanaceae	Bell pepper, Capsicum	Shimla march e waangan	Southern North America		Least concern	Edible, medicinal, ornamental	3	0-2100m
19.	*Solanum tubersum*	Solanaceae	Potato	Olu	America			Edible, medicinal, cosmetics	3	Upto 3000m
20.	*Solanum lycopersicum*	Solanaceae	Tomato	Ruwangan	South America		Least concern	Edible, medicinal, ornamental	3	Upto 4572m

21.	*Oryza sativa*	Poaceae	Rice ,Paddy	Tammul	South East Asia			Edible, medicinal, fodder,	3	2400-3050m
21.	*Cucumis sativus*	Cucurbitaceae	Cucumber	Laer	Nepal and India		Least concern	Edible, medicinal, cosmetics	3	
22.	*Lagenaria siceraria*	Cucurbitaceae	Bottle gourd	Al	Tropical Africa			Edible, medicinal,	2	Upto 2700m
23	*Cucurbita pepo*	Cucurbitaceae	Pumpkin	Paarimal	Central America and Mexico		Least concern	Edible, medicinal	2	Upto 2500m
24.	*Malva neglecta*	Malvaceae	Mallow	Tsochael	Eastern Europe and Northern Africa		Least concern	Edible, medicinal, dyes, fodder	4	2000-3000m
25.	*Abelmoschus esculentus*	Malvaceae	Okra , Ladyfinger	Bindi	Africa		Least concern	Edible, medicinal	2	Upto 1200m
26.	*Mentha arvensis*	Lamiaceae	Mint	Pudna	North America and Europe		Least concern	Edible, medicinal, aromatic	3	Upto 1000m
27.	*Taraxacum officinale*	Asteraceae	Dandelion	Handh	Eurasia and North America		Least concern	Edible, medicinal,	2	Upto 2439m
28.	*Utrica dioca*	Utricaceae	Stinging nettle	Soie	Europe			medicinal	1	1200-3000m
29.	Trigonella foenum-graecum	Fabaceae	Fenugreek	Meth	Southern Europe and the Mediterranean region			Edible, medicinal, aromatic	3	
				Grasses						
1.	*Trifolium repens*	Fabaceae	White clover	Batakh neur	Europe		Least concern	Fodder	1	Upto 3657m
2.	*Trifolium pratense*	Fabaceae	Red clover	Batakh neur	Europe		Least concern	Fodder	1	Upto 3657m
3.	*Aegilops tauschii*	Poaceae	Tausch's goatgrass , Rough spike hard grass	Barsim	Eurasia and North Africa		Least concern	Fodder	1	200-1600m
4.	*Amaranthus viridis*	Amaranthaceae	Green amaranth, Slender amaranth	Ganhar, Lisa	Mexico and Central America			Fodder	1	
5.	*Amaranthus spinosus*	Amaranthaceae	Spiny amaranth , Prickly amaranth, Thorny amaranth	Lisa	Mexico and Central America			Fodder , edible, medicinal	3	Upto 1400m
6.	*Amaranthus caudatus*	Amaranthaceae	Love-lies-bleeding, Velvet flower, Foxtail amaranth, Pendant amaranth	Lisa	Mexico and central America			Fodder, edible,medicinal	3	Upto 2400m
7.	*Echinochola crus-galli*	Poaceae	Cockspur, Water grass, Barnyard	Haame	Tropical Asia			Fodder	1	

			grass							
8.	*Lolium perenne*	Poaceae	Perennial ryegrass , Ryegrass	Dhrame	Southern Europe,the Middle East, North Africa and eastwards to central Asia		Least concern	Fodder	1	
9.	*Bromus japonicus*	Poaceae	Japanese Brome		Eurasia		Data deficient	Fodder	1	
10.	*Avena sativa*	Poaceae	Oats	Khaseel	Eurasia and Africa		Least concern	Fodder ,edible, medicinal	3	
11.	*Lolium multiflorum*	Poaceae	Italian ryegrass, Festuca perennis	Dhrame	Central and southern Europe, north-west Africa and south-west Asia		Least concern	Fodder	1	
12.	*Agrostis*	Poaceae	Common bent	Dhrama	Europe, Asia and North Africa		Least concern	Fodder	1	
13.	*Poa annua*	Poaceae	Annual bluegrass , annual meadowgrass		Eurasia		Least concern	Fodder	1	
14.	*Phleum*	Poaceae	Timothy		Europe, Asia and North Africa		Least concern	Fodder	1	
15.	*Bromus inermis*	Poaceae	Smooth brome	Shoal	Europe			Fodder	1	
16.	*Cynodon dactylon*	Poaceae	Scutch grass, Dog's tooth grass, Bahama grass , Bermuda grass	Dramun	Europe, Africa, Australia and Asia			Fodder	1	Upto 2130m
17.	*Dactylis glomerata*	Poaceae	Orchard grass, cock's foot, Barnyard grass		Temperate Eurasia and North Africa			Fodder	1	Upto 4000m
18.	*Medicago sativa*	Fabaceae	Alfalfa, Lucerne	Poshgass	Southwest Asia		Least concern	Fodder	1	
19.	*Poa pratensis*	Poaceae	Kentucky bluegrass, smooth meadow-grass	Me'hi 'gaas'	Europe and Asia		Least concern	Fodder	1	
20.	*Poa trivialis*	Poaceae	Rough stalked meadowgrass		Europe		Least concern	Fodder	1	
21.	*Poa nemoralis*	Poaceae	Wood bluegrass		Eurasia		Least concern	Fodder	1	
22.	*Rumex nepalensis*	Polygonaceae	Sorrel	Obuj				Fodder , edible, medicinal	3	900-4000m
23.	*Capsella bursa-pastoris*	Brassicaceae	Shepherd's Purse	Kralmond	Europe and West Asia		Least concern	Fodder, edible, medicinal	3	300-3000m
24.	*Portulaca*	Portulacace	Purslane	Nuner	South Africa		Least	Fodder, medicinal,	3	

	oleraceae	ae					concern	edible		

Graph 1: Utilization pattern of different species growing within different agroforestry systems in district Ganderbal



Wheras; Fl= Fuel, Fd= Fodder, Ed= Edible, M= Medicinal, T= Timber, Misc= Miscellaneou