INTRODUCTION OF NITROGEN FIXING MEDICINAL PLANTS : A SUITABLE ALTERNATIVE FOR THE CONSERVATION OF EXPOSED SITES IN THE GARHWAL HIMALAYAN ECOSYSTEM

A.K. PARANDIAL, PANKAJ KUMAR, H.B. NAITHANI AND T.C. POKHRIYAL

Plant Physiology, Botany Division,
Forest Research Institute, Dehra Dun (India).

Introduction

Garhwal Himalaya is one of the richest floristic zones of India situated between 20°26'-31°28'N latitude 77°49'-80°06'E longitude with total area of about 3,000 km^2. It provides matchless wealth of more than 300 species of medicinal plants having therapeutic property due to varied climatic and edaphic conditions. About 70% plants used in preparing drugs for indigenous system of pharmacology are available in this region. In view of ever increasing demand for herbal healthcare products, it is imperative that the precious wealth of traditionally exploited medicinal plants be scientifically preserved, conserved and utilized *in-situ* and *ex-situ* in the isoecological areas of Garhwal Himalayas.

Fifty per cent of our forests are seriously affected by soil erosion every year. Soil erosion is one of important reasons for the degradation of biodiversity and denudation of fragile Himalayan ecosystem. We are losing around 16 tonnes/ha soil every year. Low fertility is a common problem in the maximization of biomass and establishment of vegetation on the degraded sites. Nitrogen is generally deficient in these soils.

Nitrogen fixing plants are a good source of biologically fixed nitrogen. It has greater importance because it releases diverse organic compounds, which might be stimulating other beneficial microbial processes in the rhizosphere. In order to exploit judiciously the vast treasure of fabulous wealth of nitrogen fixing medicinal plants in this region, there is an urgent need to develop systematic conservation and cultivation packages of these species. To ensure the perpetual availability of these species in relation to sustainable utilization approach, the plants prevailing under natural conditions should be propagated for the conservation purposes.

Reports on N-fixing species from Himalayan forests are rare. Therefore an attempt has been made in the present article to enumerate the nitrogen fixing species of medicinal plants for the conservation of degraded sites in the Garhwal Himalaya.

Results and Discussion

A survey of N-fixing plants in the Garhwal Himalayas was conducted by Pokhriyal and associates in the pre- and post-monsoon period during the last

Table

Important Nitrogen Fixing Leguminous Medicinal Plants

Sl. No	Species	Vernacular name	Habit*	Habitat
1	2	3	4	5
1.	*Acacia nilotica* ssp. *indica* (*A. arabica* Willd)	Babul	T	Common allover India
2.	*Acacia catechu* Willd.	Khair	T	Common in many parts of India
3.	*Acacia fornesiana* Willd.	Gandh Babool	S	Throughout India
4.	*Albizia lebbek* Willd.	Siris	T	Throughout India
5.	*Abrus precatotious* Linn.	Ratti	C	Throughout India in plains
6.	*Astragalasstrabiliferous* Willd.	Kon	S	Western Himalayas
7.	*Astragalas multiceps* Wall.	Sarmul	S	Western Himalayan region
8.	*Atylosia scarabaeordes* (L.)	Wild kulthi	C	Western Himalayan region
9.	*Bauhenia variegata* Linn.	Kachnar	T	Sub-Himalayan tract and throughout forests of India
10.	*Butea frondosa* Koen. ex Roxb.	Palas	T	Mountainous regions of India

1

(herbs, shrubs, climbers and trees) of Garhwal Himalaya.

Altitudinal range (m)	Part utilised	Uses
6	7	8
Upto 600	Leaves, bark, gum	Tender growing tips are used in coughs, dysentery and diarrohea. The decoction of bark is used as gargle and mouth-wash in cancerous and syphilitic affections. It is also useful in gonorrhea, cystitis, vaginilis, leucorrhoea and conjuctivitis. Gum is used in fevers and is as tonic.
60-1000	Wood, gum	Wood extract is used as astringent, also in hoarse throat, loss of voice, bleeding of gums. Also as application of bedsores.
Up to 650	Bark, leaves	Bark is astringent, wash for teeth, and useful in bleeding gums. Leaves are useful in gonorrhoea.
Upto 1200	Bark, leaves, flowers, seeds, oil	The fresh decoction is used three times daily in stomach trouble and dysentery. Seed are aphrodisiac, astringent and are used in piles, leaves in opthalmia, flowers in boils and eruptions and oil in snakebite.
Upto 650	Leaves, root, seeds	Leaves relieve pain, swellings, used in rheumatism and leucoderma. Roots are laxative. Seeds are useful in sciatica, paralysis and other nervous diseases.
2600-4000	Gum	As substitute to tragacanth.
3000-4000	Seeds	Used in leprosy, Coliac
900-1200	Plant	The plant decoction (100ml) is used as a tonic after delivery.
Up to 1200	Bark, buds, root	Bark is astringent, tonic; root is carminative and flowers laxative. Bark is used in ulcers and skin diseases, dried buds in diarrhoea and to remove worms, roots to control obesity.
Up to 400	Leaves, flowers bark, seed, gum	Gum is used in ringworm, diarrhoea, dysentery. Seeds are laxative, anthelmintic, Leaves aphrodisiac astringent, and are used in boils, pimples, tumours, Flowers dispel swellings, promote diurasia.

Contd...

1	2	3	4	5
11.	*Cajanus cajan* (L.) Millsp.	Arhar	S	Cultivated in agricultural fields throughout India
12.	*Cassia alata* Linn.	Dadmurdan	S	Cosmopolitan in tropics
13.	*Cassia fistula* Linn.	Amalta	T	Throughout tropical India
14.	*Cassia occidentalis* Linn.	Kasunda	S	Common weed scattered from the Himalayas to plains of India
15.	*Cassia tora* Linn.	Chakunda	S	Throughout tropical India
16.	*Cicer arientinum* Linn.	Chana	H	Throughout tropical India
17.	*Clitoria ternatia* Linn.	Aparajita	C	Common all over India
18.	*Cyamopsis teragonoloda* Taub.	Gowar	S	Cultivated in many parts of India
19.	*Dalbergia lanceolaria* Linn.	Bander siris	T	Doon valley, Raiwala, Plains of India
20.	*Dalbergia sissoo* Roxb.	Shisam	T	Lower Himalaya and plains of India
21.	*Desmodium gangaticum* DC.	Saalawanna Salpan	US	Throughout the plains of India and lower Himalayan regions.
22.	*Desmodium tilifolium* Roxb.	Chamkat	S	Central and outer Himalayas
23.	*Dolichos uniflorus* Lamk.	Kulith, gahath	H	Common all over India, cultivated in hills
24.	*Erythriana suberosa* Roxb.	Pangara	T	Tons and Yamuna valley in Jaunnsar and Doon Valley
25.	*Flemingia strobilifera* R. Br.	Kasraut	S	Subtropical forests and lower hills.

6	7	8
1000	Leaves, flowers	Paste of leaves or flowers is applied in sores of mouth and tongue. Leaf decoction used in gargling.
600	Leaves	Leaves are used in ringworm, skin diseases and insect bites.
Upto 400	Leaves, fruits, seeds	Pulp of fruits, roots, bark and powdered seeds have purgative properties. Pulp is used as laxative for children. Paste of leaves is applied on ringworm.
600	Leaves, root, seeds	Leaves, roots and seeds are purgative and are useful in cough and whooping cough.
Up to 700	Leaves, root, seeds	Leaves and seeds are used in ringworm and other skin diseases, leprosy, psoriasis. Paste of roots in ringworm.
1800	Leaves, seeds	Boiled leaves are applied to sprain and dislocated limbs. Roasted pikse is used as an aphrodisiac.
Up to 1000	Seeds, roots	Root-Laxative, diuratic, anthelmintic, tonic to brain, useful for eyes, pain, tuberculosis, leucoderma, elephantitis.
650	Fruit	Fruit is laxative, improves appetite and removes night blindness.
650	Bark, seed	Bark is used in intermittent fever by external application. Oil of seeds in rheumatism.
Up to 1000	Leaves, bark, wood	Bark is aphrodisiac, expectorant, anthelmintic, antipyretic, appetizer, cures skin diseases, ulcers, diseases of blood, leucoderma. Leaves in eye diseases, wood is useful in leprosy, boils, eruptions, and to allay vomiting.
60-1800	Roots	Astringent, useful in chronic fevers, chronic affections of chest and lungs, vomiting, nausea. Plant is considered antipyretic.
1200-2500	Roots, leaves	Roots are tonic to chest, brain and cure piles, uretheral charge, opthalmia, improve appetite, teeth and enrich blood.
Up to 1200	Grain	Anthelmintic, antipyretic, diuratic. Useful in abdominal complaints, asthma, bronchitis, urinary discharge.
650	Bark, Leaves	Bark is used in medicines.
1000	Roots	Roots are used in epilepsy, small potions of roots are used to induce sleep in children under pain without any side effects.

Contd...

1	2	3	4	5
26.	*Glycine soja* Merrill.	Bhat	S	Lower Himalayan slopes
27.	*Indegofera tinctoria* Linn.	Neel	S	Throughout India
28.	*Mimosa pudica* Linn.	Lajwanti	S	Throughout tropical India
29.	*Mimosa intsia* Mart.	Shiah-kanta	S	Grown as hedge in gardens and fields throughout India
30.	*Mucuna pruriens* (Linn.) DC.	Alkushi	H	Throughout plains
31.	*Ougeinia oojeinensis* Roxb.	Sandhan, Asaindu	T	Sub-Himalayan tract and outer Himalayas
32.	*Phaseolus mungo* Linn.	Moong	S	All over India
33.	*Pongamia glabra* Vent.	Kiramal, Karanja	T	All over India
34.	*Pseudarthia viscida* W. & A. Prodr.	San parni	H	Tropical zone of India
35.	*Psoralea corylifolia* Linn.	Babehi	H	Himalayas to Sri Lanka
36.	*Puraria tuberosa* DC.	Sirala	C	W. Himalaya to Sikkim and hilly tracts of India
37.	*Rhynchosia minima*	Nahini kamalave	S	Common in forests throughout India
38.	*Saraca asoca* (Roxb.) De Willde.	Asoka-laal	T	Cultivated in gardens throughout India
39.	*Sesbania aculeata* Pers.	Daincha		Tropical zones of India

6	7	8
2000	Seed	Astringent
350	Leaves	Plant is used in piles, epilepsy, leucoderma, asthma.
650	Leaves, roots	Plant is astringent, antiseptic, blood purifier. Used in diar rhoea, dysentery, haemophilic conditions, and leucorrhoea Root is aphrodisiac, cures kapha, asthma, vaginal and uterine complaints, useful in piles and fistula.
650	Leaves, roots	Leaves used in piles, burns, root is used in debility.
1050	Seeds, roots	Roots are used to cure diseases of nervous system, kidney and in dropsy, seeds astringent and tonic.
850	Bark	Bark is anthelmentic, astringent, cures kapha, vata, dysentery, leucoderma, urinary disorders, ulcers, blood and skin diseases, and anaemia.
1100	Seeds, roots	Seeds tonic, laxative, aphrodisiac, appetizer, diuretic, good for heart cure vata, piles asthama. Root is narcotic and a remedy for aching bones.
650	Seeds, root, seeds	Root and bark are anthelmintic, used in diseases of eye, skin, piles, wounds, spleen and abdomen. Leaves are laxative, anthelmintic, cure vata, kapha and diabeties. Fruit and seeds used in diseases of head, skin, eye. Oil is used in diseases of eye, rheumatism, skin ailments and wounds.
1000	Leaves	Plant is used in rheumatism, excessive heat and fever, asthma, heart disease piles and worms.
1100	Fruit, seeds, root	Root for arresting tooth decay, Leaves in diarrohea, Fruts cure leprosy, skin diseases, kapha, vata, asthma, bronchitis, piles, anaemia. Seeds antipyretic, anthelmintic, used in skin diseases.
650	Roots, Flowers	Root is a demulucent and refrigerant in fevers, reduces swellings of joints. Flower is cooling and aphrodisiac. Tuber is aphrodisiac, used in leprosy, vata, diseases of blood.
400	Leaves	Leaves are used as abortifacient.
1200	Bark, seeds, flowers	Uterine tonic, useful in tumours, piles, colics, diseases of blood.
400	Roots, seeds	Roots anthelmintic, diuratic, useful in diseases of eye. Seeds in skin diseases.

Contd...

1	2	3	4	5
40.	*Sesbania aegyptiaca* Poir.	Saora	T	Tropical zones of India
41.	*Sesbania grandiflora* Pers.	Agasti	S	Cultivated in many parts of India
42.	*Smithia confereta* Sm.	Naichi bhaji	H	Throughout India
43.	*Sophora mollis* Garh. Wall.	Sakina	S	Plains and lower hills of NW India
44.	*Teramnus labialis* Spreng	Mashoni	H	Wild in forests and fields in the foothills of Himalayas to
45.	*Theprosia purpurea* Pers.	Jhojharu, sarpankha	H	Common weed in wastelands throughout India
46.	*Trigonella foenum-graceum* Linn.	Methee	H	Cultivated in many parts of India throughout India
47.	*Trifokum repens* Linn.	Shaftal	H	Temperate and alpine Himalayas and Nilgiris
48.	*Uraria picta* Desv.	Dabra, Chitraparni	H	Throughout plains of India, Doon valley and outer Himalayas
49.	*Zornia disphyla* Pers.	Birmach	H	Himalayas to Sri Lanka

* T = Trees, S = Shrubs, US = Under-shrubs, C = Climbers, H = Herbs

decade. The survey recorded 151 leguminous and 10 non-leguminous N-fixing species in the Garhwal Himalayas. A largenumber of nitrogen fixing herbs, shrubs, climbers and trees having medicinal uses were recorded in the survey (Table 1 and 2). Among the species surveyed and identified nitrogen fixing medicinal plants 43% were shrubs, 25% herbs, 25% trees and 7% were climbers (Fig. 1). Total six families were represented during enumerations of these species (Fig. 2). In most of these species nitrogenase activity in the root nodules has been reported by Pokhriyal *et al.* (2002). Earlier several workers have reported the medicinal uses of these species occurring in Himalayan eco-system. Important contributions include Kirtikar and Basu (1918), Chopra (1933), Chopra *et al.* (1956) in general and by Gaur (1999), Gaur *et al.* (1995), Bisht

6	7	8
400	Leaves, seeds, roots	Leaves purgative, anthelmintic, useful in hydrocoele and all pains and inflammations. Seeds in ulcers, diseases of spleen, diarrohea etc. roots in kapha, tuberculosis glands, fever, ulcer diabetes, leucoderma and throat trouble.
400	Leaves, flowers, bark, roots	Roots remove vata, kapha, andinflammation. Leaves as laxative diuratic, antipyretic Flowers in eye diseases and bark as astringent.
1000	Leaves and whole plant	Plant is used as laxative, antibilious and antirehumatic.
800	Roots, seeds	Root is used in rheumatism, venereal diseases and dysentery.
	Fruits, plant	Fruits used as aphrodisiac, astringent, antipyretic. Plant in tuberculosis.
1000	Leaves, wood, roots	Root is used as anthelmetic, diuratic, antirhumatic, in liver troubles and enlargement of spleen.
1500	Leaves, seeds	Seeds are antipyretic, anthelmintic, astringent, cure leprosy, vata vomiting, bronchitis, piles, useful in heart problems and rheumatism. Leaves used in internal and external swellings, prevent falling of hair.
1400-1800	Flower	Flower is used in gouts and as astringent
650	Whole plant, pods, roots	Heart trouble, Root is aphrodisiac used in coughs, chills and fevers.
1200	Roots, Whole plant,	Herb is used in dysentery. Roots are used to induce sleep in children.

et al. (1988, 1989), Datt and Brij Lal (1994) in relation to medicinal plants of Himalayan region.

Among the nitrogen fixing medicinal plants of the Himalayan ecosystem majority of species are shrubs and herbs (total 68%) and are capable of providing good ground cover. Many of these species are highly palatable and thus may have greater acceptability among the local populace. The benefits soil amelioration due to addition of nitrogen along with the benefits of reduction in soil erosion make these species a good choice for use in the ecorestoration projects. As most of these species are easily manageable the cost of raising them is low.

The following approaches can be followed to utilize the potentials of nitrogen fixing species under various plantations

Table

Non-leguminous N fixing medicinal plants

Sl. No.	Species	Vernacular name	Habit*	Family	Habitat
1.	*Datisca cannabine* Linn	Akalbir	H	Datiscaceae	Temperate and subtropical Himalayas
2.	*Elaeagnus latifolia* Thunb.		S	Elaeagnaceae	*Hills of India*
3.	*Elaeagnus umbellate* Thumb.		S	Elaeagnaceae	Temperate Himalayas
4.	*Elaeagnus umbellate* Thumb.	Goazwain	H	Elaeagnaceae	Temperate Himalayas
5.	*Hippophae rhamnoides* Linn.	Charma, Sorla	S	Elegnaceae	Temperate and subtropical Himalayas
6.	*Alnus nepalensis*	Utis	T	Betulaceae	Throughout Himalaya
7.	*Hippophae salicifolia* D. Don.	Chuk, Amli	S	Elegnaceae	Temperate and Subtropical Himalayas
8.	*Myrica esculenta* Buch.-Ham.ex D.Don	Kayaphalla, Kaphal	T	Myricaceae	Sub-tropical Himalayas
9.	*Potentilla fulgans* Wall.	Bajradanti	H	Rosaceae	Temeprate Himalayas

*T=Trees, S=Shrubs, C=Cimbers, H=Herbs.

apart from raising sole crops of important N fixing medicinal plants:

1. *Interplanting N-fixing trees with non N-fixing trees* : Nitrogen fixing species can be interplanted with the other medicinal plants/forestry/horticultural species under wastelands, social and agroforestry plantations. The fact that the inter-cultivation of N-fixing species with non-nitrogen fixing species improves the overall productivity as well as the soil fertility is well established in agriculture and forestry (Davey and Wollum II, 1984), (De Bell and Radwan, 1979).

2. *Underplanting of N-fixing species with non N-fixing species* : The under planting of N-fixing medicinal plants as ground cover plants in a plantation may have several advantages in addition to the added

2

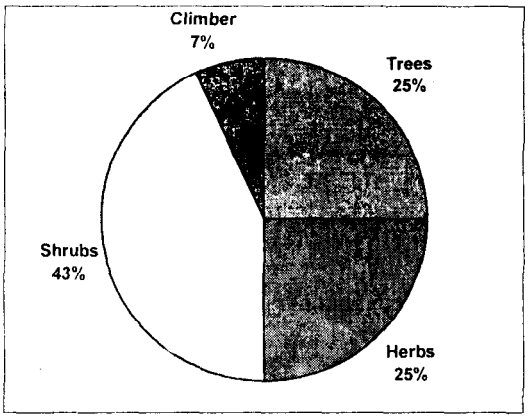
(herbs, shrubs, climbers and trees) of Garhwal Himalaya

Altitude (m)	Part Utilised	Uses
300-1800	Plant	Diuratic, expectorent and purgative.
1000-3100	Flowers	Flowers cardiac and astringent
1000-3100	Flowers, Seeds	Flower cardiac and astringent, Seeds stimulant in coughs & oil in pulmonary affections.
1000-3100	Plant	Herb is given for pulmonary affections.
2100-3600	Fruit	Fruits used in pulmonary disorders, tumour, sunburn.
Up to 2000	Bark	In Nagaland the green bark is gound into paste and this paste is taken in stomach-ache and dysentery.
2100-3600	Bark, Fruit	Bark is used in cure of cancer, wounds and ulcers. Fruits are rich in Vitamin C and are used in lung complaints.
1000-1600	Bark and fruit	Bark is rich in tannins and contains glycosides. It is used in asthma, fever, lung infection, diarrohea, and diuresis. Seeds are pectoral, sedative, carminative.
2000-3000	Root	Used in toothpastes and for strengthening gums.

Nitrogen. Development of a good ground cover may reduce erosion and eliminate the need for cultivation of young plantations. While some species may protect the principal species from frost during winter, the mat of dead plants controls the growth of weeds during the summer.

3. *Rotational planting* : The crop rotation with N-fixing medicinal herbs/ shrubs might be more favourable for sites that have been drastically eroded and disturbed such as mine spoils etc. On such areas common crops of other medicinal plants will not frequently grow with an acceptable rate, because of N deficiency, low soil organic matter content and adverse soil physical factors. The growth of N-fixing crop prior to the desired crop may be useful for the principal crop rather than inter-planting crop.

Fig. 1

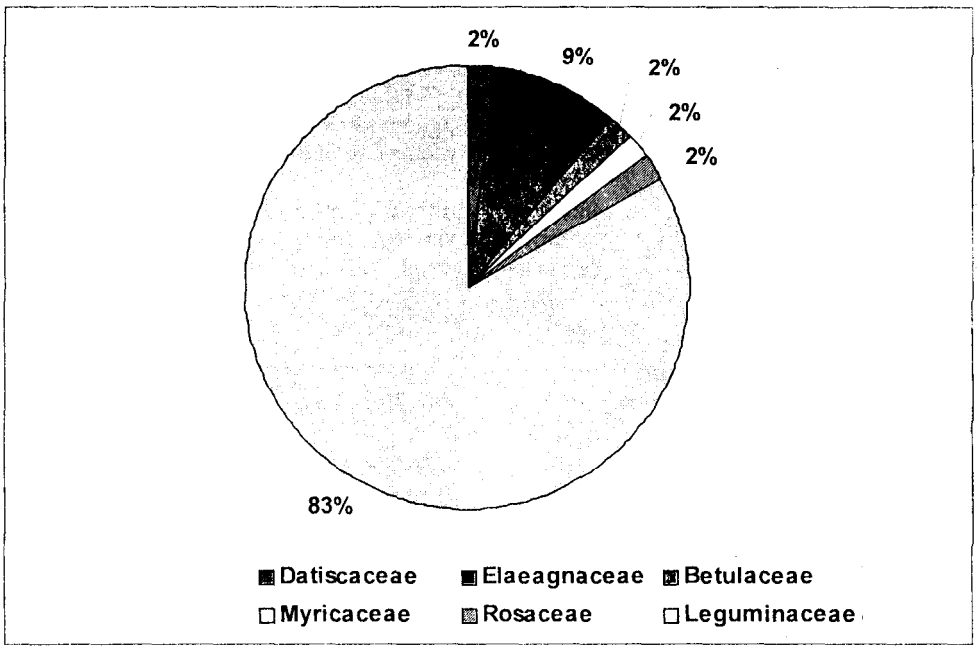


Distribution of N-fixing medicinal plants (herbs, shrubs, climbers and trees) in Garhwal Himalayas

There is a great need to popularize these species by highlighting the medicinal as well as soil conservation properties among local folk.

A suitable technology package on the various aspects of these species are required to be worked out in detail for the extension activities on the basis of agro-ecological zones in this regards.

Fig. 2



Distribution of N-fixing leguminous and non-leguminous medicinal plants in Garhwal Himalayas

SUMMARY

The Garhwal Himalayas are one of the richest floristic zones for the medicinal plants of Indian subcontinent. It provides matchless wealth of more than 300 rare and endangered species of medicinal plants having therapeutic properties. The over exploitation of these precious material from himalayan forest ecosytstem over last few decades have not only pushed these towards extinction but also enhanced the problem of soil erosion, land degradation and loss of biodiversity in the area. Introduction of nitrogen fixing plants may provide an important tool for the ecorestoration attempts in this area. Advocating nitrogen flxing plants having medicinal uses may provide wider acceptability among the local populace from economic as well as soil conservation point of view. The adoptability of indigenous species may be useful for planting and rejuvenating the degraded sites in different altitudinal zones of the Himalayan ecosystem. In the present article an attempt has been made to enumerate the existing nitrogen fixing species of medicinal values at various altitude for the conservation of degraded sites in Garhwal Himalayas.

नाइट्रोजन स्थिरक औषध पादप लगाना – गढ़वाल हिमालयी परिस्थिति प्रणाली के अनावृत स्थलों का संरक्षण **करने का उपयुक्त विकल्प**

ए०के० परंदियाल, पंकज कुमार, एच०बी० नैथाणी व टी०सी० पोखरियाल

सारांश

गढ़वाल हिमालयी क्षेत्र भारतीय उपमहाद्वीप के औषधीय पादपों की दृष्टि से सम्पन्नतम पेड़ पौधों क्षेत्रों में आता है । यहां 300 से अधिक दुर्लभ और संकटापन्न औषधीय पेड़ पौधे की अनुपम सम्पदा मिलती पाई जाती है जिसमें रोग उपचारी गुण हैं । हिमालयी वनों की परिस्थिति संहति से इस मूल्यवान वस्तु का पिछले कई दशकों से अधिक समयतक अत्याधिक विदोहन किया जाने से इसे न केवल विलोप होने की ओर धकेल दिया है बल्कि यहां मृदा अपक्षरण, भूमि व्याहास और इस क्षेत्र की जैवविविधता में कमी भी बढ़ा दी है । नाइट्रोजन स्थिरक पेड़ पौधों को यहां लगाना इस क्षेत्र में परिस्थिति - पुनर्स्थापन करने का महत्वपूर्ण उपकरण बन सकता है । औषध उपयोग नाइट्रोजन स्थिरक पेड़ पौधों को लगाने का प्रतिपादन करना आर्थिक एंव मृदा संरक्षण दृष्टि से भी स्थानीय लोगों में ज्यादा स्वीकार्य रह सकता है । देशज पादप जातियों को अपनाना हिमलायी परिस्थिति - संहति की विभिन्न ऊँचाईयों वाले क्षेत्रों में रोपने और उन्हे पुनर्जीवित प्रदान करने को भी उपयोगी रहेगा । प्रस्तुत अभिपत्र में गढ़वाल हिमालयी क्षेत्र में व्याहासित स्थलों को संरक्षित करने के लिए विभिन्न ऊंचाइयों पर लगाने के लिए औषध महत्व वाले वर्तमान नाइट्रोजन स्थिरक पादपजातियों के परिगणन का प्रयास किया गया है ।

References

Bisht, M.K. K.C. Bhatt and R.D. Gaur (1988). folk medicines of Arakot valley in District Uttarkashi: An ethanobotanical study. *Indegenous medicinal plants*. (Kaushik, P. ed.). Today & Tomorrow Printers and publishers, New Delhi. pp. 157-166.

Bisht, P.S., V.K. Kediyal and A.K. Parandiyal (1990). Some medicinal plants of Rupkund area of North-East Garhwal Himalayas. *Higher plants of Indian Subcontinent*, **1**: 259-274.

Chopra, R.N. (1933). *Indigenous drugs of India*. Calcutta Art Press, Calcutta.

Chopra, R.N., S.L. Nayar and I.C. Chopra (1956). *Glossary of Indian Medicinal Plants*. Publication and information directorate, C.S.I.R., New Delhi.

Datt, Bhaskar and Brij Lal (1994). Ethnobotanical notes on some plants from Uttarkashi district of Garhwal Himalaya, U.P. *Higher plants of Indian Subcontinent*, **3**: 263-271.

Davey, C.B. and A.G. Wollum II (1984). Nitrogen flaxation system in forest plantations. *Nutrition of plantation forests* (G.D. Bowen and E.K.S. Nambiar, eds.). Academic Press, New York. pp. 361-37.

De Bell, D.S. and M.A. (1979). Growth and nitrogen relation of coppiced black cottonwood and Red alder in pure and mixed plantations. *Symbiotic Nitrogen Fixation in Actinomycete nodulated Plants*. Bot. Gazt. (Supp.) March. pp. S-97 to S-101.

Gaur, R.D. (1999). *Flora of district Garhwal: North-west Himalaya (with ethnobotanical notes)*. Transmedia, Srinagar, Garhwal.

Gaur, R.D., D.S. Rawat and L.R. Dangwal (1995). A contribution to the flora of Kauripass Dalisera Alpine zone in Garhwal Himalaya. *J. Econ. Tax. Bot.*, **19**(1): 9-26.

Kirtiker, K.R. and B.D. Basu (1918). *Indian Medicinal Plants*. Pub. L.M. Basu Allahabad.

Pokhriyal, R.C., K.C. Himmat Singh, Vijay Rawat, A.K. Parandiyal and Pankaj Kumar (2003). Introduction of Nitrogen fixing plants a sustainable approach for the plantation forestry programme. *IInd International congress of Plant Physiology on sustainable plant productivity under changing environment* Jan. 8-13, I.A.R.I., New Delhi.