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# A floristic reconnaissance of Churdhar wildlife sanctuary of Himachal Pradesh, India

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## Abstract

Present study is an outcome of the floristic study carried out at Churdhar Wildlife Sanctuary, Himachal Pradesh of India. The survey was conducted in order to discover and document sensitive or special interest vascular plant species to help managing the sensitive plant resources. A list of botanically important plants is being given here along with the details on their medicinal and other economic values. Besides, indicator taxa, floristic records, affinities with Chinese and Korean flora and conservation status are also briefly discussed.

**Key words**: Flora, Churdhar Wildlife Sanctuary, Endemism, Phyto-geographical affinities.

## Introduction

The Himalayan region in India is stretched from Jammu and Kashmir to the northeast corners of Arunachal Pradesh and has always been a centre of attraction for the botanists. With a varied ecological climate and diverse flora and fauna, it is a home for a number of threatened and endemic taxa. Botanists from across the world are attracted by the places like Himachal Pradesh, Uttarakhand, Sikkim, Assam, West Bengal and Arunachal Pradesh. The diversity of climate, altitude, rainfall and soil conditions generates a variety of unique plant communities or eco-regions. This can be seen in the vegetation from the foothills of southern section to the cold deserts of the northern part. The Indian Red Data Book [14] has listed 619 species of vascular plants as threatened in Indian territories and out of them 137 species belongs to the Himalayan region. In view of protecting this natural heritage, a number of Wildlife Sanctuaries and Biosphere Reserves have been established in all parts of India including the Himalayas. At present there are five biosphere reserves, 28 national parks and 98 wildlife sanctuaries covering 51,889.238 sq. kms area [13]. Churdhar Wildlife Sanctuary is a recent addition to this chain which is nestled within the beautiful valley of Solan in the state of Himachal Pradesh and spread over in an area of 56.16 sq. kms. Geographically, it lies at 30° 52´N and 77° 32´E with varying elevations. The sanctuary was named after the 'Chur' peak where a big statue of Lord Shiva is situated on the top. It is perched at an altitudinal range of ca. 1500-3647 meters and surrounds an area of 5616 hectares with a thick forest cover sheltering a number of threatened flora and fauna. The peak of Churdhar is known to be the highest peak of the outer range of the Himalaya. The climate of this area exhibits considerable variations at different elevations and exposures. January is the coldest month with around 5°C and June as the warmest month with around 19°C. Snowfall is also observed infrequently during the month of December whereas during the months of June to September it receives heavy rainfall with an average of 1320 mm. Mean relative humidity round the year ranges from 15 % to 86%.

The history of Botanical explorations in this region dates back to the year 1848 when several workers including Hooker [11] made their collections from some remote localities of this area. However, the earliest noteworthy collections made by the Countess of Dalhousie from Shimla and surrounding areas can also be mentioned. Later on, some botanists like William Munro (1818-1880), Madden (1840), Strachey & Winterbloom (1846-1849), Arnott Walker (1779-1868), Edgeworth (1812-1881), Griffith (1810-1845), Jacquemont (1801-1832) and Thomson (1819-1878) explored the area and most of the collections are housed in the National Herbarium at Kew. A perusal of the herbarium collections housed at herbarium of Botanical Survey of India at Dehradun (BSD), India reveals further explorations by the botanists of Botanical Survey of India with report of many threatened and interesting plants from the area. Some other notable contributions are from Subramani and others [2, 10, 18].

## Materials and Methods

The plant specimens of Churdhar Wildlife sanctuary were thoroughly examined and identified using relevant references [4, 6, 8, 11, 15, 16, 23]. They were cross checked with the herbarium specimens housed at the herbarium of Botanical Survey of India, Dehradun

(BSD). The nomenclature given in latest taxonomic literatures [1, 17] and websites like Tropicos and IPNI were followed. Data on the medicinal use were collected following various literatures [3, 5, 7, 9, 12, 20, 21, 22].

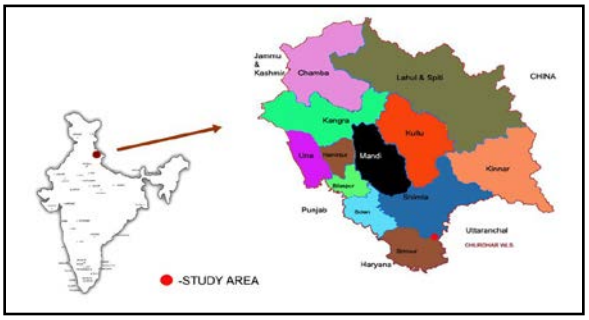
## Results and Discussion

It is interesting to mention that the district of Shimla possess only two peaks with sub-alpine vegetation. One of them is *Chur* and another one is *Hatugarh*. The vegetation of Churdhar wildlife sanctuary is quite interesting with the occurrence of a number of threatened and endemic plants. The forests include Pine groves with Oak trees (*Quercus* sps.), *Castanopsis*, *Rhododendrons* etc. The occurrence of a few subtropical elements in the sub temperate mixed forest like *Aesculus indica*, *Alnus nepalensis*, *Berberis aristata*, *Indigofera exilis*, *Arisaema jacquemonti*, *Cissampelos pareira*, *Stephania japonica* etc. makes the flora interesting. Unlike deciduous forest the sub temperate deciduous coniferous forests exhibit a high degree of species diversity along with many shrubs, undershrubs and herbaceous species although there is no clear stratification of the forests. The number of monocotyledonous plants is quite high; though comparatively lesser than the dicotyledonous plants. The top five dominant families observed in the area are Poaceae, Leguminosae, Asteraceae, Lamiaceae and Rosaceae.

The vegetation of Churdhar Wildlife Sanctuary can be classified in four distinct type viz.: (A) Sub-tropical forests: at ca 1500-2000 msl (I) Sub-tropical mixed deciduous forests, (II) Sub-tropical mixed coniferous forests; (B)Sub-temperate forests: at ca 2000-3000msl; (C) Temperate to Sub-alpine forests: at ca 3000-3647 msl.

Some of the genera with a single species only observed from the area are *Drosera*, *Melastoma*, *Balanophora*, *Phytolacca*, *Styrax*, *Monotropa*, *Orobanchane* etc. While *Ranunculus*, *Rhododendron*, *Cyanoglossum*, *Silene*, *Polygonum*, *Impatiens*, *Habenaria*, *Pedicularis*, *Polygala* and *Viola* are among some of the genera represented with more than one species.

**Arboreal flora:** The tree flora of Churdhar wildlife Sanctuary is mostly dominated by a mixed population of Pines and Angiosperms. Some of the notable pines are *Pinus excelsa*, *P. longifolia*, *Cedrus deodara*, *Abies pindrow*, *Cupressus torulosa* etc. The angiosperms include trees of *Betula alnoides*, *Alnus nepalensis*, *Quercus diltata*, *Q. glauca*, *Q. incana*, *Litsea polyantha*, *Cinnamomum tamala*, *Oroxylum indicum*, *Cordia myxa*, *Juglans regia*, *Ficus semicordata*, *Ficus religiosa*, *Morus indica*, *Limonia acidissima*, *Aegle marmelos*, *Cedrella serrata*, *Cedrella toona*, *Rhus chinensis*, *Euonymous hamiltonianus*, *Rhododendron arboreum* etc. Most of them are confined upto the lower elevations of the sanctuary and the canopies in the sanctuary characterize the successive zones. While moving towards the *Chur* peak, the habitat of *Pinus longifolia*, *P. excelsa*, *Cedrus deodara* and *Picea morinda* can be observed. Undoubtedly, conifers are the most prominent elements in each climatic belt of the sanctuary. They are very well stepped in different regions viz. *Pinus longifolia* from about 700 to 1500m, *Pinus excelsa* from about 1500 to 2200m, *Cedrus deodara* upto 2500m high. In the upper elevations, *Abies pindrow* with *Quercus semecarpifolia* can be seen. Besides, the occurrence of *Ilex dipyrena* and *Rhododendron arboreum* is quite common. Presence of trees like *Rhus chinensis* and *Toona ciliata* is the indicative of subtropical vegetation at lower altitudes.




**Shrubs and Undershrubs:** The area is also occupied with a variety of shrubs and undershrubs. *Indigofera atropurpurea*, *Bauhinia variegata*, *Rosa sericea*, *Rumex nepalensis*, *Swertia tetragona*, *Berberis aristata*, *Cotoneaster microphylla*, *Gaultheria trichophylla*, *Coriaria nepalensis*, *Salix elegans*, *Rubus ellipticus*, *R. niveus*, *Lonicera angustifolia*, *L. quinquelocularis*, *Viburnum cotinifolium*, *Desmodium tiliaefolium*, *Spiraea canescens*, *Elsholtzia polystachya*, *Buddleja paniculata* are common.

**Herbaceous flora:** Churdhar wildlife sanctuary harbors a very rich and interesting herbaceous flora. Many of them are typical representative of the Himalayas or confined to the Asian region. Some of them are *Micromeria biflora*, *Thymus serphyllum*, *Impatiens racemosa*, *Corydalis thyrsiflora*, *Polygonum amplexicaule*, *P. capitatum*, *P. posumbu*, *P. aviculare*, *P. effusum*, *P. nepalense*, *Bupleurum candollei*, *Roscoea purpurea*, *R. alpina*, *Aster thomsoni*, *Koenigia nepalensis*, *K. delicatula*, *Hedychium spicatum*, *Pilea umbrosa*, *Cautleya spicata*, *Begonia picta*, *Codonopsis viridis*, *Androsace sarmentosa*, *Cotoneaster microphyllus*, *Drosera peltata*, *Conyza aegyptiaca*, *Cirsium falconeri*, *Strobilanthes atropurpureus*, *Potentilla polyphylla*, *P. nepalensis*, *P. gerardiana*, *P. lineata*, *Euphorbia pilosa*, *Morina*

*longifolia, Prunella vulgaris, Arisaema jacquemontii, Cynoglossum amabile, C. officinale, Anaphalis margaritacea, Justicia simplex, Chirita bifolia, Silene inflata, S. setisperma, Gentiana argentea, Epilobium brevifolium, Anemone vitifolia, Thalictrum foliolosum, Ranunculus sceleratus, R. hirtellus, Delphinium denudatum, Pedicularis siphonantha, P. bicornuta, Hypericum cernuum, Rhodiola trifida, Commelina benghalensis, Rumex hastatus, R. acetosa, Cissampelos pareira Viola canescens* etc. In contrary to the eastern Himalayas, members of Orchidaceae and Melastomataceae are quite less in number. Orchidaceae is represented by a some terrestrial elements like *Epipactis helleborine, Habenaria pectinata, H. intermedia, Malaxis muscifera, Neottia listeroides, Peristylus elisabethae, Platanthera edgeworthii, Satyrium nepalense, Spiranthes sinensis* etc. We report here *Goodyera fusca* as a new record to the state of Himachal Pradesh. This taxon has earlier been reported from Eastern Himalaya and Uttarakhand state in India. Present report shows its extended distribution from Uttarakhand to Himachal Pradesh. Globally, it is distributed in Bhutan, China, Myanmar, Nepal and Tibet. Besides, *Arundinaria spathiflora* is also common in the subalpine zones. Many of the exotics like *Taraxacum officinale, Thymus serphyllum, Verbascum thapsus, Stellaria media, Cannabis sativa, Eupatorium odoratissimum, Ageratum conyzoides* also inhabit the area at lower elevations.

## Medicinal Plants

Churdhar Wildlife Sanctuary is full of medicinal plants along with a number of plants that could be of potential use for mankind. A list of medicinal plants observed in the WLS is being appended here along with their phenology and distribution details.

01. *Aegle marmelos* (L.) Correa
    Family: Rutaceae
    Phenology: Apr.-May
    Distribution: Asia-Tropical
    Uses: Fruits are used in chronic diarrhoea and dysentery. Unripe fruits are astringent, diuretic, anthelmintic and antipyretic.
02. *Ageratum conyzoides* (L.) L.
    Family: Asteraceae
    Phenology: throughout the year
    Distribution: In tropics & subtropics
    Uses: Leaf juice is used to stop bleeding.
03. *Anaphalis margaritacea* (L.) Benth. & Hook. f.
    Family: Asteraceae
    Phenology: Aug.-Nov.
    Distribution: Pakistan to SW China
    Uses: Whole plant is anodyne, antiseptic, astringent expectorant and sedative.
04. *Androsace sarmentosa* Wall.
    Family: Primulaceae
    Phenology: June-Aug.
    Distribution: Native to the Himalayas; Sikkim to Kashmir
    Uses: Entire plant is used in Tibetan medicine. Used for the treatment of tumors.
05. *Anemone vitifolia* Buch.-Ham. ex DC.
    Family: Ranunculaceae
    Phenology: Aug.-Sept.
    Distribution: Himalayas; Afghanistan, SW China & Myanmar
    Uses: Fresh root is antirheumatic and vermifuge.
06. *Begonia picta* Sm.
    Family: Begoniaceae
    Phenology: Aug.-Sept.
    Distribution: Asia-Temperate and tropical
    Uses: Plant juice is drunk to relieve headache.
07. *Berberis aristata* DC.
    Family: Berberidaceae
    Phenology: Mar.-May
    Distribution: Asia-Tropical
    Uses: Dried stems are highly medicinal. Used as tonic, laxative and diaphoretic. Infusion of leaf is used to treat Malaria, skin diseases and jaundice.
08. *Buddleja asiatica* Lour.
    Family: Buddlejaceae
    Phenology: Jan.-Oct.
    Distribution: Asia-Temperate and tropical
    Uses: Juice of the plant is applied to cure skin diseases.
09. *Bupleurum candollei* Wall. ex DC.
    Family: Apiaceae
    Phenology: June-Aug.
    Distribution: Himalayas
    Uses: Decoction of root is useful to cure cough and fever. A traditional Chinese medicine.
10. *Cautleya spicata* (Sm.) Baker
    Family: Zingiberaceae
    Phenology: July-Sept.
    Uses: Distributed in the Himalayas ranging from Himachal Pradesh to Arunachal Pradesh in India. Juice of the rhizome is used in the treatment of stomachache.
11. *Cedrus deodara* (Roxb. ex Lamb.) G. Don
    Family: Pinaceae
    Phenology: Oct-Nov.
    Distribution: Afghanistan to Nepal
    Uses: Decoction of wood is medicinal. Cures fever, flatulence and urinary disorders.
12. *Cissampelos pareira* (Roxb. ex Lamb.) G. Don
    Family: Menispermaceae

Phenology: Aug.
Distribution: Native of America; Naturalized
Uses: A potential medicine for gynaecological disorders.

13. *Coriaria nepalensis* Wall.
Family: Coriariaceae
Phenology: Feb.-Aug.
Distribution: Endemic to Indo-Pakistan
Uses: Juice of the bark is used in the treatment of Staomchache.
14. *Cotoneaster microphyllus* Wall. ex Lindl.
Family: Rosaceae
Phenology: May-Aug.
Distribution: Afghanistan to SW China
Uses: Potential Bonsai plant. The stolons are believed to be astringents.
15. *Cynoglossum officinale* L.
Family: Boraginaceae
Phenology: Aug.-Sept.
Distribution: Native to Asia-temperate and Europe
Uses: Leaves and roots are analgesic, antihaemorroidal, astringent but slightly narcotic.
16. *Delphinium denudatum* Wall. ex Hook. f. & Thomson
Family: Ranunculaceae
Phenology: Jul.-Aug.
Distribution: Native to Asia tropical
Uses: Decoction of the roots is a good stimulant and tonic.
17. *Desmodium elegans* DC.
Family: Fabaceae
Phenology: Aug.-Oct.
Distribution: Native to Asia temperate and tropical
Uses: Roots are carminative, diuretic and tonic.
18. *Drosera peltata* Thunb.
Family: Droseraceae
Phenology: Throughout the year
Distribution: Himalayas; Japan & China
Uses: Plant is a good blood tonic and carminative.
19. *Duchesnea indica* (Andrews) Focke
Family: Rosaceae
Phenology: Throughout the year
Distribution: Asia-temperate and tropical
Uses: Whole plant is anticoagulant, antiseptic and febrifuge. Fruits are used to cure skin diseases.
20. *Eclipta prostrata* (L.) L.
Family: Asteraceae
Phenology: Aug.-Oct.
Distribution: Native to warm-temperate and tropical America; widely naturalized worldwide
Uses: Highly medicinal and used for hair. A decoction of leaf is also used to cure uterine hemorrhage. Equally good for skin diseases.
21. *Habenaria intermedia* D. Don
Family: Orchidaceae
Phenology: Jul.-Aug.
Distribution: E. Asia; Himalayas
Uses: Leaves and roots are boiled and eaten.
22. *Hedychium spicatum* Sm.
Family: Zingiberaceae
Phenology: Jul.-Aug.
Distribution: E. Asia; Himalayas
Uses: Rootstocks are carminative, expectorant, stimulant and tonic.
23. *Ligularia amplexicaulis* DC.
Family: Asteraceae
Phenology: Aug.-Sept.
Distribution: Himalayas
Uses: Stem, leaves and flowers are digestive and emetic. Used for the treatment of vomiting.
24. *Micromeria biflora* (Buch.-Ham. ex D. Don) Benth.
Family: Lamiaceae
Phenology: June-Aug.
Distribution: Almost throughout the country; E. Asia; Himalayas: Bhutan to Myanmar
Uses: Root paste is used to cure toothache; a good antiseptic and odantalgic.
25. *Morina longifolia* Wall.
Family: Acanthaceae
Phenology: June-Sept.
Distribution: Kashmir to Bhutan (Himalaya)
Uses: Used in Tibetan medicine. Leaf, stem and flowers are digestive, emetic and stomachic.
26. *Pedicularis bicornuta* Klotzsch
Family: Scrophulariaceae
Phenology: Jul.-Sept.
Distribution: Himalayas
Uses: The flowers are used in Tibetan medicine to cure leucorrhea.
27. *Polygonum aviculare* L.
Family: Polygonaceae
Phenology: June-Oct.
Distribution: Origin unknown; Naturalized worldwide
Uses: A potential medicinal herb. Considered to be a very good astringent, anthelmintic, diuretic, emetic, expectorant and for so many purposes.
28. *Polygonum nepalense* Meisn.
Family: Polygonaceae

Phenology: June-Sept.
Distribution: Native of Asia-tropical and temperate
Uses: Juice obtained from roots is used to cure fever.

29. *Potentilla nepalensis* Hook.f.
Family: Rosaceae
Phenology: June-Sept.
Distribution: Himalayas (Kashmir to Nepal)
Uses: The root is depurative.
30. *Rannunculs sceleratus* L.
Family: Ranunculaceae
Phenology: May-Sept.
Distribution: Throughout the world
Uses: Whole plant is anodyne, antirheumatic, antispasmodic, diaphoretic and rubefacient.
31. *Rheum australe* D. Don
Family: Polygonaceae
Phenology: June-Jul.
Distribution: Himalayas: India, China, Bhutan, Myanmar, Nepal & Pakistan
Uses: Most widely used herb in Chinese medicine. Used as digestive, purgative, tonic and for many other ailments.
32. *Rhododendron arboreum* Sm.
Family: Ericaceae
Phenology: Apr.-Aug.
Distribution: Asia tropical & temperate: India, China, Bhutan, Nepal, Myanmar & Thailand
Uses: Young leaves are good astringent and tonic.
33. *Rosa sericea* Lindl.
Family: Rosaceae
Phenology: May-Aug.
Distribution: Himalayas; SW China to Myanmar
Uses: A paste of the flower applied on the head to cure headache. Also known to possess some anti-cancer properties.
34. *Rubia cordifolia* L.
Family: Rubiaceae
Phenology: Jul-Sept.
Distribution: Native of Asia-tropical and temperate; Africa
Uses: The roots are astringent, anodyne, diuretic, febrifuge and tonic.
35. *Rubus ellipticus* Sm.
Family: Rosaceae
Phenology: Feb.-Apr.
Distribution: Asia tropical & temperate
Uses: Root juice is used in the treatment of fever, gastric troubles, diarrhea and dysentery.
36. *Rumex hastatus* D. Don
Family: Polygonaceae
Phenology: June-Oct.
Distribution: Himalayas: Afghanistan to Nepal
Uses: Crushed leaf applied to check bleeding. Root is laxative, tonic and anti-rheumatic.
37. *Rumex nepalensis* Spreng.
Family: Polygonaceae
Phenology: Jul.-Aug.
Distribution: Asia tropical and temperate; Europe
Uses: Leaf extract is used to cure skin sores.
38. *Satyrium nepalense* D. Don
Family: Orchidaceae
Phenology: Jul.-Dec.
Distribution: Asia tropical and temperate
Uses: Powdered tubers are known to have medicinal properties as tonic
39. *Stellaria media* (L.) Vill.
Family: Scrophulariaceae
Phenology: Throughout the year
Distribution: Probably origin of Eurasia; widely naturalized
Uses: Known to possess astringent, carminative, diuretic and many medicinal properties.
40. *Taraxacum officinale* Webb
Family: Asteraceae
Phenology: Apr.-Aug.
Distribution: Origin of Eurasia; widely naturalized
Uses: Commonly used medicinal plant. Known to possess diuretic, laxative and hepato-protective properties.
41. *Thalictrum foliolosum* DC.
Family: Ranunculaceae
Phenology: Aug.-Sept.
Distribution: Himalayas; India, China, Bhutan, Nepal, Pakistan and Myanmar
Uses: Used in eye disorders.

## Other economic plants

Besides, the area is also full of plant resources that could be highly economical for the mankind like *Berberis aristata* which is used to obtain a yellow dye from its root and stem. It is perhaps one of the best tannin dyes available in India. The wood is also used as a fuel. *Polygonum aviculare*, besides being a medicinal herb, could be used to yield a blue dye. A red dye is obtained from *Rubia cordifolia*, which is frequently found in the area. *Cotoneaster microphyllus* is a good candidate for preparing Bonsai. The flowers of *Buddleja asiatica* are a source of perfume. The area is also filled with a number of wild ornamental plants such as *Morina longifolia, Ligularia amplexicaule, Epilobium laxum, Chirita bifolia, Silene setisperma, Codonopsis viridis, Polygonum amplexicaule,*

*Pedicularis siphonantha, P. bicornuta, Anemone vitifolia, Geranium himalayense, Potentilla nepalensis, Rhododendron arboreum, Thalictrum foliolosum, Strobilanthus atropurpureus, Swertia tetragona, Rhodiola trifida, Prunella vulgaris, Euphorbia pilosa, Androsace sarmentosa, Arisaema jacquemontii, Bupleurum candollei, Cautleya spicata, Corydalis thyrsiflora* etc. These plants are of immense horticulture potential and could be a future source of economy to the state.

**Fig. 1:** A bird's eyeview on the topography of Churdhar Wildlife Sanctuary

**Fig. 2:** Temperate vegetation

## Phytogeographical affinities

Several species occurring in the sanctuary appear to have migrated from Tibet, W. China and adjoining north-east Asia. There are also some species which show restricted distribution in the Western Himalayas (upto Afghanistan) like *Anaphalis margaritacea, Androsace sarmentosa, Arisaema jacquemontii, Cautleya spicata, Cedrus deodara, Cirsium falconeri, Chirita bifolia, Coriaria nepalensis, Cotoneaster microphyllus, Gaultheria trichophylla, Hedychium spicatum, Habenaria intermedia, Morina longifolia, Micromeria biflora, Lonicera quinquelocularis, Pedicularis bicornuta* etc. but many of them are distributed throughout the world. Some of the plants are known from both Western and Eastern Himalayan regions. The subtropical elements in this area are well represented in the lowlands of Taiwan and Philippines. Though the area shows much floristic affinity with the flora of China with occurrence of a number of similar plants like *Anaphalis margaritacea, Anemone vitifolia, Arisaema jacqumontii, Berberis aristata, Buddleja asiatica, Cirsium falconeri, Cotaneaster microphyllus, Cynoglossum amabile, C. officinale, Drosera peltata, Epilobium laxum, Lonicera quinquelocularis, Rosa sericea, Morina longifolia* etc. but the presence of several taxa like *Cedrus deodara, Eclipta prostrata, Euphorbia pilosa, Fallopia convolvulus, F. dumetorum, Gnaphalium affine, Gynura crepidioides, Oenanthe javanica, Polygonum aviculare, Ranunculus scleratus, R. cantoniensis, Rhus javanica, Rubia cordifolia, Rumex acetosa, Spiranthes sinensis* and many genera like *Alnus, Aster, Bupleurum, Cirsium, Codonopsis, Corydalis, Cotoneaster, Drosera, Daphne, Duchesnea, Elsholtzia, Epilobium, Ligularia, Prunella, Rhododendron, Sedum, Senecio, Silene, Smilax, Sonchus, Spiraea, Swertia, Symplocos, Thalictrum, Thymus, Viburnum, Viola, Vitex* etc. proves that the Korean flora is also closely related to this area. This gives an important clue for understanding the ecological niches created during the course of evolution and the diversification of plants in the Himalayan region.

**Fig. 3:** Sub-alpine zone of the sanctuary

**Fig. 4:** A glimpse of the sanctuary area showing the land under cultivation

*Geranium himalayense* Klotzsch

*Anemone vitifolia* Buch.-Ham. ex DC.

*Anaphalis margaritacea* (L.) Benth. & Hook. f.

*Codonopsis viridis* Wall.

*Androsace sarmentosa* Wall.

*Cotoneaster microphyllus* Wall. ex Lindl.

*Morina longifolia* Wall.

*Polygonum amplexicaule* D.Don

*Pedicularis bicornuta* Kl. ex Kl. & Garcke

*Ligularia amplexicaulis* DC.

*Pedicularis siphonantha* D.Don

*Silene setisperma* Majumdar

*Goodyera fusca* (Lindl.) Hook. f.

*Peristylus elisabethae* (Duthie) R.K. Gupta

## Conservation issues

Some of the areas in WLS are under human settlements, characterized by grassy slopes and patches of cultivation. Terrace cultivation is common and patches of forests in ravines and on the steeper hillsides can be seen. Oaks and Rhododendrons are common to these areas. As estimated by Gupta & Gupta [10], the sanctuary has 127.12 ha of agriculture land, 486.61 ha of Barren/wasteland, 50.17 ha of pasture, 204.9 ha of snowbound area, 3.6 ha of rocky area and 4866.6 ha of reserved Forests. It is heartening to see that a major area is still enjoying virgin forests. 23 villages are located within and outside the protected area having population of 558 permanent inhabitants [10].The local people residing in the WLS area are given the rights to agriculture, extraction of timbers, fuel wood and minor forest produce, grazing and collection of fodders. Fortunately, the WLS is famous as a pilgrimage due to the *Chur* peak. A temple of lord Shiva is situated on the top which is considered the lord of surrounding villages. The religious beliefs associated with the *Chur* peak helps conserving the bioresources. The area is considered a sacred grove and hence lot of restrictions are imposed by the local people on cutting and lopping of trees, grasses and collection of non timber forest products before seeds fall. This practice is prevalent in the whole area of the sanctuary. However, grazing and land sliding is a major concern for the conservation of some threatened species. Forests adjacent to the human settlement areas are also under exploitation for timber, fuel and fodders. There is a need to preserve the natural habitat of the threatened plant species by integrating traditional forest knowledge system with sustainable forest management. This should be achieved with an inter-village agreement on grazing in a particular forest in a particular area, creating awareness for the most threatened species and a limited and sustainable use of the resources.

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