



Forest Biodiversity and Livelihood of Tribal People in North Western Himalaya with Special Reference to Himachal Pradesh, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Forests are the treasures gifted to mankind since time immemorial. In Vedic era, the indigenous communities had a huge repository of knowledge pertaining to the utilization of plants and they relied on this vital comprehension for the welfare of society. This authentic knowledge of plants is vanishing among the people over the period of time due to growth and development in various human civilizations. Presently, the people living in close contact with nature aloof from the latest technologies, facilities and gadgets could practically experience the connect with the flora and fauna of the region. The tribal communities have been a part of forests for centuries, together possessing immense knowledge about the biodiversity of an area. They not only know the usage and importance of each item of forest produce including trees, herbs and shrubs but also are aware of the side effects of excess usage of a medicinal plant. Non-Timber Forest Products (NTFPs) are important component of subsistence and livelihood of tribal communities living in and near forests. This is of particular significance in the state of Himachal Pradesh having 27.73% of geographical area under forest cover and predominantly inhabited by tribal people. The tribes of Himachal

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Pradesh generally have their abode in the upper and middle level of the hills. Forest products particularly the NTFPs can provide a sustainable economic boost to millions of people, especially, tribals living in and around forests of North Western Himalayan ranges, by using existing forest resources. Hence, the present study highlights the dependence of rural and tribal communities on forests and forest products in North Western Himalayan region.

Keywords: Biodiversity; livelihood; forest; tribal people; North Western Himalaya.

1. INTRODUCTION

The Himalayan region covers approximately 2,400 km and passes through eight countries which are Bangladesh, Bhutan, Afghanistan, China, Nepal, India, Pakistan, Myanmar [1]. It occupies about 18% of India's total geographical area. The North Western Himalaya includes three Indian states viz., Jammu & Kashmir, Himachal Pradesh and Uttarakhand. It extends between 28⁰43'-37⁰05' N latitude and 72⁰40'-81⁰02' E longitude covering an area of 33 million hectares. The Himalayan ranges situated in this region exhibit a diverse climate, vegetation and land use pattern. The North Western Himalaya is enriched with several unique and valuable biodiversity elements and is a rich repository of flora and fauna having a great diversity in the floristic pattern due to wide range of altitudinal variation. The state of Himachal Pradesh is situated in the Western Himalaya covering 5,550,890.60 ha land with altitude ranging from 350 m above mean sea level (msl) to 6816 m msl. The mountain ranges in the state include the Shiwaliks, Dhauladhar, Pirpanjal, Great Himalaya and the Zaskar. The climate varies from hot, sub-humid tropical in south-west to temperate cold-alpine and glacial in the northern and eastern high mountains. It is endowed with rich biodiversity representing the uniqueness of the region. Different biological resources are used by the tribal and rural communities of the state for medicinal as well as for several other purposes based on their traditional knowledge which has been inherited by them from many generations. Various studies have been carried out on ethno-botanical and ethno-medicinal aspects of floristic diversity in Himachal Pradesh [2-13].

Globally, it has been estimated that about 40% population depends directly on mountain resources for biodiversity, minerals, water, hydroelectricity, timber and recreation [14]. Forests are the source of a range of ecosystem goods (food, fiber, fodder, medicine, fuels, timber and raw materials for industrial products) and services (purification of air and water, flood control, decomposition of wastes, soil fertility,

pollination of crops and natural vegetation for aesthetics purposes). Forests constitute the major proportion of the land use in North Western Himalaya covering an area of about 1101, 2023 and 3486 thousand ha in Himachal Pradesh, Jammu & Kashmir and Uttarakhand respectively [15]. The rural and tribal communities of North Western Himalayas closely interact with the forests to derive their economic livelihood and also for maintaining religious, cultural and spiritual identity. Forest resources have been identified as one of the key sources for sustenance and food security of tribals [16]. They have always played a significant role in survival and socioeconomic betterment of forest dwellers. The role of Non-Timber Forest Products (NTFPs) is particularly important in the Himalayan region, where a large proportion of the rural population depend on forests for meeting their basic needs [17]. The importance of commercial NTFPs for livelihood of rural and tribal people has been increasingly recognized in recent times. Agricultural production from tribal lands is not sufficient because it could just make the local populace capable of sustaining life but it couldn't be an adequate resource for their economic wellbeing. Hence the tribal communities largely depend on the collection of NTFPs. Tribal regions in Himalayas are sparsely inhabited in small settlements with high dependence of local people on adjoining forests for obtaining fuelwood, fibre, fodder, food and medicine [18]. It has been estimated that many village communities derive about 10-50% of their income from the sale of forest products. Although, NTFPs do not assure a high or regular income for forest people [19]. The viewpoint of local communities considerably varies toward forest resources depending on the distance of forest as well as availability of resource and these resources serve as a buffer at the times of hardships [20].

In the tropics, the NTFPs are the important source of livelihood to rural communities particularly for their food, fodder, medicine and raw materials for house construction as well as firewood consumption. Rural people depend on a

wide variety of plant and animal products for their use as well as marketing. In last few decades, the role of NTFPs for sustainable development and poverty alleviation has received worldwide attention. There exists a huge potential of utilizing traditional knowledge inherited by tribal communities about the wild plant resources and their management for achieving sustainable development. The forest resources play a vital role in cottage industry, health security, food security, fodder/livestock security, agricultural support, bio-energy security, socio-cultural as well as socio economic security for local people in developing countries [21]. Various tribal communities of North Western Himalaya utilize different forest resources for fulfilling their nutritional requirements, for maintaining their health and also for their socio-economic upliftment.

2. TRIBES OF NORTH WESTERN HIMALAYA

Tribal people belong to economically backward areas which are inaccessible having unfavourable geo-climatic conditions. They have very limited access to public services which reflects in their poor health and education facilities as well as low human development in tribal areas. Depending on their specific location and agro-climatic conditions (soil types, rainfall, temperature, and water availability), they can be categorised as nomadic pastoralists and subsistence farmers. They are mainly dependent on livestock rearing, agriculture and trading of NTFPs for their socio-economic welfare. The Himalayan tribal communities have established a great harmony with the nature by developing a cordial relation with the biological resources and diverse geo-climatic conditions. The Gujjars and Bakarwals are the two unique ethnic groups in Indian-Administered Kashmir that rear flocks of sheep and goat between high and low altitudes, migrating from one place to another in western Himalayas. Tribes of Uttarakhand include the Tharus, the Jaunsaries, the Buxas, the Bhotias and the Rajis presenting great cultural and ethnic diversity [22]. Tribes of Himachal Pradesh includes the Gaddis, the Gujjars, the Kinnara or Kinnauras, the Lauhalas and the Pangwalas and some other smaller tribe groups like the Bhot/Bodh, the Beda, the Jad/Lamba/ Khampa, and the Swangla. The Kinnara or Kinnauras tribe inhabit the border district of Kinnaur. The main sources of income for the Kinnauras are agriculture, horticulture and trade. The tribal inhabitants of Lahaul and Spiti district of

Himachal Pradesh are known as Lahaulas. Their main sources of economy are agriculture, horticulture, animal husbandry, trade and several crafts. The people of Pangwal tribe inhabit the high-altitude regions of Chamba district in Himachal Pradesh. The main sources of their economy are village craft, agriculture and animal husbandry. Thus, majority of the Himalayan tribal population sustains itself through agriculture and animal husbandry. Poor road connectivity restricts access to basic public goods and services in tribal areas and creates high dependence of inhabitants on natural resources for livelihood.

3. STATUS AND LIVELIHOOD OF THE TRIBAL PEOPLE OF NORTH WESTERN HIMALAYA

Globally, millions of people depend on forest resources for livelihood however dependency varies from place to place [23]. Tribal communities of North West Himalaya are closely associated with the forests as their livelihood is critically linked to the forest ecosystems. They are culturally as well as traditionally connected to the forests. Forests are extensively used for grazing, fuelwood collection, and numerous other subsistence needs by rural people. They have the potential to improve the living status of forest dwelling people, particularly tribal people, who are among the most disadvantaged groups. Forests produce a range of ecosystem goods and services which immensely contribute to the livelihood of the local people and generate employment as well as income.

Medicinal plants form an integral part of the life of most of the hill communities and inhabitants are known to collect these plants from natural habitat mainly for their own use or for trade [3]. Majority of these are used in Ayurvedic, Unani and other Traditional systems of medicine. In the Himalayan region, consumption of wild species as food has been reported high and round the year, particularly during the lean period [24]. Forest dwellers collect wild edible plants very frequently. Wild edible plants are the important components of culture and traditions of the Himalayan societies [17]. They are not only the source of income for rural and tribal people but they also have traditionally occupied an important place in their health care, socio-cultural and spiritual life [25]. Several valuable works have been carried out to describe useful aspects of plant diversity in North Western Himalaya (Table 1). The nutritive value of wild edible fruit of

Table 1. Forest resources utilized by the tribal people of North Western Himalaya

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>Abies spectabilis</i> (D.Don.) Spach.	Pinaceae	Kolroi, Tosh	Himachal Pradesh (Kinnaur)	Leaves	Used for fever, asthma and bronchitis.	Radha et al., [32];
<i>Abrus precatorius</i> L.	Fabaceae	Ratti, Gunchi	Himachal Pradesh (Sirmour), Uttarakhand	Leaves	Leaves are used for healing wounds. Seeds are used for making bracelets, necklaces, rosaries, etc. Stem fibers are woven into baskets.	Mathur and Joshi, [33]; Radha et al., [32]
<i>Acalypha indica</i> L.	Euphorbiaceae	Kuph	Uttarakhand	Leaves	Used to cure ear problems.	Sharma et al., [34]
<i>Achillea millefolium</i> L.	Asteraceae	Birnjaisif, Gondana	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Leaves, Flowers, Whole plant	Used to cure toothache, high blood pressure, body pain, high fever and respiratory infection. It is stimulative, diuretic and haemostatic.	Negi and Chauhan, [35]; Dutt et al., [36]; Radha et al., [32]
<i>Achyranthes aspera</i> L.	Amaranthaceae	Chirchira	Uttarakhand	Leaves, Roots, Seeds, Whole Plant	Used for sperm viability, boils, dysentery and dog bite. It is also used for dyeing and washing clothes. Seeds are cooked and eaten. Leaves are used as fodder for goats.	Sharma et al., [34]; Mathur and Joshi, [33]; Kumar et al., [37]
<i>Achyranthes bidentata</i> Blume	Amaranthaceae	Chirchita, Puthkanda	Himachal Pradesh (Chamba; Kinnaur)	Roots, Seeds, Leaves	The plant is astringent, diuretic and spasmolytic. It is also used for abdominal pain.	Negi and Chauhan, [35]; Rani et al., [38]
<i>Aconitum heterophyllum</i> Wall. ex Royle	Ranunculaceae	Atish	Himachal Pradesh (Pangi, Chamba; Chhota Bhangal; Kinnaur)	Root	Used for diarrhoea, stomachache, fever and vomiting.	Uniyal et al., [39]; Negi and Chauhan, [35]; Dutt et al., [36]
<i>Aconitum violaceum</i> Jacq. ex Stapf.	Ranunculaceae	Mitha patis	Himachal Pradesh (Kinnaur)	Roots	Used to cure cough in children.	Negi and Chauhan, [35]
<i>Acorus calamus</i> L.	Acoraceae	Bacch	Uttarakhand	Roots, Leaves	Roots are used for diarrhoea and rib pain. Leaves and root stock are used for the	Mathur and Joshi, [33]; Kumar et al., [37]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
					preparation of hair powders, perfumes and liquor flavoring. They are also used as insecticide in stored grains, field crops and woolens.	
<i>Aegle marmelos</i> (L.) Correa	Rutaceae	Bael patra	Himachal Pradesh (Kangra), Uttarakhand	Fruit	Fruits are edible and used to cure dysentery, cholera, indigestion and stomach ache. It is also used in cart construction and agricultural implements. Pulp is used for washing clothes having detergent properties; it is also used as a varnish. Gum which exudes from the trunk makes a good adhesive. Leaves are used in worship of Hindu deity Shiva.	Sharma et al., [34]; Mathur and Joshi, [33]; Supriya et al., [40]; Kumar et al., [37]
<i>Aesculus indica</i> (Colebr. ex Cambess) Hook.	Hippocastanaceae	Jungli khanor	Himachal Pradesh (Chhota Bhangal; Kinnaur)	Fruits, Seeds	Fruits and seeds are edible. Fruits are used for curing excessive bleeding and pain during menses.	Uniyal et al., [39]; Negi and Subramani, [41]
<i>Ageratum conyzoides</i> L.	Asteraceae	Fulnu	Himachal Pradesh (Kangra), Uttarakhand	Leaves	Used for healing wounds.	Joshi and Pant, [42]; Supriya et al., [40]
<i>Ainsliaea aptera</i> DC.	Asteraceae	Kandyari	Himachal Pradesh (Chhota Bhangal)	Roots	Prescribed for gastric problems.	Uniyal et al., [39]
<i>Ajuga bracteosa</i> Wallich ex Benth	Lamiaceae	Neel-kanthi	Himachal Pradesh (Chhota Bhangal)	Leaves	Used for the treatment of mouth ulcer and breathing problems.	Uniyal et al., [39]
<i>Allium caesium</i> Schrenk.	Amaryllidaceae	Dhum	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Leaves	Edible (used as chutney and also as condiment).	Negi and Subramani, [41]; Prakash et al., [43]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>Allium humile</i> Kunth.	Amaryllidaceae	Pareeni	Himachal Pradesh (Pangi, Chamba)	Leaves	Good for digestion and also used as flavouring agent.	Dutt et al., [36]; Prakash et al., [43]
<i>Allium sativum</i> L.	Amaryllidaceae	Lahasun	Himachal Pradesh (Kangra), Uttarakhand	Bulb	Used for curing diabetes, diarrhoea, gastrointestinal disorders, hypertension and strengthen immune system.	Sharma et al., [34]; Supriya et al., [40]
<i>Allium semenovii</i> Regel.	Amaryllidaceae	Shawan	Himachal Pradesh (Pangi, Chamba)	Whole Plant	Used as spice and vegetable.	Dutt et al., [36]; Prakash et al., [43]
<i>Amaranthus spinosus</i> L.	Amaranthaceae	Bhabri	Himachal Pradesh (Pangi, Chamba), Uttarakhand (Kumaun)	Whole Plant	Whole plant is used as a vegetable and as fodder for cattle.	Mathur and Joshi, [33]; Prakash et al., [43]
<i>Amaranthus viridis</i> L.	Amaranthaceae	Jungali chaulayi	Himachal Pradesh (Sirmour)	Leaves, Roots	Used to cure skin infection.	Radha et al., [32]
<i>Andrographis paniculata</i> (Burm. f.) Nees	Acanthaceae	Kiryat, Kalmedh	Uttarakhand	Whole plant, Leaves	Used for curing dysentery, fever, worms and stomach complaints.	Mathur and Joshi, [33]
<i>Anemone rupicola</i> Cambess	Ranunculaceae	Kakrya	Himachal Pradesh (Chhota Bhangal)	Leaves	Used for the treatment of ears with pus.	Uniyal et al., [39]
<i>Angelica glauca</i> Edgew.	Apiaceae	Chaura	Himachal Pradesh (Chhota Bhangal; Chamba; Kinnaur)	Root, Umbels	Used for arthritis, cold, cough, fever and also as spice, snake repellent and carminative.	Negi and Chauhan, [35]; Rani et al., [38]; Dutt et al., [36]; Uniyal et al., [39]; Rana et al., [44]; Prakash et al., [43]
<i>Argemone mexicana</i> L.	Papaveraceae	Satyanashi, Bharband	Himachal Pradesh (Kinnaur, Sirmour), Uttarakhand	Whole plant, Seeds	Used to cure malaria and digestive disorders.	Sharma et al., [34]; Radha et al., [32]
<i>Arisaema flavum</i> (Forssk.) Schott	Araceae	Jhamusha	Himachal Pradesh (Kinnaur)	Tubers, Fruits	Used for snakebite, stomach diseases and for preparation of wine.	Negi and Chauhan, [35]
<i>Arnebia benthamii</i> Wall ex G. Don	Boraginaceae	Ratanjot	Himachal Pradesh (Pangi, Chamba;	Roots	Used for the treatment of wounds, cuts, burns,	Negi and Chauhan, [35]; Dutt et al., [36]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
			Kinnaur)		toothache, ear-ache, eye diseases and also as hair dye.	
<i>Artemisia absinthium</i> L.	Asteraceae	Charmra	Himachal Pradesh (Chamba)	Leaves	Used for the treatment of wounds.	Rani et al., [38]
<i>Artemisia brevifolia</i> Wall.	Asteraceae	Nurcha, Sansei	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Flowering branches, Leaves	Good for asthma, worm expulsion, anaemia and diseases of brain.	Negi and Chauhan, [35]; Dutt et al., [36]
<i>Artemisia dracunculus</i> Linn.	Asteraceae	Chamary	Himachal Pradesh (Kinnaur)	Flowers, Leaves	Used as appetizer, condiment, stomachic, stimulative, febrifuge and also for throat infection.	Negi and Chauhan, [35]
<i>Artemisia sieversiana</i> Willd.	Asteraceae	Charmara	Himachal Pradesh (Chhota Bhangal)	Leaves	Used as abortifacient and also to cure pain and swelling of the wounds.	Uniyal et al., [39]
<i>Arundo domax</i> L.	Poaceae	Rajal	Himachal Pradesh (Kinnaur)	Stem	Used for making walking sticks and also as support for climbing trees.	Kumari and Saggoo, [45]
<i>Asparagus racemosus</i> Willd.	Asparagaceae	Saapaya	Himachal Pradesh (Chamba)	Roots	Used for stomach problems.	Rani et al., [38]
<i>Avena fatua</i> L.	Poaceae	Yukpa	Himachal Pradesh (Kinnaur)	Seeds	Used to cure stomach disorder and fever.	Kumari and Saggoo, [45]
<i>Bacopa monnieri</i> (L.) Wettst.	Scrophulariaceae	Brahmi	Himachal Pradesh (Chamba)	Leaves	Used for nervous disorder and to enhance memory.	Rani et al., [38]
<i>Bauhinia variegata</i> L.	Fabaceae	Kachnar	Himachal Pradesh (Chamba; Kangra), Uttarakhand	Bark, Leaves, Flower buds	Used for wound healing, dysentery, haemorrhoids, snake poisoning, stomach problems. Bark is used for dyeing and tanning. Leaves and flowers-buds are eaten as a vegetable.	Mathur and Joshi, [33]; Rani et al., [38]; Supriya et al., [40]
<i>Berberis aristata</i> DC.	Berberidaceae	Kashmal	Himachal Pradesh (Chamba; Lahaul	Roots, Fruits,	Roots are used to cure eye infection, dysentery and piles.	Singh and Chauhan, [46]; Rani et al., [38];

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
			Spiti)	Leaves, Flowers	Fruits, leaves and flowers are edible.	Rana et al., [44]; Prakash et al., [43]
<i>Berberis asiatica</i> Roxb. ex DC.	Berberidaceae	Chunchri, Kahamil, Kapacho	Himachal Pradesh (Chhota Bhangal; Pangi, Chamba; Kinnaur)	Roots, Fruits, Young shoots	Roots are used for diabetes and jaundice. Fruits are edible and also used as laxative. Young shoots are used to drive away the evil spirits.	Uniyal et al., [39]; Negi and Chauhan, [35]; Dutt et al., [36]
<i>Berberis lycium</i> Royle	Berberidaceae	Kasmal	Himachal Pradesh (Chamba; Chhota Bhangal)	Roots, Stem, Fruits, Leaves, Flowers	Used to cure gum problems and eye infections. Fruits, leaves and flowers are edible.	Uniyal et al., [39]; Rani et al., [38]; Prakash et al., [43]
<i>Bergenia ciliata</i> (Haworth) Sternb.	Saxifragaceae	Sadpottar	Himachal Pradesh (Chhota Bhangal), Uttarakhand	Roots	Used for fever, dysentery and kidney stone.	Uniyal et al., [39]; Kumar et al., [37]
<i>Bergenia ligulata</i> (Wall.) Engl.	Saxifragaceae	Shaprotri	Himachal Pradesh (Chamba)	Leaves	Used for cold.	Rani et al., [38]
<i>Bergenia stracheyi</i> (Hook f. & Thomas.) Engl.	Saxifragaceae	Lao-patra, Shamlot	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Rhizome	Used to cure indigestion, fever, burns and jaundice.	Negi and Chauhan, [35]; Dutt et al., [36]
<i>Betula utilis</i> D. Don.	Betulaceae	Bhojpatra	Himachal Pradesh (Chamba, Kinnaur)	Bark, Leaves	Used for the treatment of urinary tract infection, wounds and also as roofing material.	Negi and Chauhan, [35]; Rani et al., [38]; Dutt et al., [36]; Rana et al., [44]
<i>Bunium persicum</i> Boiss.	Apiaceae	Kalazira	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Seeds	Used for fever, cold, headache and also as spice and condiment.	Dutt et al., [36]; Negi and Subramani, [41]; Prakash et al., [43]
<i>Cannabis sativa</i> L.	Cannabaceae	Bhang	Himachal Pradesh (Chamba; Chhota Bhangal), Jammu and Kashmir, Uttarakhand	Leaves, Fiber, Seeds	Used for Joint pain, fever, depression, cholera, paralysis, dandruff, tumours, ulcers and also, for religious	Uniyal et al., [39]; Mathur and Joshi, [33]; Rani et al., [38]; Dar et al., [47]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
					purposes. Plant fiber is used for making ropes, nets, cables, sail cloth canvas, carpets, sheets, etc. Seeds are roasted and eaten by the locals.	
<i>Carica papaya</i> L.	Caricaceae	Kharbuja	Himachal Pradesh (Kangra)	Fruit, Leaves, Stem bark	Used for the treatment of asthma, jaundice, bleeding piles, abortion, urinary tract infection, wounds and sore teeth.	Supriya et al., [40]
<i>Castanea sativa</i> Mil.	Fagaceae	Mitha	Himachal Pradesh (Kinnaur)	Fruits	Fruits are edible.	Negi and Subramani, [41]
<i>Centella asiatica</i> (L.) Urb	Apiaceae	Brahmi, Manduki	Uttarakhand	Leaves, Stem	Used for urinary problems, nervous disorders and skin diseases.	Mathur and Joshi, [33]
<i>Chaerophyllum villosum</i> Wall. ex DC.	Apiaceae	Tila	Himachal Pradesh (Pangi, Chamba)	Tuber, Roots	Used to cure stomach disorders. Roots are edible.	Dutt et al., [36]; Prakash et al., [43]
<i>Cirsium wallichii</i> DC.	Asteraceae	Bursa	Himachal Pradesh (Chhota Bhangal)	Root	Used for gastric problems.	Uniyal et al., [39]
<i>Codonopsis ovata</i> Benth.	Campanulaceae	Katari	Himachal Pradesh (Pangi, Chamba)	Leaves	Good for eye diseases.	Dutt et al., [36]
<i>Convolvulus arvensis</i> Linn.	Convolvulaceae	Dhechigmendo	Himachal Pradesh (Lahaul Spiti)	Leaves, Flowers	Used to cure kidney pain.	Singh and Chauhan, [46]
<i>Corylus jacquemontii</i> Decne.	Corylaceae	Thangi/Thangoli	Himachal Pradesh (Chamba)	Seeds	Used for muscular pain.	Rani et al., [38]
<i>Cotoneaster microphyllus</i> Lindl.	Rosaceae	Kadhori	Himachal Pradesh (Chamba)	Fruits	Used to treat skin diseases.	Rani et al., [38]
<i>Crataegus oxyacantha</i> L.	Rosaceae	Pinyath	Himachal Pradesh (Chamba)	Fruits	Fruits are used for curing anaemia.	Rani et al., [38]
<i>Curcuma longa</i> L.	Zingiberaceae	Haldar	Himachal Pradesh (Kangra), Uttarakhand	Rhizome	Used to cure skin disorders, indigestion, injury, heart problems, gastrointestinal	Supriya et al., [40]; Kumar et al., [37]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>Cymbopogon distans</i> (Steud.) Wats.	Poaceae	Kurcha	Himachal Pradesh (Kinnaur)	Leaves	Used for joint pain and inflammation.	Kumari and Saggoo, [45]
<i>Cynodon dactylon</i> (L.) Persoon	Poaceae	Drub	Himachal Pradesh (Chhota Bhangal)	Aerial parts	Used to cure nasal bleeding.	Uniyal et al., [39]
<i>Dactylorhiza hatagirea</i> D. Don	Orchidaceae	Hathpanja, Salampanja	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Tubers	Used for diabetes, diarrhoea, dysentery, fracture and to check nose-bleeding.	Negi and Chauhan, [35]; Dutt et al., [36]
<i>Datura stramonium</i> Wall.	Solanaceae	Datura	Himachal Pradesh (Chamba)	Seeds	Used to cure pimples (Acne).	Rani et al., [38]
<i>Delphinium brunonianum</i> Royle	Ranunculaceae	Loskar, Nirbisha	Himachal Pradesh (Kinnaur)	Leaves, Flowers	Used to cure dysentery and fever.	Negi and Chauhan, [35]
<i>Delphinium denudatum</i> Wall. ex Hook. & Thoms.	Ranunculaceae	Losar	Himachal Pradesh (Kinnaur)	Roots	Used against toothache.	Negi and Chauhan, [35]
<i>Desmodium elegans</i> DC.	Fabaceae	Kathi	Himachal Pradesh (Chamba)	Roots, Leaves	Used to treat cholera. Leaves are used as fodder.	Rani et al., [38]
<i>Dioscorea deltoidea</i> Wall. ex Griseb.	Dioscoreaceae	Shingli-Mingli	Himachal Pradesh (Kinnaur)	Rhizome	Used for gastric complaints and also for washing wool and hair.	Negi and Chauhan, [35]
<i>Diplazium esculentum</i> (Retz.) Sw.	Woodsiaceae	Kasror	Himachal Pradesh (Chamba)	Whole plant	Used for muscular pain.	Rani et al., [38]
<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	Kangli	Himachal Pradesh (Kinnaur)	Whole plant	Used for curing dysentery, constipation and for making mats and ropes.	Kumari and Saggoo, [45]
<i>Ephedra gerardiana</i> Wall. ex Stapf	Ephedraceae	Somlata	Himachal Pradesh (Kinnaur), Uttarakhand	Shoots	Used to treat asthma, hay fever and rashes.	Negi and Chauhan, [35]
<i>Eucalyptus gigantea</i> Dehnh.	Myrtaceae	Safeda	Himachal Pradesh (Kangra)	Leaves, Bark	Used to cure bronchitis, throat infection, also as antiseptic, anti-inflammatory and insect repellent.	Supriya et al., [40]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>Fagopyrum esculentum</i> Moench	Polygonaceae	Ogala	Himachal Pradesh (Kinnaur)	Seeds, Roots	Seeds are edible. Root is used against rheumatic pain, lung diseases and typhoid.	Negi and Chauhan, [35]
<i>Ferula jaeschkeana</i> Vatke	Apiaceae	Kurash, Jangli Hing	Himachal Pradesh (Pangi, Chamba, Kinnaur)	Rhizome	Used to heal wounds, cuts, boils and burns.	Negi and Chauhan, [35]; Dutt et al., [36]
<i>Fragaria nubicola</i> Lindley ex Lacaíta	Rosaceae	Aakhe, Kida-bhumla	Himachal Pradesh (Chhota Bhangal)	Aerial parts	Aerial parts are used for fever.	Uniyal et al., [39];
<i>Grewia optiva</i> Drummond ex Burret	Tiliaceae	Dhaman	Himachal Pradesh (Chhota Bhangal)	Leaves	Used for joint pain.	Uniyal et al., [39]
<i>Heracleum lanatum</i> Michx	Apiaceae	Poral	Himachal Pradesh (Kinnaur)	Flowers, Leaves	Used to cure headache.	Negi and Chauhan, [35]
<i>Hippophae salicifolia</i> D.Don	Elaeagnaceae	Charma	Himachal Pradesh (Pangi, Chamba)	Fruits	Fruits are edible and used for making jam and juice.	Prakash et al., [43]
<i>Hypericum oblongifolium</i> Hook.	Hypericaceae	Phiunli	Himachal Pradesh (Chamba; Sirmour)	Roots, Leaves, Flowers	Used to cure diarrhoea, skin allergy and animal diseases.	Rani et al., [38]; Radha et al., [32]
<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	Basunth	Himachal Pradesh (Kangra)	Leaves	Used for wound healing and possess antibacterial and anti-inflammatory activity.	Supriya et al., [40]
<i>Juniperus macropoda</i> Boiss.	Cupressaceae	Theleru	Himachal Pradesh (Kinnaur)	Berries	Used for cough, colic, diarrhoea, indigestion, pectoral affections and impotency.	Negi and Chauhan, [35]
<i>Jurinea dolomiaea</i> Boiss	Asteraceae	Guggal dhoop	Himachal Pradesh (Pangi, Chamba)	Roots	Used for skin eruptions and cuts.	Dutt et al., [36]
<i>Justicia adhatoda</i> L.	Acanthaceae	Safed basunth	Himachal Pradesh (Kangra, Sirmour), Uttarakhand	Leaves	Used for dysentery, fever, cough, cold, bronchitis and asthma.	Mathur and Joshi, [33]; Radha et al., [32]; Supriya et al., [40]
<i>Mallotus philippensis</i> (Lam.) Muell.-Arg.	Euphorbiaceae	Rohini	Uttarakhand	Fruits	Fruits are used as anthelmintic and also as source of a dye (kamala)	Sharma et al., [34]; Mathur and Joshi, [33]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>Malus baccata</i> (L.) Borkh. R	Rosaceae	Khontli	Himachal Pradesh (Kinnaur)	Fruits	Fruits are edible.	Negi and Subramani, [41]
<i>Malva parviflora</i> L.	Malvaceae	Nasochal	Himachal Pradesh (Chhota Bhangal)	Aerial parts	Used for abortion.	Uniyal et al., [39]
<i>Melica persica</i> Kunth.	Poaceae	Karvo	Himachal Pradesh (Kinnaur)	Whole plant	Used in religious ceremonies.	Kumari and Saggoo, [45]
<i>Mentha longifolia</i> (Linn.) Hudson	Lamiaceae	Pudina	Himachal Pradesh (Kinnaur; Lahaul Spiti), Jammu & Kashmir	Leaves, Shoots	Used as antiseptic, carminative, stimulant and also for curing stomach disorder, wounds, body pain and vomiting.	Singh and Chauhan, [46]; Negi and Chauhan, [35]; Dar et al., [47]
<i>Mirabilis jalapa</i> L.	Nyctaginaceae	Raat ki rani	Himachal Pradesh (Chamba)	Roots	Used to cure cough and cold.	Rani et al., [38]
<i>Morus alba</i> L.	Moraceae	Toot	Himachal Pradesh (Kangra)	Fruits	Used to cure sore throat, fever, lower blood pressure and improve eyesight.	Supriya et al., [40]
<i>Murraya koenigii</i> Spreng.	Rutaceae	Kadhi patta	Himachal Pradesh (Chamba; Kangra), Uttarakhand	Leaves, Branches	Used for blood purification, vomiting, kidney pain, hair growth, boils, burns, diarrhoea, dysentery, joint pain and gum problems.	Sharma et al., [34]; Rani et al., [38]; Supriya et al., [40]; Kumar et al., [37]
<i>Origanum vulgare</i> Linn	Lamiaceae	Maruwa	Himachal Pradesh (Pangi, Chamba)	Leaves	Used for curing chickenpox and fever.	Dutt et al., [36]
<i>Oxyriadigyna</i> (Linn.) Hill	Polygonaceae	Chucha	Himachal Pradesh (Kinnaur)	Leaves	Used for stomach disorder and also as pickles.	Negi and Chauhan, [35]
<i>Parthenocissus semicordata</i> (Wall.) Planchon	Vitaceae	Amru bail	Himachal Pradesh (Chhota Bhangal)	Aerial parts, Root	Used against leucorrhoea, wounds and boils.	Uniyal et al., [39]
<i>Phytolacca acinosa</i> Roxb.	Phytolaccaceae	Ranshag, Ashlu	Himachal Pradesh (Chamba)	Leaves	Used to cure acne disease.	Rani et al., [38]
<i>Picrorhiza kurroa</i> Royle ex Benth	Scrophulariaceae	Karru	Himachal Pradesh (Chamba; Chhota Bhangal; Kinnaur),	Leaves, Roots, Rhizome	Used for cold, cough, fever, joint pain, stomach disorders, digestive problems and as	Uniyal et al., [39]; Negi and Chauhan, [35]; Rani et al., [38];

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
			Jammu & Kashmir		blood purifier.	Dutt et al., [36]; Dar et al., [47]
<i>Pinus gerardiana</i> Wall. ex D.Don	Pinaceae	Neoza, Ree, Chilgoza	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Nuts (Kernel)	Used in socio-religious beliefs; Kernels are edible and also used as carminative and expectorant.	Negi and Chauhan, [35]; Dutt et al., [36]; Negi and Subramani, [41]
<i>Polygonatum cirrhifolium</i> (Wall.) Royle	Liliaceae	Sobnyam	Himachal Pradesh (Kinnaur)	Leaves	Used as tonic and vegetable.	Negi and Chauhan, [35]
<i>Polygonatum verticillatum</i> (L.) All	Liliaceae	Salam mishri	Himachal Pradesh (Chhota Bhangal)	Roots	Used to cure spermatorrhoea and piles.	Uniyal et al., [39]
<i>Prunus armeniaca</i> L.	Rosaceae	Chuli	Himachal Pradesh (Kinnaur)	Fruits, Kernels	Fruits are edible and kernel oil is used for curing rheumatic pain.	Negi and Chauhan, [35]; Negi and Subramani, [41]
<i>Prunus cerasoides</i> D.Don	Rosaceae	Pajja	Himachal Pradesh (Chhota Bhangal)	Stem bark	Used for joint pain.	Uniyal et al., [39]
<i>Prunus cornuta</i> Wall.	Rosaceae	Jammu	Himachal Pradesh (Chamba)	Fruits	Used to cure anemia.	Rani et al., [38]
<i>Pteridium aquilinum</i> (L.) Kuhn	Dennstaedtiaceae	Kinus	Himachal Pradesh (Chamba)	Roots	Used to cure abdominal edema.	Rani et al., [38]
<i>Pyrus pashia</i> Buch.-Ham. ex D.Don	Rosaceae	Kainth	Himachal Pradesh (Kangra)	Fruits	Used for the treatment of throat infection, mouth boils, respiratory, cardiovascular and gastrointestinal ailments.	Supriya et al., [40]
<i>Rheum australe</i> D. Don.	Polygonaceae	Chukeri ke todhi	Himachal Pradesh (Chhota Bhangal; Pangi, Chamba; Kinnaur)	Leaves, Tubers	It is edible and also used for fracture, cold, cough and piles.	Uniyal et al., [39]; Negi and Chauhan, [35]; Dutt et al., [36]
<i>Rheum moorcroftianum</i> Royle	Polygonaceae	Pawan	Himachal Pradesh (Pangi, Chamba)	Roots	Good for digestion problems.	Dutt et al., [36]
<i>Rhododendron</i>	Ericaceae	Brah	Himachal Pradesh	Flowers	Used for cold, fever, cough	Uniyal et al., [39];

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>arboreum</i> Smith			(Chhota Bhangal, Sirmour)		and nasal bleeding.	Radha et al., [32]
<i>Rubia manjith</i> Roxb. ex Fleming	Rubiaceae	Manjith	Himachal Pradesh (Kinnaur)	Leaves	Used to heal cuts.	Negi and Chauhan, [35]
<i>Rubus ellipticus</i> Sm.	Rosaceae	Akhan	Himachal Pradesh (Chamba)	Fruits	Fruits are edible, also used for indigestion.	Rani et al., [38]
<i>Rubus niveus</i> Thunb.	Rosaceae	Khiradi	Himachal Pradesh (Chhota Bhangal)	Roots	Used to cure menstrual disorder.	Uniyal et al., [39]
<i>Rumex hastatus</i> D. Don	Polygonaceae	Almoru	Himachal Pradesh (Chhota Bhangal)	Leaves	Used to stop nasal bleeding.	Uniyal et al., [39]
<i>Rumex nepalensis</i> Sprengel	Polygonaceae	Albar	Himachal Pradesh (Chhota Bhangal), Jammu & Kashmir	Leaves, Roots	Used to cure wounds, headache, stomach and abdominal pain.	Uniyal et al., [39]; Dar et al., [47]
<i>Salix alba</i> L.	Salicaceae	Chirand	Himachal Pradesh (Chamba)	Seeds	Used to cure scabies, eczema, joint pain and also used against dandruff.	Rani et al., [38]
<i>Saussurea costus</i> (Falc.) Lipsch.	Asteraceae	Kuth	Himachal Pradesh (Chhota Bhangal), Jammu & Kashmir	Roots, Leaves	Used to cure joint pain.	Uniyal et al., [39]; Dar et al., [47]
<i>Saussurea lappa</i> (Decne) Sch. Bip.	Asteraceae	Kuth	Himachal Pradesh (Kinnaur)	Roots	Used for nausea and indigestion.	Negi and Chauhan, [35]
<i>Saussurea obvallata</i> (DC.) Edgew.	Asteraceae	Bhramkamal	Himachal Pradesh (Kinnaur)	Whole plant	Used for magico-religious purposes.	Negi and Chauhan, [35]
<i>Selinum tenuifolium</i> Wall. ex Clarke.	Apiaceae	Bhootkeshi, Matoshal	Himachal Pradesh (Chhota Bhangal; Pangi, Chamba)	Roots, Umbels.	Used to cure knee pain and swelling after delivery of women.	Uniyal et al., [39]; Dutt et al., [36]
<i>Setaria etalica</i> (L.) P. Beauv.	Poaceae	Yarka cha	Himachal Pradesh (Kinnaur)	Seeds	Used to cure fever, headache and to increase lactation of cattle.	Kumari and Saggoo, [45]
<i>Sinopodophyllum hexandrum</i> (Royle) T.S. Ying	Podophyllaceae	Bankakri	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Roots, Fruits	Used to cure cancer, cough, headache, cuts, wounds, fever, ulcer and abdominal pain.	Negi and Chauhan, [35]; Dutt et al., [36]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>Stellaria monosperma</i> Buch.-Ham. ex D.Don	Caryophyllaceae	Kokuwa	Himachal Pradesh (Chamba)	Leaves	Used for skin diseases.	Rani et al., [38]
<i>Swertia chirata</i> C.B. Clarke	Gentianaceae	Charayta	Himachal Pradesh (Chamba; Chhota Bhagal)	Leaves	Used for skin irritation.	Uniyal et al., [39]; Rani et al., [38]
<i>Taxus baccata</i> Thunb.	Taxaceae	Barhami	Himachal Pradesh (Chamba)	Leaves, Bark	Used to cure cancer.	Rani et al., [38]
<i>Terminalia arjuna</i> Wight & Arn.	Combretaceae	Arjun	Uttarakhand (Kumaun)	Bark, Wood	Bark is used against pneumonia and asthma. Wood is used for agricultural implements and boat-building.	Sharma et al., [34]; Joshi and Pant, [42]; Mathur and Joshi, [33]
<i>Terminalia chebula</i> Retz.	Combretaceae	Harad	Himachal Pradesh (Kangra)	Fruits	Used for cough, gastrointestinal disorders and possesses antibacterial, antiviral, chemo- preventive and radio protecting activity.	Supriya et al., [40]
<i>Thalictrum foliolosum</i> DC.	Ranunculaceae	Barmot	Himachal Pradesh (Chhota Bhagal)	Roots	Used to cure stomach pain and gastric trouble.	Uniyal et al., [39]
<i>Thymus linearis</i> Benth.	Lamiaceae	Ban ajwain, Sanauni, Tumro	Himachal Pradesh (Pangi, Chamba; Kinnaur)	Flower, leaves	Used as anti-spasmodic, antiseptic, as condiment and to cure stomach disorder, cough, cold and high fever.	Negi and Chauhan, [35]; Dutt et al., [36]; Prakash et al., [43]
<i>Tinospora cordifolia</i> Miers	Menispermaceae	Gloe	Himachal Pradesh (Kangra; Chamba), Uttarakhand	Stem, Whole plant	Used against skin diseases, jaundice, constipation, pneumonia, fever, cold, anaemia, inflammation, digestive problems and enhances immune system.	Rani et al., [38]; Supriya et al., [40]; Kumar et al., [37]
<i>Trillium govianum</i> Wall. ex D.Don	Trilliaceae	Nagchatri	Himachal Pradesh (Chamba)	Roots	Used to cure arthritis, menstrual and reproductive	Rani et al., [38]; Rana et al., [44]

Scientific name	Family	Common name/s	Region	Part/s used	Folk uses	Reference/s
<i>Urtica dioica</i> L.	Urticaceae	Ain	Himachal Pradesh (Chamba)	Leaves	disorders. Used for skin diseases and also as vegetable.	Rani et al., [38]; Prakash et al., [43]
<i>Valeriana jatamansi</i> D.Don	Valerianaceae	Mushkbala	Himachal Pradesh (Chamba)	Roots	Used to cure stomach ache, and also as incense ('dhoop').	Rani et al., [38]
<i>Verbascum thapsus</i> Linn.	Sambucaceae	Botiy-chi	Himachal Pradesh (Kinnaur; Lahaul Spiti)	Whole plant, Leaves, Flowers	Used to ward off evil spirits. Leaves and flowers are used to cure vomiting.	Singh and Chauhan, [46]; Negi and Chauhan, [35]
<i>Viburnum mullaha</i> Buch.-Ham. ex D.Don	Caprifoliaceae	Tilhanj	Himachal Pradesh (Chamba)	Roots Fruits	Roots used to cure cold and cough. Fruits are edible.	Rani et al., [38]; Rana et al., [44]
<i>Viola canescens</i> Wall.	Violaceae	Banaksha	Himachal Pradesh (Chamba)	Flower	Used for cold and cough.	Rani et al., [38]
<i>Viola pilosa</i> Blume	Violaceae	Vanaksa	Himachal Pradesh (Chhota Bhangal)	Flowers	Used to cure fever, cough and cold.	Uniyal et al., [39]
<i>Vitex negundo</i> L.	Lamiaceae	Bana	Himachal Pradesh (Chamba; Kangra; Sirmour)	Leaves, Stem	Used for cold, cough, fever, ulcer, joint pain, boils, toothache, sprain and inflammation.	Rani et al., [38]; Radha et al., [32]; Supriya et al., [40]
<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Ashwagandha	Uttarakhand	Fruits, Roots	Used as immune enhancer, stress resistant and also for joint pain.	Kumar et al., [37]
<i>Zanthoxylum armatum</i> DC.	Rutaceae	Trimiria	Himachal Pradesh (Chamba; Kangra; Sirmour)	Stem, Bark, Seeds, Fruits	Used to cure toothache, gum problems, fever and cardiovascular disorders.	Rani et al., [38]; Radha et al., [32]; Supriya et al., [40]

Hippophae rhamnoides L. was highlighted by Dhyani et al. [26]. Kala [27] reported 23 cultivated food crops and 15 wild edible fruit species as the most preferred species by local people in different localities of the Uttarakhand state. Kumar and Hamal [28] recorded 50 edible plant species traditionally used by local inhabitants in Kishtwar High Altitude National Park, Jammu and Kashmir (North West Himalaya). Tiwari et al. [29] recorded 55 plant species consumed as vegetables and as raw wild edibles by the local people in the hilly areas of Alaknanda Valley, Uttarakhand State. Most of the edible wild plants possess medicinal values. In addition to serving as source of nutrition, they also play important role in the treatment of several ailments. Many wild fruits such as *Punica granatum*, *Berberis asiatica*, *Solanum nigrum*, *Ficus auriculata* etc. are also known for their medicinal properties [30]. The local inhabitants of Kinnaur use the wild edible plants in raw or cooked form for maintaining their health, vitality and longevity. The different plant parts are consumed as a source of supplement of food, vegetables, spices, condiments, alcoholic beverages, according to their requirements and availability in nature. Further on the occasions of festivals, worships, weddings and other religious rituals special dishes and special drinks are traditionally prepared from the local plant-based resources. Thus, the locally available and commercially valuable natural resources support the health care as well as nutrition and can significantly contribute to rural well-being through proper planning [31].

There are several plant species in the North Western region of Himalaya which are commercially exploited for different purposes, e.g., *Aconitum heterophyllum*, *Berberis aristata*, *Bergenia ciliata*, *Ephedra Gerardiana*, *Picrorhiza kurroa*, *Sinopodophyllum hexandrum*, *Taxus baccata*, *Terminalia chebula*, *Tinospora cordifolia*, *Trillium govanianum*, *Viola canescens*, *Withania somnifera*, etc. These plants are supplied as raw material to different industries for the manufacture of various products. Thus, in addition to fulfilling the basic needs of the native people, these forest resources also generate source of income for them.

4. CONCLUSION

Livelihood-based extraction of forest resources is a common practice in every state of India, particularly, in the hilly states of Himalayan region. Himalaya is enriched with the wealth of

natural resources, but due to the high population density, there is higher rate of extraction of these valuable resources. Forests constitute the major share in the land use of North Western Himalayan region. The tribal people of North West Himalaya are dependent on forests and various forest produce for sustaining life. These products include fruits, vegetables, pulses and cereals for nutrition, fodder for domestic animals, wood for fuel, timber for construction purposes, medicinal plants for healthcare management and plant fibres for making cloth. However, due to the excessive use, these forests have come under heavy pressure for meeting the demand of ever-increasing populations. Therefore, appropriate strategies for sustainable extraction of these forest resources are required so that they can be conserved for future generations. Scientific documentation of diversity, distribution and economic importance of different species can play significant role in the conservation and sustainable use of such plant resources.

CONFERENCE DISCLAIMER

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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