Cultural and Socio-Economic Perspective of Some Promising Edible Plants from Uttarakhand Himalaya

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Abstract

Uttarakhand Himalaya (Uk) occupies a geographically favorable position in terms of topography, microclimate, and a wide range of altitudes. This advantage benefits the region and supports varied biodiversity and rich reserves of edible plants. Traditionally, wild edible plants are crucial as a source of food and nutrition, additionally are important in the socio-economic and health domains, therefore are also an integral part of culture and traditions of the Himalayan societies. The historical, cultural, environmental, religious, and spiritual aspects of culturally salient plants from the region have become important predictors of socio-economic factors of the local population. These factors and the availability of a huge biodiversity in the state of Uttarakhand has fascinated and attracted a lot of researchers. Subsequently, ample research has been carried out on various aspects of edible plants of the region which include conservation and bioprospecting, phytochemical analysis, and studies evaluating distribution and their use. While some plant species are being harvested at a commercial scale, some provide small scale livelihood for far-flung communities. Besides, in Indian mythology, several entities of biodiversity have been recognized with certain characteristics of the Hindu gods and are idolized and worshipped. Many plants and animals have everlasting symbolic importance, presence on flags, national emblems, mentions in folk stories and religious manuscripts, and as such are kept in close accordance with the lifestyles of the people of the region. This tradition over generations has been preserved and has become an integral part of the rituals and customs of this mountain region; although various anthropogenic activities,

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M. H. Masoodi, M. U. Rehman (eds.), *Edible Plants in Health and Diseases*,
https://doi.org/10.1007/978-981-16-4880-9_9

commercial farming, and lack of the supply chain for these plants have restricted their application outside the region.

Keywords

Uttarakhand Himalaya · Wild plants · Edible · Socio-economic · Cultural

9.1 Introduction

It is well-established that mankind has been sustaining biodiversity from ancient times to draw the energy from plants in the form of food. As the *Homo sapiens* started to settle, the domestication of wild species also started with both animals and plants. Humans started to domesticate all kinds of wild plants and after evolving through generations led to several cultivated plant species throughout the world. The Himalayas, the world's largest mountain range have always been considered as a hotspot of biological diversity inhabiting 10,503 plant species, including 8765 native angiosperm species. Of which Uttarakhand hosts 184 species belonging to 56 families of the wild edible plants of angiosperms and gymnosperms (Rana et al. 2019; Upreti et al. 2010). There occur 21 forest types, with species richness declining threefold from the east to the northwest of the Himalaya (Shah and Board 2015; Rana et al. 2019). The Uttarakhand State (hereafter denoted as Uk) due to highly varying altitudes (300-4500 m altitudes) is eco-rich with enormous demand and heritage of wild edible plants (Upreti et al. 2010). Traditionally, wild edible plants are important in the socio-economic and health domains and similarly are of high significance in the rural Uk (Upreti et al. 2010). As such, the historical, cultural, environmental, religious, and spiritual aspects may be important predictors of socio-economic factors to explain the importance of culturally salient plants. In terms of biological well-being, edible plants also have some traditional and modern use in nutraceuticals (Kumar et al. 2018; Namrata et al. 2011). Therefore, the impact of socio-economic and cultural aspects on the knowledge and use of plant species has been the focus of several ethnobotanical studies. Several studies have assessed the role of the plants found in the diverse region of Uk, initially known as Uttaranchal (Uniyal 2007; Gaur 2008; Upreti et al. 2010; Sekar et al. 2012; Shah and Board 2015; Rana and Rawat 2017; Rana et al. 2019) suggesting the presence of edible flora and their importance in Uttarakhand, but their work has focused mainly on the taxonomic and phyto-geographical aspect of the biodiversity. The purpose of this chapter is to broadly indicate the economic, cultural, and socio-economic perspectives of certain edible plants in the Uk Himalaya.

9.2 Background of the Area

Uttarakhand is situated between 77°34′27″ and 81°02′22″ E longitude and 28°53′ 24″ to 31°27′ 50′'N latitude. It is partitioned into 13 districts and two administrative provinces, Garhwal and Kumaon. The total area covered by Uk is 53,566 km^2that occupies 17.3% of India's total land area. Mostly, the area comprises hills (92.57%) while a small part also forms plains (7.43%) (Anthwal et al. 2010). This state is also known as Dev Bhumi, or the home of gods, and therefore is dotted with many religious places for worship (Singh et al. 2017). Uttarakhand is a tourist attraction with millions of travelers coming every year for pilgrimage as well as for leisure owing to its exquisite landscape and forestry. The land embodies 161 plant species that are known as rare or threatened by the IUCN (International Union for Conservation of Nature). Among the known orchids reported from the north-western Himalayas, over 150 have been documented solely from Uttarakhand.

9.3 Economic Importance of Plants

Among the various economic benefits of forests, the most obvious value is from direct services, such as the timber and non-timber products or obtaining plants and animals for sustenance. There may also be the provision of indirect services, such as watershed regulation or non-derivative uses such as their importance for recreational activities or travel and tourism. So, indirect services of biological diversity comprise of the role of organisms in supporting the ecosystem services such as management of floods, pests, or conservation of soil against erosion and/or fighting climate change. There are other surplus uses of resources that may have significance in the future. Other than the above stated important uses of plants, they are also a source of various important unidentified or uncharacterized chemical ingredients. Given these important roles that forests play generally, in India especially forests have major roles in the economic, survival, and market development.

9.4 Agriculture and Livelihood

Agricultural biodiversity has continually shaped the structure of man's food production and preparation manner (Brush 2008) and has offered social, sacred religious, and ornamental importance to humankind and civilizations (Mace et al. 2012; Clark et al. 2014). The major contributor to the economy of the Uk is agriculture, almost 80% of the population draw their livelihood from agriculture and agriculture-related practices, and is also a traditional way of living in this part of India (Negi et al. 2009). Certain factors such as topography and geography, biological, socio-cultural, and economic factors have played a major role in determining the course of living and source of income-generating occupations. In this part of the Himalayas, the varied biological diversity and variability in climate have led the way for agronomy and crop production. The extending topographies have allowed the farmers to grow as

many as 97 agricultural crops among which 11 horticulture plants are also cultivated (Mehta et al. 2010; Mehta et al. 2012; Sati and Wei 2018). These communities have helped in sustaining and preserving the agro diversity of the state. The farmers not only oversee and cater to the plant, they also manage the diversity of the crops and uphold the indispensable process of evolution. Farming is the main occupation of the people of the Uk, a decline in employing traditional cultivation practices has been seen in recent years attributed to changes in climate, culture, and socio-economy (Maikhuri et al. 2001). Besides, the production and diversity of crops are decreasing at an alarming rate that may result in the loss of floral diversity in the coming years (Maikhuri et al. 2000). However, some types of plant species are still preserved due to their cultural, religious, and medicinal significance.

Uk state is considered as an enormously huge reservoir of edible wild plants as well as ethnomedicinal plants. People of the Uk widely depend on vegetables as their primary food while the staple food is wheat. Crops most commonly affiliated with Uttarakhand are buckwheat (*Fagopyrum esculentum*) locally known as Kuttu and among the regional crops, finger millet (*Eleusine coracana*) locally known as Maduwa (Shah et al. 2008) and barnyard millet (*Echinochloa frumantacea*) known as Jhangora (Pandey et al. 2019), are cultivated in the inner regions of Kumaon and Garhwal, respectively. It has been documented that this state represents a total of 94 wild edible species of which 67 are edible fruits and 27 edible vegetables. Additionally, cereals, pseudocereals, oil seeds, spices, and condiments have also been reported (Arora and Pandey 1996).

With respect to the economic frame, expanding the financial ground is the prime opportunity for small farmworkers predominating in highland regions of Uttarakhand Himalaya to boost their revenues and to set a framework of financial security. The forests bring many prospects for varied terrestrial occupations resulting in the socio-economic progress of the native people. Being home to an exceptional biological diversity, the plant and animal reserves are also an integral part of the livelihood of the residents of the Uk state.

9.5 Plant Resources of Uttarakhand and their Economic Importance

India's ecosystem diversity encompasses a wide variety of habitats that include tropical rainforests, alpine vegetation, temperate forests, and coastal wetlands that have provided treats for thousands of years in the form of wild plants being used for various purposes (food, fodder, timber, medicinal purposes, and other environmental services, etc.). Procuring food from the wild has been closely associated with humankind for ages (Gosden and Hather 2004). This practice accustomed humans to develop a profound knowledge base and expertise about the environment and supplied them with an assorted collection of animal and plant-derived foods, acquired through various innovative ways (Anderson 2011; Chevalier et al. 2014; Harris and Hillman 2014). At the same time, thousands of edible plant species continued to remain wild or semi-wild that remained undomesticated. And these

uncultivated edible species have the capacity to convert our diet habits into more balanced, nutritional, sustainable, and buffer against climate change (Hunter and Fanzo 2013; Powell et al. 2015). A large and diverse assortment of wild uncultivated plants and their parts (such as leaves, shoots, roots, fruits, seeds, flowers) are still being consumed on a daily basis that supports human adaptability and complements a range of human gastronomic choice. They are rich in fiber, proteins, essential minerals, micronutrients, and vitamins that improve food quality and variety (Ogle 2001) and thus provide an economical source to fulfill dietary needs for rural and semi-urban civilizations across cultures and regions (Jones 2017; Rowland et al. 2017). Wild food acceptance and its consumption still exist in the present time, particularly in far-flung areas that are economically depleted (Angelsen et al. 2014; Wunder et al. 2014; Ickowitz et al. 2016). The state of the Uk is an excellent example of the above-stated framework regarding food cultivation and acquisition from the wild. Crop cultivation is practiced as a major source of livelihood, but at the same time, residents make great use of the available wild flora for consumption and trading.

The extending topographies with variability in climate types results in distinct floral diversity along its altitudinal gradient (Joshi et al. 2018). Therefore, Uk is one of the eco-richest regions in India in terms of natural resources which this belt encompasses. Particularly, its plant resources have immense diversity and high levels of endemism, thus indicate its rich biotic wealth. Numerous ecologically and economically valuable plants, that are also culturally and traditionally important, have resulted in conserving the great Indian Himalayan region. Hence, this is clear that among the different biogeographical regions of the Himalayas, Central Himalaya (mainly consisting of Uttarakhand state) is identified as having the richest diversity (344 species) of edible wild plants (Samant and Dhar 1997). Mostly these edible wild plants are consumed directly by the local people as fruits and vegetables (Sundriyal and Sundriyal 2001; Orech et al. 2007), while others are processed and value-added. In the context of Himalayan biodiversity, it is well-established that the edible wild plants are not only acquired to meet the nutritional requirements of the resident communities but are also an adequate source of generating income.

The edible plants among the forest vegetation have conventionally established an important place in socio-cultural, spiritual, and health domains of rural and tribal lives of India. With India having one of the oldest forms of the traditional systems of medicine (Ayurveda), using more than 2000 wild and cultivated plant species is likely because of rich and most diverse reserves of floral vegetation (Anthwal et al. 2010).

Similar to most of India, the agricultural sector is among the most important industries supporting approximately 70–80% of the population for their livelihood in the Uk (Negi and Maikhuri 2013; Sati 2017). Among the widely grown crops, rice, wheat, millets, minor millets, sugarcane, pulses, oil seeds are means of income-generating crops. Apart from the cereals and cash crops, fruits like apples, oranges, pears, peaches, are commonly grown as a significant constituent in the food processing and manufacturing industry. The land under cultivation of certain traditional crops has diminished by 20–25% owing to the apple cultivation from the past

few decades (Negi et al. 2009). Agricultural export zones have been established in the state for the trading of economically important plants like lychees, herbs and medicinal plants, and basmati rice. According to a report, the major cash crops production between 2010 and 2015 were highest for sugarcane (6275.1 MT) followed by fruits and vegetables (1136.6 MT) and wheat (860.2 MT) (Sati and Wei 2018). In addition to that, a GI (Geographical Indication) tag has been granted to Uk based *Cinnamomum tamala,* commonly known as Tejpatta or Indian bay leaf, a spice known to add flavor to food and is also known to hold some therapeutic properties (Bisht 2020). On the other hand, some plant species like *Myrica esculenta* that is collected from the wild are retailed in the local marketplace at a price of Rs. 200–300 per kg (Joshi et al. 2018). Furthermore, some other plant species (such as *Hippophae spp*., *Rhododendron arboretum,* and *Prunus armeniaca*, etc.) are used at a commercial scale for making squash and other beverages. In Central Himalayas, the local edible plants such as *Paeonia emodi*, *Fagopyrum esculentum*, and *Dryopteris cochleata* that are fetched from the forests sell at a very high price (80–150/kg). While other species like *Dioscorea bulbifera* and *Urtica dioica* L. are also traded in the markets for generating revenue. Local people have started collecting economically important plants like *P. emodi* and *D. cochleata* used to treat various illnesses, at large scales.

The Garwhal Himalaya is colonized by folks from Gujjar, Bhoxas, Tharus, Jaunsaris tribes (Gaur et al. 2010). In the tribal communities of the Uk, the wild plants offer a variety of family provisions and domestic food security. The use of wild plants in these households is significant, especially when most of the plant food of an individual is comprised of a limited number of crops. Often the nutritional value of wild plants exceeds the commonly known vegetables and fruits.

The tradition of utilizing wild plants as food, in medicine, and other non-essential use, has been extensively exploited by the locals and tribal groups living in rural and semi-urban landscapes of the Uk Himalayas. Especially, the availability of plants that are harvested from anthropogenic settings like, the surrounding rice paddy, farms, forest areas, or uncultivated fields, and their easy accessibility have indulged a large section of the population to depend on them as a valuable dietary source. Despite a unique diversification of wild plants in India and their unrestricted use and consumption, extensive studies that explain the universal patterns of the range and scope of the diversity of wild food spectra are missing.

9.6 The Cultural Importance of Plants

Besides, the consumable sources of biodiversity like food, materials, and labor, human beings have been attaching cultural importance to biodiversity for thousands of years (Pretty et al. 2009). The cultural significance of biodiversity has been widely accepted throughout the world by regular ecosystem assessments (Albon et al. 2014), which suggest that the cultural interest linked to biological diversity support human health. Many plants and animals have everlasting symbolic importance, present on flags, national emblems, in the folk stories, and religious manuscripts

(Kellert and Wilson 1993; Mabey 1996; Sinha and Mishra 2015). Especially, in Indian mythology since prehistoric times, several entities of the flora and fauna have been recognized with certain characteristics of the Hindu gods and are idolized and worshipped (Sinha 1995). There are several herbs and trees like tulsi, neem, peepal, coconut, tamarind, mango, etc., and among fauna, animals like cow, elephants, lions, mice that are highly revered (Anthwal et al. 2006; Mabey 1996; Cocker 2014; Kellert and Wilson 1993). This ideology and faith continues even today in several divisions of Indian society in one manner or another, mainly in the rural communities and the local tribes inhabiting the forest belt. This kind of belief among aboriginal folk and worship of nature has assisted in preserving numerous natural ecosystems in India. They have conserved many primitive forests—called "sacred groves" in their initial forms (Sinha 1995). About 14,000 sacred groves are known to be scattered all over India, and are an abode to rare flora and fauna, amid rural, and semi-urban areas. Besides, being of religious importance and featuring in various cultures, they are rich in biodiversity. Sacred groves have become part of the "biosphere reserves" of India. Earlier, these groves were not sanctioned under any law, but in 2002 an amendment was made in the Wildlife Protection Act, 1972 to include Sacred Groves under the act.

Forests, certain trees, and plant species hold a very special status in the ideologies and beliefs of the folks in Uttarakhand. In their mindsets, trees that are revered indicate specific arrays of ethnological and individual conditions, prospects, and, expectations (Chandrakanth and Romm 1991). Various tree species are considered sacred and are worshipped in many ways, as an illustration of gods and divinities or in sentimental ways pertaining to their religion. There are cases where civilizations have controlled the exploitation of a resource by limiting the entry to resources and imposing obligation through religious or sacramental beliefs, and social practice which actually helped in biodiversity management (Pandey 2003). The association of rural people to the forest and their interests in its protection have been cultivated through various social and cultural means (like taboos). Regardless of their obvious impracticality, religious constraints may thus be regarded as highly reasonable ways of preserving resources. Similar to Garhwal Himalaya, *Ficus bengalensis* is considered to be sacred in Indonesia as well. While in Dodital and Devariyatal lakes in Uttarkashi and Rudraprayag regions of Uttarakhand, fishing is completely prohibited to preserve the sanctity of these water bodies. Besides, species such as *Ficus religiosa* (sacred fig, Somvati Amavasya), *Azadirachta indica* (Sheela Asthami, Nimb Saptami), *Ficus bengalensis* (Vat Savitri), *Aegle marmelos* (Bilvamengal sawan ke somvaar), *Musa paradisiaca* (Kadii Vrat) are protected by Hindus' taboo and have also been associated with religious festivals across the Indian sub-continent (Anthwal et al. 2006; Colding and Folke 2001). In agreement with preserving cultural integrity, management of biological resources through religious practices and belief has a long history in Uk Himalaya and will continue to be.

9.7 Some Known Edible Plants of the Uttarakhand State

Cinnamomum tamala (Ham.) Nees & Eberm. (Family. Lauraceae): Indian Bay Leaf or Tejpata. *C. tamala* is an average-sized perennial tree growing 10–20 meters tall, and a thickness of 150 cm. Concerning its cultural importance, Uk holds the GI tag for this plant. It is used as a spice in cooking, beverages, and food items in the Indian sub-continent (Bisht 2020).It is generally found in the wild or is often cultivated by the people of northern India, Pakistan, and Nepal for the multiple benefits this tree provides. At about the age of 10 years the leaves of the tree can be harvested and can continue to produce the crop for another 100 years, thus serves as a good source of income for the generations. On average, the tree can yield between 50 and 100 kgs of leaves annually. Moreover, the leaves are also used by the Indian people as an alternative to the betel leaves in the preparation of paan. The bark is used as a pseudo-spice instead of the true cinnamon (*Cinnamomum verum*) and is usually added as an adulterant to it (Upadhyay 2017; Al-Mamun et al. 2011).

The dried bark is used to cure stomach pain as a home remedy while the leaves are used to treat colic disease and diarrhea. In traditional medicine, *C. tamala* plant is an excellent source of chemical ingredients mainly found in bark essential oils. The hydro-distilled essential oils possess antifungal activity against ringworm diseases. Plant bark, fruits, and leaves show nematicidal, termiticidal, larvicidal, microbicidal, antipyretic, and anxiolytic activity. The bark is a good source of essential oils and is used as a perfuming agent in the soap industry and cosmetic preparations. It also contains phenolic compounds that have beneficial effects for Alzheimer's disease and arteriosclerosis. (Sharma and Nautiyal 2011). The plant also shows therapeutic effects against cancer and inflammation, cardiac, and neurological disorders. In broader terms, the plant is used as an antidiarrheic, antitumor, anti-inflammatory, anti-arthritic, antiparasitic, antioxidant, chemopreventive, and gastroprotective agent (Ahmed et al. 2000).

Myrica esculenta Buch.-Ham. ex. D. Don (Family. Myricaceae): Hairy Bayberry Kaiphal or Kataphala. *Morella esculenta* (Buch.-Ham. ex. D. Don) I.M. Turner newly accepted name for *M. esculenta* is a small, evergreen, dioecious tree, a well-known plant for its medicinal properties (Patil et al. 2016). This plant is native to the sub-tropical Himalayas and temperate zones (Jeeva et al. 2011; Kabra et al. 2019a). It is the most popular and selling edible fruit in Indian Himalaya and has industrial use as well (Pandey et al. 1993; Makdoh et al. 2014). The berries are used for making syrups, jams, pickling, and preparation of juices (Makdoh et al. 2014).Its bark is used against the treatment of several illnesses such as asthma, cough, chronic bronchitis, ulcers, inflammation, anemia, fever, diarrhea (Kabra et al. 2019c; Kabra et al. 2019a). Due to its multiple uses in treating various diseases and for its therapeutic effects, it is well documented in the ayurvedic pharmacopeia. Additionally, on a large scale, its bark is used in paper and rope industries (Kabra et al. 2019c). The tannins derived from its bark are used as a coloring agent (Dawang et al. 1988). Myricetin, a key compound obtained from this plant, has the potential to guard against cancer, diabetes, inflammation, and jaundice (Agnihotri et al. 2012; Patel

et al. 2010; Kabra et al. 2019b; Kabra et al. 2019a). In general, all the plant parts of *M. esculenta* possess high nutritional value in addition to the therapeutic effect (Kabra et al. 2019a). Despite being a valuable and beneficial tree, its cultivation is highly restricted and its conventional and industrial uses are exclusively dependent on acquiring from the wild by native people (Kala 2007).The plant parts of *M. esculenta* are highly priced and are a potential source for generating income in tribal communities (Bhatt and Dhar 2004). Its use in various Ayurvedic and Unani formulations has led to the over-exploitation of this plant that may result in its extinction from the wild (Kabra et al. 2019b; Patil et al. 2016).

Rhododendron arboretum (Family. Ericaceae) Burans or Buransh in Garhwal, Brons in Almora, Bras in Kumaon. *R. arboretum*, the state tree of Uttarakhand, also holds the Guinness Record for World's Largest *Rhododendron* (Srivastava 2012). It is an economically and pharmaceutically significant plant (Rawat et al. 2017). It is an evergreen tree that looks highly attractive due to its crimson or pink flowers (Purohit 1960; Solanki et al. 2013). The flowers have religious importance and are used as an offering in temples (Srivastava 2012). Its flowers are used to treat heart diseases and have anticancer properties (Dhar et al. 1968) and are also eaten raw in times of famine. In domestic setups, the flowers are used to prepare juices, jellies, squashes, teas, syrups, and sauces (barah ki chutney), also used to prevent high altitude sickness by the local people (Bhatt et al. 2017; Srivastava 2012). In common households, the extract of the leaves is sprinkled over the mattresses and beds to get rid of bed lice and bugs (Srivastava 2012). The flowers of this plant can be considered as a good source of ascorbic acid (Vitamin C) along with sugar, pectin, and anthocyanin (Krishna et al. 2014).In terms of its pharmacological importance, *Rhododendron* has been reported to be effective as an antioxidant, diuretic, choleretic, antispasmodic, chronic eczema, diarrhea, dysentery, anti-irritable bowel syndrome (IBS) therapy, antidiabetic, anti-hyperlipidemic, anti-inflammatory, and anti-nociceptive (Nisar et al. 2013; Matin et al. 2001; Rawat et al. 2017; Sahu et al. 2011; Verma et al. 2011). It is rich in alkaloids, flavonoids, steroids, glycosides, tannins, and saponins (Prakash et al. 2007; Dhan et al. 2007; Kiruba et al. 2011). In traditional medicine, the concoction of the dried leaves has been used to treat gout rheumatism, diarrhea, and blood dysentery (Raut and Khanal 2011; Laloo et al. 2006) while the young leaves are known to be poisonous when taken in large quantities. The textured/grained wood is used in buildings and construction while the old wood is used as a fuel (Paul et al. 2005; Srivastava 2012).

Prunus armeniaca L. (Family. Rosaceae) Apricot or locally known as Khumani. *P. armeniaca* is a fruit, which is a rich source of several vitamins and minerals. Apricot trees are not abundant since they can only thrive in specific regions where the environmental settings are suitable. Several species of the genus Prunus are grown in the Uk state such as *P. cerasoides*, *P. cornuta*, *P. persica,* etc. but *P. armeniaca* is widely known for its use in traditional medicine for treatment against various diseases (Upreti et al. 2010). The bark extract is used as an astringent, antibacterial, antifungal, protection against hemorrhages, infertility, eye

inflammation, constipation, cough, asthma, and the seed paste can cure vaginal infections (Durmaz and Alpaslan 2007; Akin et al. 2008; Yiğit et al. 2009). The apricot seed oil has widely been used in cosmetics, medicines, and confectionaries (Joshi et al. 2018). It is used to make purees, jams, juices, syrups, and the kernels are rich in dietary proteins, oil, and fiber (Abd El-Aal et al. 1986; Nout et al. 1995). A significant amount of phenols, esters, and terpenoids have also been detected (Ruiz et al. 2005a; Ruiz et al. 2005b; Riu-Aumatell et al. 2005; Sefer et al. 2006). Fruits when ripened are eaten and traded fresh or dried in local markets.

Ficus religiosa *Linn* (Family. Moraceae) sacred fig, bodhi tree, peepal tree. *F. religiosa,* a tree native to the Indian sub-continent, is believed to have a religious connection to three main religions originated from there, i.e. Hinduism, Buddhism, and Jainism (Khumbongmayum et al. 2006). It is also cultivated for its fig fruit and the small fruits are generally eaten at the time of famine (Orwa et al. 2009).In terms of devotion to one's system of beliefs, Buddha attained enlightenment under this tree, hence, Buddhist monks meditate underneath this tree while Hindu ascetics conduct pradakshina around this tree (Spradling 2019). Pradakshina is performed by reciting a chant translated as- "greeting to the king of trees." It is also claimed that 27 stars are represented by 27 trees and of worship, and *F. religiosa* symbolizes a star named Pushya (Sharma et al. 2019). Also, prayer rosaries are made from the seeds of the bodhi tree. Many local tribes and communities of various regions of the Uk state regard this tree as a mark of worship by symbolizing it with the abode of Deities. Many grooves encompassing this tree by its own nature are fundamentally considered as scared. Besides, *F. religiosa* is used in folk medication since ancient times for more than 50 types of diseases such as asthma, diabetes, diarrhea, epilepsy, digestive problems, inflammatory complaints, sexual and transmitting disorders (Iqbal et al. 2017; Prasad et al. 2006; Singh et al. 2011).

Azadirachta indica A. Juss. (Family. Meliaceae) Indian lilac, Neem, Sheela Asthami, Nimb Saptami. *A. indica* is an evergreen tree native to the Indian sub-continent. Neem has been used in various Ayurvedic and Unani products for the past 2000 years. It is known to be anthelmintic, antifungal, antidiabetic, antibacterial, contraceptive, and sedative (Khadda et al. 2018).It is used in the commercial production of soap. This plant species is also known to cure snakebites, scorpion bites, and insect bites in Uk state. Traditionally, the local people have used the leaf of neem to determine the type (venomous or non-venomous) and quantity of the snake poison inflicted in the human body (Kala 2015).The paste of leaves is also applied to the wounds to prevent infection. The storage containers used for storing seed/grain are protected against insects and pests by coating the containers with a paste of this plant material along with other items that aboriginal people have learn from their ancestors (Mehta et al. 2010). Neem seeds are used as a pesticide, insecticide, and neem extract or cake is used as a fertilizer (Sidhu et al. 2004). Neem oil is also used for a number of purposes such as in polymeric resins (Siddiqui 1942; Chaudhari et al. 2015) to stabilize blood sugar levels, for promoting hair growth, etc. Neem products are highly prescribed for skin diseases like eczema,

psoriasis, and in detoxification of blood (Kala 2011). In some parts of India and Southeast Asia, neem is used as a vegetable in a variety of dishes. Also, *A. indica* has been used as an indicator in measuring elevated air pollution in Uttarakhand Himalaya (Madan and Verma 2015).

Saccharum officinarum L., (Family. Poaceae) Sugarcane, ganna. *S. officinarum* is a widely cultivated plant in the Uk state, India being the second-largest producer of sugarcane in the world. In the Uk sugarcane is mainly grown in four districts of the state, namely, Udamsingh Nagar and Nainital districts having 62.6 MT/ha combined productivity of sugarcane, while Haridwar and Dehradun have 60.3 and 58.7 MT/ha productivity, respectively (Sati and Wei 2018). The production of sugarcane in the Tarai region where it is mostly grown, in the year 2010 decreased to 5.05 MT. However, the highest production was recorded at 7.68 MT in the year 2008 (Singh and Bhosale 2014). People's source of revenue and socio-economic growth, largely depends on this crop, as it has a high yield (59.2 MT/ha) (Sati and Wei 2018).

Dioscorea bulbifera *L.*, (Family. Dioscoreaceae) air potato, Gethi. *D. bulbifera* is a widely cultivated perennial food crop, it is a traditional medicinal plant native to Asia, America, and some parts of Africa and Australia (Guan et al. 2017) and in some parts of the world considered invasive. This plant is known to have beneficial effects against certain diseases such as hemoptysis, epistaxis, pharyngitis, scrofula, trauma, cancer, goiter, skin infections, and orchitis (Kundu et al. 2020). It acts as antibacterial, antiviral, antidiabetic, anti-obesity, and protects against neurological disorders and is used in Ayurvedic, Unani, and traditional Chinese medicine (Xu and Ding 1998; Hu et al. 2007; Ahmed et al. 2009; Mbiantcha et al. 2011; Guan et al. 2017). In Uk, it is used as a vegetable, however, its toxicity effects are also documented (Kapkoti et al. 2014; Mehta et al. 2010) that are known to cause damage to the liver, and kidneys (Guan et al. 2017).It is also used by local people to treat diarrhea and dysentery (Gairola et al. 2013). It is used by the Gujjar tribes of the Uk to treat their cattle affected with worm-inflicted wounds (Gaur et al. 2010). More than 100 compounds have been found in this plant, most of which are valuable pharmaceutically. It is rich in phenols, organic acids, flavonoids, terpenoids, steroids (Guan et al. 2017). (Table 9.1)

Adapted from Singh 2017, Joshi et al. 2018, Anthwal et al. 2006, Namrata et al. 2011

9.8 Biodiversity Conservation

In the past few decades, the perception of biodiversity, i.e. diversity of species, genes, and ecosystem, has initiated certain social, economic, and cultural reforms. The recent biotechnology gene reserves have recognized and supported the benefits and awareness of biodiversity and its elements (Demir 2009). The idea of biodiversity conservation has been used commonly in the current time period and has drawn the attention of many ecologists and environmentalists around the globe with the

Table 9.1 Showing some edible plants of Uttarakhand

Plants consumed as vegetables			
Plant species	**Local name**	**Family**	**Type**
Acacia modesta	Phulai	Fabaceae	Deciduous tree
Achyranthes aspera	Perkanda, Latjiri	Amaranthaceae	Herbaceous
Agave americana	Rambans	Agavaceae	Shrub
Albizia lebbeck	Siris tree, koko	Fabaceae	Deciduous tree
Allium atropurpureum	NA	Amaryllidaceae	Herbaceous bulb
Allium jacquemontii	Pharna	Amaryllidaceae	Herbaceous bulb
Allium roylei	NA	Amaryllidaceae	Herbaceous bulb
Allium stracheyi	Keer, Jambu	Amaryllidaceae	Herbaceous bulb
Allium tuberosum	Zimu	Amaryllidaceae	Herbaceous bulb
Allium wallichii	Jimbur	Amaryllidaceae	Herbaceous bulb
Alternantheasessilis	Garundi, Guroo	Amaranthaceae	Herbaceous
Amaranthus blitum	Shandalio	Amarnthaceae	Herbaceous
Amaranthus caudatus	Marchhu	Amarnthaceae	Herbaceous
Amaranthus viridis	Jungalichaulayi	Amarnthaceae	Herbaceous
Angelica glauca	Choru, Hanw, Gandraini	Apiaceae	Herbaceous
Arisaema speciosum	Bankh	Araceae	Herbaceous bulbous
Asparagus adscendens.	Sens, satavar	Asparagaceae	Shrub
Asparagus filicinus	Jhinjan, Kairua	Asparagaceae	Evergreen tree
Asparagus polypodioides		Asparagaceae	Herbaceous
Atriplex hortensis	Arrach	Amaranthaceae	Herbaceous
Bambusa arundinacea	Kalak	Poaceae	Grass/tree
Bambusa variegata		Poaceae	Shrub
Bauhinia purpurea	Guiral, Khairwal	Fabaceae	Evergreen shrub/ tree
Bauhinia variegata	Guiral, Kuira	Fabaceae	Deciduous tree
Benincasahispida	Petha	Cucurbitaceae	Herbaceous climber
Bidens pilosa		Asteraceae	Herbaceous
Ceiba pentandra	Semal	Bambacaceae	Deciduous tree
Chaerophyllum villosum	Ganziadi, jangligazar	Apiaceae	Herbaceous
Chenopodium album	Bathua	Amaranthaceae	Herbaceous
Colocasia esculenta	Gadpaper,Arbi	Araceae	Herbaceous
Cynoglossum glochidiatum	Lichkura	Boraginaceae	Herbaceous
Cyperus rotundus	Motha	Cyperaceae	Herbaceous
Dendrocalamus harmitonii		Poaceae	Culms
Dendrocalamus strictus	Nar bans	Poaceae	Culms
Deparia acrostichoides		Athyriaceae	Herbaceous
Dioscorea bulbiflora	Genthi	Dioscoreaceae	Herbaceous
Dioscorea deltoidea	Tairu	Dioscoreaceae	Herbaceous climber
Dioscorea glabra	Tarur	Dioscoreaceae	Herbaceous climber

(continued)

Table 9.1 (continued)

Dioscorea rotunda		Dioscoreaceae	Herbaceous
Diplazium esculentum	Lingura	Dryopteridaceae	Fern
Dipsacus inermis	Phulee	Dipsaceae	Herbaceous
Fagopyrum cymosum	Jhangar	Polygonaceae	Herbaceous
Indigofera pulchella	Sakina	Fabaceae	Shrub
Lactuca dissecta		Asteraceae	Herbaceous
Lepidium sativum	Halang	Cruciferae	Herbaceous
Nasturtium officinale	Machhai/Padya	Cruciferae	Aquatic herb
Ophioglossum reticulatum		Ophioglossaceae	Fern
Origanum vulgare	Ban tulsi	Lamiaceae	Herbaceous
Oxalis corniculata	Bhilmori, Chalmosi	Oxalidaceae	Herbaceous
Paeonia emodi	Ud-salap	Paeoniaceae	Herbaceous
Phytolacca acinosa	Jarag	Phytolaccaceae	Herbaceous
Polystichium aculeatum	Quathode	Dryopteridaceae	Fern
Pueraria tuberosa	Birau, Bilikand, kudzu	Fabaceae	Herbaceous twiner
Rheum australe	Archa	Polygonaceae	Herbaceous
Rheum moorcroftianum	Dolu	Polygonaceae	Herbaceous
Rumex hastatus	Kilmoru, Almoru	Polygonaceae	Herbaceous
Rumex nepalensis	Khatura	Polygonaceae	Herbaceous
Salvia lanata	Ghanyajhar	Lamiaceae	Herbaceous
Silene conoides	Chotatakla, thumriya	Caryophyllaceae	Herbaceous
Stellaria media	Badyalu	Caryophyllaceae	Herbaceous
Taraxacum officinale	Dudheri	Asteraceae	Herbaceous
Typhonium diversifolium	Rugi	Araceae	Herbaceous
Urtica ardens	Bichchhughas	Urticaceae	Herbaceous
Urtica dioeca	Kandali	Urticaceae	Herbaceous
Urtica parviflora		Urticaceae	Herbaceous
Vigna vexillata	Janglee Mung	Fabaceae	Herbaceous tuber
Plant species consumed as fruits			
Plant species	**Local name**	**Family**	**Type**
Aegle marmelos	Bel	Rutaceae	Tree
Aesandra butyracea	Chura/Baehni	Sapotaceae	Tree
Aesculus indica	Pangar	Hippocastanaceae	Tree
Amaranthus caudatus	Marchhu	Amarnthaceae	Herbaceous
Amaranthus viridis	Jungalichaulayi	Amarnthaceae	Herbaceous
Bauhinia vahlii	Malu	Fabaceae	Shrub/creeper
Benthamedia capitata	Bhamora Hara	Cornaceae	Tree
Berberis aristata	Chatur	Berberidaceae	Shrub
Berberis asiatica	Kilmora, kingor	Berberidaceae	Shrub
Callicarpa macrophylla	Daya	Lamiaceae	Shrub
Carissa opaca	Karaunj	Apocynaceae	Shrub
Castanea sativa	Meethapangar	Fagaceae	Tree
Catunaregam spinosa	Mainphal	Rubiaceae	Deciduous tree

(continued)

Table 9.1 (continued)

Celtis australis	Kharik	Cannabaceae	Deciduous tree
Chenopodium album	Bathua	Amaranthaceae	Herbaceous
Citrus medica	Jamir	Rutaceae	Shrub/small tree
Cornus capitata	Bhamor	Cornaceae	Evergreen tree
Corylus jacquemontii	Kabasi, BhotiaBadam	Betulaceae	Tree
Debrigeasia longifolia	Tushar/ Tushiyari	Urticaceae	Shrub
Dendrophthoe falcata	Banda	Loranthaceae	Parasitic shrub
Diospyros melanoxylon	Taidua/ Taidu	Ebenaceae	Tree
Diploknema butyracea	Phalwara	Sapotaceae	Tree
Elaeagnus augustifolia	Giwain	Elaeagnaceae	Shrub
Elaeagnus conferta		Elaeagnaceae	Shrub
Elaeagnus umbellata	Ghain	Elaeagnaceae	Shrub
Eleagnus parvifolia	Giwain, kanal	Elaeagnaceae	Shrub
Emblica officinalis	Aonla	Phyllanthaceae	Deciduous tree
Ficus auriculata	Timla/ Timila/Timul	Moraceae	Tree
Ficus carica	Anjir	Moraceae	Tree
Ficus cunia	Dudila	Moraceae	Tree
Ficus glomerata	Gular	Moraceae	Tree
Ficus palmata	Bedu	Moraceae	Deciduous shrub
Ficus religiosa	Peepal	Moraceae	Tree
Ficus sarmentosa	Paakhuree	Moraceae	Shrub/tree
Ficus semicordata	Khiriya	Moraceae	Tree
Flemingia vestita	Sohphlang	Fabaceae	Herbaceous
Fragaria indica	Kaphai/Bhekaphal	Rosaceae	Herbaceous creeper
Fragaria nubicola	Gand-kaphal	Rosaceae	Herbaceous
Fragaria vesca	Bhuinkaphal	Rosaceae	Herbaceous
Garuga pinnata	Titmar	Burseraceae	Tree
Grewia optiva	Vimal/ Bhimal	Tiliaceae	Tree
Hedera nepelensis	Laguli	Araliaceae	Shrub
Hippophae rhamnoides		Elaeagnaceae	Shrub
Hippophae salicifolia	Ameous	Elaeagnaceae	Tree
Hippophae tibetana	Turuchuk	Elaeagnaceae	Shrub
Holboelia latifolia	Gomphal	Lardizabalaceae	Climbing shrub
Indigofera heterantha	Sakina, kathi	Fabaceae	Shrub
Juglans regia	Akhroat	Juglandaceae	Tree
Leea aspera	Kurmali	Vitaceae	Shrub
Madhuca indica	Mahua	Sapotaceae	Tree
Maytenus rufa		Celastraceae	Shrub
Melia azedarach	Bakain	Meliaceae	Tree
Melothria heterophylla	Amantamul	Cucurbitaceae	Herbaceous climber
Moringa oleifera	Sonjal	Moringaceae	Tree
Morus serrata	Kimu	Moraceae	Tree
Myrica esculenta.	Kaphal	Myricaceae	Tree
Parthenocissus himalayana		Vitaceae	Deciduous climber

(continued)

Table 9.1 (continued)

Phoenix humilis	Thankal	Arecaceae	Short tree
Pistacia integerrima	Kakra	Anacardiaceae	Tree
Polygonum nepalensis		Polygonaceae	Herbaceous
Polygonum nepalensis		Polygonaceae	Herbaceous
Prinsepia utilis	Bhikal, bekkra	Rosaceae	Shrub
Prunus armeniaca	Chulu	Rosaceae	Tree
Prunus cerasoides	Paiya, Paya, Padam	Rosaceae	Tree
Prunus cornuta	Jamun	Rosaceae	Deciduous tree
Prunus napaulensis	Bamhalu	Rosaceae	Tree
Punica granatum	Darim, Anar	Lythraceae	Deciduous shrub
Pyracantha crenulata	Ghingaru	Rosaceae	Shrubs
Pyrus lanata	Mole	Rosaceae	Tree
Pyrus pashia	Mehal	Rosaceae	Tree
Randia tetrasperma	Kamoli	Rubiaceae	Shrub
Rhamnus triquetra	Galodan, Gaunt	Rhamnaceae	Shrub
Rhus parviflora	Titnulya	Anacardiaceae	Shrub
Ribes alpestre	Sirkuti	Grossulariaceae	Deciduous shrub
Robus elliptica	Hisalu	Rosaceae	Shrub
Rosa macrophylla	Phelalo	Rosaceae	Shrub
Rosa moschata	Kunji, Kwiala	Rosaceae	Climbing shrub
Rosa sericea	Dhurkunja/ Sepala	Rosaceae	Shrub
Rubus biflorus		Rosaceae	Shrub
Rubus ellipticus	Hisalu	Rosaceae	Shrub
Rubus foliolosus	Kala Hisar	Rosaceae	Shrub
Rubus fruticosus	Kathula	Rosaceae	Shrub
Rubus macilentus		Rosaceae	Shrub
Rubus nepalensis	Lal hisol	Rosaceae	Shrub
Rubus niveus	Kala hisalu	Rosaceae	Shrub
Rubus paniculatus		Rosaceae	Shrub, woody climber
Schleichera oleosa	Kusum	Sapindaceae	Tree
Smilax glaucophylla	Kanjolya	Smilacaceae	Herbaceous creeper
Solanum erietinum	Ban-tambakhu	Solanaceae	Herbaceous
Solanum nigrum	Makoi	Solanaceae	Herbaceous
Solena amplexicaulis	Mat kakari	Cucurbitaceae	Herbaceous climber
Sorbus cuspidata	Nepalo/ Nepala	Rosaceae	Tree
Spondias pinnata	Ambara	Anacardiaceae	Tree
Tamarindus indica	Imli, amlika	Fabaceae	Tree
Taxillus vestitus	Bani/Ban	Loranthaceae	Shrub parasitic
Terminalia chebula	Harra, haritak	Combretaceae	Tree
Tulipa clusiana stellata	Mijhau	Liliaceae	Herbaceous bulb
Viburnum cordifolium	Bhatnoi, guya	Adoxaceae	Shrub
Viburnum cotinifolium	Caprifolaceae	Adoxaceae	Shrub
Viburnum cotinifolium	Ghatmila	Adoxaceae	Deciduous shrub

(continued)

Table 9.1 (continued)

Viburnum mullah	Titmalewa	Adoxaceae	Shrub
Vitis lanata	Purain	Vitaceae	Deciduous climber
Ziziphus jujube	Baryan, Unnab.	Rhamnaceae	Tree
Ziziphus mauritiana	Badar	Rhamnaceae	Shrub
Ziziphus vulgaris		Rhamnaceae	Shrub
Cereals and pseudo-cereals			
Plant species	**Local name**	**Family**	**Type**
Amaranthus caudatus	Marchhu	Amaranthaceae	Herbaceous
Amaranthus viridis	Jungalichaulayi	Amaranthaceae	Herbaceous
Chenopodium album	Bathua	Amaranthaceae	Herbaceous
Fagopyrum esculentum	Buckwheat/ Kuttu	Polygonaceae	Herb
Hordeum vulgare	Barley/Jau	Poaceae	Grass
Oryza sativa	Chawal	Poaceae	Herbaceous
Triticum aestivum	Gehoon	Poaceae	Herbaceous
Zea mays	Makai,bhutta	Poaceae	Herbaceous
Millets			
Plant species	**Local name**	**Family**	**Type**
Echinochloa crus-galli	Sanwa/ Samvat	Poaceae	Herbaceous
Eleusine coracana	Mandua	Poaceae	Herbaceous
Panicum miliaceum	Chena	Poaceae	Herbaceous
Paspalum scrobiculatum	Kodo/ Kodon	Poaceae	Grass
Setaria italica	Kangni / Kakum	Poaceae	Herbaceous
Sorghum vulgare	Jowar	Poaceae	Herbaceous grass
Oilseeds			
Plant species	**Local name**	**Family**	**Type**
Linum usitatissimum	Alsi	Linaceae	Herbaceous
Litsea elongate		Lauraceae	Tree
Perilla frutescens	Bhangjiri	Lamiaceae	Herbaceous
Spices and condiments			
Plant species	**Local name**	**Family**	**Type**
Allium carolinianum	Laut, Arum	Amaryllidaceae	Herbaceous bulb
Allium griffthianum	Neolagu, Keer	Amaryllidaceae	Herbaceous bulb
Allium humile	Duna	Amaryllidaceae	Herbaceous bulb
Allium roylei		Amaryllidaceae	Herbaceous bulb
Allium rubellum		Amaryllidaceae	Herbaceous bulb
Allium stracheyi	Keer, Jambu	Amaryllidaceae	Herbaceous bulb
Allium tuberosum	Zimu	Amaryllidaceae	Herbaceous bulb
Alpinia galanga	Galangal	Zingiberaceae	Herbaceous
Bombax ceiba	Semwal	Malvaceae	Tree
Cinnamomum tamala	Kirkiria	Lauraceae	Tree
Cleome viscosa	Jakhya	Cleomaceae	Herbaceous
Zanthoxylum armatum	Timur	Rutaceae	Shrub

Adapted from Singh (2017), Joshi et al. (2018), Anthwal et al. (2006), Namrata et al. (2011)

idea of conserving resources especially with respect to biological diversity. In the face of the growing risk of climate change, and various economic crises, there has been a fear and at the same time interest in provisioning of food security with agronomy and food production in its current shape (Lichtfouse et al. 2009). This can be a challenge predominantly in the rural areas of the Uk state given the soil security and stability of landscapes in the area. Generally speaking, the aboriginal communities residing near the bio-rich areas rely mainly on the wild flora for their subsistence and everyday needs. In this part of the Himalayas, the ethnic groups show high dependency, familiarization, and respect (traditional attachments, value recognition, and spiritual association) for the wild flora with respect to their food supply (Haridasan et al. 1990). Thus, the state presents an excellent opportunity of harvesting these wild resources and yet conserving and preserving the biodiversity. In this context, many plant species have great applicability as a food source in the coming years.

The current world scenario like frequent floods, famines, organic and natural food orientation, demand, variety, have driven a lot of pressure on the wildlife to meet the needs of the growing population. Some wild plants are consumed at the time of famine, some are consumed for treating certain ailments and disorders while some support the poor population as a primary source of nutrition. Such conditions raise the burden on wild edible species. In addition, unnecessary and involuntary selection, urbanization, industrialization, chemical use, etc., create a substantial danger to wild edible plants. In terms of edible wild plants, Uk has abundant and now these species are commonly eaten in the remote regions of the state. The edible biodiversity in Uk is critical in the economic sense, which supports these species' yield and their interaction with the socio-cultural framework. Studying the economic value and appraisal of biodiversity globally and in the Uk has seen a spike in recent years. This intensive discourse and research on the economics of biodiversity have also been included in the literature on environmental economics (Nijkamp et al. 2008).

The huge diversity in the mountain region has been maintained through a variety of crop compositions, the indigenous method of maintaining soil fertility, socio-cultural, and religious rituals. The Garhwal Himalayas, of Uk state, has been the capital of spiritual and theological awareness, and pilgrimage from prehistoric periods, also cited in the religious texts and scriptures, and numerous elements of flora and fauna biodiversity are being utilized by masses for idolization and for rituals pertaining to one's beliefs (Gairola and Biswas 2008). Popularly, the inhabitants of Garhwal district, Uk have a practice of nature preservation by means of socio-religious restrictions on dissipated usage of public resources (Anthwal et al. 2006). The significance of socio-cultural principles in preserving biodiversity is an intimate part of the residents of Uk, this was possible by the efforts from old generations who had set certain rules and instructions for the management of agricultural biodiversity, such practices are still followed. The objective is to recognize the collective roles of environmental and social aspects of agricultural biodiversity, regulate its influence on ecological goods and services and benefit society at large, and take into account the possibilities for the sustainable use and conservation of biodiversity.

Approximately 65 percent of Uttarakhand Himalayas is under forests out of which 12 percent is under protected areas, six national parks, and six wildlife sanctuaries (Gokhale et al. 2011). Various measures are been taken by the state's tourism division to promote ecotourism activities, in particular, a draft "*Uttarakhand Ecotourism Policy 2020*" is proposed to promote ecotourism while preserving natural diversity in the region. This policy ensures a sustainable source of revenue for the indigenous people living in the rural parts of the Uk state. This policy proposes adopting large areas of the forests for the ecotourism industry. However, this plan has provoked opposition from resident people and conservationists who consider that such reforms can destroy wildlife besides harming many rare and endangered species. The disapproval by the common people and local environmentalists indicates the intimate association of indigenous people to the culture and tradition linked to the biodiversity of the UK.

9.9 Socio-Cultural Factors

Socio-culture highlights values, customs, rituals, behaviors, and laws that are created by people engaging in society and the interactions that arise from the influence of this system on people's lives. In brief, it is the community and institutions where people communicate with the culture in which they live. The dynamics of human nutrition are influenced by the ethnic, spatial, environmental, and economic systems and the historical phase. Factors such as the range of food types, rituals, and practices have produced diverse food consumption habits within these cultural exchanges. Such a confluence, described as the culture of diet, encompasses the subjects of how people choose what to eat, when the chosen food is eaten, cooking techniques and varieties are based on the dietary behaviors of the society in which the person lives (Gidalar and Kitabi 2010). People in Uk have been acquainted with many cultures since ancient times, different areas within Uk have different cultures and beliefs. The species are eaten and their methods of processing, cooking, and how they are consumed vary across various cultures. Generally, there are variabilities in how various sections of the society or region assume various food habits or roles in the food chain. For example, among the 5 tribal communities of Arunachal Pradesh consuming alga, *Prasiola crispa* in the form of a vegetable was found in only tribes—Monpa and Sherdukpens (Saha et al. 2014). Similar patterns of distinct social behaviors can be seen in the Uk as the bulk of those who gather and market the wild plant species were from a certain lower societal stratum (Saha et al. 2014). This has led to various communities being involved in different levels of the food systems in the past thus driving that part of the economic value chain. Such impressions can still be seen in Uk communities.

Given that the socio-cultural infrastructure of this area is comprised of varied ethnic communities that formed and fashioned its own traditions thus making the area culturally rich. It is also observed that the formation of these communities and the various social statuses are largely influenced by the food system and its association with procuring, cultivating, processing, and marketing of local products and

needs. The eco-diversity, remoteness, and ethic people's reliance on the plant resources for treating diseases, are also factors leading to cultural uniqueness. The indigenous tribes have shown a close dependence on the environmental resources and thus exist alongside in accord with the environment. At higher elevations, more utilization of plant species has been seen indicating the intimate dependence on wild flora (Saha et al. 2014). In the last few decades, various nutraceutical plant sources are harvested on a large scale for trading nationwide and around the global markets, this has led to another development of such communities whose livelihood now is linked to cultivating such plants for these companies. They cultivate similar or related crops, fight the same challenges in cultivation, access the same supply chain, and sell at the same market place, this creating and following a set-up that links them together and bring in a new sense of community.

The major contributor to the economy of the Uk is agriculture and almost 80% of the population are farmers while 90% are low-income with land-holdings less than 1 ha (Alam and Verma 2008). Thus, the socio-economic development of the people chiefly depends on crop production. Sometimes, this leads to the dependency of the people on the wild plants of the Uk Himalayas. With increasing altitudes, the crop production and productivity decreases which results in more dependence of the local communities on the wild flora. The major setbacks apart from the remoteness of the area and the less production per ha. are the limitations in the promotion of agricultural produce owing to the poor roads and lacking proper supply chains (Kala 2014). In this economically weak and ecologically delicate area, sustainable agriculture is needed for reasonably enhancing crop production and land-use planning.

9.10 Conclusion

Socio-culture dynamics of a community though beneficial for the protection of certain floral species has also detrimental impacts on wild edible species. Such results can be observed more distinctly in rural areas. Young individuals who travel for purposes like higher education, better employment opportunities, marriages are not able to fully comprehend and value the consumption of these herbs possibly because they are not acquainted with them. Thus, culture and food habits in rural areas are steadily changing. Analyzing the socio-cultural framework allows one to assess the edible wild native populations from an economic viewpoint, and also helps to recognize and adopt the best techniques by looking at the components that affect them. It is really important to hand over and monitor conventional uses from down the generations to ensure sustainable consumption. There is a need for standardizing the documentation regarding the use, conservation, and cultivation of all the local and traditional plants including medicinal, wild, religious, spices, condiments, cash crops, and other functional and miscellaneous plants. This will promote the awareness of the impacts of these plants on human health, economic, cultural, and traditional domains of life. The specific tribal familiarity with various plants should be highlighted for their use as food and sources of other human needs. At the same time, the over-exploitation of wild plants should be regulated and the

conservation of biodiversity of the area should be promoted at the national scale. Since a balance of utilizing wild resources along with commonly cultivated crops is important, the production, trading, and supply chain of the cash crops should be improved to achieve this balance.

References

Abd El-Aal MH, Khalil MKM, Rahma EH (1986) Apricot kernel oil: characterization, chemical composition, and utilization in some baked products. Food Chem 19(4):287–298

Agnihotri S, Wakode S, Ali M (2012) Essential oil of *Myrica esculenta* Buch. Ham.: composition, antimicrobial and topical anti-inflammatory activities. Nat Prod Res 26(23):2266–2269

Ahmed A, Choudhary MI, Farooq A, Demirci B, Demirci F, Can Başer KH (2000) Essential oil constituents of the spice *Cinnamomum tamala* (ham.) Nees & Eberm. Flavour Fragr J 15(6):388–390

Ahmed Z, Chishti MZ, Johri RK, Bhagat A, Gupta KK, Ram G (2009) Antihyperglycemic and antidyslipidemic activity of aqueous extract of *Dioscorea bulbifera* tubers. Diabetol Croat 38(3):63–72

Akin EB, Karabulut I, Topcu A (2008) Some compositional properties of main Malatya apricot (*Prunus armeniaca* L.) varieties. Food Chem 107(2):939–948

Alam G, Verma D (2008) Connecting small-scale farmers with dynamic markets: a case study of a successful supply chain in Uttarakhand., India

Albon S, Turner K, Watson B, Anger A, Baker J, Bateman I, Brown I (2014) UK National Ecosystem Assessment follow-on: synthesis of key findings

Al-Mamun R, Hamid A, Islam MK, Chowdhury JA, Azam AZ (2011) Lipid-lowering activity and free radical scavenging effect of *Cinnamomum tamala* (fam: Lauraceae). Int J Nat Sci 1(4):93–96

Anderson EN (2011) Ethnobiology: overview of a growing field. In: Anderson EN, Pearsall DM, Hunn ES, Turner NJ (eds) Ethnobiology. pp. 1-14

Angelsen A, Jagger P, Babigumira R, Belcher B, Hogarth NJ, Bauch S et al (2014) Environmental income and rural livelihoods: a global-comparative analysis. World Dev 64:S12–S28

Anthwal A, Sharma RC, Sharma A (2006) Sacred groves: traditional way of conserving plant diversity in Garhwal Himalaya. Marsland Company, Uttaranchal

Anthwal A, Gupta N, Sharma A, Anthwal S, Kim KH (2010) Conserving biodiversity through traditional beliefs in sacred groves in Uttarakhand Himalaya, India. Resour Conserv Recycl 54(11):962–971

Arora RK, Pandey A (1996) Wild edible plants of India: diversity, conservation and use. National Bureau of Plant Genetic Resources, New Delhi

Bhatt ID, Dhar U (2004) Factors controlling micropropagation of *Myrica esculenta* buch.–ham. Ex D. Don: a high value wild edible of Kumaun Himalaya. Afr J Biotechnol 3(10):534–540

Bhatt M, Abrol GS, Kumar S, Nautiyal BP (2017) Preparation and evaluation of functionally enriched squash from *rhododendron* (*Rhododendron arboreum* Sm.) flowers. Int J Food Ferment Technol 7(1):191–196

Bisht VK (2020) Cinnamomum tamala (Buch.-ham.) T. Nees & Eberm.: an alternative source of natural linalool. Nat Acad Sci Lett 12:1–3

Brush SB (2008) Farmers? Bounty: locating crop diversity in the contemporary world. Yale University Press

Chandrakanth, M. G., & Romm, J. (1991). Sacred forests, secular forest policies and people's actions. Nat Resour J 21: 741-756

Chaudhari A, Kulkarni R, Mahulikar P, Sohn D, Gite V (2015) Development of PU coatings from neem oil-based alkyds prepared by the monoglyceride route. J Am Oil Chem Soc 92(5):733–741

Chevalier A, Marinova E, Peña-Chocarro L (eds) (2014) Plants and people: choices and diversity through time, vol 1. Oxbow Books, Oxford, UK

Clark NE, Lovell R, Wheeler BW, Higgins SL, Depledge MH, Norris K (2014) Biodiversity, cultural pathways, and human health: a framework. Trends Ecol Evol 29(4):198–204

Cocker M (2014) Birds and people. Random House

Colding J, Folke C (2001) Social taboos: "invisible" systems of local resource management and biological conservation. Ecol Appl 11(2):584–600

Dawang S, Zuchun Z, Wong H, Lai YF (1988) Tannins and other phenolics from *Myrica esculenta* bark. Phytochemistry 27(2):579–583

Demir A (2009) The effects of global climate change on biodiversity and ecosystems resources. Environmental Sciences of Ankara University 1:037–054

Dhan P, Garima U, Singh BN, Ruchi D, Seep K, Singh KK (2007) Free radical scavenging activities of Himalayan *rhododendrons*. Curr Sci 92:526–532

Dhar, M. L., Dhar, M. M., Dhawan, B. N., Mehrotra, B. N., & Ray, C. (1968). Screening of Indian plants for biological activity: part I

Durmaz G, Alpaslan M (2007) Antioxidant properties of roasted apricot (*Prunus armeniaca* L.) kernel. Food Chem 100(3):1177–1181

Gairola Y, Biswas S (2008) Bioprospecting in Garhwal Himalayas, Uttarakhand. Curr Sci:1139–1143

Gairola S, Sharma J, Gaur RD, Siddiqi TO, Painuli RM (2013) Plants used for treatment of dysentery and diarrhoea by the Bhoxa community of district Dehradun, Uttarakhand, India. J Ethnopharmacol 150(3):989–1006

Gaur RD (2008) Traditional dye yielding plants of Uttarakhand., India

Gaur RD, Sharma J, & Painuli RM (2010) Plants used in traditional healthcare of livestock by Gujjar community of sub-Himalayan tracts, Uttarakhand, India

Gidalar G, Kitabi B (2010) The 1st International Symposium on "Traditional Foods from Adriatic to Caucasus" Proceedings Book

Gokhale V, Pala NA, Negi AK, Bhat JA, Todaria NP (2011) Sacred landscapes as repositories of biodiversity a case study from the Hariyali Devi sacred landscape, Uttarakhand. Int J Conserv Sci 2(1)

Gosden C, Hather JG (2004) The prehistory of food: appetites for change. Routledge

Guan XR, Zhu L, Xiao ZG, Zhang YL, Chen HB, Yi T (2017) Bioactivity, toxicity and detoxification assessment of Dioscorea bulbifera L.: a comprehensive review. Phytochem Rev 16(3):573–601

Haridasan K, Bhuyan DR, Deori DL (1990) Wild edible plants of Arunachal Pradesh. Arunachal Forest News 18(1&2):1–8

Harris DR, Hillman GC (2014) Foraging and farming: the evolution of plant exploitation. Routledge, New York

Hu J, Ma Y, Song Y (2007) Preliminary study on antibacterial action of decoction of Dioscorea bulbifera L. in vitro. HeiLongJiang Med J 20:13–15

Hunter D, Fanzo J (2013) Introduction: agricultural biodiversity, diverse diets and improving nutrition. In: Diversifying food and diets. Routledge. pp. 33-46

Ickowitz A, Rowland D, Powell B, Salim MA, Sunderland T (2016) Forests, trees, and micronutrient-rich food consumption in Indonesia. PLoS One 11(5):e0154139

Iqbal J, Rauf HA, Shah AN, Shahzad B, Bukhari MA (2017) Allelopathic effects of rose wood, guava, eucalyptus, sacred fig and jaman leaf litter on growth and yield of wheat (*Triticum aestivum* L.) in a wheat-based agroforestry system. Planta Daninha 35:122

Jeeva S, Lyndem FG, Sawian JT, Laloo RC, Mishra BP (2011) *Myrica esculenta* Buch. –ham. Ex D. Don. –a potential ethnomedicinal species in a subtropical forest of Meghalaya, Northeast India. Asian Pac J Trop Biomed 1(2):S174–S177

Jones AD (2017) Critical review of the emerging research evidence on agricultural biodiversity, diet diversity, and nutritional status in low-and middle-income countries. Nutr Rev 75(10):769–782

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
Kabra A, Martins N, Sharma R, Kabra R, Baghel US (2019a) *Myrica esculenta* Buch.-ham. Ex D. Don: a natural source for health promotion and disease prevention. Plants *8*(6):149
Kabra A, Sharma R, Hano C, Kabra R, Martins N, Baghel US (2019b) Phytochemical composition, antioxidant, and antimicrobial attributes of different solvent extracts from *Myrica esculenta* buch.-ham. Ex. D. Don leaves. Biomolecules 9(8):357
Kabra A, Sharma R, Singla S, Kabra R, Baghel US (2019c) Pharmacognostic characterization of *Myrica esculenta* leaves. Journal of Ayurveda and integrative medicine 10(1):18–24
Kala CP (2007) Prioritization of cultivated and wild edibles by local people in the Uttaranchal hills of Indian Himalaya. Ind J Tradit Knowl 6:239–243
Kala CP (2011) Medicinal plants used for dermatological disorders: a study of Uttarakhand state in India. Aust J Med Herbal 23(3)
Kala CP (2014) Changes in traditional agriculture ecosystem in Rawain Valley of Uttarakhand state in India. Appl Ecol Environ Sci 2(4):90–93
Kala CP (2015) Herbal treatment for snakebites in Uttarakhand state of India. Ind J Nat Prod Resour (IJNPR) 6(1):56–61
Kapkoti B, Lodhiyal N, Lodhiyal LS (2014) Ethno-medicinal plants and their uses by van panchayat people in Nainital of kumaun region, Uttarakhand. Biolife J Biol Life Sci 2(2):526–532
Kellert SR, Wilson EO (1993) The biophilia hypothesis. Island Press
Khadda BS, Singh B, Singh DV, Singh JL, Singh SK, Singh CB, Singh D (2018) Inventory of traditional ethno-veterinary practices followed by goat keepers in Uttarakhand
Khumbongmayum AD, Khan ML, Tripathi RS (2006) Biodiversity conservation in sacred groves of Manipur, Northeast India: population structure and regeneration status of woody species. In: Human exploitation and biodiversity conservation. Springer, Dordrecht, pp 99–116
Kiruba S, Mahesh M, Nisha SR, Paul ZM, Jeeva S (2011) Phytochemical analysis of the flower extracts of *Rhododendron arboreum* Sm. Ssp. nilagiricum (Zenker) Tagg. Asian Pac J Trop Biomed 1(2):S284–S286
Krishna H, Attri BL, Kumar A (2014) Improvised *rhododendron* squash: processing effects on antioxidant composition and organoleptic attributes. J Food Sci Technol 51(11):3404–3410
Kumar A, Kumar R, Sharma M, Kumar U, Gajula MNV, Singh KP (2018) Uttarakhand medicinal plants database (UMPDB): a platform for exploring genomic, chemical, and traditional knowledge. Data 3(1):7
Kundu BB, Vanni K, Farheen A, Jha P, Pandey DK, Kumar V (2020) Dioscorea bulbifera L. (Dioscoreaceae): a review of its ethnobotany, pharmacology and conservation needs. South Afr J Bot
Laloo RC, Kharlukhi L, Jeeva S, Mishra BP (2006) Status of medicinal plants in the disturbed and the undisturbed sacred forests of Meghalaya, Northeast India: population structure and regeneration efficacy of some important species. Curr Sci 120:225–232
Lichtfouse E, Navarrete M, Debaeke P, Souchère V, Alberola C, Ménassieu J (2009) Agronomy for sustainable agriculture: a review, Sustainable agriculture. Springer, Dordrecht
Mabey R (1996) Flora britannica. Random House
Mace GM, Norris K, Fitter AH (2012) Biodiversity and ecosystem services: a multilayered relationship. Trends Ecol Evol 27(1):19–26
Madan S, Verma P (2015) Assessment of air pollution tolerance index of some trees in Haridwar City, Uttarakhand. J Environ Biol 36(3):645
Maikhuri RK, Nautiyal S, Rao KS, Semwal RL (2000) Indigenous knowledge of medicinal plants and wild edibles among three tribal sub communities of the Central Himalayas, India. Indigenous Knowl Dev Monitor 8(2):7–13
Maikhuri RK, Rao KS, Semwal RL (2001) Changing scenario of Himalayan agroecosystems: loss of agrobiodiversity, an indicator of environmental change in central Himalaya, India. Environmentalist 21(1):23–39

Makdoh K, Lynser MB, Pala KHM (2014) Marketing of indigenous fruits: a source of income among Khasi women of Meghalaya, north East India. J Agric Sci 5(1–2):1–9
Matin A, Khan MA, Ashraf M, Qureshi RA (2001) Traditional use of herbs, shrubs and trees of Shogran valley, Mansehra, Pakistan. Pak J Biol Sci 4(9):1101–1107
Mbiantcha M, Kamanyi A, Teponno RB, Tapondjou AL, Watcho P, & Nguelefack TB (2011) Analgesic and anti-inflammatory properties of extracts from the bulbils of Dioscorea bulbifera L. var sativa (Dioscoreaceae) in mice and rats. Evid-Based Complement Altern Med 20:25
Mehta PS, Negi KS, Ojha SN (2010) Native plant genetic resources and traditional foods of Uttarakhand Himalaya for sustainable food security and livelihood
Mehta PS, Negi KS, Rathi RS, Ojha SN (2012) Indigenous methods of seed conservation and protection in Uttarakhand Himalaya. Ind J Tradit Knowl (IJTK) 11(2):279–282
Namrata KL, Ghosh D, Dwivedi SC, Singh B (2011) Wild edible plants of Uttarakhand Himalaya: a potential nutraceutical source. Res J Med Plants 5(6):670–684
Negi VS, Maikhuri RK (2013) Socio-ecological and religious perspective of agrobiodiversity conservation: issues, concern and priority for sustainable agriculture, central Himalaya. J Agric Environ Ethics 26(2):491–512
Negi VS, Maikhuri RK, Rawat LS, Bahuguna A (2009) Traditional agriculture in transition: a case of Har-ki Doon Valley (Govind pashu vihar sanctuary and national park) in central Himalaya. Int J Sustain Dev World Ecol 16(5):313–321
Nijkamp P, Vindigni G, Nunes PA (2008) Economic valuation of biodiversity: a comparative study. Ecol Econ 67(2):217–231
Nisar M, Ali S, Qaisar M, Gilani SN, Shah MR, Khan I, Ali G (2013) Antifungal activity of bioactive constituents and bark extracts of *Rhododendron arboreum*. Bangl J Pharmacol 8(2):218–222
Nout MJR, Tuncel G, Brimer L (1995) Microbial degradation of amygdalin of bitter apricot seeds (*Prunus armeniaca*). Int J Food Microbiol 24(3):407–412
Ogle BM (2001) Wild vegetables and micronutrient nutrition: studies on the significance of wild vegetables in women's diets in Vietnam. Doctoral dissertation, Acta Universitatis Upsaliensis
Orech FO, Aagaard-Hansen J, Friis H (2007) Ethnoecology of traditional leafy vegetables of the Luo people of Bondo district, western Kenya. Int J Food Sci Nutr 58(7):522–530
Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S (2009) Agroforestree database: a tree reference and selection guide version 4.0. World agroforestry Centre, Kenya, 15
Pandey DN (2003) Sacred Forest: the case of Rajasthan. India in Forest Service, India, pp 1–16
Pandey G, Sharma DD, Hore DK, Rao NK (1993) Indigenous minor fruits genetic resources and their marketing status in north-eastern hills of India. J Hill Res 6(1):1–4
Pandey M, Nautiyal BP, Kumar N (2019) Sustainability improvement of traditional cropping system in Uttarakhand, India, through intercropping with medicinal and aromatic plants. Curr Sci 117(8):1281
Patel KG, Rao NJ, Gajera VG, Bhatt PA, Patel KV, Gandhi TR (2010) Anti-allergic activity of stem bark of *Myrica esculenta* Buch.-ham.(Myricaceae). J Young Pharm 2(1):74–78
Patil SP, Pardeshi ML, Ghongane BB (2016) Screening for anti-allergic and anti-histaminic activity of extract of *Momordica dioica*, *Myrica esculenta* and *Euphorbia hirta* in animal models. Res J Pharmaceut Biol Chem Sci 7(3):21–28
Paul A, Khan ML, Arunachalam A, Arunachalam K (2005) Biodiversity and conservation of *rhododendrons* in Arunachal Pradesh in the indo-Burma biodiversity hotspot. Curr Sci 89(4):623–634
Powell B, Thilsted SH, Ickowitz A, Termote C, Sunderland T, Herforth A (2015) Improving diets with wild and cultivated biodiversity from across the landscape. Food Security 7(3):535–554
Prakash D, Upadhyay G, Singh BN, Dhakarey R, Kumar S, Singh KK (2007) Free-radical scavenging activities of Himalayan *rhododendrons*. Curr Sci:526–532
Prasad PV, Subhaktha PK, Narayana A, Rao MM (2006) Medico-historical study of" aśvattha"(sacred fig tree). Bull Ind Instit Hist Med (Hyderabad) 36(1):1–20

Pretty J, Adams B, Berkes F, De Athayde SF, Dudley N, Hunn E et al (2009) The intersections of biological diversity and cultural diversity: towards integration. Conserv Soc 7(2):100–112
Purohit K (1960) *Rhododendron* poisoning in animals. Indian Vet J 37:631–633
Rana SK, Rawat GS (2017) Database of Himalayan plants based on published floras during a century. Data 2(4):36
Rana SK, Price TD, Qian H (2019) Plant species richness across the Himalaya driven by evolutionary history and current climate. Ecosphere 10(11):e02945
Raut B, Khanal DP (2011) Present status of traditional healthcare system in Nepal. Int J Res Ayurveda Pharm 2(3):876–882
Rawat P, Rai N, Kumar N, Bachheti RK (2017) Review on *Rhododendron arboreum*-a magical tree. Orient Pharm Exp Med 17(4):297–308
Riu-Aumatell M, López-Tamames E, Buxaderas S (2005) Assessment of the volatile composition of juices of apricot, peach, and pear according to two pectolytic treatments. J Agric Food Chem 53(20):7837–7843
Rowland D, Ickowitz AMY, Powell B, Nasi R, Sunderland T (2017) Forest foods and healthy diets: quantifying the contributions. Environ Conserv 44(2):102–114
Ruiz D, Egea J, Gil MI, Tomas-Barberan FA (2005a) Phytonutrient content in new apricot (Prunus armeniaca L.) varieties. In XIII international symposium on apricot breeding and culture 717 (pp. 363-368)
Ruiz D, Egea J, Tomás-Barberán FA, Gil MI (2005b) Carotenoids from new apricot (*Prunus armeniaca* L.) varieties and their relationship with flesh and skin color. J Agric Food Chem 53(16):6368–6374
Saha, D., Sundriyal, M., & Sundriyal, R. C. (2014). Diversity of food composition and nutritive analysis of edible wild plants in a multi-ethnic tribal land, Northeast India: an important facet for food supply
Sahu PK, Rao CV, Verma N, Singh AP, Amresh G (2011) Anti-inflammatory and anti-nociceptive activity of *Rhododendron arboreum*. J Pharm Res 3:47–57
Samant SS, Dhar U (1997) Diversity, endemism and economic potential of wild edible plants of Indian Himalaya. Int J Sustain Dev World Ecol 4(3):179–191
Sati VP (2017) Enhancing food security through sustainable agriculture in Uttarakhand Himalaya. Productivity 58(2)
Sati VP, Wei D (2018) Crop productivity and suitability analysis for land-use planning in the Himalayan ecosystem of Uttarakhand, India. Curr Sci 115(4):767
Sefer F, Misirli A, Gülcan R (2006) A research on phenolic and cyanogenic compounds in sweet and bitter apricot kernels. Acta Hortic 701:167–169
Sekar KC, Manikandan R, Srivastava SK (2012) Invasive alien plants of Uttarakhand Himalaya. Proc Nat Acad Sci India Sect B: Biol Sci 82(3):375–383
Shah R, Board UB (2015) Edible plants of north west Himalaya (Uttarakhand). Uttarakhand Biodiversity Board
Shah R, Pande PC, Tiwari L (2008) Traditional veterinary herbal medicines of western part of Almora district., Uttarakhand Himalaya
Sharma G, Nautiyal AR (2011) *Cinnamomum tamala*: a valuable tree from Himalayas. Int J Med Arom Plants 1(1):1–4
Sharma V, Mishra S, Yesudas R, Rajput RS(2019) A review on *Ficus religiosa* (Sacred Fig). Int J Res Analyt Rev. e ISSN 2348–1269, Print ISSN 2349–5138
Siddiqui S (1942) A note on the isolation of three new bitter principles from the nim oil. Curr Sci 11(7):278–279
Sidhu OP, Kumar V, Behl HM (2004) Variability in triterpenoids (nimbin and salanin) composition of neem among different provenances of India. Ind Crop Prod 19(1):69–75
Singh AK (2017) Revisiting the status of cultivated plant species agrobiodiversity in India: an overview. Proc Indian Natl Sci Acad 83(1)
Singh TP, Bhosale AT (2014) Comparative performance evaluation of different mechanical equipment for weed control in sugarcane crop in northern-Western Tarai region of Uttarakhand. Afr J Agric Res 9(43):3226–3232

Singh D, Singh B, Goel RK (2011) Traditional uses, phytochemistry and pharmacology of *Ficus religiosa*: a review. J Ethnopharmacol 134(3):565–583

Singh S, Youssouf M, Malik ZA, Bussmann RW (2017) Sacred groves: myths, beliefs, and biodiversity conservation—a case study from Western Himalaya, India. Int J Ecol 2017

Sinha RK (1995) Biodiversity conservation through faith and tradition in India: some case studies. Int J Sustain Dev World Ecol 2(4):278–284

Sinha B, Mishra S (2015) Ecosystem services valuation for enhancing conservation and livelihoods in a sacred landscape of the Indian Himalayas. Int J Biodivers Sci Ecosyst Serv Mgmt 11(2):156–167

Solanki SN, Huria AK, Chopra CS (2013) Physico-chemical characteristics of buransh (Rhododendron arboreum)-a nutritious and edible flower. J Hill Agric 4(1):50–52

Spradling AJ (2019) Leaves of the Bodhi tree from east to west: the symbol of the sacred fig tree in ancient India. Northern Illinois University, Southeast Asia and Contemporary Contexts

Srivastava P (2012) *Rhododendron arboreum*: an overview. J Appl Pharmaceut Sci 2(1):158–162

Sundriyal M, Sundriyal DC (2001) Wild edible plants of the Sikkim Himalaya: nutritive values of selected species. Econ Bot 55(3):377

Uniyal BP (2007) Flowering plants of Uttarakhand. Bishen Singh Mahendra Pal Singh

Upadhyay RK (2017) Therapeutic and pharmaceutical potential of Cinnamomum Tamala. Pharm Pharmaceut Sci 6(3):18–28

Upreti K, Tewari LM, Pangtey YPS, Jalal JS (2010) Diversity and distribution of wild edible fruit plants of Uttarakhand. Biodiversity Potentials of Himalaya, Nainital, Gyanodaya Prakashan, pp 157–196

Verma N, Singh AP, Gupta A, Sahu PK, Rao CV (2011) Antidiarrheal potential of standardized extract of *Rhododendron arboreum* smith flowers in experimental animals. Ind J Pharmacol 43(6):689

Wunder S, Börner J, Shively G, Wyman M (2014) Safety nets, gap filling and forests: a global-comparative perspective. World Dev 64:S29–S42

Xu ZL, Ding ZZ (1998) Study of Dioscorea bulbifera L. Chin Herb Med 29:125–128

Yiğit D, Yiğit N, Mavi A (2009) Antioxidant and antimicrobial activities of bitter and sweet apricot (*Prunus armeniaca* L.) kernels. Braz J Med Biol Res 42(4):346–352