

*Full Length Research Paper*

# Diversity and use of wild edible plants by migratory shepherds in the Himachal Pradesh of the Western Himalayas, India

Radha<sup>1\*</sup>, Sunil Puri<sup>1</sup> and Sanjeev Kumar<sup>2</sup>

<sup>1</sup>School of Biological and Environmental Sciences, Shoolini University of Biotechnology and Management Sciences, Solan (H.P.) – 133229, India.

<sup>2</sup>College of Horticulture and Forestry, Neri, Hamirpur (HP), India.

Received 26 September, 2018; Accepted 4 December, 2018

The present study was carried out in Himachal Pradesh of the Western Himalayas, India to obtain information on the wild edible plants used by the migratory shepherds. The shepherds started their migration in July from Chitkul, Rakchham, Batseri, Sangla and Kamru of district Kinnaur (Himachal Pradesh). Questionnaire for the survey, personal field visits and participatory observations were used to collect information about the use of various plants by the migratory shepherds. The shepherds move in a group of 5 to 6 comprising their own family members and size of the flock (of sheep and goats) varied from 654 to 990. The migration route followed from their villages to Churdhar ranges (mid hills) and to Sirmour ranges (low hills). It was observed that in all 50 species were used by shepherds enroute from high hills to low hills. In high hills, 23 species, in mid hills 31 species and in low hills 34 species were found to be used as livelihood source. Some of the plants, besides being used as fruits and vegetables, are also used as herbal tea (bark of *Betula utilis*) and condiments. *Morchella esculenta* was found to be one of the delicacies used for food in their tribe. The documentation of plant resources and the indigenous knowledge of shepherds highlighted in the present study is a step in raising awareness about the importance of these edible plants and their further conservation.

**Key words:** Edible plants, sheep, goats, shepherds, seasonal migration, Himachal Pradesh.

## INTRODUCTION

Forest constitutes an important resource in the mountain of the Himalayas. The Indian Himalayan region (IHR) occupies about 18% of the total geographical area of India and is the world's youngest mountain range. It exhibits a diverse topography, climate, ecology, and land

use pattern and is known for rich biodiversity in the foot hills and the mountainous region of the Himalayas throughout. The rich floral composition is extensively utilized in various forms including medicine, food, fuel, fodder, fiber and timber by the inhabitants (Misri, 1995).

\*Corresponding author. E-mail: radhuchauhan7002@gmail.com.

The Himalaya also comprises diverse human groups, which differ in terms of language, culture, tradition, religion and pattern of resources use (Sharma et al., 2005).

Himachal Pradesh, a north Indian state, lies in western part of the Himalayan range with variation in altitude, rainfall and temperature. Average elevations above mean sea levels vary from 350 to 7000 m and the climate is typically temperate. It has a forest cover of 26% (FSI, 2013). Himachal Pradesh is home to a sizeable tribal population like the Gaddis, Pangwals, Kinnauras, Lahulis, Bhots and Gujjars. Nomadic graziers use sub-alpine and alpine pastures for rearing their livestock. Due to ever-increasing demand of animal products, the livestock population has increased manifold, thereby increasing pressure on these pastures (Suri, 2014).

Nomadic tribes rearing sheep and goats move their livestock throughout the year in search of fodder and pastures. They move from high hills to low hills and vice versa and move throughout the year, leaving for low hills and plains with the commencement of winter season and returning to their villages in summer season. Shepherds move from high hills in the month of July towards mid hills, and finally by September-October reach low hills and plains where they settle temporarily upto March, and again start their return journey for high hills. The routes followed are century's old. Their duration of stay both during migration and reverse migration often differs. The caravans generally move along the roads for convenience and avoid traffic. Every year the movement of shepherds is in the early morning and the routes of migration and reverse migration differ and there is no set pattern to the variation (Suri, 2014).

Although in the state of Himachal Pradesh, it is very difficult to make an exact estimate of the migratory goat and sheep population it has been reported that these constitute about 70% of the total goat and sheep (Misri, 1998). The recent trend of nomadic herders settling in hospitable climates has brought agriculture and other occupations to front and shepherding taking the secondary position (Biswas and Rao, 2016). Wild edible plants have supported human populations in all inhabited continents (Khyade et al., 2009) and the relationship between the surroundings and their indigenous people form the subject of ethnobotany dealing with the study of plants used by people for medicine, clothing and food (Jain and De, 1996). The majority of ethnobotanical surveys and reviews focus on medicinal plants. Native knowledge of wild plants is important for sustained utilization of these edible plant species (Kapoor, 1978; Arora, 1981; Jain, 1987; Jasmine et al., 2007) and the availability of enormous diversity of wild plants has attracted attention of researchers over time (Joshi et al., 2018). However, there is still paucity of detailed information and documentation of wild edible plants in the country and Himachal Pradesh is no exception to this;

and the available information is sparse and scattered (Arora and Pandey, 1996).

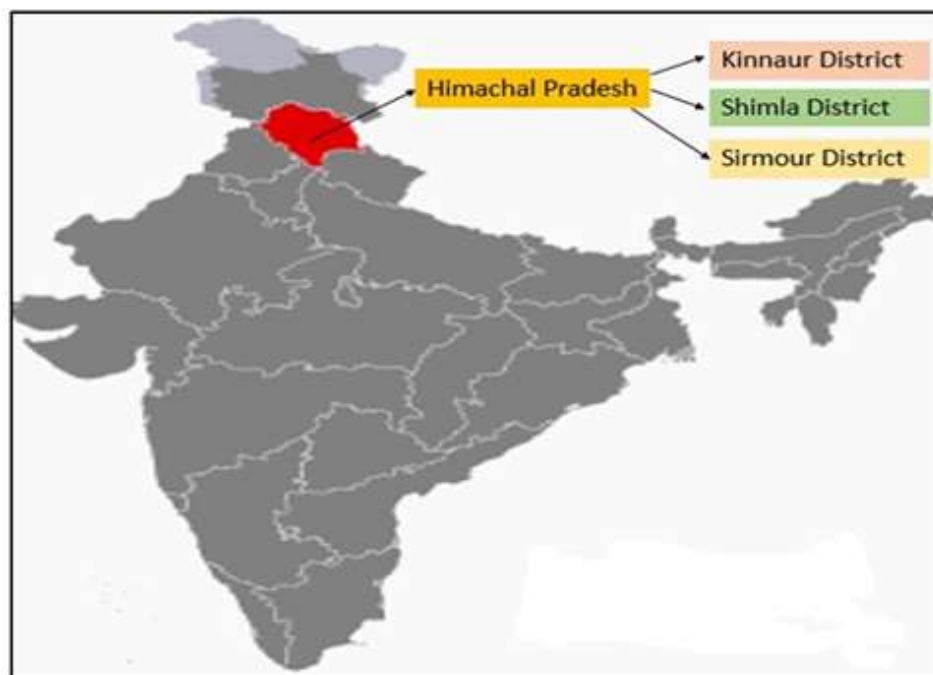
In the recent past, prominence of wild plants in food and other nutraceutical uses has gained importance and, as a result, there is extractive pressure on these plant resources. Extraction of these edible plants (like *Picrorhiza kurrooa*, *Rhododendron arboretum*, *Bauhinia variegata*, *Cannabis sativa*, *Morchella esculenta*, *Ficus palmata*, *Dioscorea deltoidea*, *Zanthoxylum armatum*, *Asparagus filcinus*, *Juglans regia*, *Ephedra gerardiana*, medicinal and aromatic plants, etc.) is already popular even amongst urban people. This is now putting increased market pressures on these species with the rural people realizing the supplementary income generation and nutritional potential of these plants (Jana and Chauhan, 1998). Therefore, there has been a revival of interest in survey, identification and documentation of wild edible plants during the last few decades (Jasmine, 2007).

Furthermore, the shepherds who are always on the move throughout the year are mostly dependent upon the wild food and fruits available as they move and no much studies have been conducted to know about the use of wild plants as food by migratory shepherds in Himachal Pradesh. With this aim in view the present studies were conducted to know the wild edible plants used by shepherds during migration. It was also aimed to analyze the migration route of shepherds from upper regions to the foot hills of the Himalayas.

## MATERIALS AND METHODS

Himachal Pradesh is one of the most fascinating mountainous state of India (Figure 1). Nestled in the lap of the Western Himalaya, Himachal Pradesh is located almost in the center of the Himalayan mountain range and is a land of remarkable bio-geographical diversity (Kayastha, 1971). The present study is undertaken in Himachal Pradesh situated between 30°22'40"-33°12'40" N latitude and 75°45'55"-79°04'20"E longitude, covering an area of 55,675 sq Km. Physiographically, the state consists of three discrete regions, the outer Himalaya, mid hills and greater Himalaya. The outer Himalaya, also called Shivalik hills, ranges from 350 to 1,500 m a.m.s.l. The mid hills cover an area up to 3,500 m. The greater Himalaya also called as high altitude alpine zone generally starts from an elevation of 3,510 m and above. It includes higher altitude areas of Kinnaur, Kullu, Lahul-Spiti districts and Pangi valley of Chamba district. Because of varied altitudinal variations and climatic conditions, the state is enriched by diverse plant species, which include around 3,400 species of flowering plants ranging from tropical to alpine zone (Kaur and Sharma, 2004). The unique feature of Himachal Pradesh is the presence of fodder and fruit trees, shrub and herbs throughout the state (Thakur and Puri, 2016).

The present study documents the use of wild edible foods (plants and / or plant parts) by the tribal migratory shepherds of Kinnaur district in Himachal Pradesh. A total of five field surveys were carried out taking into account the migratory route of the shepherds from high alpine region to low foot hills. In the higher reaches of Kinnaur district the Kinnaure (shepherds) started movement from



**Figure 1.** Google map of India showing study sites in Hamachi Pradesh.

five different villages of Kinnaur and they were Chitkul, Rakchham, Batseri, Sangla, and Kamru. Besides the place of origin of shepherds surveys were done for four other sites namely—Chopal, (mid hills), Churdhar (mid hills), Renukaji (low hills) and Poanta Sahib (low hills). These four places were their part of migratory route (Figure 2). The migratory shepherd's groups were randomly selected and interviewed during field trips shown in Figure 4 (Khanna and Ramesh, 2000).

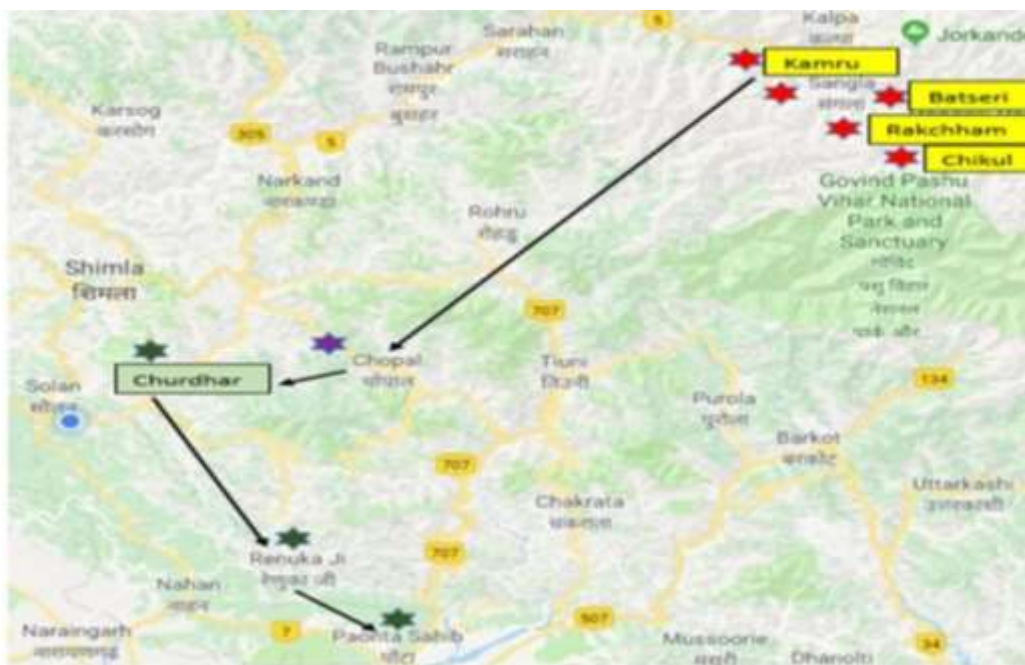
Shepherds migration from Chitkul (3,450 m), Rakchham (3,100 m), Batseri (2,700 m), Sangla (2,600 m), and Kamru (2,700 m) starts in the month of July. These sites situated at high altitude remain cut-off from rest of the world for about 3-4 months due to heavy snowfall and harsh environment conditions during winters. The information on wild edible plants was collected using a pretested questionnaire, through participatory observation and discussion during July 2017 to August 2018. The specimens of edible plants being used by shepherds were collected, dried and mounted on herbarium sheets, with label information describing when and where they were collected. Plants were identified either in the field itself or with the help of experts from Botanical Survey of India, and Forest Research Institute, Dehradun, Uttarakhand. Vouchers of plants were placed in the herbarium of the Shoolini University, Solan (BSI, 1996).

## RESULTS AND DISCUSSION

Harsh environmental conditions and non-availability of feed cause seasonal migration of shepherds. It is a traditional process in the tribes of higher Himalayan region. It was observed that most of the shepherds start migration from their villages in the month of July and

August and in October there is no migration as the winters sets in. The shepherds move in a group of 5-6 comprising their own family members (Table 1). The migratory flock includes both sheep and goats and size of the flock is huge and varied from 654 to 990 (Table 1). Irrespective of their origin of migration the shepherds move first to grazing sites in Chopal in Shimla district. The shepherds also take along with them 2-4 horses (local hardy breeds) for carrying provisions and tents (Kumaravelu et al., 2008).

Often four to five dogs also accompany the shepherds and, in fact, these dogs are trained in protecting the sheep and goats from wild animals and also keep the flock together. The disparity of flock size generally is an indicator of status of farmer's livestock holding capacity. The present study also indicated that shepherds having high number of flock are comparatively well off compared to those with less number (Table 1). Many studies have reported that flock size is directly associated with migration distance, flock with larger size travel longer distance as compared to small sized flocked (Kumaravelu et al., 2008; Balamurugan et al., 2012). In our study it was found that irrespective of flock size, the shepherds travel same distance. In the second stage, the shepherds then move to Churdhar ranges and from here to Renukaji in Sirmour district. The routes of migration are generally fixed and proper permission is obtained from the authorities for the purpose. Finally, in the months of September-October they reach the low hills in Poanta-



**Figure 2.** Satellite map showing migratory routes of shepherds from their originated villages Chitkul, Batseri Sangla and Kamru (high hills) to Chopal and Churdhar (Mid hills) to the final destination Renukaji and Paonta Sahib (Loe hills).

**Table 1.** Basic information of the shepherd's caravan in the study area.

S/N	Particulars	Study sites				
		I Chitkul (3,450 m)	II Rakchham (3,100 m)	III Batseri- (2,700 m)	IV Kamru (2,700 m)	V Sangla (2,600 m)
1	Group size (No.)	5	5	6	5	6
2	Average family income (all sources, Rs. Lakh/annum)	3	2	4	3	2
3	Horses	3	2	4	2	2
4	Dogs	3	2	4	2	3
5	Flock size (sheep & goats)	780	640	990	654	712
6	Migration period	July-August				

\* 1 US \$ = Rs70.

Sahib in Sirmour district and temporarily settle here upto the month of March, and start their return journey to their respective places by end March (spring season). Similar study on seasonal migration of Bakkarwals and Gujjars tribes from high hills to low hills has been carried out in Jammu and Kashmir (Suri, 2014).

The present studies revealed that the livelihood of shepherd's family is dependent either getting food and fruits from the forests / trees on the path they transect and selling the meat and milk products from their herds. The wild plants not only serve as their food but also for their livestock. It was observed that during their migration

from upper hills to lower hills, a total of 50 species (Figure 3) were being used by the migratory shepherds and a few of these belonged to the same families, all these plants are integral part of shepherd's diet during migration (Tables 2 to 5). The collection of various plants and plant parts varied from plant to plant, depending upon their availability and usability; both as those (1) consumed raw and (11) used after cooking. During their seasonal migration the shepherds are much dependent on forest products for their requirements of fruits, vegetables and medicines (Thakur and Puri, 2016).

As the shepherds move from their place of origin (high

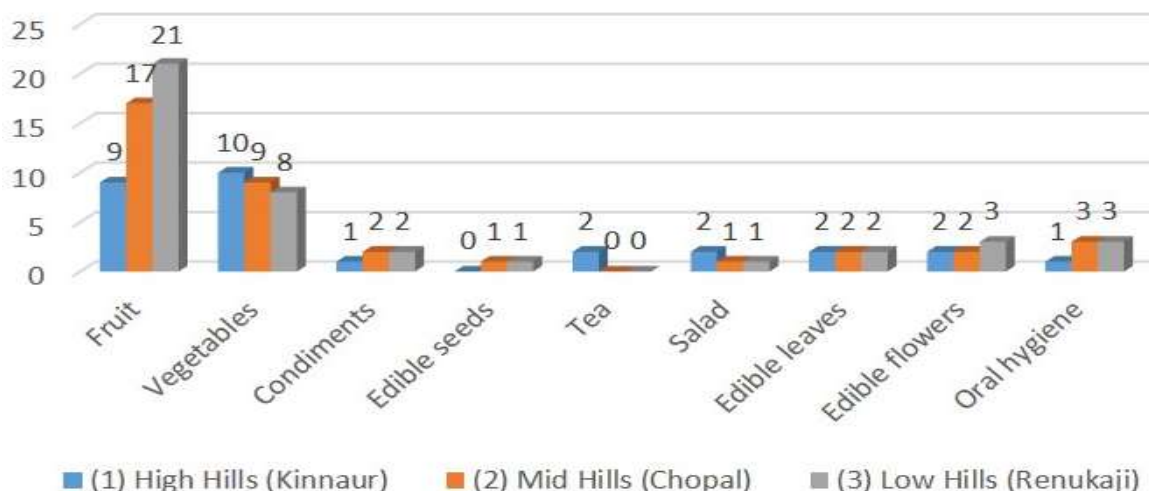


Figure 3. Number of wild edible species used by shepherds for food purpose in the study.

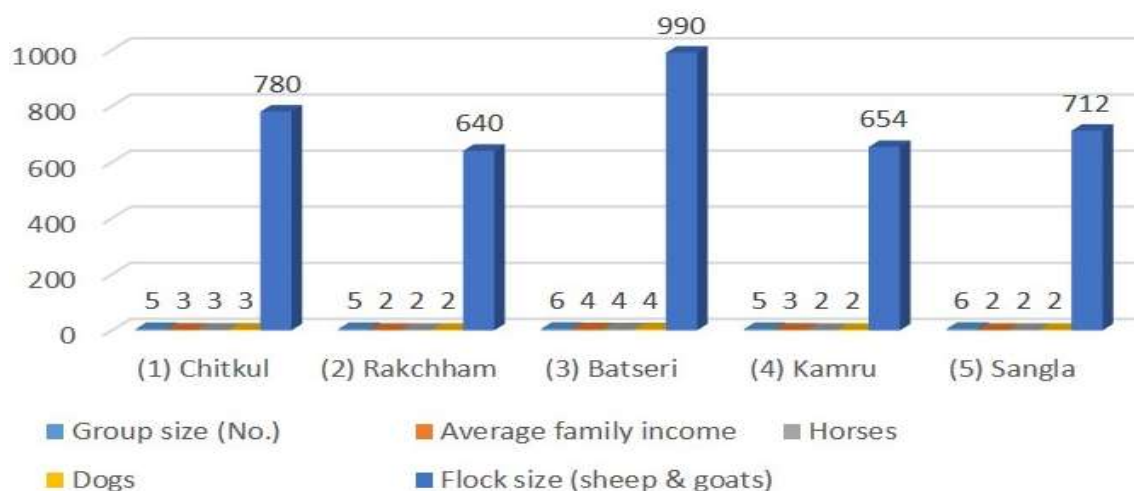


Figure 4. Basic information of the shepherds caravan in the study area.

hills) towards the lower hills the plant species varies with altitude. In the higher hills 23 species (herbs, shrubs and trees) were found to be consumed by the shepherds (Table 2). Interestingly, the shepherds informed that their preference for food is *Morchella esculenta* (Fungi) as it is one of the delicacy in food in their tribe. Similarly, in the mid hills 31 plant species were found to be taken as food as the shepherds move towards Shimla hills (Table 3). It was observed that some edible species like *Chenopodium album*, *Cannabis sativa*, *Dioscorea deltoidea*, *Hippophae salicifolia*, *Juglans regia*, *Myrsine africana*, *Oxalis corniculata*, *Rumex hastatus* and *Urtica palviflora* were

also present in higher hill regions (Table 3). However, there are many others (numbering 22) which are new to their diet. From mid hills as the shepherds move towards lower hills (Poanta-Sahib), they encounter 34 type of edible species (Table 4). Among these it was observed that 50% of these species are used as fruit. The use of many of these edible species has been already reported in many surveys from different parts of Himachal Pradesh (Monika et al., 2016; Thakur and Puri, 2016).

It is evident from Tables 2 to 4 that most of the plants or their parts are being used as fruits and vegetables. While the fruits are often consumed as raw, vegetables

**Table 2.** Wild edible food plants consumed by the shepherds during migration in the high hills of Himachal Pradesh of the Western Himalayas, India.

S/N	Plant name	Family	Voucher no.	Part used	Habit	Uses
1	<i>Asparagus filcinus</i> Buch.-Ham. ex D.Don	Asparagaceae	SUBMS/BO 750	Young shoots	Herb	Young shoots used as vegetable
2	<i>Berberis lyceum</i> Royle	Berberidaceae	SUBMS/BOT-659	Fruits	Shrub	Fruits are edible
3	<i>Berginia ciliate</i> (Royle) Raizada.	Saxifragaceae	SUBMS/BOT-352	Leaves	Herb	Leaves are used as vegetable
4	<i>Betula utilis</i> D.Don.	Betulaceae	SUBMS/BOT-387	Bark	Tree	Bark used in tea
5	<i>Chenopodium album</i> L.	Chenopodiaceae	SUBMS/BOT-628	Young shoots	Herb	Young shoots are used as vegetable
6	<i>Cannabis sativa</i> L.	Cannabinaceae	SUBMS/BOT-658	Seeds	Herb	Roasted seeds are used as condiments
7	<i>Celtis tetrandra</i> Roxb.	Cannabaceae	SUBMS/BOT-378	Fruits	Tree	Fruits are edible
8	<i>Dioscorea deltoidea</i> Wall. ex Griseb.	Dioscoreaceae	SUBMS/BOT-661	Tuber	Herb	Tuber used as vegetables
9	<i>Euphorbia hirta</i> L.	Euphorbiaceae	SUBMS/BOT-662	Leaves	Herb	Leaves used as vegetable
10	<i>Ephedra gerardiana</i> Wall. ex Florin.	Ephedraceae	SUBMS/BOT-422	Ripe Fruits	Shrub	Ripe fruits are edible
11	<i>Hippophae salicifolia</i> D.Don.	Elaeagnaceae	SUBMS/BOT-425	Fruits	Shrub	Fruits are edible
12	<i>Juglans regia</i> L.	Juglandaceae	SUBMS/BOT-687	Fruits	Tree	Fruits are edible, Twigs used as tooth brush
13	<i>Morchella esculenta</i> Fr.	Morchellaceae	SUBMS/BOT-446	Whole plant	Fungi	Used as vegetable (a delicacy and an important source of income)
14	<i>Myrsine africana</i> L.	Myrsinaceae	SUBMS/BOT-690	Fruits	Shrub	Fruits are edible
15	<i>Oxalis corniculata</i> L.	Oxalidaceae	SUBMS/BOT-343	Leaves	Herb	Leaves taken as salad or cooked as vegetable
16	<i>Oxalis acetosella</i> L.	Oxalidaceae	SUBMS/BOT-386	Fruits, Leaves	Herb	Fruits are edible; and leaves are cooked
17	<i>Polygonum capitatum</i> Buch.-Ham. ex D.Don.	Polygonaceae	SUBMS/BOT-339	Fruits	Herb	Fruits are edible
18	<i>Prunus armeniaca</i> L.	Rosaceae	SUBMS/BOT-619	Fruits	Tree	Fruits are edible
19	<i>Rumex hastatus</i> D. Don.	Polygonaceae	SUBMS/BOT-689	Aerial leaves	Herb	Aerial leaves are edible
20	<i>Stellaria media</i> L.	Caryophyllaceae	SUBMS/BOT-404	Fresh leaves	Herb	Fresh leaves are used as vegetable
21	<i>Taxus wallichiana</i> Zucc.	Taxaceae	SUBMS/BOT-390	Stem Bark, Leaves	Tree	Bark and leaves are used for making tea
22	<i>Thymus serpyllum</i> L.	Lamiaceae	SUBMS/BOT-461	Leaves	Herb	Leaves used as cooked food
23	<i>Urtica palviflora</i> Roxb.	Urticaceae	SUBMS/BOT-687	Tender, Shoot, Inflorescence	Herb	Used as vegetable

**Table 3.** Wild edible food plants consumed by the shepherds during migration in the mid hills of Shimla and Sirmour districts (HP) of the Western Himalayas.

S/N	Plant name	Family	Voucher no.	Part used	Habit	Uses
1	<i>Amaranthus viridis</i> L.	Amaranthaceae	SUBMS/BOT-751	Whole plant	Herb	Young leaves are cooked and used as vegetable/saag
2	<i>Bauhinia variegata</i> L.	Fabaceae	SUBMS/BOT-637	Flowers, buds	Tree	Flower buds eaten as vegetable, petals used in a curd preparation
3	<i>Berberis asiatica</i> Roxb. ex DC.	Berberidaceae	SUBMS/BOT-691	Fruits	Shrub	Fruits are edible
4	<i>Berberis vulgaris</i> L.	Berberidaceae	SUBMS/BOT-445	Fruits	Shrub	Fruits are edible
5	<i>Berginia ciliate</i> (Royle) Raizada.	Saxifragaceae	SUBMS/BOT-752	Leaves	Herb	Leaves are used as vegetable SUBMS/BOT-692



Table 3. Contd.

6	<i>Chenopodium album</i> L.	Chenopodiaceae	SUBMS/BOT-693	Young shoots	Herb	Young shoots are used as vegetable
7	<i>Cannabis sativa</i> L.	Cannabinaceae	SUBMS/BOT-695	Seeds	Herb	Roasted seeds are used as condiments
8	<i>Coriaria nepalensis</i> Wall.	Coriariaceae	SUBMS/BOT-698	Fruits	Shrub	Ripen fruit are edible
9	<i>Celtis tetrandra</i> Roxb.	Cannabaceae	SUBMS/BOT-699	Fruits	Tree	Fruits are edible
10	<i>Carissa opaca</i> Stapfex. ex Haines	Apocynaceae	SUBMS/BOT-700	Fruits	Shrub	Fruits are edible
11	<i>Dioscorea deltidea</i> Wall. ex Griseb.	Dioscoreaceae	SUBMS/BOT-701	Tuber	Herb	Edible vegetable
12	<i>Dabregesia hypoleuca</i> (Hochst.) Wedd.	Urticaceae	SUBMS/BOT-702	Fruits	Shrub	Fruits are edible
13	<i>Ficus palmate</i> Forsk.	Moraceae	SUBMS/BOT-703	Fruits	Tree	Fruits are edible
14	<i>Grewia optiva</i> Drumm. ex Burret.	Tiliaceae	SUBMS/BOT-704	Fruits	Tree	Ripen fruits are edible
15	<i>Hippopha esalicifolia</i> D.Don.	Elaeagnaceae	SUBMS/BOT-705	Fruits	Shrub	Fruits are edible
16	<i>Juglans regia</i> L.	Juglandaceae	SUBMS/BOT-706	Fruits	Tree	Fruits are edible, Twigs used as tooth brush
17	<i>Myrsine africana</i> L.	Primulaceae	SUBMS/BOT-707	Fruits	Shrub	Fruits are edible
18	<i>Oxalis corniculata</i> L.	Oxalidaceae	SUBMS/BOT-708	Leaves	Herb	Leaves taken as salad or cooked as vegetable
19	<i>Pinus roxburghii</i> Sarg.	Pinaceae	SUBMS/BOT-709	Seeds	Tree	Seeds are edible
20	<i>Prunus armeniaca</i> L.	Rosaceae	SUBMS/BOT-710	Fruits	Tree	Fruits are edible
21	<i>Prunus cerasoides</i> D.Don.	Rosaceae	SUBMS/BOT-711	Fruits	Tree	Fruits are edible
22	<i>Pyracantha crenulata</i> (D.Don) M. Roem.	Rosaceae	SUBMS/BOT-712	Fruits	Tree	Fruits are edible
23	<i>Punica granatum</i> L.	Lythraceae	SUBMS/BOT-713	Fruits	Tree	Directly consumed
24	<i>Rhododendron arboretum</i> Sm.	Ericaceae	SUBMS/BOT-714	Flowers, Buds	Shrub	Flowers, buds are used as vegetable
25	<i>Rhus palviflora</i> Roxb.	Anacardiaceae	SUBMS/BOT-715	Fruits	Shrub	Fruits are edible
26	<i>Rubus ellipticus</i> Sm.	Rosaceae	SUBMS/BOT-716	Fruits	Shrub	Fruits are edible
27	<i>Rumex hastatus</i> D. Don.	Polygonaceae	SUBMS/BOT-717	Aerial parts and leaves	Herb	Aerial parts; leaves are edible
28	<i>Urtica palviflora</i> Roxb.	Urticaceae	SUBMS/BOT-697	Tender, Shoot, Inflorescence	Herb	Used as vegetable
29	<i>Urtica dioica</i> L.	Urticaceae	SUBMS/BOT-673	Leaves, Shoot	Herb	Used as vegetables
30	<i>Vitex negundo</i> L.	Verbenaceae	SUBMS/BOT-718	Flowers	Shrub	Flowers are edible
31	<i>Zanthoxylum armatum</i> DC.	Rutaceae	SUBMS/BOT-696	Dried fruits and seeds	Shrub	Dried fruits and seeds as condiment and for oral hygiene

are used after cooking and in some cases these are also used as salad. Number of plants being used for collection of fruits ranged from 9 in high hills to 21 in the low hills (Table 5). In the high hills, some parts of the plants were also used as herbal tea and further for oral hygiene. Number of species used for oral hygiene is relatively higher in

low and mid hills than in high hills. Other uses include the use of plants or plant parts as condiments or as edible seeds/nuts. Ethnobotanical uses of wild plants and plant products obtained from the environment without any cost have been already reported from many states of India (Tambe and Rawat, 2009).

The shepherds during migration generally move along the roadside and rarely adopt bridal pathways or shortcuts. For their own stay they use makeshift tents and shift tents frequently within 5 to 6 days. There is always scarcity of food and fodder for themselves and livestock. For this they explore adjoining areas, particularly degraded

**Table 4.** Wild edible food plants consumed by the shepherds during migration towards the low hills of Sirmour district.

S/N	Plant name/Family	Family	Voucher no.	Part used	Habit	Uses
1	<i>Achyranthus bidentata</i> Blume.	Amaranthaceae	SUBMS/BOT-719	Leaves	Herb	Leaves are used as vegetable
2	<i>Achyranthes aspera</i> L.	Amaranthaceae	SUBMS/BOT-720	Whole plant	Herb	Edible, young leaves are cooked and used as vegetable/ saag
3	<i>Amaranthus viridis</i> L.	Amaranthaceae	SUBMS/BOT-721	Whole plant	Herb	Young leaves are cooked and used as vegetable/saag
4	<i>Bauhinia variegata</i> L.	Fabaceae	SUBMS/BOT-401	Flowers, buds	Tree	Flower buds eaten as vegetable, Petals used in a curd preparation
5	<i>Berberis umbellata</i> Wall.	Berberidaceae	SUBMS/BOT-438	Fruits	Shrub	Fruits are edible
6	<i>Berginia ciliata</i> (Royle) Raizada.	Saxifragaceae	SUBMS/BOT-722	Leaves	Herb	Leaves are used as vegetable
7	<i>Celtis australis</i> L.	Cannabaceae	SUBMS/BOT-379	Fruits	Tree	Ripen fruits are edible
8	<i>Cannabis sativa</i> L.	Cannabinaceae	SUBMS/BOT-723	Seeds	Herb	Roasted seeds are used as condiments
9	<i>Coriaria nepalensis</i> Wall.	Coriariaceae	SUBMS/BOT-724	Fruits	Shrub	Ripen fruits are edible
10	<i>Celtis tetrandra</i> Roxb.	Cannabaceae	SUBMS/BOT-725	Fruits	Tree	Fruits are edible
11	<i>Carissa opaca</i> Stapf ex. Haines.	Apocynaceae	SUBMS/BOT-726	Fruits	Shrub	Fruits are edible
12	<i>Dabregesia hypoleuca</i> (Hochst.) Wedd.	Urticaceae	SUBMS/BOT-727	Fruits	Shrub	Fruits are edible
13	<i>Ficus palmate</i> Forsk.	Moraceae	SUBMS/BOT-728	Fruits	Tree	Fruits are edible
14	<i>Grewia optiva</i> Drumm. ex Burret.	Tiliaceae	SUBMS/BOT-729	Fruits	Tree	Ripen fruits are edible
15	<i>Hippophae salicifolia</i> D.Don.	Elaeagnaceae	SUBMS/BOT-730	Fruits	Shrub	Fruits are edible
16	<i>Juglans regia</i> L.	Juglandaceae	SUBMS/BOT-731	Fruits	Tree	Fruits are edible, Twigs used as tooth brush
17	<i>Myrica esculenta</i> Buch,- Ham. ex D. Don.	Myricaceae	SUBMS/BOT-732	Fruits	Tree	Fruits are edible
18	<i>Myrsine africana</i> L.	Primulaceae	SUBMS/BOT-733	Fruits	Shrub	Fruits are edible
19	<i>Oxalis corniculata</i> L.	Oxalidaceae	SUBMS/BOT-734	Leaves	Herb	Leaves taken as salad or cooked as vegetable
20	<i>Polygonum capitatum</i> Buch,-Ham. ex D.Don.	Polygonaceae	SUBMS/BOT-735	Fruits	Herb	Fruits are edible
21	<i>Pinus roxburghii</i> Sarg.	Pinaceae	SUBMS/BOT-736	Seeds	Tree	Seeds are edible
22	<i>Prunus armeniaca</i> L.	Rosaceae	SUBMS/BOT-737	Fruits	Tree	Fruits are edible
23	<i>Prunus cerasoides</i> D.Don.	Rosaceae	SUBMS/BOT-738	Fruits	Tree	Fruits are edible
24	<i>Pyracantha crenulata</i> (D.Don) M. Roem.	Rosaceae	SUBMS/BOT-739	Fruits	Tree	Fruits are edible
25	<i>Pyrus pashia</i> Buch.- Ham. ex D.Don.	Rosaceae	SUBMS/BOT-740	Fruits	Tree	Fruits are edible
26	<i>Punica granatum</i> L.	Lythraceae	SUBMS/BOT-741	Fruits	Tree	Directly consumed
27	<i>Rhododendron arboretum</i> Sm.	Ericaceae	SUBMS/BOT-742	Flowers, Buds	Shrub	Flowers , buds are used as vegetable
28	<i>Rhus palviflora</i> Roxb.	Anacardiaceae	SUBMS/BOT-743	Fruits	Shrub	Fruits are edible
29	<i>Rubus ellipticus</i> Sm.	Rosaceae	SUBMS/BOT-744	Fruits	Shrub	Fruits are edible
30	<i>Rumex hastatus</i> D. Don.	Polygonaceae	SUBMS/BOT-745	Aerial parts; leaves	Herb	Aerial parts; leaves are edible
31	<i>Solanum nigrum</i> L.	Solanaceae	SUBMS/BOT-746	Fruits	Herb	Fruits are edible
32	<i>Urtica dioica</i> L.	Urticaceae	SUBMS/BOT-747	Leaves, Shoot	Herb	Used as vegetables
33	<i>Vitex negundo</i> L.	Verbenaceae	SUBMS/BOT-748	Flowers	Shrub	Flowers are edible
34	<i>Zanthoxylum armatum</i> DC.	Rutaceae	SUBMS/BOT-749	Dried fruits and seeds	Shrub	Dried fruits and seeds as condiment and for oral hygiene



**Table 5.** Number of wild edible species used by shepherds for food purposes in the study area.

S/N	Plant /plant parts used as	Altitude range and plants (No.)		
		High Hills (Kinnaur-2,320 m to 6,816 m)	Mid Hills (Chopal-2,550 m; Churdhar-3,647 m)	Low Hills (Renukaji-672 m; Poanta Sahib-398 m)
		Number of species		
1	Fruit	9	17	21
2	Vegetables	10	9	8
3	Condiments	1	2	2
4	Edible seeds	0	1	1
5	Tea	2	0	0
6	Salads	2	1	1
7	Edible leaves	2	2	2
8	Edible flowers (including use in preparation as raita)	2	2	3
9	Oral hygiene (including use as tooth brush)	1	3	3

lands, allow fields and village commons. It was interesting to note that their migration patterns closely mirrors the seasonal availability of natural food and fodder. Tambe and Rawat (2009) also observed in Khangchendzonga National Park that migration movements match with seasonal fodder resource availability. Shepherds during enroute migration face constraints like food, fodder, water deficit, veterinary facilities, wild animals, predators and sometimes road accidents of their livestock. Such constraints have also been reported by many previous studies (Rao et al., 2011; Suresh et al., 2011; Kaintura et al., 2017). The livelihood of shepherds and their family members is also met through selling of meat (of sheep and goat) and dairy products (milk, yoghurt, butter etc.).

### Conclusions

The shepherds are very close to nature as they spend most of their time in forests and pastures with their livestock. They move with their livestock in search of quality grazing lands; and while on the move during migration they depend on local wild edible plants as their food. Unfortunately, deforestation activities and the changing climatic conditions have made availability of wild edible plants as a scarce resource to the migratory shepherds. Plants and plant products play an important role in the lives of these shepherds. The critical review of the past work done and the results of this survey suggest that wild edible plants are very important for migratory shepherds living in tribal areas in Himachal Pradesh. It is also emphasized that sufficient interest has not been put in conserving and promoting traditional wild edible plants. The need is to adopt large scale plantation of these wild edible plants within the forests as well as along roadsides so that the migratory shepherds are benefitted.

### RECOMMENDATION

This study is an approach to promote the wild edible plants that are richly existing in the rural regions to the global level. Wild edible plants are easy to available from our surroundings without any cost and provide substantial health and economic assistances to those who depend on them. It is now clear that efforts to conserve wild edible plants and preserve traditional food systems and farming practices need to be enhanced and combined.

### Future work

Further research focusing on these wild edible plants might give information regarding the bioactive compounds to fight diseases in an effective manner. For future public awareness and community based management needs to be encouraged. Research on indigenous wild edible plants should also be taken up and disseminate the results so to have diversity in diet.

### CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

### ACKNOWLEDGEMENTS

The author is deeply thankful to the migratory shepherds of the study area along with local inhabitants for their input and cooperation during the course of this work. He is highly thankful to Forest Research Institute Dehradun (Uttarakhand) and Botanical Survey of India Dehradun (Uttarakhand) for specimens identification.

## REFERENCES

- Arora RK (1981). Native food plants of the north-eastern tribes. In Jain SK (Ed) *Glimpses of Indian Ethnobotany*. Oxford and TBH Publishers Co., New Delhi. pp. 91-106.
- Arora RK, Pandey A (1996). Wild edible plants of India: Diversity, conservation and use available at <https://www.researchgate.net/publication/236278305>
- Balamurugan V, Saravanan P, Sen A, Rajak KK, Venkatesan G, Krishnamoorthy P, Bhanuprakash V, Singh RK (2012). Prevalence of peste des petits ruminants among sheep and goats in India. *Journal of Veterinary Science* 13(3):279-285.
- Biswas MP, Rao RM (2016). Socio-economic status of gaddi tribe in Himachal Pradesh: A study. *International Journal of Advance Research* 4(8):159-167.
- Botanical Survey of India (BSI) (1996). *Flora of India*. Botanical Survey of India, Kolkatta, India. Available at <https://www.jstor.org/stable/24102380>.
- Forest Survey of India (FSI) (2013). State of the forest report. Dehradun: Forest Survey of India, Ministry of Environment and Forests (GOI). Available at [fsi.nic.in/forest-report-2013](http://fsi.nic.in/forest-report-2013)
- Jain SK (1987). "Interdisciplinary approaches in Ethnobotany" In: Jain SK, (ed.) *A Manual of Ethnobotany*. Scientific Publishers Jodhpur pp. 3-32.
- Jain SK, De JN (1966). Observations on Ethnobotany of Purulia, West Bengal. *Nelumbo* 8(3-4):237-251.
- Jana SK, Chauhan AS (1998). Wild Edible Plants of Sikkim Himalaya. *Journal of Non Timber Forest Products* 5:20-28.
- Jasmine TS, Jeeva S, Febreena GL, Mishra BP, Laloo RC (2007). Wild edible plants of Meghalaya, North-east India. *Natural Product Radiance*. 6:410-426.
- Joshi SK, Ballabh B, Negi PS, Dwivedi SK (2018). Diversity, distribution, use pattern and evaluation of wild edible plants of uttarakhand, India. *Defence Life Science Journal* 3(2):126-135.
- Kaintura S, Kumar N, Kothiyal P (2017). Correlation of antihypertensive drugs and new onset diabetes: A review. *International Research Journal of Pharmacy* 8(5).
- Kapoor P (1978). Exploration of plant resources of Himachal Pradesh as food source. In *Proceedings of National Seminar on Resource Development and Environment in the Himalayan Region* pp. 153-163.
- Kaur H, Sharma M (2004). *Flora of Sirmaur, Himachal Pradesh*. Bishen Singh Mahendra Pal Singh. Savita Rani and J.C. Rana, National Bureau of Plant Genetic Resources Regional Station, Phagli, Shimla, Himachal Pradesh - 171 004, INDIA. 12:407-414 (2014). Published: 19 September 2014
- Kayastha SL (1971). Himachal Region., R.L. Singh, India-A Regional Geography, National Geographical Society of India, Varanasi pp. 390-442.
- Khanna KK, Ramesh K (2000). Ethno-medicinal plants used by Gujjar tribe of Sharanpur district, Uttar Pradesh. *Ethonobotany* 12:17-22.
- Khyade MS, Kolhe SR, Deshmukh BS (2009). Wild edible plants used by the tribes of akoletahasil of ahmednagar district (Ms), India. *Ethnobotanical Leaflets* 13:1328-1336.
- Kumaravelu N, Murallidharanand R, Sivakumar T (2008). A study on migratory sheep production system in southern agro climatic zone of Tamil Nadu. *Indian Journal of Small Ruminants* 14(1):137-140.
- Misri B (1995). Range and forest grazing in the Himalaya. In *Workshop proceedings, temperate Asia pasture and fodder sub-regional working group*. Available <https://www.researchgate.net/publication/286383506> Pasture and Forages in North Western Himalayan Region: Current Status and Future Strategies Conference Paper • October 2015.
- Misri B (1998). Migratory system of goat and sheep-rearing in Himachal Pradesh, India. In [www.fao.org/ag/agp/agpc/doc/publicat/tapafon3/32.doc](http://www.fao.org/ag/agp/agpc/doc/publicat/tapafon3/32.doc).
- Monika S, Kumari A, Angmo K, Bhalla TC (2016). Traditional pickles of Himachal Pradesh. *Indian Journal of Tradititonla Knowledge* 15(2):330-336.
- Rao KA, Rao KS, Rao SJ, Ravi A, Anitha A (2011). Studies on migration of sheep flocks in north coastal zone of Andhra Pradesh: identification of traditional migration tracts. *Indian Journal of Small Ruminants* 17(2):260-263.
- Sharma PK, Chauhan NS, Lal B (2005). Studies on plant associated indigenous knowledge among Malanis of Kullu district, Himachal Pradesh. *Indian Journal of Traditonal Knowledge* 4(4):403-408.
- Suresh A, Gupta DC, Mann JS (2011). Trends, determinants and constraints of temporary sheep migration in Rajasthan-an economic analysis. *Agricultural Economics Research Review* 24(2).
- Suri H (2014). Towards methodologically inclusive research syntheses: Expanding possibilities. New York, NY: Routledge 191 p.
- Tambe S, Rawat GS (2009). Traditional livelihood based on sheep grazing in the Khangchendzonga national park, Sikkim. *Indian Journal of Traditional Knowledge* 8(1):75-80.
- Thakur K, Puri S (2016). Ethnobotanical plants of bandli wildlife sanctuary, mandi, himachalpradesh. *International Journal of Advanced Research* 4(6):106-108.