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# An ethnobotanical study of traditional recipes used in the peripheral villages of the Ghurdauri region, Uttarakhand, India

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The wild and locally collected edible plants of the peripheral villages in the Ghurdauri region, Uttarakhand, are an under-researched tradition that plays a vital role in food security during market disruptions, whether seasonal or crisis-related. This study records these species and associated traditional recipes, assesses their cultural importance based on Frequency of Citation (FC) and Relative Frequency of Citation (RFC) and investigates the effect of plant life-form and seasonality on citation. The data were collected from 36 informants in 10 villages through direct interviews, participant observation, and questionnaires. Forty-five species from 27 botanical families were recorded, with RFC values ranging from 0.19 to 0.97, indicating high heterogeneity in cultural importance. Herbaceous species were the most common, followed by trees, shrubs, and climbers, with those that were easily available and abundant in season being used; leaves and seeds were the most common plant parts used, for both nutritional value and versatility. The documented species were used in various traditional preparations such as saag, sabji, chutneys, desserts, beverages and pickles, indicating their regular use in daily and seasonal diets. There was no significant relationship between plant life-form and RFC (Spearman $\rho$ = -0.255, $R^2$ = 0.065, p = 0.626), but there was a moderate correlation between seasonal availability and RFC (Spearman $\rho$ = -0.673, $R^2$ = 0.452, p = 0.068), with species with defined seasonal windows being cited more frequently than year-round taxa. The results emphasize the importance of ethnobotanical knowledge of these culturally relevant and narrowly seasonal species as conservation and food security priorities and the need to document the loss of this knowledge to ensure sustainable food systems and conservation of biodiversity in the Himalayan region.

**Keywords:** Ethnobotany, Indigenous knowledge, Local edible plants, Relative frequency of citation, Traditional food systems

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In India, within the Himalayan region, communities have been historically relying on the wild food sources when they are disrupted, like in floods, landslides, loss of roads, and restricted access to markets[1]. These species of wild edible plants are not just secondary foods but serve as emergency food stores in case of any disaster[2]. The Indian Himalayas are internationally known as a biodiversity hotspot and are home to a rich collection of wild and local edible plants used to provide food security to the household[3]. According to other historical sources and oral traditions, the use of foods based on forests has always been an inseparable part of subsistence in Himalayan communities over the centuries[4]. Uttarakhand is a state in the central Indian Himalayan region and is known to have ecological heterogeneity and reliance of the rural populations on the forest resources[5]. Climate-related disasters, including flash floods, cloudbursts and landslides, are particularly vulnerable to the state, and they often cause damage to transport networks and food supply chains[6]. In these settings, the local population uses local food plants and established recipes to curb food deficiency[7]. As they are usually cooked with locally available plant parts, such as leaves, tubers, fruits, seeds, and shoots, they have a direct connection to seasonality and crisis-specific demands[8,9]. Nevertheless, the erosion of this traditional food knowledge has risen at a faster rate due to increasing migration, changing lifestyles, modernisation and natural habitat degradation[10].

A peripheral region, Ghurdauri, is one such unexplored region where villagers still use local edible plants in such unfavourable circumstances. Despite the importance of such adaptive knowledge, there are no ethnobotanical records documenting crisis-related wild food practices and traditional recipes in the region.

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**Abbreviations**
FC – Frequency of Citation, RFC – Relative Frequency of Citation

Only a limited number of past ethnobotanical researchers in Uttarakhand have focused on medicinal plants, and their work is based on narrow geographical or plant-group settings; the survival strategies of food-based survival remain largely untapped[11]. The present study thus aims to document edible wild and locally collected plants and traditional recipes from the peripheral villages of the Ghurdauri region of Uttarakhand. Specifically, the following objectives were set: (i) to document local edible plant species, their local names, parts used and modes of preparation using structured field surveys; (ii) to determine the cultural significance of the documented species by calculating Frequency of Citation (FC) and Relative Frequency of Citation (RFC); and (iii) to investigate the relationship between ecological attributes life form and seasonal availability. The study helps document this lost knowledge, which is important for food security, cultural identity, and the resilience of the Himalayan people, and also serves as a baseline for future ethnobotanical, nutritional, and conservation studies.

#### The geoclimatic conditions of Ghurdauri region

The Ghurdauri is located in the Pauri Garhwal district of Uttarakhand, in the Garhwal Himalayas, which are part of the lesser Himalayan mountains, with complex topography, steep gradients, and pronounced altitudinal variation. The land mainly comprises steep slopes and dissected valleys, and elevation and aspect play critical roles in shaping the climate and vegetation.

The climatic conditions of the area are sub-temperate to temperate, characteristic of mid-Himalayan areas. Summers (March-June) are usually warm at lower elevations, while at higher altitudes they remain cold, occasionally with snowfall. Winters in the region are cool and severe, with temperatures dropping to near freezing at higher altitudes. The southwest monsoon is a distinct rainy season during which most of the yearly precipitation is received. The average annual rainfall in the district is approximately 218 cm, although about 90% of the rainfall occurs during the monsoon months (June - September). Because of the complex interplay among altitude, orography, and monsoon processes, the region exhibits high microclimatic heterogeneity. This, together with steep slopes, predisposes the landscape to soil erosion and mass-wasting processes, especially during severe rainfall events. The vegetation cover of the area ranges from mixed broadleaf forests to coniferous species, according to adaptation to changing temperature and moisture regimes[12].

## Materials and Methods

#### Study area

The study was carried out in the villages around Ghurdauri, Pauri Garhwal district, Uttarakhand, central Indian Himalaya. It is a region of undulating terrain, a subtropical-to-temperate climate, and mixed broad leaf forest cover. The region is often cut off from other market centres by frequent landslides, heavy monsoon rains, and infrastructure damage, so during crises it is necessary to rely on edible plants for food.

#### Field visits and informant selection

The residents of the en peripheral villages were approached directly during field visits. Informants were selected based on the following criteria: people involved in cultivating local/traditional crops, village elders, elderly people, and women primarily involved in preparing food at home. The number of informants was determined by informational saturation, which was reached with 36 informants (28 female, 8 male; age range 30-68 years; 3-6 informants per village) to cover the spectrum of ethnobotanical knowledge held locally.

#### Data collection

Structured questionnaires, personal interviews, focus group discussions, and direct field observations (Additional file 1) were used to collect data on local names, botanical names, parts used, seasonal occurrence, preparation methods, and traditional uses. Species were identified in the field based on their morphology, cross-checked with the POWO database, other online resources and regional floras, and documented photographically in situ. Logistical constraints prevented the deposition of physical voucher specimens in a herbarium, so photographic records serve as visual vouchers.

#### Data analysis and quantitative indices

Data were recorded by botanical name, family, local name, plant part, and method of preparation, and by qualitative analysis of trends in cultural use. Cultural significance was assessed using Frequency of Citation (FC) and Relative Frequency of Citation (RFC = FC/N, N = 36 informants; range 0–1). Species were classified by life-form, family, plant part and preparation method, and numerical codes were assigned to life-form and seasonal categories. Spearman's rank correlation and linear regression were used to test relationships between ecological attributes and citation frequency ($\alpha = 0.05$).

## Results

### Study area description

The survey covered ten villages in the Ghurdauri region, as shown in (Fig. 1). Supplementary Table S1 shows the spatial distribution of the surveyed villages.

### Documented diversity of local edible plants

The ethnobotanical survey of the peripheral villages in the Ghurdauri region recorded 45 local edible plant species used in traditional food preparation. Information was gathered on local names, the specific plant parts used in the dishes, and the use of each plant as reported by informants (Fig. 2-3). There was a slight difference in the names of local plants between villages, which could be explained by the cultural diversity at the local level. The documented flora included wild leafy vegetables, fruits, shoots, tubers, seeds, and flowers, thus showing how forest resources have contributed significantly to local diets. FC- and RFC- based quantitative analyses revealed a marked difference in the cultural significance of the documented species.

### Relative Frequency of Citation (RFC) of documented edible species

RFC was used to assess the cultural significance of documented edible plant species in the fringe villages of the Ghurdauri region (Table 1). The RFC values ranged from 0.19 to 0.97, indicating significant differences in local knowledge and usage preferences among the species.

The maximum RFC value of *Eleusine coracana* (Mandwa) (FC = 35; RFC = 0.97), then *Rhododendron arboreum* (FC = 33; RFC = 0.91), *Chenopodium album* (FC = 32; RFC = 0.88), *Echinochloa frumentacea* (FC = 32; RFC = 0.88) The citation values of *Macrotyloma uniflorum* (FC=31; RFC= 0.86), *Cajanus cajan* (FC=31; RFC= 0.86), *Urtica dioica* (FC=30; RFC= 0.83), *Cucurbita maxima* (FC=30; RFC= 0.83) and *Sesamum indicum* (FC=30; RFC= 0.83) were moderate (Fig. 4). Lower RFC values were found among *Allium stracheyi* (FC = 7; RFC = 0.19), *Pinus gerardiana* (FC = 9; RFC = 0.25) and *Pyracantha crenulata* (FC = 9; RFC = 0.25), which were not cited often by informants.

### Relationship between ecological attributes and RFC

The mean RFC differed among life-forms, being highest for climbers (0.74), herbs (0.69), and ferns (0.63), and lowest for bamboo and fungi (0.30 each) (Table 2). There was no significant effect of life-form on RFC (Spearman $\rho = -0.255$; $R^2 = 0.065$, $F = 0.277$, $p = 0.626$; full ANOVA and regression output in Supplementary Table S2-S3). This indicates that cultural salience is more related to accessibility than to growth habit: herbs and climbers are generally fast-growing and easily located along field margins and forest edges, and do not require any special foraging skills, while species with narrower ecological windows (e.g., *Morchella esculenta*) may be mentioned less frequently, even though they are known to be valuable (Fig. 5).

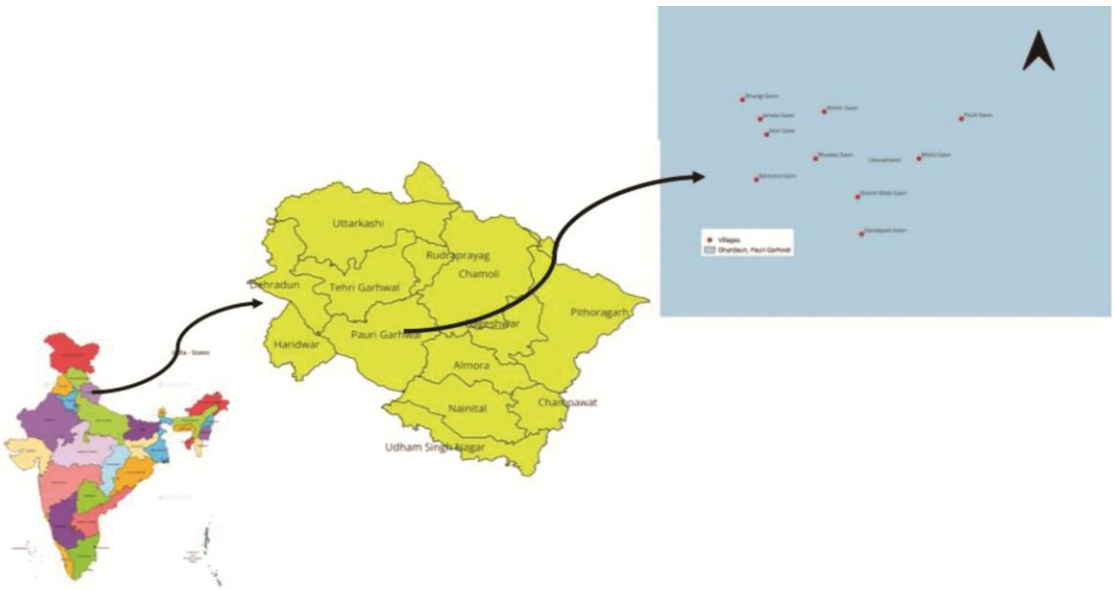


Fig. 1 — Location map of the study area showing the geographical position of the selected peripheral villages of the Ghurdauri region in Pauri Garhwal district, Uttarakhand, India (Base map adapted from publicly available sources)


Fig. 2 — Photographic representation of selected local edible plant species documented from the Ghurdauri region, Uttarakhand, India


Fig. 3 — A visual collage showcasing diverse regional foods prepared from locally available seasonal plants from the Ghurdauri region, Uttarakhand, India

Table 1 — Documented edible plant species and their ethnobotanical attributes in the Ghurdauri region, Uttarakhand

| S. No | Botanical Name | Local Name | Family Name | Life Form | Seasonal Availability | Plant Part Used | Mode of preparation | FC (N=36) | RFC |
|---|---|---|---|---|---|---|---|---|---|
| 1. | *Aegle marmelos* (L.) Corrêa | Bael | *Rutaceae* | Tree | Summer | Fruits and leaves | Bael Sharbat: Fruit is smashed and mixed with water, jaggery. Bael Murabba: Unripe fruit is boiled and cooked in thick sugar syrup. | 25 | 0.69 |
| 2. | *Allium stracheyi* Baker | Faran / Jambu | *Amaryllidaceae* | Herb | Summer | Leaves | Faran ki Chutney: Fresh leaves were crushed with green chilies and salt to make paste. Flavouring Herb: Used in soup and dals. | 7 | 0.19 |
| 3. | *Amaranthus cruentus* L. | Chaulai / Laal Saag | *Amaranthaceae* | Herb | Summer–Monsoon | Leaves, stems, and seeds | Chaulai Saag: Fresh leaves chopped and cooked in oil with garlic and mixed with nettle leaves. | 29 | 0.80 |
| 4. | *Arundinaria falcate* Nees | Ringal | *Poaceae* | Bamboo (Grass) | Year-round | Stem | Ringal Sabzi: Outer layer is peel, boiled and sauteed in oil with local spices. Ringal Pickle: Boiled shoots cut into pieces mixed with oil and spices. | 11 | 0.30 |

... Contd.

Table 1 — Documented edible plant species and their ethnobotanical attributes in the Ghurdauri region, Uttarakhand (Contd.)

| S. No | Botanical Name | Local Name | Family Name | Life Form | Seasonal Availability | Plant Part Used | Mode of preparation | FC (N=36) | RFC |
|---|---|---|---|---|---|---|---|---|---|
| 5. | *Bauhinia vahlii* Wight & Arn. | Malu / Kachnar | *Fabaceae* | Tree | Spring | Young leaves | Malu Patta Sabzi: Leaves are chopped, boiled, and cooked with local spices. Malu Patta Pakoda: Leaves are dipped in gram flour and fried until crisp. | 22 | 0.61 |
| 6. | *Berberis asiatica* Roxb. ex DC. | Kilmora | *Berberidaceae* | Shrub | Summer | Fruits | Kilmora Chutney: Fresh berries crushed with salt, green chilies, and garlic. Kilmora Sharbat: Berries boiled, strained, sweetened, and served as a refreshing drink. | 24 | 0.66 |
| 7. | *Cajanus cajan* (L.) Mill sp. | Toor Dal | *Fabaceae* | Shrub (Legume) | Kharif | Seeds (dried), leaves | Toor dal Khichdi: Jhangora and Toor dal is cooked together with spices. | 31 | 0.86 |
| 8. | *Cannabis sativa* L. | Bhaangke Patte | *Cannabaceae* | Herb | Summer | Leaves and seeds | Bhaang ki Chutney: Leaves are ground with green chilies and local spices. Bhaang ka Namak: Seeds are roasted and powdered with rock salt | 20 | 0.55 |
| 9. | *Chenopodium album* L. | Bathua | *Amaranthaceae* | Herb | Winter | Leaves | Bathua Saag mix: Fresh leaves of Bathua mixed with Chaulai, Palak and Lingda added with local spices. | 32 | 0.88 |
| 10. | *Citrus limon* (L.) Osbeck | Pahadi Nimbu / Gulgul | *Rutaceae* | Tree | Winter | Fruit | Gulgul ki Chutney: Lemon pulp mixed with Bhangjeera, green chilies, salt, and coriander. | 27 | 0.75 |
| 11. | *Cleome viscose* L. | Jakhya | *Cleomaceae* | Herb | Summer | Tiny black/ brown seeds | Jakhya Roti: Dough is prepared with Jakhya for flavor. | 27 | 0.75 |
| 12. | *Colocasia esculenta* (L.) Schott | Gaderi / Pahadi Arbi /Pindalu | *Araceae* | Herb | Monsoon | Underground roots & leaves | Gaderi ki Sabzi: Tubers are boiled, cut into pieces, fried with jakhiya and eaten with mandwa. Gaderi Ke Pakode: Boiled and sliced, coated in rice batter and deep fried. | 29 | 0.80 |
| 13. | *Cucurbita maxima* Duchesne | Pahadi Kaddu | *Cucurbitaceae* | Climber | Monsoon | Fruit, leaves, flowers, and seeds | Kaddu ke Phool ki Pakodi: Fresh pumpkin flowers dipped in a thin batter of rice flour, spices and deep-fried. Kaddu ke Patto ka saag: Leaves are washed and chopped finely, boiled with spices and eaten with Jhangora. | 30 | 0.83 |

... *Contd.*

Table 1 — Documented edible plant species and their ethnobotanical attributes in the Ghurdauri region, Uttarakhand (Contd.)

| S. No | Botanical Name | Local Name | Family Name | Life Form | Seasonal Availability | Plant Part Used | Mode of preparation | FC (N=36) | RFC |
|---|---|---|---|---|---|---|---|---|---|
| 14. | *Curcuma longa* L. | Pahadi Haldi | *Zingiberaceae* | Herb | Monsoon | Underground roots | Pahadi Haldi Pickle: Haldi is cut into pieces and mixed with mustard seeds, oil, with lemon juice. | 29 | 0.80 |
| 15. | *Dendrocalamus hamiltonii* Nees & Arn. Ex Munro | Thuner | *Poaceae* | Tree | Summer | Young Leaves | Thuner Ka Thechwani: Boil and crush the shoots and cook with mustard oil and spices. | 15 | 0.41 |
| 16. | *Dioscorea bulbifera* L. | Gethi / Kand | *Dioscoreaceae* | Herb (Tuber) | Winter | Underground root | Gethi Chips: Tuber is thinly sliced, sun dried and fried as chips. Gethi Sabji: Tuber is peeled, chopped into small pieces and cooked with spices. | 19 | 0.52 |
| 17. | *Diplazium esculentum* (Retz. ) Sw. | Lingda | *Athyriaceae* | Fern | Spring | Young curled leaves | Lingda Pickle: Fronds are sun dried and mixed with spices and oil. | 23 | 0.63 |
| 18. | *Diploknema butyracea* (Roxb.) H.J. Lam | Chyura | *Sapotaceae* | Tree | Winter | Seeds, flowers, and leaves | Chyura Ladoo: Roasted flour in oil and mixed with melted with jaggery. | 11 | 0.30 |
| 19. | *Echinochloa frumentacea* Link | Jhangora | *Poaceae* | Herb (Cereal) | Kharif | Seeds | Jhangora ki Kheer: Soaked in water then cooked with milk and jaggery. Jhangora ka Halwa: Roasted seeds cooked with jaggery. | 32 | 0.88 |
| 20. | *Eleusine coracana* (L.) Gaertn. | Mandwa | *Poaceae* | Herb (Cereal) | Kharif | Seeds | Baadi: Roasted Mandwa flour in ghee and jaggery added to form thick paste. Mandwa Kheer: Mandwa flour cooked in milk and jaggery. | 35 | 0.97 |
| 21. | *Fagopyrum dibotrys* (D.Don) H. Hara | Ogal | *Polygonaceae* | Tree | Summer | Young leaves | Ogal Saag: Leaves are washed, boiled Sauteed in mustard oil with local spices. | 12 | 0.33 |
| 22. | *Ficus auriculata* Lour. | Timla | *Moraceae* | Tree (Fig) | Summer | Fruits | Timla Ki Sabji: Ripe fruits are collected, cut into pieces and cooked with oil, local spices. Timla Pickle: Fruits are boiled, sun dried and mixed with oil. | 21 | 0.58 |

... Contd.

Table 1 — Documented edible plant species and their ethnobotanical attributes in the Ghurdauri region, Uttarakhand (Contd.)

| S. No | Botanical Name | Local Name | Family Name | Life Form | Seasonal Availability | Plant Part Used | Mode of preparation | FC (N=36) | RFC |
|---|---|---|---|---|---|---|---|---|---|
| 23. | *Ficus palmata* Forssk. | Bedu | *Moraceae* | Tree (Wild fig) | Summer | Fruits | Bedu ki Sabzi: Ripe fruits are cut and cooked with mustard oil and local spices. Bedu Launji: Fruits are mixed with jaggery and spices to make a thick, sweet preserve. | 22 | 0.61 |
| 24. | *Glycine max* (L.) Merr. | Bhatt ki Dal | *Fabaceae* | Herb (Legume) | Kharif | Seeds | Bhatt ki Phalli: Pods are washed, cut and cooked in mustard oil. | 31 | 0.86 |
| 25. | *Lablab purpureus* (L.) Sweet | Pahadi Sem | *Fabaceae* | Climber | Monsoon | Seeds and young leaves | Sem ki Sabji: Green pods cut into pieces, cooked with oil. | 25 | 0.69 |
| 26. | *Lawsonia inermis* L. | Mehandi | *Lythraceae* | Shrub | Summer | Young leaves | Mehandi ki Sabzi: Leaves are boiled and sauteed in oil with local spices, eaten with Jhangora. | 14 | 0.38 |
| 27. | *Macrotyloma uniflorum* (Lam.) Verdc. | Gahat / Kulthi | *Fabaceae* | Herb (Legume) | Rabi | Seeds | Gahat ki Phanu: A thick curry is prepared by Gahat flour mixed with water and local spices. | 31 | 0.86 |
| 28. | *Momordica dioica* Roxb. ex Willd. | Kankoda | *Cucurbitaceae* | Climber | Monsoon | Leaves and Fruit | Kankode Saag and Sabji: Leaves are washed, chopped finely and boiled for 5–10 min to reduce sourness, mustard oil with garlic, onion added. Sometimes mixed with Bichhu Ghas or Lingda to balance taste. | 25 | 0.69 |
| 29. | *Morchella esculenta* (L.) Pers. | Jangli Gucchi | *Morchellaceae* | Fungus | Spring | Fruit | Gucchi Curry: Cooked in milk with local spices, eaten with Jhangora. Gucchi ki Sabzi: Dried, soaked and sauteed in ghee with oil and spices. | 11 | 0.30 |
| 30. | *Musa acuminate* Colla | Chote/ Pahadi Kele | *Musaceae* | Herb | Monsoon | Fruit, stem and leaves | Kele ka Halwa: Ripe bananas mashed and cooked with ghee and jaggery. Kele ki Pakodi: Bananas are thinly sliced, sun dried and dipped in besan paste to make pakodi. | 15 | 0.41 |

... Contd.

Table 1 — Documented edible plant species and their ethnobotanical attributes in the Ghurdauri region, Uttarakhand (Contd.)

| S. No | Botanical Name | Local Name | Family Name | Life Form | Seasonal Availability | Plant Part Used | Mode of preparation | FC (N=36) | RFC |
|---|---|---|---|---|---|---|---|---|---|
| 31. | *Myrica esculenta* Buch.-Ham. Ex D.Don | Kaafal | *Myricaceae* | Tree | Summer | Fruits | Kaafal Sherbet: Fruit mashed and mixed with jaggery and black salt. Kaafal ki Chutney: Pulp is mixed with green chilies, lemon and local spices. | 27 | 0.75 |
| 32. | *Oryza sativa* L. | Lal Chawal | *Poaceae* | Herb (Cereal) | Kharif | Seeds | Red Rice Khichdi: It is cooked with Gahat dal with local spices. Red Rice Kheer: Rice boiled in milk with jaggery. | 18 | 0.50 |
| 33. | *Paspalum scrobiculatum* L. | Kodu | *Poaceae* | Herb (Cereal) | Kharif | Seeds | Kodu Khichdi: Kodu soaked and. Cooked with vegetables and Jhangora. Kodu kepakode: Kodu grain mashed and layer with besan flour with local spices. | 26 | 0.72 |
| 34. | *Perilla frutescens* (L.) Britton | Bhangjeera | *Lamiaceae* | Herb | Winter | Seeds | Bhangjeera Chutney: Seeds are dry roasted and grounded with green chilies and local spices. Bhangjeera Raita: Seeds are roasted, powdered and then mixed with curd and spices. | 18 | 0.50 |
| 35. | *Pinus gerardiana* Wall. ex D.Don | Chilgoza /Pine nut | *Pinaceae* | Tree | Autumn | Seeds and cones | Roasted Chilgoza: Nuts roasted for a winter snack. Chilgoza Chutney: Roasted cones grind with garlic and add some salt with spices. | 9 | 0.25 |
| 36. | *Prunus armeniaca* L. | Khubani | *Rosaceae* | Tree | Summer | Fruit Seeds | Khubani Chutney: Peeled the fruit, cooked with jaggery, pepper, salt and served as chutney. | 19 | 0.52 |
| 37. | *Pyracantha crenulate* (D.Don) M.Roem. | Ghingaru | *Rosaceae* | Shrub | Summer | Fruits and leaves | Ghingaru ki Chutney: Fresh flowers is mashed and mixed with local spices and salt. | 9 | 0.25 |
| 38. | *Rhododendron arboreum* Sm. | Buransh | *Ericaceae* | Tree | Spring | Flowers | Buransh Pakora: Whole petals dipped in chickpea flour batter and deep fried. Buransh Chutney: Petals are blended with green chilies, cumin, black salt, and lemon, giving a tangy flavor. | 33 | 0.91 |

... Contd.

Table 1 — Documented edible plant species and their ethnobotanical attributes in the Ghurdauri region, Uttarakhand (Contd.)

| S. No | Botanical Name | Local Name | Family Name | Life Form | Seasonal Availability | Plant Part Used | Mode of preparation | FC (N=36) | RFC |
|---|---|---|---|---|---|---|---|---|---|
| 39. | *Rubus ellipticus* Sm. | Hisalu | *Rosaceae* | Shrub | Summer | Fruits | Hisalu Chutney: Fruits are mashed, mixed with green chilies and salt. Hisalu Sharbat: Fruits are crushed, mixed with water and sugar, then strained to make a cooling summer drink. | 21 | 0.58 |
| 40. | *Rumex nepalensis* Spreng. | Jalbhangru | *Polygonaceae* | Herb | Monsoon | Young leaves | Jalbhangru ka Saag: Chopped leaves boiled and heat with oil and local spices. | 20 | 0.55 |
| 41. | *Sesamum indicum* L. | Til | *Pedaliaceae* | Herb | Kharif | Leaves and seeds | Til Ladoo: Roasted seeds added to melted jaggery and made into ladoos. | 30 | 0.83 |
| 42. | *Setaria italica* (L.) P.Beauv. | Kauni | *Poaceae* | Herb (Cereal) | Kharif | Seeds | Kauni Ki Kheer: Kauni millet is washed and simmered in milk and mixed with sugar or jaggery. Kauni Khichdi: Kauni grains are cooked with turmeric and salt. | 22 | 0.61 |
| 43. | *Solanum xanthocarpu* Schrad. & J.C. Wend I. | Kantkari | *Solanaceae* | Shrub | Summer | Leaves and Fruits | Kantkari Berry Chutney: Fresh berries are crushed with salt and chilies. | 14 | 0.38 |
| 44. | *Urtica dioica* L. | Kandali | *Urticaceae* | Herb | Monsoon | Young leaves and stems | Bicchu Ghas ka Saag: Leaves are boiled and grounded into paste in mustard oil. Kandali Chutney: Leaves are crushed with chilies and garlic salt. | 30 | 0.83 |
| 45. | *Zanthoxylum armatum* DC. | Timur | *Rutaceae* | Shrub/ Small tree | Summer | Seeds, Leaves and fruit | Timur Chutney: Roast Timur and crushed with garlic, tomato. Timur Pickle: With mustard oil, the fruit is cut into pieces with local spices. | 28 | 0.77 |

The seasonal availability of Mean RFC also varied, with the highest values for the Rabi (0.86), Kharif (0.78), and summer-monsoon (0.80) cropping seasons, and the lowest for year-round availability (0.30) and Autumn (0.25) (Table 3). This relationship was close to conventional significance (Spearman $\rho$ = -0.673; $R^2$ = 0.452, F = 4.96, p = 0.068; full ANOVA and regression output in Supplementary Tables S4-S5), but not significant, probably due to the small number of seasonal categories (n = 8) rather than the absence of a real effect. This pattern indicates a salience effect due to scarcity, where seasonally scarce species are more saliently anticipated and remembered than continuously available species, and has a practical implication for prioritising conservation or cultivation support for high-citation, narrow-season species to fill in the seasonal food-security gaps (Fig. 6).

**Growth form, Family, plant part, and preparation type, and distribution of documented species**

The recorded flora was dominated by herbaceous species (44.4%, n=20), followed by trees (26.7%, n=12), shrubs (15.6%, n=7) and climbers (6.7%, n=3), with bamboo, ferns and fungi each contributing one species (2.2%) (Fig. 7a). This herb-dominant pattern suggests a food system based on readily available,

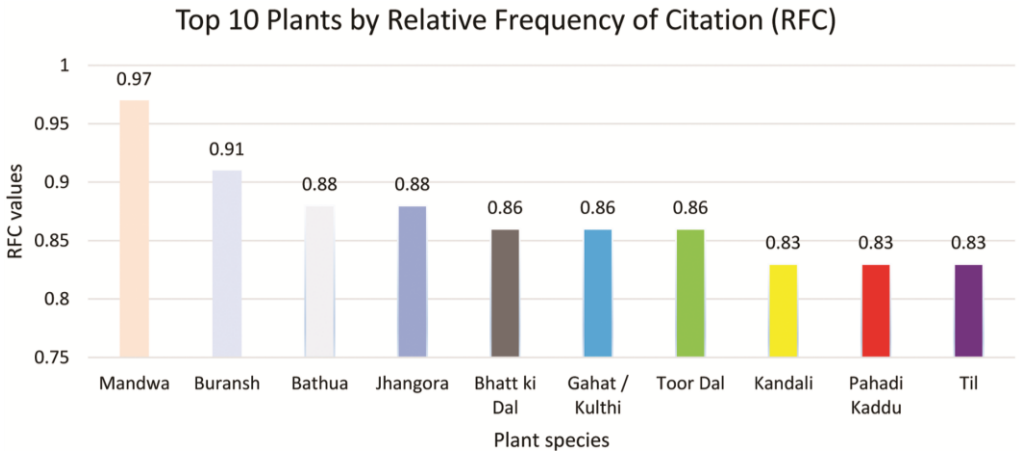


Fig. 4 — Relative frequency of citation (RFC) of the ten most frequently cited local edible plant species used in traditional food systems of the Ghurdauri region, Uttarakhand

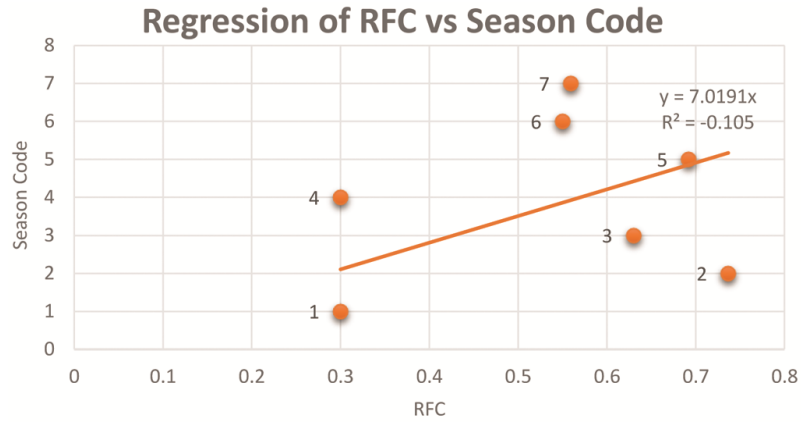


Fig. 5 — Linear regression showing the relationship between life-form codes and mean relative frequency of citation (RFC) of edible plant species

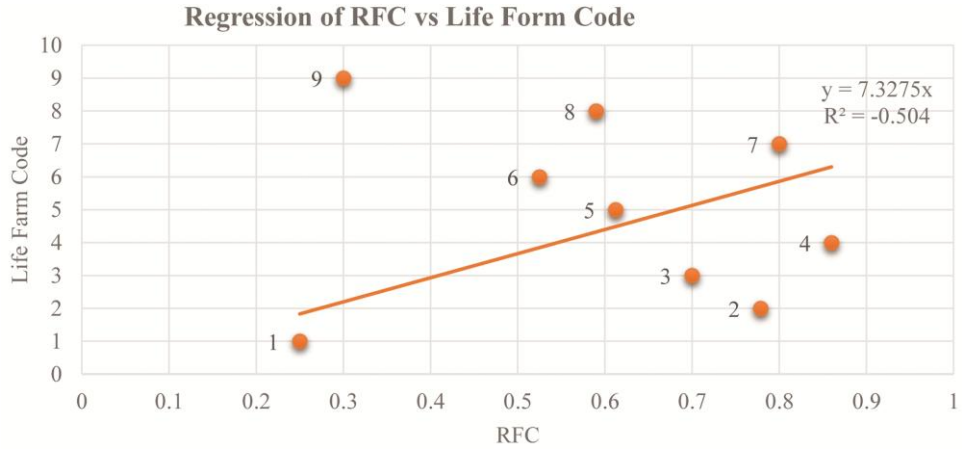


Fig. 6 — Linear regression showing the relationship between seasonal availability codes and the mean relative frequency of citation (RFC) of edible plant species

rapidly growing taxa, rather than on specialised or slow-maturing resources. Poaceae was the most represented family (15.6%, n=7), followed by Fabaceae (11.1%, n=5), and Rutaceae and Rosaceae were equally represented (6.7%, n=3) with the remaining nineteen families represented by a single species each, showing a high degree of taxonomic diversity despite the dominance of a few key families (Fig. 7b). The most exploited part of the plant was the leaves (23 preparations, 38%), followed by the seeds (19 preparations, 31%) and fruits (15 preparations, 25%) (Fig. 7c), which is related to the ease of harvest and processability of the plant parts, not necessarily to their nutritional value. The preparation types were also concentrated, with saag being the highest (15 species, 23%), followed by chutneys (18%), sabji (15%), pickles (6%), khichdi (5%) and spice-based preparations (4%) (Fig. 7d), indicating a high regional dependence on leafy-green cooking traditions.

Table 2 — Mean relative frequency of citation (RFC) values of edible plant species across different life-form categories recorded from the Ghurdauri region, Uttarakhand

| Life form | Code | Mean RFC |
|---|---|---|
| Bamboo | 1 | 0.30 |
| Climber | 2 | 0.74 |
| Fern | 3 | 0.63 |
| Fungus | 4 | 0.30 |
| Herb | 5 | 0.69 |
| Shrub | 6 | 0.55 |
| Tree | 7 | 0.56 |

Table 3 — Mean relative frequency of citation (RFC) of edible plant species based on seasonal availability in the Ghurdauri region, Uttarakhand

| Season | | Code | Mean RFC |
|---|---|---|---|
| Universal Seasons | Spring | 5 | 0.61 |
| | Summer | 6 | 0.53 |
| | Monsoon | 3 | 0.70 |
| | Autumn | 1 | 0.25 |
| | Winter | 8 | 0.59 |
| | Summer–Monsoon | 7 | 0.80 |
| | Year-round | 9 | 0.30 |
| Indian Cropping Seasons | Kharif | 2 | 0.78 |
| | Rabi | 4 | 0.86 |

## Discussion

This study is the first quantitative documentation of wild and semi-cultivated edible plants utilised in the peripheral villages of the Ghurdauri region, connecting local biodiversity, cultural preferences, and dietary requirements within a central Himalayan food system constrained by ecological availability. The range of the values of the RFCs was from 0.19 to 0.97, with a small number of species anchoring local food practice: Mandwa (0.97), Buransh (0.91), Bathua and Jhangora (0.88), and Bhatt ki Dal, Gahat/Kulthi, and Toor Dal (0.86) – all nutritionally important,

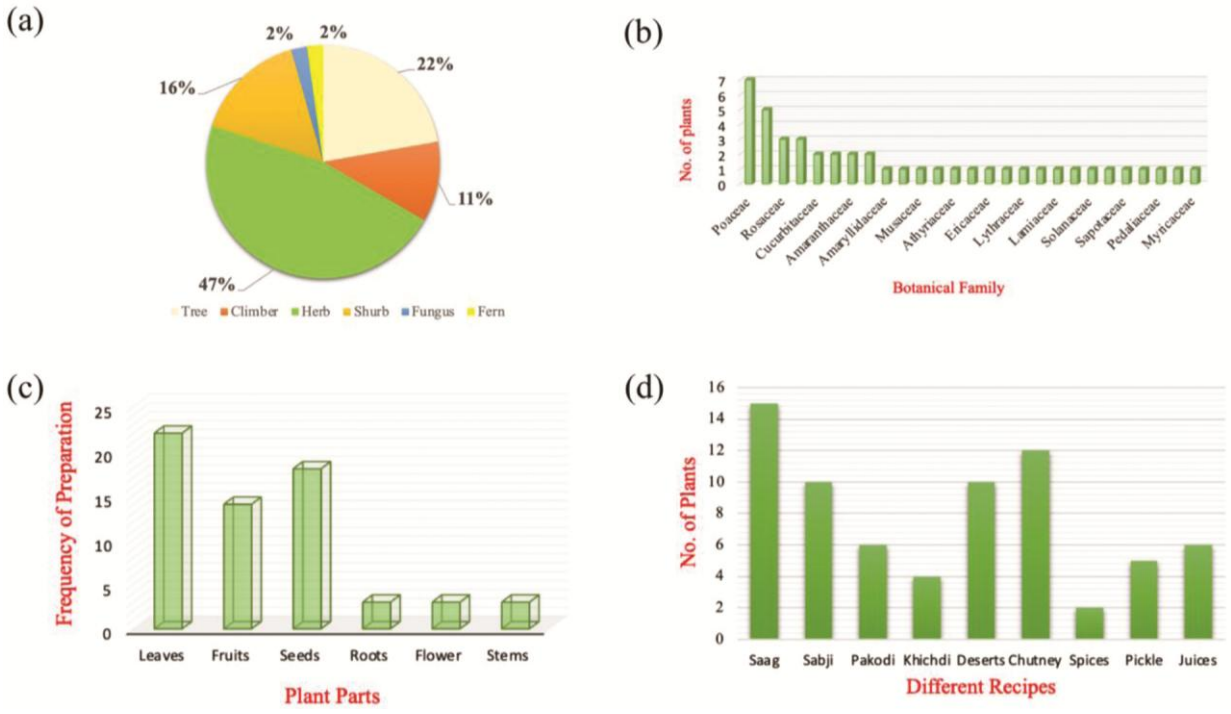


Fig. 7 — Distribution of documented edible plant species (n=45) in the Ghurdauri region, Uttarakhand, by (a) Life form, (b) botanical family, (c) plant part used, and (d) mode of preparation

widely distributed staples deeply embedded in traditional diets. The 45 species recorded are within the range of the other Garhwal and Kumaon surveys (45-95 species)[13].

There was no significant difference in mean RFC between life-forms ($\rho = -0.255$, $R^2 = 0.065$); climbers and herbs had slightly higher mean RFC, indicating that accessibility and familiarity with the species, rather than botanical grouping, drive species selection. By contrast, species with narrow, well-defined seasons (particularly those of the Rabi and Kharif seasons) were cited more often than those that are available throughout the year (mean RFC 0.30), a pattern that was moderately to strongly correlated ($\rho = -0.673$, $R^2 = 0.452$) and has direct implications for conservation and food-security planning. This was not significant ($p = 0.068$), probably because there were only a few season categories ($n = 8$), not because there was no effect.

The flora was dominated by herbaceous species (44.4%) followed by trees (26.7%), shrubs (15.6%) and climbers (6.7%), which is in accordance with the herb's ability to regenerate quickly, harvest easily and have little ecological impact as reported elsewhere in the Garhwal and Kumaon Himalaya[14,15]. Wild and semi-cultivated fruit trees remain a significant seasonal buffer for food security. Poaceae was the most dominant family (15.6%), followed closely by Fabaceae (11.1%), Rutaceae and Rosaceae (6.7% each). This dominance contrasts with most regional wild edible plant surveys, which report Rosaceae or Fabaceae as dominant; for example, a recent survey in Tehri Garhwal found Rosaceae (10 species) and Fabaceae (7 species) as the most dominant families among 73 species documented[13]. This difference may be due to methodological scope: this study included all plants used in traditional recipes, not just strictly wild-foraged ones, resulting in a higher relative abundance of Poaceae than in other studies, while the relative abundance of Fabaceae was fairly similar to the regional pattern.

Leaves were the most utilised part of the plants (38%), followed by seeds (31%) and fruits (25%), reflecting a preference for low-impact, sustainable harvesting, with millet/legume seeds providing dietary protein and energy and fruits being used seasonally[16,17]. Roots, flowers and stems were the least used (7%), which may be due to seasonal availability and processing requirements. Saag preparations were the most common, followed by chutneys and sabji/desserts (15% each); pickles, juices, khichdi and spices were comparatively marginal, consistent with more specialised or seasonal use reported in other Himalayan studies[18].

Ethnobotanical knowledge was held by elderly informants and women, who are the main keepers of food-preparation practices and their intergenerational transmission, while younger residents were not involved in this knowledge, indicating a genuine threat of knowledge loss. In general, the dietary system described here in the Himalayas, which includes millets, legumes, leafy vegetables, fruits, and condiments, is a nutritionally balanced, resilient traditional food system that supports food security in the region[19].

## Conclusion

The present study aims to document the ethnobotanical importance of edible wild and locally collected plants in the peripheral villages of Ghurdauri, Uttarakhand, and their contribution to the traditional food system and household food security. Forty-five species were recorded, indicating a significant reliance on wild and semi-cultivated resources influenced by regional vegetation, culture, and seasonality. Herbaceous species were the most abundant, followed by trees and shrubs, indicating adaptive preference for easily accessed, rapidly regenerated, sustainably harvested taxa. The continued importance of millets, legumes and seasonal fruits in the diet is highlighted by the dominant families Poaceae, Fabaceae, Rutaceae and Rosaceae. The range of the RFC was from 0.19 to 0.97, with Mandwa (0.97) and Buransh (0.91) being the most culturally important staple species. There was no significant relationship between plant life-form and citation frequency ($\rho = -0.255$, $R^2 = 0.065$), but there was a significant relationship between species with narrow seasonal windows and those with year-round windows ($\rho = -0.673$, $R^2 = 0.452$; $p = 0.068$), which is a scarcity-driven pattern with direct implications for conservation and food-security planning. Yet, even with this depth of traditional knowledge, there is a real risk of erosion as younger generations become less engaged. The preservation, documentation, and promotion of this knowledge are crucial to ensuring food security, cultural identity, and biodiversity in the Himalayan region.

## Supplementary Data

Supplementary data associated with this article is available in the electronic form at

https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_25(8)(2026)753-767_SupplData.pdf

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**Author Contributions**

MR: Conceptualisation, Investigation/Fieldwork, Formal analysis, Writing original draft; MB: Conceptualisation, Supervision, review, and editing.

**Conflict of Interest**

The authors declare no conflict of interest.

**Ethics Approval and Consent to Participate**

The study was conducted in accordance with the ethical guidelines for ethnobotanical research. Prior verbal informed consent was obtained from all participants before conducting interviews and group discussions. Participation was voluntary, and no personal identifiers were recorded.

**Use of Artificial Intelligence (AI)**

The authors declare that Artificial Intelligence (AI) assisted tools were not used for the generation, analysis, or interpretation of research data, nor for drawing scientific conclusions. The authors have carefully reviewed, verified, and edited the article and accept full responsibility and accountability for the accuracy, originality, and integrity of the manuscript.

**Data Availability**

The data supporting the findings of this study are included within the article.

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