



# Classification and Utilization Pattern of Fruits and Vegetables Available in Papum Pare District of Arunachal Pradesh

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## ABSTRACT

Documentation of species were carried out for a period of two years (2007-09) based on the standard questionnaire to report the diversity of locally available fruits and vegetable crops in different agro-climatic regime in Papum Pare district of Arunachal Pradesh. The study revealed that a total of 36 fruit and 48 vegetable species were available in the study area. Vegetable crops were represented by 38 genera from 19 families; however, fruit crops by 21 families from 26 genera. Diversity of the species under different genera resulted that *Brassica* was among the most dominant genera represented by the 7 species followed by *Phaseolus* (3 species), *Allium* and *Solanum* (2 species each). Large number of plants were represented by the single species and contributing to 71 per cent of the total species diversity. Family diversity resulted that Rutaceae was among the most dominant (7 species) family and large numbers of families were mono-specious and contributing 47 per cent of the total species richness. However, in vegetables Brassicaceae and Cucurbitaceae were among the most dominant family and 11 families were represented by single species only. Utilization pattern of the crops revealed that large numbers of species were used as leafy components, followed by whole plants, fruits, inflorescence, rhizomes and tubers etc. Most of the fruit crops were used as fresh followed by fire wood, medicine and preparation for juice, jelly, jam, beverages etc.

**Key Words:** Arunachal Pradesh, Availability, Fruits, Vegetable, Utilization Pattern, Traditional Knowledge.

## INTRODUCTION

The North Eastern region of India comprising eight states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim has vast physiographical variations represented in 6 agro climatic zones. This region is one of the richest reservoir of genetic variability and diversity of different crops i.e., various kinds of fruits, vegetables, spices, ornamental plants and also medicinal and aromatic plants. The diversity for horticultural crops of this region has mainly been managed by local farmers, often women. Considerable diversity exists among the regional horticultural species including variation in plant type, morphological and physiological characteristics, reactions to diseases and pests, adaptability and distribution. Apart from the

nutritional value, many regional horticultural crops are used for medicinal purposes, income generating and poverty alleviation programmes in the rural areas.

The per capita availability of fruits and vegetables is quite low because of post harvest losses which account for about 25 to 30 per cent of production. Besides, quality of a sizable quantity of produce also deteriorates by the time it reaches the consumer. Perishability is responsible for high market costs, market gluts, price fluctuations and other similar problems.

Keeping in view the growing population and to overcome the poverty and hunger, a systematic study was undertaken to document the cultivated fruits and vegetable in the district in terms of

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species diversity and their utilization pattern based on the extensive survey.

### MATERIALS AND METHODS

Arunachal Pradesh situated in the North-Eastern part of the country, lies between 26° 28' N to 29° 31' N latitude and 91°30'E to 97°30'E longitude and comprising the major part of the Eastern Himalaya with a total geographical area 83,743 km<sup>2</sup>. The total forest cover is about 68,847 km<sup>2</sup> accounting about 82.2 per cent of total geographical area of the state. Papum Pare is one of the major and capital district of the state situated between 26°55'N to 28° 40' N latitude and 92° 40' E to 94° 21' E longitude with an altitudinal range of 459 to 1250 msl covering geographical area of 2, 875 sq km

The present study was undertaken during the year 2012-13. In the study area, the documentation of fruits and vegetables grown in different agro-climatic regions was done through questionnaire and field survey in the selected village and indigenous farming communities across different eco-regions and the secondary information from published sources. Traditional cultivation methods were recorded through personal approach with the selected farmers and by visiting their fields. To understand and record data for the utility of fruits and vegetables, species were collected as per methodology given by Jain (1987) and Martin (1995).

Survey of villages and market places was made separately for complete documentation of uses and economic potentiality of fruits and vegetables available. Information was gathered with the help of local interpreter by consulting village elders and wise men, which have profound knowledge in the use of fruits and vegetables wealth. A detailed enquiry was made regarding different plant parts used and its method of use. All the species of fruits recorded were then categorized according to its use viz. fresh use, juice, jam, jelly, pickle, medicinal, fodder, fire-wood. For vegetables, i.e. fresh salad, cooked, soup, pickle, medicine, fodder, and others. Based on observation in market demand and the rate of utilization of the species by the people, the probable highly economically potential species were identified for management and sustainable

utilization.

### RESULTS AND DISCUSSION

#### Documentation of fruits and vegetables

Altogether, 84 species were recorded in which 36 species were classified under fruits and 48 species under vegetables. Thirty six species of fruit crops were taxonomically represented by 21 families and 26 genera whereas 48 species of vegetable crops were represented by 19 families under 37 genera (Table 1, 2). Diversity of the species under different genera indicated that *Brassica* was among the most dominant genera represented by the 7 species followed by *Phaseolus* (3 species), *Allium* and *Solanum* (2 species each). Out of 84 species large numbers of plants were represented by the single species and contributing to 71 per cent of the total species diversity (Fig. 1).

Ramachandran (2007) reported that largest category was the leaves and green shoot from 25 species. As source of fresh fruits, trees dominant with 20 species; shrubs 13 species and herbs 3 species were also recorded. Family Amaranthaceae was found to be dominant amongst them with 9 species, Euphorbiaceae with 6 species, Solanaceae with 5 species, Moraceae and Tiliaceae with 3 species and the rest were represented by one or two species. In the Indian Himalayan Region, medicinal plants (1748), wild edibles (675), fodder (279), essential oil yielding medicinal and aromatic plants (118) and sacred (155) plants were reported (Samant *et al* 1998; Samant and Pant 2003), while in India about 2,500 species of ethno-botanical importance are known (Jain, 1991). Occurrence of maximum wild edibles in shady moist, riverine, degraded and boundary habitats identifies these habitats as potential habitats, and merit priority attention for conservation. Awareness among the villagers and mass multiplication through conventional and *in-vitro* methods of wild edibles facing high anthropogenic pressures and their establishment and maintenance in the *in situ* and *ex situ* conditions may help in the conservation and management of these species.

Based on the species richness of the family of fruit crops, Rutaceae was among the most

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dominant (7 species) family followed by Rosaceae (6 species) Moraceae (4 species) and Myrtaceae (2 species). Large numbers of families were single species and contributing 47 per cent of the total species richness. However, in vegetables Brassicaceae and Cucurbitaceae were among the most dominant (8 species each) family on the basis of species diversity in the family followed by Fabaceae (7 species) and Solanaceae (4 species). Three species each were recorded from the families Amaranthaceae and Apiaceae while families Amaryllidaceae and Araceae were represented by 2 species each. Altogether, 11 families were represented by single species only (Fig. 1).

Species diversity of family at genera level in vegetables crop resulted similar pattern to that of species richness of different family except in few cases. Family Cucurbitaceae was among the richest (7 genera) family followed by Fabaceae (5 genera). Three families were characterized by three genera each and two family by two genera. Diversity of genera under different families of fruit species shows that family Rosaceae was among the most important family (3 genera) followed by Moraceae, Myrtaceae and Rutaceae (2 genera each). Seventeen families were represented by single genera only in the study area (Fig. 1).

Sharma *et al* (2013) reported a total 43 species of wild edible plants belonging to 25 families and 33 genera from district Hamirpur, Himachal Pradesh. Rosaceae (7 species) and Moraceae were among the dominant families; 13 families were monotypic. Among the genera, *Rubus* (4 species) were dominant genera. Among the parts of plants used, fruits of maximum species (25 species), followed by leaves (22 species), roots (13 species), bark and whole plant (8 species, each), flower, seed and wood (4 species each), tuber (2 species) and aerial part (1 species) were consumed by the inhabitants of the area. These wild edibles were also used in the treatment of various diseases/ailments of different body organs such as skin, sex organs, stomach, teeth, throat, ear, eyes, liver, heart, nervous system, muscles, joints, bones, etc.

All the habitat groups like tree, shrub, herbs and climbers are represented by the vegetable and fruit crops. Among the fruits crops (36) the

dominant habitat is the tree and represented by more than 90 percent species, where in case of vegetable crops (48) the habitat is mostly represented by annual herbs, shrubs and climbers. In the vegetable group the representation of tree habit is only one (*Moringa oleifera*). One fungus *i.e.* *Agaricus bisporus* is also been recorded as a vegetable crop in the area, but limited in its cultivation.

### Utilizations pattern

Although the production of cultivated vegetable crops in the state is generally low and majority was consumed at home leaving minimum of it is being sold. The local communities cultivate only limited number of established vegetable crops for their common consumption. The community largely prefers the wild plants from the forest to meet the vegetable demand. The vegetables utilized at home were either eaten direct or together with other foods. Although the species are cultivated for vegetable purposes they are also being utilized for other purposes like medicine, ornamental, fodder, pickle etc (Table 1). It has been found that the species like *Allium sativum*, *Beta vulgaris*, *Solanum melongena*, *Momordica charantia*, *Coriandrum sativum*, *Zingiber officinale* are extensively used for medicine in traditional healing practices. Similarly the species like *Bambusa vulgaris*, *Brassica oleracea*, *Praecitrullus fistulosus*, *Phaseolus vulgaris*, *Cucumis sativus*, *Cyamopsis tetragonoloba* etc are used for fodder. A few species which yield vegetables are also used as ornamental purposes like *Amaranthus cruentus*.

All such species which have other important uses are preferred by the communities for cultivation in their home garden. The analysis of parts used of the vegetable species revealed that in large number (34.5%) of species of fruit and seed are used for the vegetable followed by leafy parts (15.6%), underground parts like root/rhizome/bulbs (14.5%). It has been found that 65 per cent of the total species contributed by these three parts (Fig. 2a). The other parts used for various purposes were represented by 35 per cent species which include stem, shoot, and flower. Vegetable species were grouped in to 10 categories (vegetables, salad, soup, juice, pickles

etc.) based on its uses and resulted that of the total species diversity about 77 per cent species were used for other purposes than the vegetables (Fig. 2b).

The local communities of the district although grow and cultivate limited number of crops, they take interest to grow many fruit plants in the home garden or other agricultural systems. Most of these established fruit crops are not only to meet the demand of fruits but for other uses like medicine, fodder, firewood, and religious etc. The fruits are used as fresh and also for preparation of juice, jam, soft drink, pickles, jelly, etc. However it was observed that these species are largely used for other purposes which include, firewood, timber, fodder, medicinal, and for worship. Various parts of the plants such as leaves, roots, inflorescences, fruits, etc. or in combination of these parts are used for various purposes (Table 2).

Among the different plant parts used for various purposes in the 34 fruit crop species, it was recorded that the fruit (38%) was most frequently used part followed by whole plant (34.7%), leaves/bud (15.8%) (Fig. 3a). The collected plant species were also grouped as per the use for various purposes for day to day requirements of the local inhabitants as well as for marketability. Utilization pattern revealed that, out of the 36 species recorded from the study area, about 30.5 per cent species were used fresh or juice while medicinal values were reported by 13.2 per cent and 27 per cent species having firewood/fodder values (Fig. 3b). The ripen fruits which are used for fruit purposes, the different parts of the fruit like, mesocarp, endocarp, seeds, endosperms are used. However in majority of the cases the fleshy and juicy mesocarp is being consumed. Various parts of these majority of the

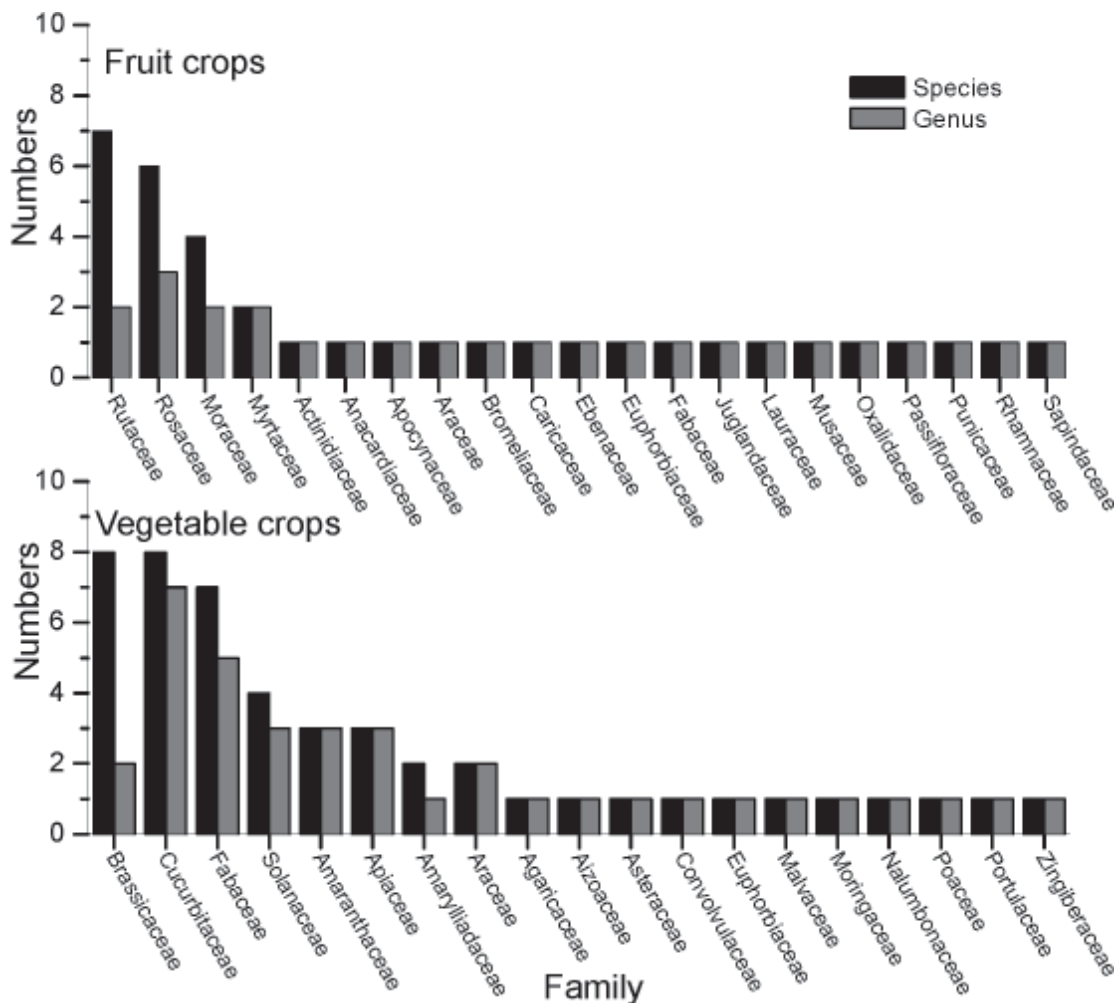


Fig. 1. Family diversity of species and genera of fruit and vegetable species in district Papum Pare.

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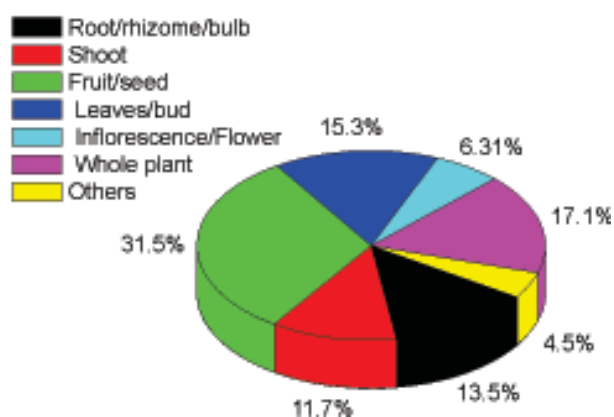


Fig. 2a: Part used (%) of selected vegetable species.

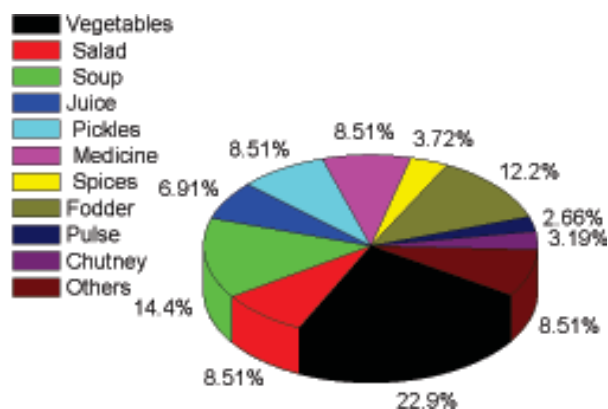


Fig. 2b: Uses (%) of selected vegetable species.

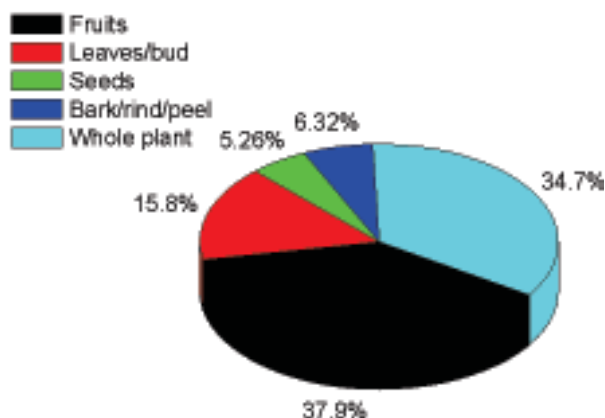


Fig. 3a: Part used (%) of fruits species

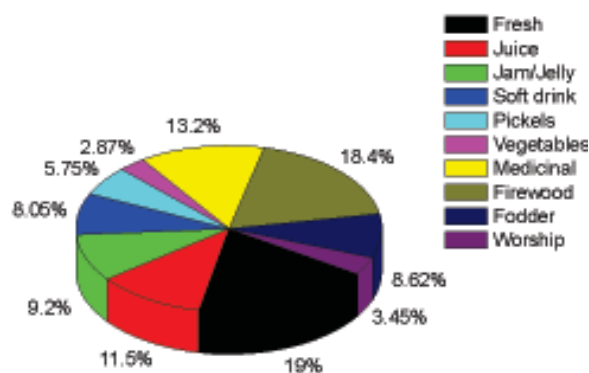


Fig. 3b: Utilizations (%) of fruits species

species like *Aegle marmelos*, *Averrhoa carambola*, *Emblia officinalis*, *Punica granatum*, *Prunus armeniaca*, *P. avium*, *Pyrus communis*, *Tamarindus indica*, *Syzygium cumini* etc. are commonly used as medicinal. At the same time the species of *Artocarpus heterophyllus* and *Carica papaya* are mostly consumed as vegetable.

Several wild relatives of cucurbits and gourds were reported with significant genetic variability and these vegetables are consumed (Sirohi *et al* 2005; Ram *et al* 2002; Singh *et al* 2012). Squash grows abundantly without much care and attention in tropical America having variation in shape and size (Asati and Yadav, 2004). Deb *et al* (2013) from Manipur have reported 22 per cent species was used as fruity vegetable, 17 per cent species consumed as whole plant, 12 per cent species as leafy vegetable, 10 per cent species as tuber and shoot each, 7 per cent species as stem vegetable, 5 per cent species as twig vegetable and rest other

species as flower/ inflorescence and root or rhizome. The important leafy vegetables grown in North East India includes lai (*Brassica juncea*), lafa (*Malva verticillata*), palak (*Spinacea oleracea*), amaranth (*Amaranthus spp*), pui sag (*Vasella rubra* and *B. alba*), sorrel (*Rumex rasicarius*) etc. Reddy *et al* (2007) reported that most of the edible parts of fruits are used as fruits, followed by leaves, tubers and flowers.

### CONCLUSION

A total of 36 fruits and 48 vegetables species were recorded from the study area. *Brassica* was most dominant genus and majority of genera were represented by single species. Parts of the plant used were fruits, leaves, roots, inflorescences etc. or in combination of these parts for various purposes. Utilization pattern (vegetables) for parts used revealed that large numbers (34.5%) of species were used as fruit or seed followed by

**Table 1. Diversity of species, common name, part used and uses of vegetable species in Papum Pare District of Arunachal Pradesh.**

Plant Species	Family	Common name	Part used and Uses
<i>Amaranthus cruentus</i> L.	Amaranthaceae	Amaranth	Tender shoot, root as vegetable, soup, fodder and making food color, dyes and ornamental plant.
<i>Bambusa vulgaris</i> Schrad.	Poaceae	Bamboo shoot	Shoots as vegetables, pickle, fodder and traditional medicine.
<i>Beta vulgaris</i> L.	Amaranthaceae	Beet root	Fleshy root as vegetable, salad, juice, jelly, jam, fodder, food colour and medicine.
<i>Momardica Charantia</i> Descourt	Cucurbitaceae	Bitter Gourd	Tender fruits as vegetable, juice, soup and medicinal as anticancer, anti malaria, antiviral, weight loss, diabetes.
<i>Solanum melongena</i> L.	Solanaceae	Brinjal	Immature fruit as vegetable, chutney,. Medicinally for curing diabetes, cholera, bronchitis, dysentery, toothache, skin infections and shoot as fodder.
<i>Brassica rapa</i> L.	Brassicaceae	Broccoli	Tender inflorescences as vegetable, soup, pickle and whole plant as fodder.
<i>Brassica oleracea</i> L.	Brassicaceae	Brussels sprout	Green buds as vegetable, soup and pickle, whole plant as fodder.
<i>Brassica oleracea</i> ( <i>Capitata</i> )	Brassicaceae	Cauliflower	Green bud as vegetable, salad, soup, making chow-mein and plants as fodder.
<i>Daucus carota</i> L.	Apiaceae	Carrot	Fresh tap root as vegetable, salad, juice, soup, pickle and sweet etc.
<i>Brassica oleracea</i> (var. <i>Botritis</i> ) L.	Brassicaceae	Cauliflower	Tender inflorescences as vegetable, soup, pickle and plants as fodder.
<i>Phaseolus vulgaris</i> L.	Fabaceae	Common bean	Tender fruit as vegetable, salad, soup, ripen and dry as pulse, floor and whole plant as fodder.
<i>Coriandrum sativum</i> L.	Cucurbitaceae	Cucumber	Fresh shoot as chutney, garnishing; dry seeds as spice, medicine against colds and cough.
<i>Cucumis sativum</i> L.	Cucurbitaceae	Cucumber	Tenders fruits as salad, vegetable, juice, soup, ayurvedic traditional medicine; whole plant as fodder.
<i>Moringa oleifera</i> Lam.	Moringaceae	Drumstick	Tenders fruit as vegetable, soup, and young leaf medicinally as blood pressure regulator.
<i>Lablab purpureus</i> (L.)	Fabaceae	Dolichos bean	Tender fruit as vegetable; ripen seeds as pulse; whole plant as fodder.
<i>Amorphophallus paeoniifolius</i> (Dennst)	Araceae	Elephant foot yam	Rhizomes as vegetable, pickle and as medicine in bronchitis, piles, dysentery, abdominal pain, asthma, enlargement of spleen, rheumatic swellings etc.
<i>Allium sativum</i> L.	Amaryllidaceae	Garlic	Green shoot as spices, chutney, pickle; bulb has pungent flavor or condiment, spicy test; cloves as medicine against cold and cough.
<i>Zingiber officinale</i> (Roscoe)	Zingiberaceae	Ginger	Rhizomes as spices, ginger tea, candy, pickle, ginger wine and such as seafood or goat meat.
<i>Phaseolus vulgaris</i> L.	Fabaceae	Green bean	Tender fruit as vegetable, soup, ripen seed as pulse, whole plant as fodder.
<i>Cyamopsis tetragonoloba</i> L.	Fabaceae	Guar	Tender fruit as vegetable, ripen seed as pulse; tender leaves as spinach; whole plant as fodder.
<i>Brassica oleracea</i> L. Gongylodes group	Brassicaceae	Kohlrabi	Green buds as vegetable, salad, soup, pickle, tender leaves as vegetable; whole plant as fodder.
<i>Lactuca sativa</i> L.	Asteraceae	Lettuce	Leaves as vegetable, salad, soup and as medicinal herb.
<i>Phaseolus lunatus</i> L.	Fabaceae	Lima bean	Tender fruit as vegetable, soup, salad, ripen seed as pulse, whole plant as fodder and as medicinal control blood sugar and cholesterol level.

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Plant Species	Family	Common name	Part used and Uses
<i>Nelumbo nucifera</i> (Gaertn.)	Nalumbonaceae	Lotus root	Young leaves and root as vegetable, pickle, old leaves as packing of food, flowers and seeds as worship and roasted seed as food.
<i>Luffa cylindrica</i> (Tourn)	Cucurbitaceae	Luffa	Tender fruits, leaves, flower as vegetable and fruit juice for jaundice; ripen dry fruits as natural scrubber and washing sponge.
<i>Agaricus bisporus</i> (Lange)	Agaricaceae	Mushroom	Whole plant as vegetable, soup, pickle.
<i>Brassica juncea</i> (L.)	Brassicaceae	Mustered	Tender shoot and fruit as vegetables, fodder; dry seed as a spice, condiment and mustard oil.
<i>Tetragonia tetragonoides</i>	Aizoaceae	New Zealand	Tender shoot as vegetable, salad, soup and whole plant as fodder.
<i>Abelmoschus esculentus</i> (L.)	Malvaceae	Okra	Tender fruits as vegetable, soup, and also useful in genito-urinary disorders, chronic dysentery, roasted dry seed as spice.
<i>Allium cepa</i> L.	Amaryllidaceae	Onion	Green shoot as vegetable, salad, chutney; bulb has pungent flavour, condiment, spices and juice as medicine in hair fall and ear pain.
<i>Trichosanthes dioica</i>	Cucurbitaceae	Parwal	Tender fruit as vegetable, soup and vine as fodder.
<i>Pisum sativum</i> L.	Fabaceae	Pea	Mature fruit and tender shoot as vegetable, soup, salad and whole plant as fodder; ripen dry seed as pulse.
<i>Cajanus cajan</i> L.	Fabaceae	Pigeon pea	Mature fruit and tender shoot as vegetable; whole plant as fodder; ripen dry seed as pulse.
<i>Pastinaca sativa</i> L.	Apiaceae	Parsnip	Fresh tap root as vegetable, salad, juice, soup.
<i>Solanum tuberosum</i> L.	Solanaceae	Potato	Tubers as vegetable, staples food, eaten boiled, baked, fried, chips, flour and medicinally, potato juice as peptic ulcers, relief in pain and acidity, swellings, skin rashes, crushed potato as plaster to burns and scalds.
<i>Cucurbita pepo</i> L.	Cucurbitaceae	Pumpkin	Fresh fruit and tender leave, flowers as vegetable, soups, seeds as dry fruit, juice in stomach problem.
<i>Raphanus sativus</i> L.	Brassicaceae	Radish	Fresh tape root as vegetable, salad, pickle, juice; tenders leave as vegetables.
<i>Sechium edule</i> L.	Cucurbitaceae	Squash	Tender fruit as vegetable, leaves boiled as tea in the treatment of hypertension and kidney stones.
<i>Trichosanthes cucumerina</i> L.	Cucurbitaceae	Snake gourd	Tender fruit as vegetable, pickle, salad, soup.
<i>Spinacia oleracea</i> L.	Amaranthaceae	Spinach	Tender shoot as vegetable, juice, soup and plant as fodder.
<i>Portulaca oleracea</i> L.	Portulacaceae	Summer perslane	Tender shoot and leave as vegetable, juice, soup; medicinally as insect bites, skin boils, sores, bee stings, bacillary dysentery, diarrhoea, haemorrhoids, postpartum and intestinal bleeding.
<i>Ipomoea batatas</i> (L.)	Convolvulaceae	Sweet Potato	Tuberous root boiled as various staple foods, soup. Tender leave and vine tips as vegetable and fodder.
<i>Capsicum annum</i> L.	Solanaceae	Sweet pepper	Mature fruit as vegetable, pickle, salad, plant as ornamental.
<i>Manihot esculenta</i> Crantz.	Euphorbiaceae	Tapioca	Boiled root as food and can replace potato or made into dumplings, soups, stews, gravies.
<i>Brassica rapa</i> var. <i>Rapa</i> L.	Brassicaceae	Turnip	Tender tuberous root, shoot as vegetable, salad and seed as oil.
<i>Praceitrullus fistulosus</i>	Cucurbitaceae	Tinda	Tender fruits as vegetable, pickle, soup, sweet and whole vine as fodder.
<i>Lycopersicum esculentus</i>	Solanaceae	Tomato	Ripen fruit as vegetable, salad, soup, juice, chutney, sauce and also as protective and productive supplementary food.
<i>Colocasia esculenta</i> (L.)	Araceae	Taro	Corms and tender leaves as vegetables.

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leafy components, root/rhizome/bulbs etc. Among the fruit crops 30.5 per cent species were used as fresh and juice and 13.2 per cent as medicinal values. About 27 per cent fruits species are used as firewood or fodder. It has been found that fruits and vegetables were also used for other purposes such as medicine, firewood and fodder etc. There is plenty of scope to strengthen the database on fruits and vegetables of district if biodiversity are thoroughly explored. Promotion for cultivation of such wild edibles in the villages may reduce the human pressure on the wild habitats. Conservation measures need to be taken up in order to maintain the current status of these habitats and species. Awareness among the villagers and mass multiplication through conventional and *in-vitro* methods of wild edibles may help in the conservation and management of these species and sustainable development.

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