

## A Survey to Explore the Herbal Wealth and Its Utility as Edibles, Ethno-Medicine and Ethno-Veterinary Practices in Nanda Devi Biosphere Reserve (NDBR), Uttarakhand as a Step to Bio Prospection

Jaiyati R<sup>1</sup>, Rajdeo K<sup>1</sup>, Ashish C<sup>2</sup>, Archana S<sup>3</sup> and Ruchi B<sup>3</sup>

<sup>1</sup>Forest Ecology and Environment Division, Forest Research Institute, Dehradun, India

<sup>2</sup>National Institute of Pharmaceutical Education and Research, Mohali, Punjab, India

<sup>3</sup>Doon University, Uttarakhand 248001, India

\*Corresponding author: Ashish C, Junior Scientist, National Institute of Pharmaceutical Education and Research (NIPER), Punjab, India, Tel: +91-9464616773; E-mail: aashishchauhan26@gmail.com

Received date: July 21, 2016; Accepted date: November 18, 2016; Published date: November 21, 2016

Copyright: © 2016 Jaiyati R, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

### Abstract

This paper explores the traditional knowledge of herbal wealth amongst local people and its use as edible, medicine and ethno-veterinary purposes. Information of about 55 species belonging to 32 families was collected from 8 villages under NDBR region, as a step towards sustainable utilization and conservation of medicinal plant species. Information given by the people about the medicinal plants provides an interesting ethno-botanical data and the distribution of ethno-botanical knowledge of the germane ethno-botanical and its utilization held by aged members of the society. There is earnest need to capture and preserve the knowledge related to the herbal wealth for future use and its bio prospection.

**Keywords:** Traditional knowledge; Uttarakhand Himalaya; Medicinal plants; Bio prospection

### Introduction

Rich local heritage represents ubiquitous knowledge regarding medicinal plants. Our history is evident about the peculiar properties of medicinal plant species. The traditional medicinal system thus considers all forms of medicine as potential exploitable source of effectual substances and procedures. In context to cultural meanings, the Asian medical beliefs and practices form an essential pragmatic point of view. Thus, with this regard, we can consider that the Indian system of medicine and its variegated usage has attracted minds of many great scholars. The Indian system of medicine has been remarked to be engrafted with distinct cultural proluions and symbols. However, the role of medicinal plants has also found to be increased tremendously in raising economic status of rural people [1-3].

Numerous plants species that are significant sources of medicine are present around us. With the passage of time, human guilds learnt autochthonous uses of such plant resources and adopted them in their traditional medicinal system for therapeutics and other purposes. This medicinal knowledge of resource use was later transited through generations; acculturated as cultural inheritance and then pertained as traditional knowledge [4-6].

The herbal state 'Uttarakhand', famous for its exotic medicinal plant species, is falling under trailed acculturation. The verbal knowledge of age old traditional systems is in danger of getting extinct as the vast knowledge of medicinal plants has mostly been restricted to few rural communities only. Compounding of allopathic drugs is also a major factor for deprivation of precious traditional knowledge and its subject to resource use [7-9].

The present study focuses on the extent of the use of wild edibles and other plant resources for ethno-medicinal and ethno-veterinary purposes of the Bhotiya community. Along with the medicinal aspects, the importance of religious and cultural usage of plants and their significance for the tribal community has also been kept in mind. This study will help in getting a wide scenario and addition of data to the approaches made so far in the field of medicinal plant species of the Himalayan region [10-17].

### Study Area

The study was conducted in 8 villages under Nanda Devi Biosphere Reserve (NDBR) i.e., Laung, Phagti, Tolma, Surraithoda, Lata, Reni, Parsari and Merag. The reserve is located between 30°17' and 30°41'N latitude and 79°40' and 80°5'E longitudes and spreads over 5860.69 km<sup>2</sup> of land area with a core zone of 712.12 km<sup>2</sup> and covers a wide altitude range from 1700-7817 m. The annual approximate variation in precipitation ranges from 750-2000 mm, while the temperature varies from below 0°C (December-January) to 35°C (June-July) [18].

The vegetative cover of the reserve spreads over 22.2% of its total area; 6.6% is wasteland and 4.5% is grasslands or alpine pastures, locally known as bugyal. Only 0.7% of the NDBR is developed or under agriculture. Of the total forest cover, about 47% is dense forests (>40% crown cover), 35% open (10-40% crown cover), and 18% miscellaneous and degraded forests (<10% crown cover). So far, a total of 793 plant species have been recorded in the entire biosphere reserve. There is a high level of ethnic diversity throughout the Nanda Devi region. Human habitation is limited in the 19 villages in the buffer zone. The Bhotiya, a tribal community, dominate the human population [19].

## Methods

Eight villages of Chamoli district namely Lata, Laung, Merag, Parsari, Phagti, Reni, Suraithoda and Tolma under NDBR were selected for the present study realizing that mountain people have more dependency on the forest and forest produce than the residents of lowland and plains of India, hence they occupy a great deal of knowledge on the medicinal use of plant species. Structured questionnaires are the traditional method of collecting information from a community but in combination with semi-structured open questions, a depth and breadth of information can be obtained. Following this, two basic approaches were carried out to study the ethno-botany. The first approach involved household interviews in which questionnaire about medicinal use of plant for different purposes were asked and the second approach, which is called inventory, was done which included collection of the plant specimen and also interviewing their local names and uses [20].

The people were also asked about their knowledge about the plant. The vaidyas/folk traditional healers, elders and women were consulted for the medical uses of the plants. The parts of plants used to treat diseases, types of diseases treated, doses and method of administration were also recorded. Secondary data was collected by governmental and non-governmental organizations.

## Results

The results have important entailments for ethno-botany, economic botany and conservation of traditional knowledge in the respective area. The high percentage use of these traditionally important medicinal plant species among the people of the respective area is one such striking pattern to emerge from the analysis. Fifty-five species of plants used in context to wild edibles, ethno-medicinal and ethno-veterinary practices have been identified. Among the various life forms of medicinal plant species found in the study area, herbs are the most dominant, as out of 55 medicinal plant species, 41 are herbs, 5 are shrubs and 9 are trees. These plant species are distributed over 32 families.

In terms of number of species, Asteraceae and Rosaceae are the dominant families (5 species each), followed by Polygonaceae (4 species), Apiaceae, Lamiaceae, Liliaceae and Poaceae (3 species each), Ranunculaceae and Valerianaceae (2 species each), Amaranthaceae, Araceae, Berberidaceae, Betulaceae, Boraginaceae, Brassicaceae, Combretaceae, Ericaceae, Elaeagnaceae, Equisetaceae, Fabaceae, Juglandaceae, Linaceae, Myrtaceae, Orchidaceae, Paeoniaceae, Plantaginaceae, Podophyllaceae, Primulaceae, Saxifragaceae, Scrophulariaceae, Taxaceae and Violaceae (1 species each).

The responses of local people on the use and importance of medicinal plants were diverse across the villages covered under NDBR. Among wide range of medicinally important plant species, total 30 plant species were maximum used as well as marked important by the villagers. The most common species preferred by the local people were *Picrorhiza kurrooa* and *Angelica glauca*.

The medicinal plant species told by the villagers are used in various traditional medicinal treatments but most of them fall under the list of endangered plants category. The villagers use to treat various human and animal ailments by making use of different parts of either a particular plant or parts from more than one plant species. Different uses of parts of these exotic plant species directly/indirectly pose a threat to their survival.

Besides, the local people are so much confident about the potential of most of the medicinal plant species e.g., *P. kurrooa*, which is generally used in curing fever, that they don't even consult any doctor or vaidya/folk medicinal practitioners. Most of the medicinal plant species were being used in more than one uses or ailment e.g., many other species like *Allium sativum* and *Allium humile* are used not only for medicinal purposes but also as spices. This traditional multi-purpose use of these species shows the health concerns of the people of the study area but also shows the over-exploitation of these medicinally important species [21-27].

The homogenous responses of the local people indicate that the knowledge on medicinal plants is more or less uniformly distributed among the local people. It has been found that three critically endangered plant species i.e., *P. kurrooa*, *Dactylorhiza hatagirea* and *Saussurea costus* were generally preferred by the local people due to their authentic traditional medical ailment. Out of the total number of plant species favored by the people, 8 species were critically endangered, 5 endangered and 4 were near threatened species and the hale on the survival of these threatened species has increased manifolds due to their low population size, over assemblage from the wild and high predilections of the local people (Table 1).

Local Name	Scientific Name	Part Used	Indigenous Uses	Status	Important to local people (%)
Kala zeera	<i>Carum carvi</i>	Seeds	Delivery time, cold, fever	-	72.26
Pharan	<i>Allium humile</i>	Leaf	Indigestion	-	68.61
Katuki	<i>Picrorhiza kurrooa</i>	Root	Fever, blood purification	CR EN	65.69
Phapher	<i>Fagopyron tataricum</i>	Seed	Lung disorder, urinary complaints	-	61.31
Hathajari	<i>Dactylorhiza hatagirea</i>	Root	Bone fracture, wounds	CR EN	60.58
Kuth	<i>Saussurea costus</i>	Root	Dysentery, ulcer, stomachache	CR EN	59.85
Dolu/ Archa	<i>Rheum emodi</i>	Root	Internal pain	EN	56.93
Surai	<i>Cupressus torulosa</i>	Leaf	Body pain	-	56.20
Bhenkal	<i>Principia utilis</i>	Seed, fruit, root	Rheumatic pain, diarrhea	-	54.74
Choru	<i>Angelica glauca</i>	Root, fruit	Gastric complaints	EN	54.01
Kilmor	<i>Rumex hastatus</i>	Leaf	Cuts, wounds, check bleeding, insect bites	-	51.82
Thuner	<i>Taxus baccata</i>	Leaf, Fruit	Cancer	EN	50.36
Pashanbhed/Silphori	<i>Bergenia ligulata</i>	Root	Fever, stone	NT	50.36

Burans	<i>Rhododendron arboretum</i>	Flower, bark	Digestive & respiratory disorders	-	49.63
Uwa	<i>Hordeum himalayens</i>	Seed	Healing effect	-	48.17
Chaulai	<i>Amaranthus paniculatus</i>	Whole plant	Blood purification, cough, cold, boils	-	45.25
Akhrot	<i>Juglans regia</i>	Bark, leaf, fruit	Toothache	-	43.79
Atis	<i>Aconitum heterophyllum</i>	Root	Tonic, diarrhoea	CR EN	31.38
Bishjadi	<i>Aconitum balfouri</i>	Root	Fever, swelling and pain	CR EN	28.46
Chandru/ chandrayan	<i>Paeonia emodi</i>	Flower	Cuts, ulcer, dysentery	NT	28.46
Tagar	<i>Valeriana jatamansi</i>	Root	Mental disorder	CR EN	20.43
Balchhadi	<i>Arnebia benthamii</i>	Root	Hair tonic, fever, cuts, wounds	CR EN	20.43
Purchu	<i>Artemisia maritime</i>	Whole plant	Antiseptic, blood purification	NT	19.7
Kingor	<i>Berberis aristata</i>	Root, bark	Fever, eye complaints	NT	18.24
Brahmakamal	<i>Saussurea obvallata</i>	Flowers	Cuts, reproductive disorder	EN	17.51
Amesh	<i>Hippophae rhamnoides</i>	Seed, fruit	-	-	11.67
Jatamansi	<i>Nardostachys grandiflora</i>	Root	Pain	CR EN	9.48
Bhojpatra	<i>Betula utilis</i>	Bark, root	Cuts, wounds	-	6.56
Bankakdi	<i>Podophyllum hexandrum</i>	Root, fruit	Cancer, fever, gastric ulcer	EN	5.10
Jangali Lahsun	<i>Allium sativum</i>	Root	Infection	-	3.64

**Table 1:** Indigenous uses, plant part used status and medicinal species important to local people (on basis of %) across the villages in the study area under NDBR region, Uttarakhand. CR EN: Critically Endangered; EN: Endangered; NT: Near Threatened.

Among these 55 plant species, 19 species are used in treating gastrointestinal problems, followed by general health care (15 species), generalized body ache (12 species), uro-genital disorder (6 species), respiratory disorder (5 species), mental disorder (3 species), eye diseases (3 species), blood purification (3 species), heart problems (2 species), bone disease (2 species) and antiseptic (1 species) (Table 2).

Ailments	No. of Species	Name of Species Used
Dermatological Problem	3	<i>Brassica rugosa</i> ; <i>Rosa sp.</i> ; <i>Tagetes patula</i>
Gastrointestinal Problem	19	<i>Saussurea costus</i> ; <i>Allium humile</i> ; <i>Angelica glauca</i> ; <i>Artemisia maritima</i> ; <i>Allium sativum</i> ; <i>Allium stracheyi</i> ; <i>Origanum vulgare</i> ; <i>Potentilla fulgens</i> ; <i>Amaranthus paniculatus</i> ; <i>Podophyllum hexandrum</i> ; <i>Principia utilis</i> ; <i>Rubus foliosus</i> ; <i>Aconitum heterophyllum</i> ; <i>Mentha longifolia</i> ; <i>Colocasia esculenta</i> ; <i>Calotropis procera</i> ; <i>plantago ovata</i> ; <i>Quercus leuco-tricophora</i>
Generalized Body ache	12	<i>Terminalia catappa</i> ; <i>Principia utilis</i> ; <i>Juglans regia</i> ; <i>Cupressus torulosa</i> ; <i>Allium sativum</i> ; <i>Primula macrophylla</i> ; <i>Prunus armeniaca</i> ; <i>Picrorhiza kurrooa</i> ; <i>Ocimum sanctum</i> ; <i>Brassica rugosa</i> ; <i>Arnebia benthamii</i> ; <i>Aconitum balfouri</i>
Respiratory Disorder	5	<i>Angelica glauca</i> ; <i>Ocimum sanctum</i> ; <i>Origanum vulgare</i> ; <i>Eleusine coracana</i> ; <i>Fagopyron tataricum</i>
Uro-genital Disorder	6	<i>Fagopyron tataricum</i> ; <i>Hordeum vulgare</i> ; <i>Saussurea obvallata</i> ; <i>Artemisia nilagirica</i> ; <i>Betula utilis</i> ; <i>Equisetum arvense</i>
Bone Disease	2	<i>Dactylorhiza hatagirea</i> ; <i>Allium sativum</i>
General Health and Tonic	15	<i>Aconitum balfouri</i> ; <i>Aconitum heterophyllum</i> ; <i>Arnebia benthamii</i> ; <i>Carum carvi</i> ; <i>Ocimum sanctum</i> ; <i>Picrorhiza kurrooa</i> ; <i>Pleurospermum angelicoides</i> ; <i>Syzygium cumini</i> ; <i>Allium sativum</i> ; <i>Allium stracheyi</i> ; <i>Amaranthus paniculatus</i> ; <i>Hippophae rhamnoides</i> ; <i>Podophyllum hexandrum</i> ; <i>Taxus baccata</i> ; <i>Mentha longifolia</i>
Eye Diseases	3	<i>Terminalia catappa</i> ; <i>Berberis aristata</i> ; <i>rheum emodi</i>
Mental Disorder	3	<i>Valeriana jatamansi</i> ; <i>Paeonia emodi</i> ; <i>Bergenia ligulata</i>
Antiseptic	1	<i>Artemisia maritime</i>
Blood Purification	3	<i>Amaranthus paniculatus</i> ; <i>Rheum emodi</i> ; <i>Artemisia maritima</i>
Heart Problems	2	<i>Nardostachys grandiflora</i> ; <i>Viola biflora</i>
Others	13	<i>Berberis aristata</i> ; <i>Rhododendron arboreum</i> ; <i>Paeonia emodi</i> ; <i>Allium sativum</i> ; <i>Saussurea obvallata</i> ; <i>Saussurea costus</i> ; <i>Rheum emodi</i> ; <i>Nardostachys grandiflora</i> ; <i>Hordeum himalayens</i> ; <i>Fagopyrum dibotrys</i> ; <i>Carum carvi</i> ; <i>Betula utilis</i> ; <i>Bergenia ligulata</i>

**Table 2:** Plant species used in curing important ailments.

### Plant Parts Used

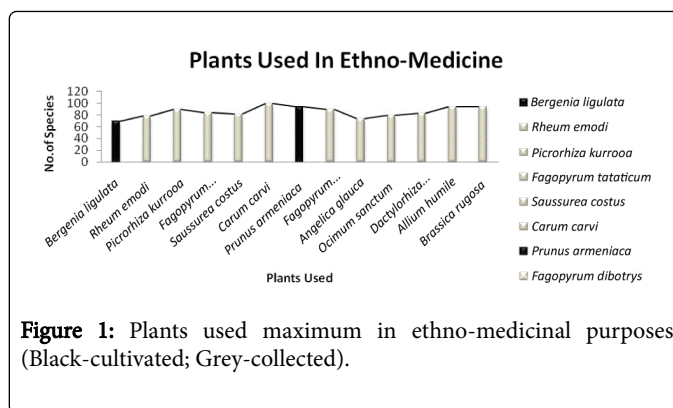
The ethno-medicinal and ethno-veterinary treatments done by the traditional methods depend largely on the medicinal properties of various plant parts. People know that which part of the plant (root, seeds, leaf and bark) can be used for which particular ailment. Thus, if in a particular ailment if root is used, it will result in loss of a whole plant. It has been observed that in most of the ailments, more than one part of the medicinal plant is being used and sometimes parts of more than one medicinal plant species are used in the treatment. It has been observed that people of the study area are less concerned about

medicinally important wild edible species, as according to the people, wild species are abundant in nature, hence need less assiduity, but they are also used in an illicit manner. The analysis of the study area indicates that roots are used in majority of the treatments (17 species), followed by seeds (10 species) and whole plant of 14 species are used in preparing traditional medicines. Among ethno-medicinally, ethno-veterinary and medicinally important wild edibles, roots are seemed to be used maximum in ethno-medicinal practices, followed by ethno-veterinary purposes. Similarly, whole plant is used maximum in ethno-veterinary practices, followed by wild edibles and then in ethno-medicinal purposes. Combination of different parts of plant i.e., roots and bark; flower and fruits etc. is used maximum in context to wild edibles, followed by ethno-medicinal and then ethno-veterinary purposes. The plant parts used in ethno-medicinal purposes include use of 70% of roots, combination of different plant parts is 18% and whole plant is 12%. Similarly in case of ethno-veterinary plants, 57% of the whole plant is used, roots (29%) and combination of different plant parts (14%). Whereas the percentage use of combination of plant parts is maximum in wild edibles i.e., 61%, whole plant (31%) and roots (8%). The collective use of plant parts increases potential of plant for specific ailments but on the other hand it decreases the scope for existence of species. Thus the results show the importance of these plant species in traditional methods of treatment but it also shows the uncontrollable manner of resource use.

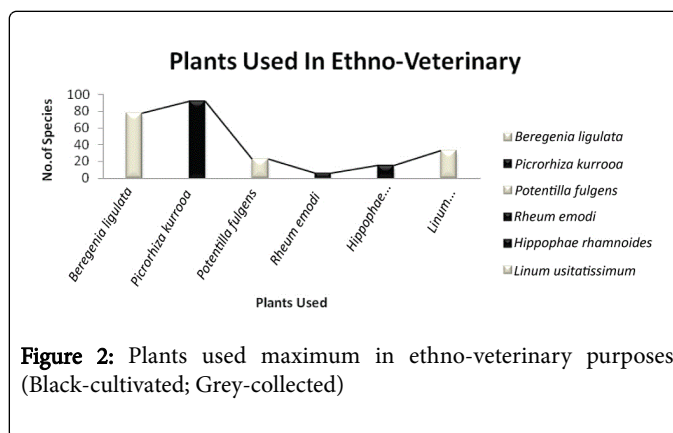
It has been observed that in some cases two or more than two different plant species have common local name that create confusion in identification. Besides, each medicinal plant species has been described in appendix with scientific name, local name, family, life form, and part used, medicinal uses and methods of treatment of plant species. The information in the appendix shows that most of the plant species are used to treat more than one ailment. The pressure has increased on such threatened species with the increase on the number of ethno-botanical uses e.g., *Taxus baccata* (endangered) is preferred for its medicinal value as well as for timber; *Saussurea obvalata* (endangered) is known for medicinal properties and offerings to deity [21-27].

### Trend in Medicinal Plant Collection & Cultivation

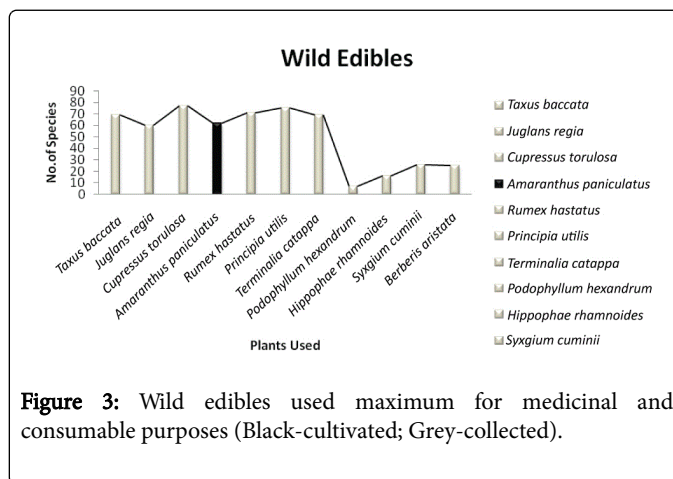
Among the plants used in ethno-medicinal purposes, *Carum carvi* is the highly used medicinal species (now cultivated) whereas, *Berginia ligulata* and *Prunus armeniaca* are still collected from forest (Figure 1). Plants used in ethno-veterinary purposes are still collected from forest but some species e.g., *Picrorhiza kurrooa* and *Rheum emodi* are now cultivated (Figure 2). Among wild edibles, *Amaranthus paniculatus* is now cultivated (Figure 3). But the trend in the cultivation of medicinally important species has still not taken place at a larger extent which can be ascertained by the differences between groups of cultivators (48.9%) and non-cultivators (32.1%) of medicinal plant species. If we compare the consumption and continuous use of wild edibles, it has been found that local people prefer to consume them directly from nature.



**Figure 1:** Plants used maximum in ethno-medicinal purposes (Black-cultivated; Grey-collected).



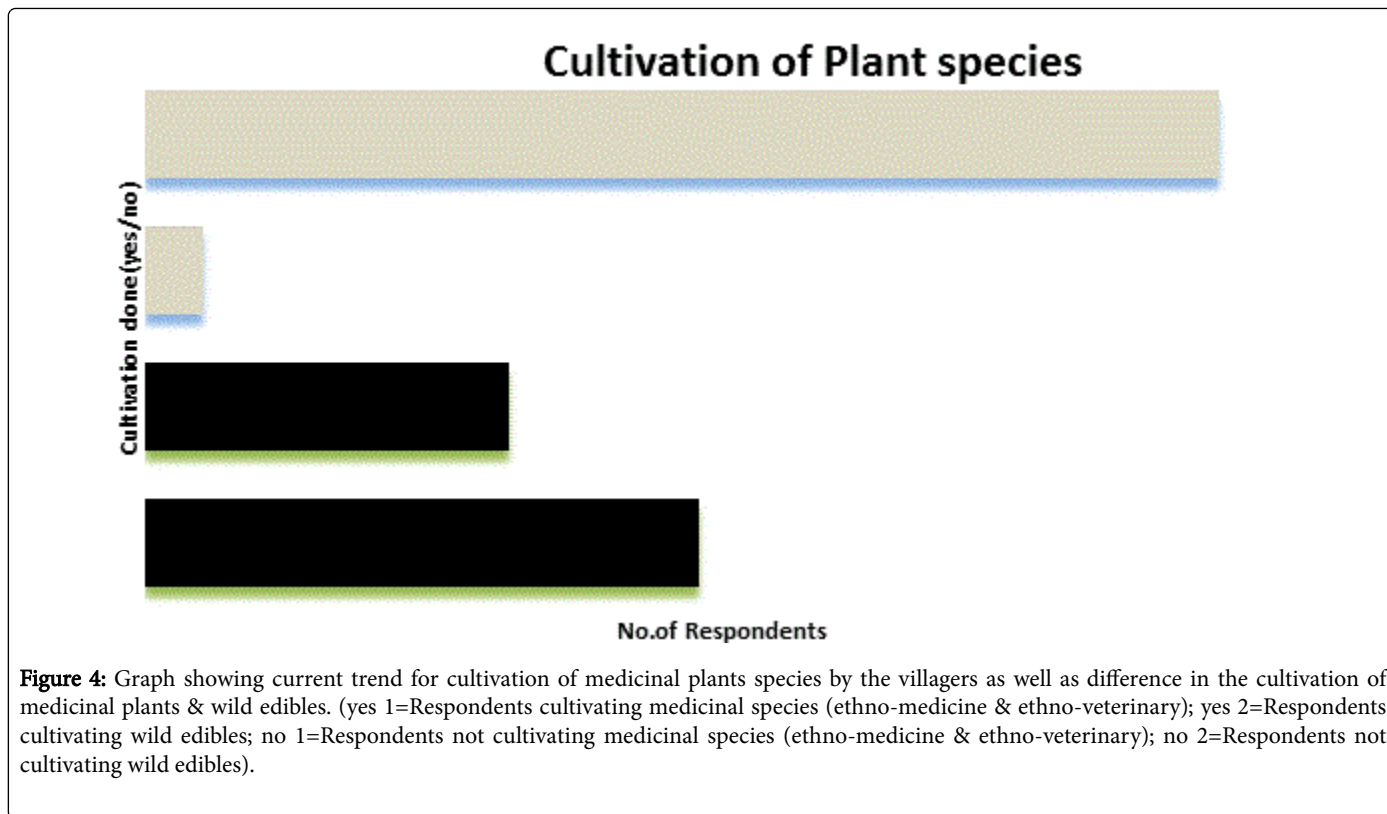
**Figure 2:** Plants used maximum in ethno-veterinary purposes (Black-cultivated; Grey-collected)



**Figure 3:** Wild edibles used maximum for medicinal and consumable purposes (Black-cultivated; Grey-collected).

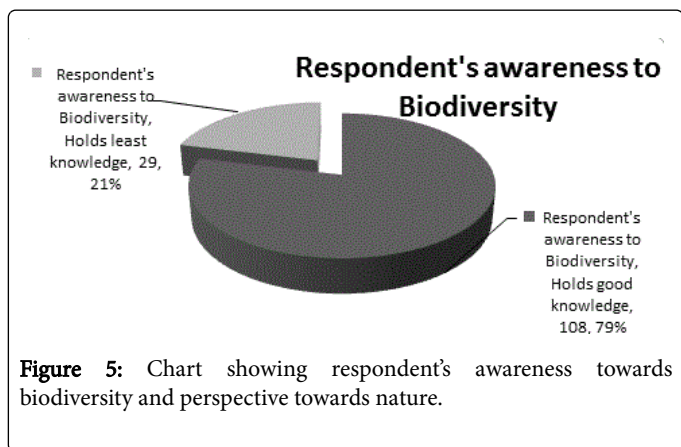
The results also show that 48-49% people cultivate medicinal plants (ethno-medicinal and ethno-veterinary) whereas this figure is very much low in case of wild edibles (5.10%). On the other hand, non-cultivating sector for medicinal plant species constitutes around 32.1% whereas this figure is unexpectedly high in case of wild edibles i.e., 94.8% (Figure 4) [21-27].





### Respondents Awareness to Biodiversity

The results show that 79% of the people are aware about biodiversity and the damage which is being caused to nature, also to their environment. On the other hand, 21% of the villagers are still unaware about the changes that are occurring near to them which show the urgency of proper awareness in the area (Figure 5).



### Conclusion

Illegitimate usage of threatened plant species is raising a question on the susceptibility of their pertinacity. The study also depicts that magnitude of resource use in traditional medicinal system has been drastically reduced and it is on the flux of complete decline or extinction. Thus there is a need for transformation in the traditional

methods of resource use so that it may be upheld for future generations.

An increase in the cultivation of the medicinal plants has been observed in the study area which is a convincing step in the preservation of endangered medicinal plant species but their production is very less due to unavailability of market. There is a need for rise in concern among villagers in order to increase production of medicinal plants of every type which will also help in improving the economic condition of people. Overall, it has given a new hope in preventing the exploitation of medicinal plant of higher altitudes as well as preserving the natural environment.

### References

- Rashid AZMM, Tunon H, Khan NA, Mukul SA (2014) Commercial cultivation by farmers of medicinal plants in Northern Bangladesh. *E J Envi Sci* 4: 60-68.
- Kloos S (2013) How Tibetan Medicine in Exile Became a "Medical System". *East Asian Science, Technology and Society: An International Journal* 7: 381-395.
- Heinen JT, Acharya RS (2011) The Non-Timber Forest Products Sector in Nepal: Emerging Policy Issues in Plant Conservation and Utilization for Sustainable Development. *J Sust Fore* 30: 543-563.
- Shackleton CM, Pandey AK, Ticktin T (2015) Ecological Sustainability for Non-Timber Forest Products. Dynamics and case studies of harvesting, pp: 1-294.
- Sen S, Chakraborty R, De B (2011) Challenges and opportunities in the advancement of herbal medicine: India's position and role in a global context. *J Herb Med* 1: 67-75.
- Berkes F (2012) *Sacred Ecology* (3rd edn.). Routledge, pp: 1-289.
- Kareiva P, Tallis H, Ricketts TH, Daily GC, Polasky S (2011) *Natural Capital, Theory and Practice of Mapping Ecosystem Services*, Oxford University Press Inc., New York pp: 1-357.

8. Gokhale Y, Negi AK (2011) Community-based Biodiversity Conservation in the Himalayas. The Energy and Resources Institute (TERI), pp: 1-178.
9. Rai M, Acharya D, Rios JL (2011) Ethnomedicinal plants: Revitalizing of Traditional Knowledge of Herbs. Science Publishers, CRC Press, pp: 1-518.
10. Bhatt D, Kumar R, Joshi GC, Tewari LM (2013) Indigenous Uses of Medicinal Plants by the Vanraji Tribes of Kumaun Himalaya, India. *J Med Pla Res* 7: 2747-2754.
11. Chauhan A, Kumar A (2011) Phyto-chemical Analysis of the *Zizyphus numularia* roots, National Chemical Constellation Cheminar, Punjab, pp: 20-21.
12. Awan ZI, Rehman AA, Minhas FA, Khan MN (2013) Ethnobotanical Importance of Some Highly Medicinal Plants of District Muzaffarabad, Pakistan with special reference to the Species of the Genus *Viburnum*. *IOSR J Phar Biol Sci* 6: 53-66.
13. Samant SS, Vidyarthi S, Pant S, Sharma P, Marpa S, et al. (2011) Diversity, Distribution, Indigenous Uses and conservation of the medicinal plants of Indian Himalayan Region used in Cancer. *J Biodiv* 2: 117-125.
14. Rawat B, Joshi M (2014) Nanda Devi Biosphere Reserve as a successful example of old traditions and new approaches in long-term research and their analyses. *Int J Adv Res* 2: 245-256.
15. Dangwal LR, Rana CS, Sharma A (2011) Ethno-medicinal plants from transitional zone of Nanda Devi Biosphere Reserve, District Chamoli, Uttarakhand (India). *Ind J Nat Pro Res* 2: 116-120.
16. Sharma VP (2010) *Nature at Work: Ongoing Saga of Evolution*. Publication of the National Academy Sciences, India, Springer, pp: 369-394.
17. Ballabha R, Rawat DS, Tiwari JK, Tiwari P, Gairola A (2013) Wild Edible Plant Resources of the Lohba Range of Kedarnath Forest Division (KFD), Garhwal Himalaya, India. *Int Res J Biol Sci* 2: 65-73.
18. Kandari LS, Phondani PC, Payal KC, Rao KS, Maikhuri RK (2012) Ethnobotanical Study towards Conservation of Medicinal and Aromatic Plants in Upper Catchments of Dhauri Ganga in the Central Himalaya. *J Moun Sci* 9: 286-296.
19. Kumar A, Mitra M, Adhikari BS, Rawat GS (2016) Flora of Niti valley: a cold arid region of Nanda Devi Biosphere Reserve, Western Himalaya, India. *Check List: The J Bio Data* 12: 1824.
20. Bernard HR (2011) *Research methods in Anthropology: Qualitative and Quantitative Approaches* (4th edn.) Altamira Press, United States, pp: 1-187.
21. Kala CP, Silori CS (2013) *Biodiversity, Communities and Climate Change*. The Energy and Resources Institute (TERI), pp: 1-354.
22. Bussmann RW (2013) The globalization of traditional medicine in northern Peru-from shamanism to molecules. *Evid Based Complement Alternat Med*, p: 46.
23. Morgon PA (2015) *Sustainable development for the healthcare industry*. Springer, Berlin, p: 154.
24. Kuniyal CP, Bisht VK, Negi JS, Bhatt VP, Bisht DS, et al. (2015) Progress and prospect in the integrated development of medicinal and aromatic plants (MAPs) sector in Uttarakhand, western Himalaya. *Environment, Development and Sustainability, Springer* 17: 1141-1162.
25. Kumar A, Mitra M, Adhikari BS, Rawat GS (2016) Flora of Niti valley: a cold arid region of Nanda Devi Biosphere Reserve, Western Himalaya, India. *Check List: The J Biodi Data*.
26. Shackleton CM, Pandey AK, Ticktin T (2015) *Ecological Sustainability for Non-Timber Forest Products: Dynamics and case studies of harvesting*. Routledge, pp: 1-294.
27. WHO (2013) *WHO Traditional Medicine Strategy 2014-2023*, Geneva.