The Scientific Temper
Vol. 13, No. 2, July-December, 2022:pp 341-347
ISSN 0976-8653, E-ISSN 2231-6396
A Web of Science Journal
DOI: https://doi.org/10.58414/SCIENTIFICTEMPER.13.2.2022.341-347
Doc ID: https://connectjournals.com/03960.2022.13.2.341

Diversity of Wild Edible Plants in the Kotla Valley in Uttarkashi, Uttarakhand, India

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ABSTRACT

The current study focuses on the variety of wild edible plants that the locals of Uttarakhand, India's Kotla valley Barkot (Uttarakashi) consume. During a field survey, local informants provided all of the information. The informants included laborers in the fields, priests, physicians, and birth attendants older than 55, to repeatedly verify the validity of the information gathered from the research area. There were 64 wild edible plant species in total, with 56 genera and 39 families represented. There were 22 kinds of shrubs, 20 species of trees, 17 species of herbs, and 5 species of climbers that were edible. 49% of the species were used for foraging edible wild fruits, 26% for leaves, 13% for seeds, 7% for roots, and 6% for flowers. The most widespread species included *Ficus species, Elaeagnus umbellata, Morus serrata, Amaranthus caudatus, Berberis aristata, Myrica esculenta, Pinus roxburghii, Prunus cerasoides, Pyracantha crenulata, Pyrus pashia, Rhododendron arboretum, Rubia manjith,* and *Rubus spp.* The importance of wild edible plants in supplying stable and supplementary sustenance cannot be overstated.

Keywords: Biodiversity, Informants, Life forms, Socio-economic, Vegetation,

INTRODUCTION

Indigenous groups, which have complex socio-economic, and biocultural regimes and distinctive values, customs, and lifestyles, depend on biodiversity to provide ecosystem services (Pretty et al., 2009). India is regarded as one of the most mega-diverse nations, with a wealth of traditional knowledge and associated biodiversity. Plants are essential for the livelihood of rural people especially tribal communities because these people use plants for different purposes like as a source of food, fuel, fodder, timber, medicine, and agricultural implements. Before the dawn of civilization and the domestication of modern fruits, wild edible plants were a significant source of food for humans (Alcorn, 1990). Wild edible plants have been an integral part of human life since the beginning of time, and they have supported human populations on all inhabited continents (Khyade et al., 2009). In India, the majority of rural residents rely on wild plant species to meet their supplemental needs (Tiwari et al., 2010).

The local population makes use of the area's great diversity in a variety of ways, including for food, medicine, fuel, agricultural tools, fodder, and fodder (Samant and Dhar, 1997; Rautela et al., 2018; Sharma et al., 2016). The variety of wild plant species provides dietary variety for families and helps ensure the security of household food supplies. Among these, wild edible plants are crucial for locals' food replenishment during times of scarcity. Due to its challenging geology, harsh climate, and excellent fruit flavor, Uttarakhand is ideal for wild edible fruiting plants. The region's residents depend on these plants as a valuable source of sustenance (Sharma et al., 2017; Rautela et al., 2018; Rautela et al., 2020). Due to their modest land holdings and reliance on subsistence farming, the locals gather a variety of wild plants for food (Dhyani

et al., 2007). Many works have emphasized the diversity and traditional uses of wild plants from the Garhwal Himalayas (Negi and Gaur, 1991). Wild edible plants provide food to tribals living in and around forests and these plants act as an alternative to staple food during food crises as they are rich in various vitamins, minerals, and proteins (Kumar and Hamal, 2009; Sundriyal et al., 2021; Khanduri et al., 2021).

MATERIAL AND METHODS

The systematic field survey was carried out during the year 2020 to 2022 in different seasons i.e., winter, spring, summer, and rainy. Different wild edible plant species were collected from study sites. The information on wild edible plant species was collected through questionnaires from local guides and local people. The informants included farmers, priests, doctors, and birth attendants older than 55. They also included men and women who worked in the fields. Repeated verification of the recorded data from various informants was done to ensure the veracity of the data that was acquired from the study region. Therefore, only the precise and trustworthy information that has been double-checked with informants has been used in the current study. Information on local names, plant parts used, and mode of use was congregated after proper tagging and assigning of different edible plant species specimens. These plant samples were then dried, and their identities were determined using data from informants, local guides, regional floras, herbariums (BSD and GUH), and specialists. The current accepted names and classification (family) are given as per the Royal Botanic Gardens (Kew) maintained online database (https://powo.science.kew.org/).

STUDY AREA

The holy Yamuna river originates from the Yamunotri glacier (ca. 6,387 m asl) near the Bandar punch peaks in the lower Himalayas of Uttarakhand state (NW-Himalaya, India). The river along with rivulets and offshoots forms numerous watersheds in its giant catchment (Yamuna Valley). The valley is extended over the Uttarkashi, Tehri, and Dehradun districts of the Uttarakhand. It flows towards Delhi from Dehradun and merges with the holy Ganga River at the Prayagraj in Uttar Pradesh. The Yamuna has great religious significance as the Yamunotri temple (Uttarkashi, Uttarakhand), a shrine dedicated to the goddess Yamuna, is one of the holiest shrines in Hinduism, and is part of the Char Dham yatra in the state.

The Kotla valley is situated in the upper catchment of the Yamuna valley near Barkot town (Uttarkashi, Uttarakhand). Kotla valley is enriched with a huge plant diversity of wild edible plants which are utilized by local people in different forms. Geographically it is located between 30.900364º to 30.868901º N latitudes and 78.17739º to 78.187412º E longitudes and covers an area of about 15 km^2. The elevation of the valley ranges ca. 1200–2700 m asl. Physiographically, the area represents forest mountainous terrain that runs into a series of ridges (e.g. Jakhali, Dhausali, Akhodika, and Surka) and sub-valley slopes characterized by terraced agricultural lands and village ecosystems. Kotla, Nathergoun, Ghund, Byali, Nald, and Kud are the main villages of the Kotla watershed. The vegetation of the area is widely dominated by conifer forests at lower and middle zones while the upper ridges bear broad-leave species. Chir, Deodar, Banj, Burans, Ayar, Moru, Kail, Rai-murando and Kharsu are common tree elements. The area represents a temperate climatic condition with distinct seasons (spring, summer, rainy, and winter). The average annual temperature is 11.5º C while the annual rainfall is 1720 mm (climate-data.org).

RESULTS AND DISCUSSION

The study revealed 64 wild edible plant species belonging to 56 genera and 39 families in the Kotla valley in the Upper Yamuna catchment (Uttarkashi, Uttarakhand). The state of being available and native uses of the plant species have been presented in Table1. The recorded species belong to different life forms i.e., trees (20 species), shrubs (22 species), herbs (17 species), and climbers (5 species) (Figure 1).

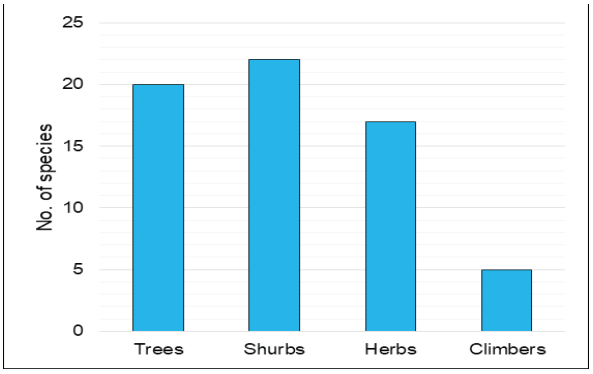

Figure 1: Number of species in different life forms in Kotla valley, Barkot, Uttarkashi.

The families, Rosaceae (11 species), Moraceae (5 species), Asteraceae (3 species), Polygonaceae (3 species), Rhamnaceae (3 species), Amaranthaceae (2 species), Cannabaceae (2 species), Fabaceae (2 species), Lamiaceae (2 species) were represented by the higher number of species, whereas *Ficus* (4 species), *Rubus* (3 species) and *Rhamnus* (2 species) were the genera with two or more than two species. Of these, 49% of species were used as wild edible fruits, 26% leaves, 12% seeds, 7% roots, and 6% flowers (Figure 2). All the edible plant

species were collected from their native habitats in the Kotla valley forest. Local people used wild edible species for their daily need of food and other supplements.

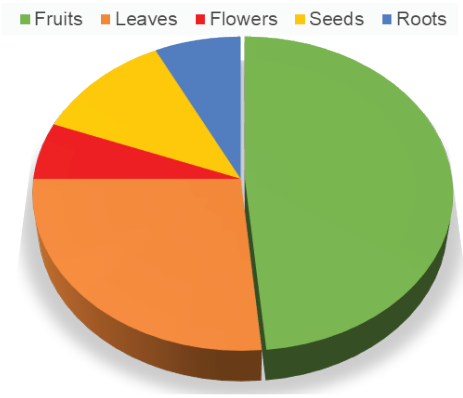

Figure 2: Edible parts of plants species used by local people in Kotla valley Barkot, Uttarkashi

A local person wanders in the forest in search of litter, wood, fodder, and edible plant species and for grazing their livestock. In the forest, they use edible plant parts mostly fruits for food as raw or cooked. All the edible plant species are undoubtedly very crucial for sustaining the lives of local people (Rautela et al., 2018; Bapai et al., 2021). As of right now, neither the government nor NGOs nor the local community's sole department of forest work to protect trees in these places through conservation or preservation methods. Our thorough investigation revealed that the Kotla Valley's inhabitants exploited wild plant resources as a source of food and a supplement (Figure 3). Locals routinely travel to the woodlands to get essential food supplements and to meet other daily needs.

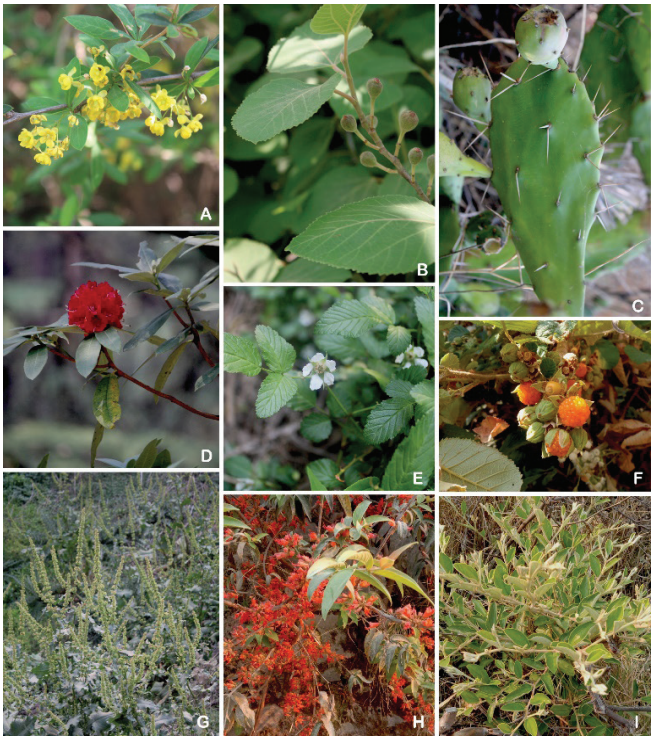

Figure 3: A. *Berberis aristata*, **B.** *Ficus palmata*, **C.** *Opuntia elatior*, **D.** *Rhododendron arboreum*, **E.** *Rubus macilentus*, **F.** *Rubus ellipticus*, **G.** *Rumex nepalensis,* **H.** *Woodfordia fruticosa* and **I.** *Ziziphus mauritiana*.

For dietary supplements, leaves, fruits, tubers, flowers, and the entire plant were among the edible plant components employed. The majority of edible species were produced by shrubs, followed by trees, herbs, and climbers. Plant species' edible portions can be consumed raw or cooked (Rautela et al., 2018).

Table 1: Wild edible plants in the Kotla valley in Uttarkashi, Uttarakhand, India

S.No	Name of species	Family	Habit	Local name	Part used	Mode of use
1.	*Agave cantula* Roxb.	Asparagaceae	Shrub	Rambans	Tender stems	Used as vegetable
2.	*Agrimonia pilosa* Ledeb.	Rosaceae	Herb	_	Young leaves and seeds	Used as medicine and vegetables
3.	*Amaranthus caudatus* L.	Amaranthaceae	Herb	Marsha	Young shoots and leaves	Used as vegetable
4.	*Bauhinia variegata* L.	Fabaceae	Tree	Goriyaw	Young flowering buds	Used as vegetable
5.	*Berberis aristata* DC.	Berberidaceae	Shrub	Kasmou	Fruits	Fruits are edible
6.	*Bergenia ciliata* (Haw.) Sternb.	Saxifragaceae	Herb	Singadu	Roots	Roots are edible
7.	*Bergera koenigii* L.	Rutaceae	Shrub	Karipatta	Leaves	Used as spices
8.	*Bombax ceiba* L.	Malvaceae	Tree	Semouw	Young flowering buds	Used as vegetable
9.	*Callicarpa macrophylla* Vahl	Lamiaceae	Shrub	_	Fruit & leaf	Fruits are edible
10.	*Cannabis sativa* L.	Cannabaceae	Shrub	Bhang	Seeds and leaves	Seed are edible

11.	*Celtis tetrandra* Roxb.	Cannabaceae	Tree	Khadik	Fruits	Ripe fruits are edible
12.	*Chenopodium album* L.	Amaranthaceae	Herb	Bathua	Leaves	Leaves are used as vegetable
13.	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & C.H.Eberm.	Lauraceae	Tree	Dalchini	Leaves	Used as spices
14.	*Cirsium wallichii* DC.	Asteraceae	Herb	Kandaru	Root	Used as vegetable
15.	*Cleome viscosa* L.	Cleomaceae	Herb	Jakhiya	Seeds	Used as spices
16.	*Coriaria napalensis* Wall.	Coriariaceae	Shrub	_	Fruits	Ripe fruits are edible
17.	*Cornus macrophylla* Wall.	Cornaceae	Tree	Khagsai	Fruits	Ripe fruits are edible
18.	*Cotinus coggygria* Scop.	Anacardiaceae	Shrub	_	Fruits	Ripe fruits are edible
19.	*Cotoneaster microphyllus* Wall. Ex Lindl.	Rosaceae	Shrub	_	Fruits	Ripe fruits are edible
20.	*Cyperus rotundus* L.	Cyperaceae	Herb	_	Root and Seed	Used as raw food or cooked
21.	*Dioscorea belophylla* (Prain) Voigt ex Haines	Dioscoreaceae	Climber	Tor	Tubers	Used as vegetable
22.	*Echinops echinatus* Roxb.	Asteraceae	Herb	_	Root	Used as salad
23.	*Elaeagnus umbellata* Thunb.	Elaeagnaceae	Shrub	Titrai	Fruits	Fruits are edible
24.	*Fagopyrum esculentum* Moench	Polygonaceae	Herb	_	Young twigs and leaves	Used as vegetable
25.	*Ficus auriculata* Lour.	Moraceae	Tree	Timil	Fruits	Ripe fruits are edible
26.	*Ficus palmate* Forssk.	Moraceae	Tree	Fedu	Fruits	Ripe fruits are edible
27.	*Ficus sarmentosa* Buch.-Ham. ex Sm.	Moraceae	Climber	_	Fruits	Ripe fruits are edible
28.	*Ficus semicordata* Buch.-Ham. ex Sm.	Moraceae	Tree	_	Fruits	Used as vegetables
29.	*Girardinia diversifolia* (Link) Friis	Urticaceae	Herb	Bhainskandali	Leaves	Cooked as a green vegetable
30.	*Grewia optiva* J.R.Drumm. ex Burret	Malvaceae	Tree	Biyu	Fruits	Ripe fruits are edible
31.	*Impatiens balsamina* L.	Balsaminaceae	Herb	_	Leaves and seed	Leaves are used as vegetable and seed as oil
32.	*Juglans regia* L.	Juglandaceae	Tree	Akhod	Fruits	Ripe fruits are edible
33.	*Justicia adhatoda* L.	Acanthaceae	Shrub	Basingu	Leaves and roots	Used as vegetables
34.	*Mentha arvensis* L.	Lamiaceae	Herb	Pudina	Young leaves and twigs	Used as flowering agents
35.	*Morus serrata* Roxb.	Moraceae	Tree	Keemu	Fruits	Ripe fruits are edible
36.	*Myrica esculenta* Buch.-Ham. ex D.Don	Myricaceae	Tree	Kafal	Fruits	Fruits are edible
37.	*Opuntia elatior* Mill.	Cactaceae	Shrub	Nagfani	Fruits	Ripe fruits are edible
38.	*Oxalis corniculata* L.	Oxalidaceae	Herb	_	Young leaves and twigs	Used as vegetable
39.	*Phanera vahlii* (Wight &Arn.) Benth.	Fabaceae	Climber	Maloo	Seed	Roasted seed eaten as namkeen
40.	*Phoenix loureiroi* Kunth	Arecaceae	Shrub	Khajoor	Fruits	Ripe fruits are edible
41.	*Phyllanthus emblica* L.	Phyllanthaceae	Tree	Aawla	Fruits	Ripe fruits are edible

42.	*Pinus roxburghii* Sarg.	Pinaceae	Tree	Sali	Seeds	Seeds are edible
43.	*Potentilla indica* (Andrews) Th.Wolf	Rosaceae	Herb	Bajradanti	Fruits	Fruits are edible
44.	*Prinsepiautilis* Royle	Rosaceae	Shrub	Beku	Seed	Used as oil seed
45.	*Prunus cerasoides* Buch.-Ham. Ex D.Don	Rosaceae	Tree	Pajoo	Fruits	Ripe fruits are edible
46.	*Pyracantha crenulata* (D.Don) M.Roem.	Rosaceae	Shrub	_	Fruits	Ripe fruits are edible
47.	*Pyrus pashia* Buch.-Ham. ex D.Don	Rosaceae	Tree	Mol	Fruits	Ripe fruits are edible
48.	*Rhamnus triquetra* (Wall.) Brandis	Rhamnaceae	Tree	_	Fruits	Ripe fruits are edible
49.	*Rhamnus virgata* Roxb.	Rhamnaceae	Shrub	_	Leaves	Used for tea
50.	*Rhododendron arboreum* Sm.	Ericaceae	Tree	Burans	Flowers	Flowers are edible
51.	*Rosa moschata* Herrm.	Rosaceae	Shrub	_	Fruits	Ripe fruits are edible
52.	*Rubia manjith* Roxb.	Rubiaceae	Climber	_	Fruits	Ripe fruits are edible
53.	*Rubus ellipticus* Sm.	Rosaceae	Shrub	Hisow	Fruits	Ripe fruits are edible
54.	*Rubus macilentus* Cambess.	Rosaceae	Shrub	Hisow	Fruits	Ripe fruits are edible
55.	*Rubus paniculatus* Sm.	Rosaceae	Climber	Hisow	Fruits	Ripe fruits are edible
56.	*Rumex hastatus* D.Don	Polygonaceae	Shrub	Almodu	Leaves	Used as salad
57.	*Rumex nepalensis* Spreng.	Polygonaceae	Herb	_	Young leaves and twigs	Used as vegetables
58.	*Scurrula elata* (Edgew.) Danser	Loranthaceae	Shrub	_	Leaves and fruits	Fruits eaten as raw. Tender shoots used as tea beverage
59	*Solanum nigrum* L.	Solanaceae	Herb	_	Fruits	Ripe fruits are edible
60.	*Symplocos paniculata* (Thunb.) Miq.	Symplocaceae	Tree	Lothar	Fruits	Used as jams, jellies and sauce
61.	*Tagetes minuta* L.	Asteraceae	Herb	_	Leaves	Used for soup and vegetables
62.	*Viburnum cotinifolium*	Viburnaceae	Tree	_	Fruits	Ripe fruits are edible
63.	*Woodfordia fruticosa* (L.) Kurz	Lythraceae	Shrub	Doulu	Flower	Ripe flowers are edible
64.	*Ziziphus mauritiana* Lam.	Rhamnaceae	Shrub	Ber	Fruits	Ripe fruits are edible

CONCLUSION

The hill communities must be made aware of the sustainable use of these species if the environment is to remain in balance. Wild edible plants have a well-established history of helping Himalayan tribes meet their nutritional demands. The NW Himalayas between altitudes of 700 m to 2700 m asl, are available in and near habitation in a semi-domesticated state, and the local population routinely visits forests to obtain necessary foods and food supplements. The interviews with locals revealed that wild food plants are used as typical household foods and significantly contribute to the area's population's food security.

ACKNOWLEDGMENTS

The authors are grateful to the inhabitants of the study area for sharing their knowledge and time. We thank Mr. Jagmohan Singh Rawat (local guide) for his support during the fieldwork.

Declaration: *We also declare that all ethical guidelines have been followed during this work and there is no conflict of interest among authors.*

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