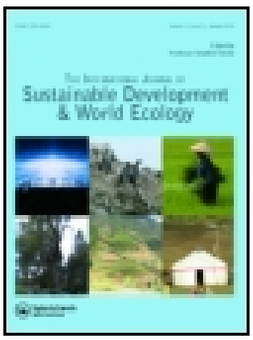

The International Journal of Sustainable Development & World Ecology

ISSN: 1350-4509 (Print) 1745-2627 (Online) Journal homepage: https://www.tandfonline.com/loi/tsdw20

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To cite this article: S. S. Samant & U. Dhar (1997) Diversity, endemism and economic potential of wild edible plants of Indian Himalaya, The International Journal of Sustainable Development & World Ecology, 4:3, 179-191, DOI: 10.1080/13504509709469953

To link to this article: https://doi.org/10.1080/13504509709469953

Int. J. Sustain. Dev. World Ecol. 4 (1997) 179–191

Diversity, endemism and economic potential of wild edible plants of Indian Himalaya

S.S. Samant and U. Dhar

G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora-263 643, India

Key words: Himalaya, native communities, diversity, endemism, potential

SUMMARY

The rich plant diversity of the Indian Himalaya is utilized by the native communities in various forms as medicine, edible/food, fodder, fuel, timber, agricultural tools, etc. Among these, wild edible plants form an important source as a supplement/substitute food in times of scarcity for native communities. Because land holdings are small and subsistence agriculture prevails, the natives gather many wild plants for food. This paper presents an inventory of wild edible plants of Indian Himalaya used by local communities. Over 675 wild plant species, representing 384 genera and 149 families, are used as food/edible and their various parts are either consumed raw, roasted, boiled, fried, cooked or in the form of oil, spice, seasoning material, jams, pickles, etc. The species were analysed for diversity in different phytogeographical provinces, altitudinal distribution, endemism, origin and potentials. West Himalaya shows the highest diversity (50.96%) of edible plants and East Himalaya the maximum number of endemics (18 taxa) and wild relatives of economic plants (39 taxa). Mass scale propagation, dissemination of information packages to local inhabitants to ensure that wild edibles remain as a resource for income generation, and strategies for conservation and management are recommended.

INTRODUCTION

Indian Himalaya, stretching from Jammu and Kashmir in the northwest to Arunachal Pradesh in the east, includes parts of Trans, Northwest, West, Central and East Himalaya (Rodger and Panwar, 1988). It lies between 27°50'–37°6' N and 72°30'–97°25' E, covering approximately an area of 419 873 km^2 with 2500 km length and 240 km width. The entire region is endowed with a wide range of physiography, climate, soil and biological wealth. It has a large altitudinal range (300–8000 m), with a rich diversity of habitats providing varied macroclimates and ecological niches not only for plants but also for humans. The vegetation along an altitudinal gradient includes sub-tropical, temperate, sub-alpine and alpine types.

Indian Himalaya supports about 8000 species of flowering plants (47.06% of the total flowering plants of India) of which 30% are endemic to the region. The richness of the flora is due to the occurrence of species of other biogeographic regions like Irano-Turanian, Mediterranean, Indo-Chinese, Indian, Malesian, Eastern Asiatic,

Correspondence: S.S. Samant, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora-263 643, India

Circumboreal, Australian, Amazonian, Brazilian, Andean, North American and others (Chatterjee, 1939).

The human population of the Indian Himalaya is 2 018 000 which is 2.37% of the total population of India (Premi, 1991). The majority of them live in the villages and belong to diverse cultures and communities. Among the tribes Gaddi (Trans/Northwest Himalaya), Bhotias, Rajees, Tharus, Buxas, Jaunsarees (West Himalaya), Bhutias, Lepchas (Central Himalaya) and Chakma, Nagas: subtribes – Singpho, Tangsa, Hillmiri, Adis, Nishi, Apatani, Monpas, Mijis, Akas, Knowas, Bongnis, Sulungs, Mishmis, Noctes, Wanchoes etc. (East Himalaya) are well known. The rich diversity of the useful plants of Indian Himalaya has been used by different communities as food/edible, medicine, fodder, fuel, timber, agricultural tools, religious and other purposes for a long time.

Among these uses, wild edibles form an important source as a supplement or substitute food in time of scarcity for hill communities. The land holdings in the region are small and cannot afford optimum agricultural inputs. Therefore, they rely on a number of unconventional food plants such as *Vigna vexillata*, (L.) R.Rich.(Sophlong), *Chenopodium* (Bathuwa), buckwheat (Phapar), amaranth (Chaulai), mushrooms (Guchhi), etc. Different parts of wild plants such as roots, tubers, rhizomes, stems, leaves, inflorescence/flowers, fruits/seeds/embryo, thallus, fruiting body or fronds are consumed either raw, roasted, fried, cooked, boiled or in the form of oil, spice, seasoning material, jams, pickles, etc. Currently their use is limited to certain communities/areas in spite of their potential in local, national and international markets. There is a great scope for enhancing the acceptability of wild edibles as an income-generating resource for the hill communities and the potential plant resources for human consumption. These attributes have necessitated the identification of such species to develop effective strategies for their wider consumption. In the Himalayan context, information on edible plants is scant and mainly restricted to enumerations (Arora, 1991; Atal *et al.*, 1980; Gaur, 1977; Hajra and Chakravorty, 1981; Jain and Sinha, 1987; Kaul *et al.*, 1982, 1985; Badhwar and Fernandes, 1964; Negi and Pant, 1992; Negi *et al.*, 1990; Gaur and Semwal, 1983; Negi and Gaur, 1991; Pangtey, 1980; Singh and Arora, 1978; Brij Lal *et al.*, 1994; Singh, 1994; Bhargava, 1959; Pangtey *et al.*, 1982; Raju and Krishna, 1990; Samant and Dhar, 1994).

Mention of wild edibles has also been made in the floras and ethnobotanical studies of some workers (Atkinson, 1982; Anonymous, 1978–1988; Kirtikar and Basu, 1984; Kanjilal and Das, 1934–40; Pal, 1984; Grierson and Long, 1983, 1984, 1987, 1991; Hajra and Rao, 1990; Kapur and Sarin, 1990; Singh and Kachroo, 1987; Saklani and Jain, 1987; Rao and Jamir, 1990; Rawat and Pangtey, 1989; Pangtey *et al.*, 1989; Kapahi, 1990). However, comprehensive explorations of the wild edible plants of West Himalaya, compilation of the wild edible plants of Indian Himalaya and the possibilities of exploring the economic potential, and accordingly developing appropriate conservation strategies, have not been undertaken so far. The present study is an initial step in this direction.

METHODS

Extensive survey of the literature was carried out to compile the wild edible plants of Indian Himalaya. Information on plant parts used, habitats, life forms, potential values and other uses was also collected from the secondary resources. For West Himalaya, survey/exploration of the area was carried out along an altitudinal gradient throughout the study area. The information collected includes identification of sites, habitats, plants, distribution range. Concurrently, through interaction with the local communities of the area, information on local names, plant parts used and mode of utilization were collected. Identification of West Himalayan edibles was made with the help of available literature (Osmaston, 1927; Babu, 1977; Naithani, 1984) and the Herbarium at the Botany Department, Kumaun University, Nainital and Botanical Survey of India, Northern Circle, Dehradun. Information on the trade values of some plants was gathered from secondary sources (Samant *et al.*, 1996), local markets, and from the officials of the District Drug Cooperative Limited, Almora. The multipurpose nature of wild edibles was identified on the basis of information collected from primary and secondary sources, and

Table 1 Species composition of wild edible plants in major taxonomic groups

		Life forms							
Taxonomic groups	*Families*	*Genera*	*Species*	*H*	*Sh*	*T*	*Pt*	*Fi*	*Lich*
Angiosperms	127	361	647	285	169	193	–	–	–
Gymnosperms	5	6	7	–	3	4	–	–	–
Pteridophytes	9	9	12	–	–	–	12	–	–
Fungi	6	6	7	–	–	–	–	7	–
Lichens	2	2	2	–	–	–	–	–	2
Total	149	384	675	285	172	197	12	7	2

H = Herb; Sh = Shrub; T = Tree; Pt = Pteridophytes; Fi = Fungi; Lich = Lichen

Table 2 Diversity of plant parts used within the taxononic groups

	Total parts used									
Taxonomic groups	*Tsh*	*Lv*	*WP*	*S*	*F*	*R/T/Rh*	*Misc.*	*Th*	*Frd*	*FB*
Angiosperms	38	118	22	37	266	62	104	–	–	–
Gymnosperms	–	–	–	2	3	–	2	–	–	–
Pteridophytes	–	–	–	1	–	1	–	–	10	–
Fungi	–	–	–	–	–	–	–	–	–	7
Lichens	–	–	–	–	–	–	–	2	–	–
Total	38	118	22	40	269	63	106	2	10	7

Tsh = Tender shoots; Lv = Leaves; WP = Whole plant; S = Seeds; F = Fruits; R/T/Rh = Roots/Tubers/Rhizomes; Misc. = Miscellaneous; Th = Thallus; Frd = Fronds; FB = fruiting body

endemism on the basis of the phytogeographical distribution of the plant. Altitudinal distribution indicated in the text refers to the upper limit of the range.

RESULTS AND DISCUSSION

Diversity

Of the 800 edible taxa reported from India (Singh and Arora, 1978), 300 occur in Northeast parts of India (Watt, 1889–99; Kanjilal *et al.*, 1934–40). The present study records 675 wild edible plant species from Indian Himalaya, belonging to 384 genera and 149 families. The family Rosaceae (45) showed the highest number of edible species, followed by Polygonaceae (30), Moraceae (26), Asteraceae (20), Fabaceae (20), Euphorbiaceae (15), Anacardiaceae (13), Rubiaceae (13), Apiaceae (13), Urticaceae (14), Lamiaceae (12), Alliaceae (12), Rutaceae (12), Poaceae (13), Berberidaceae (11), Caprifoliaceae (10) and Vitaceae (10). Among the genera, *Rubus* (20) showed the richness of the wild edible species followed by *Polygonum* (18), *Ficus* (15), *Allium* (12), *Dioscorea* (9), *Berberis* (8), *Prunus* (7), *Viburnum* (7), *Ribes* (6), *Piper* (6), *Grewia* (5), *Rhus* (5) and *Chenopodium* (5). The diversity of the taxonomic groups, families, genera, species, life forms and parts used is illustrated in Tables 1 and 2.

The distribution pattern of the wild edible plants of the Indian Himalaya along an altitudinal gradient is given in Table 3. The 1001–2000 m zone exhibits the maximum diversity of wild

Table 3 Altitudinal distribution of wild edibles in Indian Himalaya

Altitudinal range (m)	*Total number of species*	%
< 1000	392	58.07
1001–2000	477	70.67
2001–3000	279	41.33
3001–4000	135	20.00
4001–5000	30	4.44

edibles. The mild climatic conditions and richness of biological resources in this zone supports the maximum number of habitations and diversity of native communities. Hence, the diversity of knowledge of wild plants as food is also the maximum in this zone. The notable edibles of this zone are *Rhus griffithii* Hk.f., *Alocasia macrorhiza* (L.) G. Don, *Penanga gracilis* Bl., *Caralluma tuberculata* Br., *Asparagus racemosus* Wild., *Begonia roxburghii* (Miq.) DC., *Impatiens scabrida* DC., *Berberis lycium* Royle, *Bauhinia retusa* Roxb. *Viburnum simonsii* Wall., *V. mullaha* Ham., *Lobelia affinis* Wall., *Chenopodium blitum* Hk.f., *Cyanotis vaga* (Lour.) Schult., *Coriaria nepalensis* Wall., *Trichosanthes tricuspidata* Lour., *Scleria terrestris* (L.) Fass., *Dioscorea pentaphylla* L., *D. prazeri* Prain & Burkill, *Elaeocarpus lanceaefolius* Roxb., *E. sikkimensis* Masters, *Gaultheria discolor* Nuttal, *Flemingia strobilifera* (L.) R. Br., *F. procumbens* Roxb., *Vigna vexillata* (L.) R. Rich., *Castanopsis purpurella* (Miq.) Ballak, *Castanea sativa* Mill., *Angiopteris evecta* (Forst.) Hoffm., *Botrypus lanuginosus* (Wall. ex Hk. et Grev.) Holub., *Dryopteris elongata* Ktze., *Cantharellus cibarius* Fr. Above and below this zone, the richness of the wild edibles decreases gradually. The lowest number of wild edibles (i.e. 30) occurs in the 4001–5000 m zone. Because of the harsh climatic conditions, this zone supports very specialized taxa. In addition, this zone lacks permanent settlements, and, consequently, knowledge about the potential use of many taxa as a supplement food is absent. This zone is inhabited by seasonal migrants and they use wild plant resources in different ways. The popular wild edibles of this zone are *Allium jacquemontii* Kunth., *A. stracheyi* Baker, *Erysimum hieracifolium* L., *Lonicera parvifolia* Hk.f. & Th., *Axyris amaranthoides* L., *Sedum tibeticum* Hk.f.&Th., *Rhodiola imbricata* Edgew., *Hippophae tibetana* Scheicht, *Ephedra gerardiana* Wall. ex Stapf., *Rhododendron anthopogon* D.Don, *Meconopsis aculeata* Royle, *Polygonum bistorta* L., *P. sibiricum* Laxm., *Rheum speciforme* Royle and *Triglochin maritima* L.

The overlapping of the wild edibles within different elevational zones is noted in the present study. Among the wild edibles, some of the species show a wide range of altitudinal distribution. Distinguished among them are *Cardamine impatiens* L. (up to 4000 m), *Capsella bursa-pastoris* (L.) Medik. (up to 3000 m), *Silene vulgaris* (Moench.) Garcke (up to 3600 m), *Drymaria cordata* Wild. (up to 3000 m), *Allium rubellum* Bieb. (1500–3500 m), *A. wallichii* Kunth (2500–4500 m), *Cyathula tomentosa* (Roth) Moq. (up to 2500 m), *Centella asiatica* (L.) Urban (up to 2000 m), *Taraxacum officinale* Webb. (1800–4000 m), *Rubus ellipticus* Sm. (500–2600 m), *Pyracantha crenulata* (D. Don) Roem. (600–2800 m), *Stellaria media* L. (up to 350 m), *Chenopodium botrys* L. (up to 3600 m), *Polygonum molle* (D. Don) Hara (900–4250 m), *P. runcinatum* Buch.-Ham ex D. Don. (1000–3800 m), *Edgaria darjellingensis* Cl. (900–3200 m), *Rhododendron arboreum* Sm. (1200–3300 m), *Elaeagnus caudata* Schlecht. ex Momiyama (500–3300 m), *E. parvifolia* Wall. ex Royle (500–3600 m), *Zanthoxylum nitidum* (Roxb.) DC. (500–2500 m), *Celtis australis* L. (up to 2400 m).

The numbers of wild edibles known from different biogeographical provinces of Indian Himalaya are shown in Table 4. The richest diversity (50.96%) of wild edibles is exhibited in West Himalaya (i.e. Kumaun, Garhwal). This may be due to the occurrence of Central/East Himalayan elements as well as Trans/Northwest Himalayan elements, forming an ecotone. Moreover, West Himalaya has been well explored

Table 4 Occurrence of wild edibles in different biogeographical provinces of Indian Himalaya

Biogeographical region	*Species number (%)*	*Sub-region*	*Species number (%)*
Trans/Northwest Himalaya	169 (25.04)	Jammu andKashmir	132 (19.56)
		Himachal Pradesh	94 (13.93)
West Himalaya	344 (50.96)	Kumaun	344 (50.96)
		Garhwal	176 (26.07)
Central Himalaya	173 (25.63)	Sikkim	173 (25.63)
East Himalaya	221 (32.74)	Arunachal Pradesh	221 (32.74)

in comparison to other biogeographic provinces of Indian Himalaya. Trans/Northwest Himalaya with a wide geographical area (277 909 km^2) among all the provinces exhibits lowest percentage (25.04%) of wild edibles (Table 4). This may be either due to the poor exploration of edible taxa from these provinces or poor knowledge of wild plants as food/edibles.

The origins of wild edibles in different biogeographical provinces is shown in Table 5. Most of the taxa are Himalayan in origin. Hence, the chances of endemism in the wild edibles of Himalayan region are maximum.

Endemism

In spite of the influence of the flora of adjoining countries/region, the flora of Indian Himalaya includes about 46.20% (3165) endemics out of a total of 6850 endemics in India (Chatterjee, 1939). In the context of wild edibles of Indian Himalaya, the taxa restricted to these biogeographical provinces were considered as endemics and those extending their distribution to adjacent countries/states like Nepal, Bhutan, Tibet, Pakistan, Afghanistan, Assam and Meghalaya were considered as near endemics.

Of the 675 wild edible species, 39 are restricted to Indian Himalayan provinces, hence classified as endemics. On the other hand, 93 species showed extension of their range to adjacent countries/states and are considered as near endemics. In a broader sense (*sensu lato*), the near endemics represent endemics of the whole region. East Himalaya showed the highest number of endemics (18 taxa). The distribution of endemics in different phytogeographical provinces is presented in Table 6.

Among the near endemics, *Allium humile* Kunth, *A. simonovii* Regel, *Actinidia strigosa* Hk.f. & Th., *Calamus floribundus* Griff., *Rhaphidophora glauca* (Wall.) Schott, *Berberis lycium* Royle, *B. umbellata* Wall., *Mahonia napaulensis* DC., *Megacarpaea polyandra* Benth., *Flemingia vestita* Benth. ex Baker, *Edgaria darjellingensis* Cl., *Horsfieldia kingii* (Hk.f.) Warburg, *Rheum australe* D.Don, *R. nobile* Hk.f. & Th., *Paeonia emodi* Wall. ex Royle, *Pyrus vestita* Wall., *Rubus kumaonensis* Baker, *R. paniculatus* Sm., *Schisandra grandiflora* (Wall.) Hk.f. & Th., *Malus sikkimensis* (Wenz.) Koehne are well represented among endemic wild edibles.

Table 5 Origin of wild edibles in different countries (Source: Anonymous, 1883–1970)

Region	*Total taxa*	%
Himalaya region	239	35.41
Himalaya with extension	47	6.96
Indian oriental	61	9.04
Europe with extension	48	7.11
Tropical Asia	23	3.40
Miscellaneous	257	38.07

Table 6 Endemic wild edibles of Indian Himalaya

Trans/North West Himalaya	*Allium consanguinium*
	Caralluma tuberculata
	Campanula cashmiriana
	Sedum tibeticum
	Ribes nigrum
	Linaria incana
West Himalaya	*Allium stracheyi*
	Cordia vestita
	Ribes uva-crispa var. sativum
Central Himalaya	*Mahonia sikkimensis*
	Rubus treutleri
	R. wardii
	Sterculia roxburghii
East Himalaya	*Calamus erectus*
	Caryota obtusa
	Livistonia jenkisiana
	Begonia rubrovenia
	B. episcopalis
	Streptolirion volubile
	Stixis suaveolens
	Gaultheria discolor
	Baliospermum calycinum
	Garcinia pedunculata
	G. sopsopia
	G. cowa
	G. stipulata
	Illicium griffithii
	Musa sanguina
	Phoenix rupicola
	Rubus insignis
	Spiradiclis bifida
Trans/Northwest/West	*Berberis zabeliana*
Northwest/West/Central	*Lonicera parvifolia*
West/Central	*Angelica glauca*
West/Central/East	*Decaisnea insignis*
Central/East	*Elaeagnus pyriformis*
	Elaeocarpus sikkimensis
	E. floribundus
	Saurauia punduana

The potential

Nutritional

Wild edible plants are important and cheap sources of protein, carbohydrates, fats, vitamins and minerals; moreover, their dietary contribution is increased because they are available during most seasons, including the periods in the year when the conventional staples and vegetables are scarce. The flushes of most of the species used as vegetables appear in the dry season when cultivated vegetables are scarce. Notable among these are *Amaranthus paniculatus* L., *Heracleum candicans* Wall. ex DC., *H. pinnatum* Cl., *Calamus acanthospathus* Griff., *Caryota obtusa* Griff., *Asparagus curillus* L., *Crambe kotschyana* Boiss., *Chenopodium botrys* L., *Fagopyrum debotrys* (D. Don) Hara, *Edgaria darjellingensis* Cl., *Dryopteris elongata* Ktze., *Embelia gamblei* Kurz. Similarly, fruits of *Myrica esculenta* Ham., *Horsfieldia kingii* (Hk.f.) Warburg, *Syzygium cuminii* (L.) Skeels, *S. venosum* DC., *Fragaria vesca* L., *Prunus cornuta* (Wall. ex Royle) Steud., *Rubus* spp., *Berberis* spp. are ripe when cultivated fruits are not available

Nutritive values of some of the wild edibles are known and the values presented compare well with the values for cultivated/domesticated plants (Table 7). For example, The pods of *Lathyrus sativus* L. contain 10% moisture, 28.20% protein, 0.60% fat and 58.20% carbohydrate and is one of the preferred vegetables of the Himalayan communities. Seeds of *Castanea sativa* Mill. (29.30% moisture, 10.90% Protein, 1.84% fat and 32.64% carbohydrate) are used as a substitute for cashew nuts in West Himalaya. The foliage and seeds of *Amaranthus paniculatus* L. are edible and contain minerals (Fe, Ca) and carbohydrates (55.87%). They have a considerably higher grain yield. Grains assume more nutritional significance as bread, pastry, biscuits, flacks, crackers, ice creams and elaborating lysine-rich body foods (Anonymous, 1970–1988).

The wild edible mushrooms (*Morchella esculenta* (L.) Pers., *M. comica* Pers., *Pleurotus ostreatus* (Jacq.) Fr., *Boletus edulis* Bull. ex Fr., *Cantharellus cibaricus* Fr., *Hydnum coralloides* Scop. and *Lycoperdon gemmatum* Bats.) are used as a delicacy for domestic consumption as well as in tourist hotels. They are rich in proteins, especially in lysine and leucine, which are lacking in most of the staple cereal foods (Anonymous, 1970–1988).

Medicinal

In many instances it is very difficult to make a distinction between food and medicinal values. Many wild edible species are also used in traditional medicine. Of the 675 species recorded, 171 are used in traditional medicine. For example, the leaves and roots of *Taraxacum officinale* Webb., the roots of *Costus speciosa* (Koenig) Sm., the tubers and seeds of *Arisaema tortuosum* L., the leaves of *Dipsacus inermis* Wall. and the tubers of *Dicentra thalictroides* Hk.f. are reputed as poison antidotes.

The roots of *Geranium wallichianum* Don ex Sweet are given for colds, dysentery, and ear troubles; the roots of *Flemingia vestita* Benth. ex Baker are given for hysteria; the rhizome of *Podophyllum hexandrum* Royle is used in tumour, skin diseases and as a purgative; the fruits of *Hippophae salicifolia* D. Don are used to treat coughs, colds, influenza and lung complaints; the roots of *Angelica glauca* Edgew. and *Pleurospermum angelicoides* (DC.) Cl. are used as a treatment for food poisoning and dysentery. In addition, most of the species contain coumarins, alkaloids, flavonoids, steroids and triterpenes and are used in the treatment of a variety of diseases/ailments (Pathak *et al.*, 1986).

Oil seeds

In order to meet the acute shortage of oils and fats in the country, the potential of oil seeds of forest origin can be augmented. The Indian Himalaya is rich in oil seed-bearing plants. It is therefore imperative to document oil seed-bearing edibles of the Himalaya.

In the present study, 32 species of wild edibles bear oil seeds and the percentage of yield for each species is indicated in Table 8. Seeds of *Diploknema butyracea* (Roxb.) Lam. provide a soft tallow which is used as a cooking medium and the oil produced from *Prinsepia utilis* Royle is used as a cooking medium as well as for burning. Studies on such species merit attention.

Multipurpose utility

Among the wild edibles of the Indian Himalaya, some species are used by the local communities

Table 7 Nutritive values of some of the wild edibles of Indian Himalaya (Source: Kapur and Sarin, 1990, Anonymous, 1970–1988)

			Nutritive values					
Taxa	*Part(s) extracted*	*Moisture (%)*	*Protein (%)*	*Fat (%)*	*Carbohydrate (%)*	*Fibre*	*Minerals*	*Vitamins*
Fagopyrum esculentum	S	11.30	10.30	2.40	65.00	8.60	Ca,P,Fe	–
Lathyrus sativus	P	10.00	28.20	0.60	58.20	–	–	–
Castanea sativa	S	29.30	10.90	1.84	32.64	–	–	–
Nelumbo nucifera	Rh	83.80	2.70	0.11	11.30	0.80	Ca	–
Emblica officinalis	F	81.20	0.50	0.10	14.10	3.40	Ca,P,Fe	C
Ficus bengalensis	F	12.90	8.10	6.10	35.50	31.00	P	–
F. semicordata	F	–	8.70	5.70	43.10	–	P	–
F. glomerata	F	13.60	7.40	5.60	49.00	17.90	P	–
F. religiosa		9.90	7.90	5.30	34.90	–	Ca	–
F. palmata	F	–	13.27	–	–	–	Ca	–
Fragaria vesca	F	88.00	–	14.30	4.50	–	–	–
Morus alba	F	87.50	1.50	0.40	8.30	1.40	Ca,P,Fe	–
Psidium guajaya	F	81.70	0.90	0.30	11.10	5.20	Ca,P,Fe	–
Randia tetrasperma	F	–	0.90	0.20	17.70	–	–	–
Solanum nigrum	F	–	17.50	21.50	20.00	–	–	A, C
Spondias pinnata	F	90.30	0.70	3.00	4.50	1.00	Ca,P,Fe, Na,K,Cu S,Cl	–
Syzygium cuminii	F	83.70	0.70	0.30	14.00	0.90	Ca,P,Fe	A,B,C,E
Trichosanthes dioica	F	92.00	2.00	0.30	2.20	–	Ca,P,Fe	
Zizyphus mauritiana	F	81.60	0.80	0.30	17.00	–	Ca,P,Fe	–
Nasturtium officinale	WP	89.20	2.90	2.20	5.50	–	Ca,P,Fe	–
Rumex acetosa	WP	90.00	2.60	0.50	–	–	Ca,Fe	C
Taraxacum officinale	Lv,F	88.80	3.60	1.60	3.70	0.04	Ca,P,Fe	A
Urtica dioica	WP	–	30.40	3.40	10.30	10.30	Ca,P,Fe	–
Allium rubellum	WP	77.80	1.61	–	18.46	–	–	A,B,C
A. ampeloprassum	St	78.90	1.80	0.10	17.20	01.30	Ca,P,Fe	A,B,C
Amaranthus paniculatus	S	–	–	–	55.87	–	Fe,Ca	–
Chenopodium album	WP	82.77	4.63	–	8.32	–	–	–
Punica granatum	S	88.80	2.12	–	14.81	–	–	C
Rubus niveus	S	84.56	1.23	–	5.24	–	–	–
Polygonum alpinum	R	–	10.75	1.08	12.70	12.10	–	–
Pueraria tuberosa	R	–	23.80	–	–	10.90	–	–
Phytolacca acinosa	Lv	–	15.60	2.08	16.80	14.10	–	–
Caralluma tuberculata	R	–	5.45	2.24	47.87	8.27	–	–
Ribes nigrum	F	–	–	–	–	–	Ca,K,Mg	C
Sapindus mukorosii	S	–	31.00	–	–	–	–	–
Sapium sebiferum	S	–	75.00	53–64	–	–	–	–
Semecarpus anacardium	S	3.80	26.40	36.40	28.40	1.40	–	–
Shorea robusta	S	–	10.12	–	50.00	–	–	–
Carum carvi	F	11.5–15.5	–	–	–	–	–	–
Crotalaria medicaginea	S	–	23.31	6.76	42.04	–	–	–
Cyphomandra betacea	F	82.70	1.50	0.20	10.30	4.20	Ca,P,Fe	A
Diplazium esculentum	Fr	86.00	–	–	8	–	–	–
Euphorbia hirta	Lv	78.14	4.65	–	–	–	–	C
Bambusa arundinacea	Tsh	88.80	3.90	0.50	5.70	–	Ca,P,Fe Na, Cu, Cl	A,B,C
Bauhinia variegata	Fl	78.90	1.80	0.20	17.80	1.30	Ca,P,Fe	C
Boerhaavia diffusa	AP	84.50	6.10	0.90	7.20	–	Ca,P,Fe	

S = Seed; P = Pod; Rh = Rhizome; F = Fruit; WP = Whole plant; Lv = Leaves; St = Stem; R = Root; Fr = Fronds; Tsh = Tender shoots; Fl = Flowers; AP = Aerial parts

Table 8 Oil seed-bearing wild edibles of Indian Himalaya

	Oil yield (%)	
Taxa	*Jain et al., 1990*	*Anonymous, 1970–1988*
Justicia adhatoda	25.8	–
Aegle marmelos	34.4	45
Bombax ceiba	22.3	–
Buchanania latifolia	61.8	–
Buxus wallichiana	34.0	–
Dipoknema butyracea	60–67	–
Emblica officinalis	16.0	–
Juglans regia	60–67	–
Madhuca indica	35–40	–
Mangifera indica	6.12	–
Moringa oleifera	21–24	–
Morus alba	25–35	–
Myrica esculenta	20–25	–
Bauhinia vareigata	–	15.65
Litsea pallens	–	16.3–20
Oroxylum indicum	20	–
Perilla frutescens	30–51	–
Pinus roxburghii	41.32	–
Prinsepia utilis	37.2	–
Prunus persica	35–39	–
Quercus leucotrichophora	16	–
Ribes nigrum	–	25
Sapindus mukorosii	35	–
Sapium sebiferum	17–20	40
Semecarpus anacardium	38.2	20–25
Shorea robusta	12.5–18.0	19–20
Taxus baccata ssp. *wallichiana*	63.5	–
Terminalia bellerica	25	–
Trichosanthes tricuspidata	31.6	–
Urtica dioica	32.6	–
Viburnum coriaceum	21.8	–
Zanthoxylum armatum	20.0	–

for more than one purposes (Table 9). For example, the leaves and petioles of *Moringa oleifera* Lamk. are used medicinally, the seeds yield ben oil, used by watchmakers, and the young roots make a good substitute for the true horseradish. Fruits of *Litsea cubeca* (Lour.) Pearson are used medicinally and the leaves for rearing silkworm (Grierson & Long, 1984). *Castanopsis indica* (Roxb.) A.DC., *C. tribuloides* A.DC., *Quercus leucotrichophora* A. Camus and *Q. floribunda* Rehder provide excellent fodder, fuel and timber. *Ougeinia oojeinensis* (Roxb.) Hochr. adds to soil fertility and is used by the inhabitants for their day to day requirements of fodder, fuel, timber, agricultural tools and miscellaneous items. *Diploknema butyracea* (Roxb.) Lam. is liked by the local inhabitants for its fruits, vegetable oil, fodder, fuel and fragrant flowers that attract honey bees.

Commerce/trade

Wild edible species are not only consumed for food by the hill communities but are also a source of income generation. In the West Himalaya, Kumaon Mandal Vikas Nigam, Garhwal Mandal Vikas Nigam and the District Drug Cooperative Limited are the active exploiters and traders. The trade values known for some of the wild edible

Table 9 Some multipurpose wild edibles occurring in Indian Himalaya

Taxa	*Local name*	*M*	*Fd*	*Fl*	*T*	*AT*	*Misc.*
Bauhinia vahlii	Malu	+	+	+	–	–	+
B. variegata	Kweral	+	+	+	–	–	–
Bombax ceiba	Semal	+	+	–	–	–	–
Castanopsis indica	Katus	–	+	+	+	–	–
C. purpurella	Katus	–	+	+	+	–	–
C. tribuloides	Katonj, Patle Katus	–	+	+	+	+	–
Cornus macrophylla	Khagsa	+	–	+	–	–	–
Corylus fexox	Kabase	–	+	+	–	–	–
C. jacquemontii	Kabasi	–	+	+	–	–	–
Cordia obliqua	Lisora	–	+	+	–	–	–
C. vestita	Bharalu	–	+	+	–	–	–
Diploknema butyracea	Cheura	–	+	+	–	–	+
Emblica officinalis	Aonla	+	+	+	–	–	+
Ficus roxburghii	Timal	+	+	+	–	–	+
Hippophae rhamnoides	Ameos	+	–	+	–	+	+
H. salicifolia	Chuk	+	–	+	–	+	+
Juglans regia	Okhar	+	+	–	+	–	+
Camellia kissii	Hinguwa	–	–	–	+	+	+
Litsea cubeca	Timus, Siltimur	+	–	–	–	–	+
Moringa oleifera	Horseradish	+	–	–	–	–	+
Pinus roxburghii	Chir	+	–	+	+	–	+
Myrica esculenta	Kaphal	+	+	+	–	–	–
Ougeinia oojeinensis	Sanan	+	+	+	+	+	+
Prunus cerasoides	Paya	+	+	+	–	–	+
Pyrus pashia	Mail, Mehal	+	+	+	–	–	+
Pyracantha crenulata	Ghingaru	–	–	+	–	–	+
Quercus floribunda	Telonj	–	+	+	+	–	–
Q. leucotrichophora	Banj	+	+	+	+	–	–
Syzygium cuminii	Jamun	+	+	+	+	–	+
Terminalia chebula	Harar	+	+	+	+	–	–
T. bellirica	Barar	+	+	+	–	–	–
Trichosanthes tricuspidata	Indrain	+	+	–	–	–	–
Rhododendron arboreum	Burons	+	+	+	–	–	–
Aesculus indica	Pangar	+	+	+	–	–	–
Measa indica	Bakaria	–	+	+	–	–	–
Grewia oppositifolia	Bhimal	–	+	+	–	–	+
Celtis tetrandra	Kharik	–	+	+	–	–	–
Zanthoxylum acanthopodium	Temoor	+	+	–	–	–	+
Z. armatum	Temoor	+	+	–	–	–	+

M = Medicinal; Fd = Fodder; Fl = Fuel; T = Timber; AT = Agricultural tools; Misc. = Miscellaneous; + = Used; – = Not used

species are given in Table 10. In the remote areas, tribal communities collect the dry leaves of *Allium humile* Kunth, *A. stracheyi* Baker, the roots of *Rheum australe* D. Don, *Dactylorhiza hatagirea* (D. Don) S00, *Angelica glauca* Edgew., *Pleurospermum angelicoides* (DC.) Cl., *Aconitum heterophyllum* Stapf., the fruiting body of *Morchella esculenta* (L.) Pers., the seeds of *Corylus jacquemontii* Decne and *Castanea sativa* Mill. and generate income to meet their daily needs (Samant *et al.*, 1996). Similarly, the trade potential of wild leafy vegetables and fruits could be harnessed for income generation. Trade evaluation and documentation of such species needs priority action to ensure their optimum utilization.

Wild relatives of cultivated plants

Among the wild relatives of cultivated plants, a rich diversity (125 taxa) is represented in the Western Himalaya (Trans/Northwest/West), 82

Table 10 Trade values of some wild edible plants occurring in Indian Himalaya (Source: District Drug Cooperative Limited, Almora (1992–93); Samant *et al.*, 1996)

Botanical name	*Local name*	*Trade name*	*Rates* (Rs/Kg)
Aconitum heterophyllum	Atees	Atees	160–200
Allium humile	Pharan	Pharan	50–60
A. stracheyi	Jambu	Jambu	50–60
Corylus jacquemontii	Kabasi	Bhotia Badam	100–120
Dactylorhiza hatagirea	Hatthajari	Hatthajari	500–1000
Juglans regia	Okhar	Akhrot	60–70
Hippophae salicifolia	Ameous	Ameous	35
Trichosanthes tricuspidata	Indraini	Indraini	55–65
Morchella esculenta	Guchhi	Mushroom	2500
Angelica glauca	Gandraini	Chhipi	40
Diplazium esculentum	Lingura	Lingura	20–25
Eulophia dabia	Salam misri	Salam misri	35–40
Pleurospermum angelicoides	Choru	Choru	10
Podophyllum hexandrum	Ban-Kakri	Ban-Kakri	35–40
Castanea sativa	Khan Pangar	Pangar	30–35
Zanthoxylum armatum	Temoor	Temoor	20–30
Paris polyphylla	Bankh	Satuwa	15–22
Rheum australe	Dolu	Dolu	15–20
Rhododendron anthopogon	Takkar	Takkar	10
Lichens (*Parmelia* sp., *Usnea* sp.)	Safed Jhula	Jhula	12–20
Myrica esculenta	Kaphal	Kaphal	5–28
Polygonatum cirrhipetalum	Salam misri	Maha maida	10–12
P. verticillatum	Salam misri	Maha maida	10–12
Centella asiatica	Khuchoria	Brahmi	10–15
Asparagus racemosus	Kairwa	Satawar	6–10
Sapindus mukorossi	Rith	Reetha	5–10
Cinnamomum tamala	Kirkiria	Tejpat	7–9
Bergenia ligulata	Silphoru	Silphor	6–9
Bauhinia variegata	Kweral	Kweral	5–6
Solanum nigrum	Niniyoni	Makoi	5–6
Syzygium venosum	Jamun	Jamun	25–30
Taxus baccata, spp. *wallichiana*	Thuner Lewait	Talis patra	3–7
Terminalia chebula	Harar	Harar	1–2
Emblica officinalis	Anola	Anola	1–2

in the East Himalaya (Central/East) and 132 in the contiguous belt of Northeast Region (Arora and Nayar, 1984). The present study reveals the occurrence of 28 wild edible species in Trans/Northwest/West Himalaya and 39 in Central/East Himalaya (Table 11). Species recorded merit attention of horticulturists because they could possibly be utilised as marketable fruits.

Edible plants of the wild habitats contribute economic value by virtue of their use in indigenous and immigrant cultures, and by their taxonomic proximity to cultivated species. Most of the wild edible species provide a good root stock for the commercial cultivars of the fruit crops because of their wider adaptability, vigorous growth, and resistance to major diseases and pests. Hence, the native fruit species can be utilized as a good breeding material for the improvement of horticultural crops (Arora and Nayar, 1984; Paroda and Arora, 1986). It must be added that while each of the wild edible species exhibits desirable qualities, they would nonetheless require significant improvement through breeding and selection. To assess their existing and potential economic value, ethnobotanical observations, quantitative data on the diversity and abundance of the species need to be intensified.

Table 11 Wild edibles reported as wild relatives of economic plants in Indian Himalaya (Source: Arora *et al.*, 1986)

Trans/Northwest/West	*Central/East*
Legumes	
Cicer microphyllum	*Flemingia vestita*
Lathyrus aphaca	
Fruits	
Cordia vestita	*Myrica esculenta*
Duchesnia indica	*Zizyphus oenoplia*
Ficus palmata	*Citrus medica*
Grewia elastica	*Docynia indica*
Malus baccata	*Duchesnia indica*
Morus indica	*Elaeocarpus floribundus*
Prunus ceasoides	*Garcinia cowa*
P. cornuta	*G. sopsopia*
P. nepalensis	*G. pedunculata*
P. undulata	*Malus baccata*
Punica granatum	*Mangifera indica*
Pyrus pashia	*M. sylvatica*
Ribes glaciale	*Morus indica*
R. nigrum	*M. serrata*
Rubus ellipticus	*Phoenix acaulis*
R. fruticosus	*Prunus cerasoides*
R. niveus	*P. cornuta*
R. nepalensis	*P. nepalensis*
R. kumaonensis	*P. undulata*
	Pyrus pashia
	Ribes glaciale
	Rubus ellipticus
	R. molluccanus
	R. paniculatus
	Pyrus vestita
	Spondias pennata
Tubers	
Coleus forskohlii	*Coleus forskohlii*
Dioscorea bulbifera	*Dioscorea bulbifera*
	D. hamiltonii
	D. hispida
Oil seeds	
Lepidium ruderale	
Spices/Condiments	
Allium rubellum	*Piper longum*
Carum carvii	
Beverages	
Fagopyrum debotrys	*Camellia kissi*
	Coffea benghalensis
Vegetables	
Solanum indicum	*Trichosanthes tricuspidata*
	T. dioica
	Flemingia vestita

CONCLUSIONS

1. Indian Himalaya represents a rich diversity of the wild edible species which are capable of supplementing the food requirements of hill communities. However, there is scope to enhance the diversity of these species through survey/exploration of unexplored areas and interviews/interactions with the local communities of the Indian Himalayan regions.

2. Adequate information on population biology (i.e. habit, habitat, life form, distribution range, population size, phenology, reproduction, pollination, seed biology, seedling ecology and several other aspects) for potential species is essential.

3. Mass scale propagation of wild edibles in the nurseries, arboreta and botanical gardens through asexual and sexual methods need to be popularised among the hill communities for their conservation and management.

4. Proper evaluation of the potentials and dissemination of this information package to hill communities need to be prioritized.

5. Wild edible species may prove a good root stock for the commercial cultivars of the fruit crops due to their wider adaptability to abrupt climatic variations, vigour, growth and resistance to insects and pests. Hence, these may be utilized as good breeding material for the improvement of horticultural crops as well as restoration and reclamation of degraded land and revised cropping systems.

6. To maintain the ecosystem equilibrium, awareness of the sustainable utilization of these species needs to be created among the hill communities.

ACKNOWLEDGEMENTS

The authors thank the Director of the Institute for necessary facilities and encouragement, Dr R.S. Rawal for extending help and Smt. Sarita Bagdwal for typing the manuscript.

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