



Traditional food knowledge of local people and its sustainability in mountains of Uttarakhand State of India

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Abstract

With homogenisation of various cultural groups due to outside forces and the effect of globalisation, many traditional foods, as developed by various cultural groups, have been lost or on the verge of elimination. In this context, the present study aims to examine and document the traditional food knowledge of local people in Uttarakhand State of India. Interviews and interactions with the local people resulted in documentation of 38 cuisines traditionally prepared by the local people of selected study regions in Uttarakhand. Apart from boiled rice and chapattis (flatbread) of wheat flour, chapattis and porridge of finger millet flour and boiled barnyard and foxtail millets were frequently consumed dishes in combination with dishes made with locally grown pulses such as horse gram and black gram and vegetables such as potato, radish and other leafy vegetables. The supplementary dishes were locally called as fanu, chaisu, gathoni, thechwani, kaflī and kadhi. Plants formed the major ingredients in making traditional cuisines. The present study documented 41 plant species comprising of cereals, millets, pulses and spices. With a view to enhance the taste of the dishes, different spices and condiments such as *Allium humile*, *Allium wallichii*, *Cleome viscosa*, *Cannabis sativa*, *Perilla frutescens* and *Cinnamomum tamala* were used by the local people. These dishes possessed some unique characteristics and ethno-medicinal values; hence, when required, they were used to cure a number of ailments as well. Since most of the mountain region in the study area was once inaccessible and health facilities were not much developed till recent times, the traditional health-care system was supported by the traditional food systems. The findings of the present study are further discussed in the context of sustainability of socio-ecological systems of Uttarakhand.

Keywords Traditional food knowledge · Uttarakhand · Mountain community · Declining food tradition · Sustainable development

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Introduction

People across the world have developed their own food systems depending on various factors, which may include prevailing climatic conditions and the availability of bio-resources. India being a country possessing rich biodiversity, diverse eco-climatic zones, geographical diversity and geological variability has sustained diverse ecosystems for the evolution of various cultural groups. India is known to harbour thousands of cultural-ethnic groups, tribes, castes and religions (Cheema 2011); hence, it is considered as one of the biggest cultural diversity nations in the world. These cultural groups have very distinct identities with regard to their ecology, appearance, norms, taboo and food habits (Kala 2005). They have developed a range of traditional food systems. The distinct food culture, as devised by these people, signifies the heritage and socio-cultural perspectives for their respective socio-ecological systems (Kwon and Tamang 2015). However, the younger generation is not fully aware about the distinctive properties of the diversified food systems. Lack of knowledge often leads to discontinuation of some of the food items. This kind of knowledge is, however, very much essential for value addition to local land race diversity and also in IPR protection (Bisht et al. 2006; Nautiyal et al. 2008).

Since there are a plenty of functional components such as antioxidants, body-healing chemicals and dietary fibres in traditional foods of Indian origin, they are also acknowledged as healthy foods (Sarkar et al. 2015). Consuming healthy food and balanced diet are also the fundamentals of the oldest therapeutic system in India, well known as the Ayurvedic system of medicine. Historically in India, people mainly rely on sattvika foods that consist of varieties of plants, for example, cereals, millets, vegetables, fruits and sweets (Kwon and Tamang 2015). People in Uttarakhand generally believe that consuming sattvika foods gives the benefit of longevity, health, strength and happiness.

However, with the homogenisation of various cultural groups, including tourism and globalisation, many recipes, as developed by various cultural groups in India, either have lost or on the verge of elimination (Shiva 2004; Farooquee et al. 2004; Pingali 2007). It is highly prevalent to note that the dominant people food systems have replaced the food systems of marginalised societies. In many cases, societies living in ecologically fragile regions have considered their food systems inferior while comparing them with the food systems of the societies living in ecologically established and richer regions of the country. Food systems and habits are an integral part of socio-ecological and socio-cultural setup of ecosystems, thus linked with sustainability of the particular region. Change in food habit has the potential to change the regional resource flow and resource dynamics. Thus, it impacts the sustainable functioning of socio-ecological systems negatively (Nautiyal and Kaechele 2007).

The values of traditional food crops and traditional food systems are not explored and documented scientifically barring a few (Bisht et al. 2006; Nautiyal and Kaechele 2007; Nautiyal et al. 2008). Hence, there is a need to study and document the traditional food knowledge (TFK) that has developed and evolved over the centuries suitable to local cultural and socio-ecological systems before it is eliminated completely with the race towards modernisation. In this context, the present paper aims to examine and document the traditional food crops and food systems of the people in Uttarakhand State of India.

Methodology

Study area

Uttarakhand, the present study area, is ecologically fragile, and due to its unique ecological setting, this region was marginalised from the rest of the fertile agricultural plain areas of India for long period of time. This marginalisation had created an ecosystem for evolution and preservation of diverse land use and systems on the food systems on which the local cultural groups were dependent for their sustenance. This state is a natural reservoir as the region is rich in flora and fauna. The rich biological diversity is closely associated with various cultural groups of the region. These cultural groups have developed a unique ecological knowledge for use and conservation of biodiversity (Kala 2007, 2020). This region shares boundaries with Nepal and China and therefore has high strategic importance. Uttarakhand is bounded in the northwest by Himachal Pradesh and in the south by Uttar Pradesh. This state is comprised of 13 districts. Population of state is 10.1 million people comprising 51% males and 49% females, with 70% of the population living in rural areas. Among all the states of India, Uttarakhand is the 20th most populous state where 0.83% of the country's population live on 1.63% of land area. Five major tribal groups inhabit the state with their sub-tribes.

From the religious and cultural viewpoint, Uttarakhand holds high importance in India as major shrines, viz. Badrinath, Kedarnath, Gangotri, Yamunotri and Hemkund, are located in this state. Also, the high Himalayan region of the state has the origins of sacred river, the Ganges, whose environmental flow helps the large Indo-Gangetic food plains thrive. This region spans over a wide altitudinal range from 210 to 7,817 m asl, which subsequently offers variations in the climatic and topographical conditions so that there is the establishment of different forest types and agro biodiversity (Kala 2014, 2020).

Survey methods

The present study area, Uttarakhand, was divided into three agro-ecological regions namely lower altitude (<1,000 m asl), middle altitude (1,000–1,800 m asl) and higher altitude (>1,800 m asl) based on the ecology, land use types and altitude. Since the middle and high altitudinal regions of Uttarakhand harbour rich biological and socio-ecological diversity¹⁶, field surveys were undertaken in this part of Uttarakhand. Interviews with villagers living in Pauri, Tehri (middle altitude), Uttarkashi, Chamoli (high altitude) districts were conducted for gathering information on the TFK (Fig. 1). This includes the ingredients used in preparation of traditional recipes, methods of preparation, cooking pattern and frequency of use of various dishes. Information was also gathered on the crops grown by the local people for making traditional recipes, changes in traditional crops cultivation and present status of various crops grown, which included cereals, millets and pulses. The perceptions of local people were also recorded on the sustainability of TFK. The information on TFK was also acquired through field inspections, field observations, participation in the social life of local people and their cultural functions.

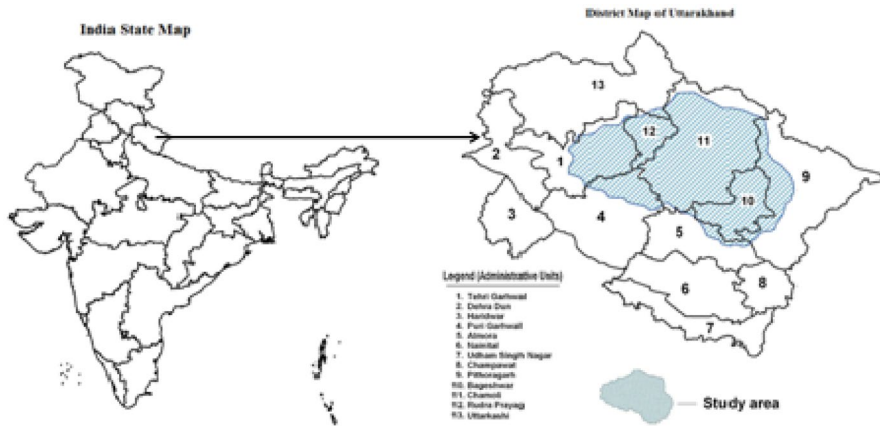


Fig. 1 Location of the study area in the Uttarakhand State of India. Nautiyal, 2011

Results and discussion

Traditional food crops

People in Uttarakhand cultivate a variety of cereals, pseudo-cereals, millets, pulses, spices and vegetables in their agricultural land. During the present study, a total of 41 plant species were documented (excluding many seasonal vegetables) that were used in preparing various traditional cuisines. Of these species, six species were cereals (viz. *Hordeum vulgare*, *Amaranthus paniculatus*, *Oryza sativa*, *Triticum aestivum*, *Fagopyrum esculentum* and *F. tataricum*), three were millets (viz. *Echinochloa frumentacea*, *Eleusine coracana* and *Setaria italic*) and four species were of pulses (viz. *Macrotyloma uniflorum*, *Vigna mungo*, *Cicer arietinum* and a variety of *Glycine max*). Out of 11 vegetable species, five were cultivated (viz. *Solanum tuberosum*, *Lycopersicon esculentum*, *Spinacea oleracea*, *Colocasia himalayensis* and *Cucurbita moschata*) and six were gathered from the wild (viz., *Urtica dioica*, *Chenopodium foliolosum*, *Diplazium esculentum*, *Bauhinia variegata*, *Ficus auriculata* and *Indigofera pulchema*). To enhance the taste of the dishes, different spices and condiments were used by the local people, of which *Allium humile*, *Allium wallichii*, *Cleome viscosa*, *Cannabis sativa*, *Perilla frutescens* and *Cinnamomum tamala* were collected from the wild and *Coriandrum sativum*, *Allium cepa*, *Allium sativum*, *Curcuma longa*, *Trigonella foenum-graecum* and *Zinziber officinale* were grown mainly in the kitchen gardens. Edible oil was extracted from seeds of three major species such as *Brassia juncea*, *Sesamum orientale* and *Perilla frutescens*. Besides, two species of mushroom such as *Agaricus* spp. and *Morchella esculenta* were also collected from the wild for making delicious dishes (Table 1).

Traditional recipes

The present study documented 38 cuisines traditionally prepared by the local people of Uttarakhand State by using different cereals, pseudo-cereals, millets, pulses, spices and vegetables. Twenty-three recipes, as documented, related to main food course or primary dishes consumed routinely. Apart from boiled rice and chapattis of wheat flour, as described in

Table 1 Food plants as grown and used by the local people of Uttarakhand

Sl. no.	Local name	English name	Botanical name	Source
1	Marsa, chaulai	Amaranth	<i>Amaranthus paniculatus</i>	Cultivated
2	Jau	Barley	<i>Hordeum vulgare</i>	Cultivated
3	Gehun	Wheat	<i>Triticum aestivum</i>	Cultivated
4	Satti	Rice	<i>Oryza sativa</i> ,	Cultivated
5	Owa, kuttu	Buckwheat	<i>Fagopyrum esculentum</i>	Cultivated
6	Phaper	Tartary buckwheat	<i>Fagopyrum tataricum</i>	Cultivated
7	Jhangora	Barnyard millet	<i>Echinochloa frumentacea</i>	Cultivated
8	Mandua	Finger millet	<i>Eleusine coracana</i>	Cultivated
9	Koni	Foxtail millet	<i>Setaria italica</i>	Cultivated
10	Gahath	Horse gram	<i>Macrotyloma uniflorum</i>	Cultivated
11	Urad, urd	Black gram	<i>Vigna mungo</i>	Cultivated
12	Chana	Chick pea	<i>Cicer arietinum</i>	Cultivated
13	Kala bhatt	-	A variety of <i>Glycine max</i>	Cultivated
14	Aalu	Potato	<i>Solanum tuberosum</i>	Cultivated
15	Tamatar	Tomato	<i>Lycopersicon esculentum</i>	Cultivated
16	Palak	Spinach	<i>Spinacea oleracea</i>	Cultivated
17	Pindalu	Elephant ear	<i>Colocasia himalayensis</i>	Cultivated/ wild
18	Kaddu	Pumpkin	<i>Cucurbita moschata</i>	Cultivated
19	Kandali	Stinging nettle	<i>Urtica dioica</i>	Wild
20	Bathua	-	<i>Chenopodium foliolosum</i>	Wild
21	Lingura	-	<i>Diplazium esculentum</i>	Wild
22	Kwiral	Ebony tree	<i>Bauhinia variegata</i>	Wild
23	Timla	-	<i>Ficus auriculata</i>	Wild
24	Sakina	-	<i>Indigofera pulchema</i>	Wild
25	Faran	-	<i>Allium humile</i>	Wild
26	Faran	-	<i>A. wallichii</i>	Wild
27	Jakhya	Asian spider flower, tick weed	<i>Cleome viscosa</i>	Wild
28	Bhang	Hemp, marijuana	<i>Cannabis sativa</i>	Wild
29	Bhangjeera	Perilla	<i>Perilla frutescens</i>	Cultivated
30	Dalchini, tejpatta	Indian bay leaf	<i>Cinnamomum tamala</i>	Wild
31	Dhaniya	Coriander	<i>Coriandrum sativum</i>	Cultivated
32	Pyaz	Onion	<i>Allium cepa</i>	Cultivated
33	Lahsun	Garlic	<i>Allium sativum</i>	Cultivated
34	Haldi	Turmeric	<i>Curcuma longa</i>	Cultivated
35	Methi	Fenugreek	<i>Trigonella foenum-graecum</i>	Cultivated
36	Adrak	Zinger	<i>Zinziber officinale</i>	Cultivated
37	Sarson	Mustard	<i>Brassia juncea</i>	Cultivated
38	Til	Sesame	<i>Sesamum orientale</i>	Cultivated
39	Bhangjeera	Perilla	<i>Perilla frutescens</i>	Cultivated
40	Chyun	Mushroom	<i>Agaricus spp.</i>	Wild
41	Guchhi	Mushroom	<i>Morchella esculenta</i>	Wild

Table 2 Traditional dishes prepared by the local people of Ultrakhand

Sl no	Local name of traditional dishes	Preparation style	Plant used as a major ingredient	Ethno-medicinal and cultural values
1	Chhachh-indu	Jhangora is cooked and then it is boiled with mattha (buttermilk). Salt, chillies and turmeric powder are added to it	<i>Echinochloa frumentacea</i>	Considered to keep the body cool and also given to the patients suffering from stomach disorders
2	Baadi	The flour of buckwheat is cooked in boiled water. Ghee is added and stirred	<i>Eleusine coracana</i>	Nutritionally rich and considered very healthy and given to expectant mothers
3	Jhangoru	Jhangora is cooked in water like rice	<i>Echinochloa frumentacea</i>	Easily digestible and used as a substitute for rice in the areas where rice does not grow. Used to cure constipation
4	Koni	Koni is cooked in water like the one cooks rice	<i>Setaria italica</i>	Considered highly nutritious and used to cure indigestion
5	Chaisu	Black gram (urad) pulse is roasted and then it is cooked with water. Salt, chillies, coriander powder is added to it as per taste	<i>Vigna mungo</i>	Rich in several minerals and vitamins and considered to cure bone-related problems
6	Fanu	Gahath is soaked in water overnight, and then it is crushed under a roller to make a paste. Once onion and garlic are fried in mustard oil in a cauldron gahath paste is added, along with a teaspoonful of coriander, red chilli powder and salt. It is cooked with water	<i>Macrotyloma uniflorum</i>	Very good recipe and considered to cure various stomach-related ailments
7	Gathoni	Gahath is boiled in water. The boiled gahath is fried with mustard oil. Salt, coriander, chilli and turmeric powder is added to it	<i>Macrotyloma uniflorum</i>	Preferred to eat during winter to keep the body warm in a cold climate. Also considered to remove kidney stones
8	Thechwani	Potato is crushed to pieces. It is fried slightly with mustard oil and then cooked with water and spices including jakhiya seeds	<i>Solanum tuberosum</i>	Adding jakhiya (<i>C. viscosa</i>) to thechwani is considered to cure ulcers

Table 2 (continued)

Sl no	Local name of traditional dishes	Preparation style	Plant used as a major ingredient	Ethno-medicinal and cultural values
9	Kaffli	It is a thick gravy of green vegetables. Mainly leaves of spinach and fenugreek are preferred for making kaffli. They are cooked in an iron pot, and salt and spices are added	<i>Spinacea oleracea</i>	It helps in keeping body cool and is considered a natural medicine to cure influenza
10	Bodi	Gahath is ground with water to make a paste. The paste is sun-dried. As and when required sun-dried material is cooked in water. Salt, chillies and turmeric are added as per taste Different seasonal vegetables are also chopped into pieces and mixed up with a paste of urd or gahath before sun drying. As and when required, the dried material is shallow fried in oil, garlic and onion, and then cooked with water. Salt, chillies and turmeric powder are added as per taste	<i>Macrotyloma uniflorum</i> , <i>Vigna mungo</i>	It is normally consumed during the winter season when scarcity of fresh vegetables and resources prevail. Traditionally the healers used to recommend this recipe to cure a severe cold and cough. Also recommended for curing bone-related problems
11	Mandua ki roti	Mandua flour is kneaded with water to make a dough. It is used to make chapattis	<i>Eleusine coracana</i>	Highly nutritious and contains a high quantity of calcium and other nutrients. Traditional healers recommend it to cure bone-related disorders and also to cure sinus and severe cold
12	Jau ki roti	Seed flour of jau or barley is mixed up with wheat flour to make chapattis. It is also used in making a local beverage	<i>Hordeum vulgare</i>	It is given to patients suffering from stomach heat and related constipation. It is recommended to patients suffering from sinus and headache. Juice of fresh shoots of jau is recommended to cure earache and related problems

Table 2 (continued)

Sl no	Local name of traditional dishes	Preparation style	Plant used as a major ingredient	Ethno-medicinal and cultural values
13	Kuttu ki roti	Seeds of kuttu or buckwheat are crushed to powder. This powder is kneaded with water to make a dough. It is used to make chapattis	<i>Fagopyrum esculentum</i>	It is consumed during fasting by local people to boost spirituality. It is highly nutritious but lesser known. It is given to an anaemic person and is also considered to cure migraine and colds
14	Phaper ki roti	Seeds of phaper or Tartary buckwheat are powdered. This powder is kneaded with water to make a dough, which is used to make chapattis	<i>Fagopyrum tataricum</i>	It is consumed during fasting by local people to boost spirituality. It is highly nutritious but lesser known. It is given to an anaemic person and is also considered to cure migraine and colds
15	Marsa ki roti	The seeds of amaranthus are powdered, and then it is kneaded with water to make a dough, which is finally used to make chapattis	<i>Amaranthus paniculatus</i>	Highly nutritious and have found an important place in local cultural systems. Offered to the deities during various festivals. It is used to cure throat infections and fever
16	Aaloo ke Gutke	Pieces of boiled potatoes are fried in mustard oil, Asafoetida, salt, chillies, faran and Jakhya are added to it	<i>Solanum tuberosum</i> , <i>Allium humile</i> or <i>A. wallichii</i> , <i>Cleome viscosa</i>	It is considered good for curing stomach-related disorders
17	Kandali (<i>Urtica dioica</i>) Kee Sabji	The leaves of kandali or stinging nettle are slightly fried with mustard oil and then cooked on low flame. Salt and chillies are added as per taste	<i>Urtica dioica</i>	It is cooked, normally, during the winter season when other resources are scarce. It is used to cure a cold, influenza and cough that is caused due to cold
18	Bhatwani	Black bhat (black soybean) is fried in an iron cauldron with some mustard oil and black chickpea flour. Spices are added with water to cook	Variety of <i>Glycine max</i>	Generally, it is cooked during the winter season when other resources are scarce. Very effective to keep the body warm during winter. Also used to cure severe cold and throat infection

Table 2 (continued)

Sl no	Local name of traditional dishes	Preparation style	Plant used as a major ingredient	Ethno-medicinal and cultural values
19	Kadhi	A paste of chickpea flour is prepared by mixing coriander powder, red chilli paste is deep-fried in mustard oil to make pakoras. Now in a separate utensil, the curd is stirred and mixed up with gram flour and powder of red chilli, coriander and turmeric along with salt and water. This mixture is shallow fried in mustard oil and pakoras are added and mixed up before cooking	<i>Cicer arietinum</i>	It is highly nutritious. During cold, it is considered as a medicine to cure fever-induced due to cold
20	Jholi	Tomatoes, potatoes and curd are cooked together with asafoetida to make gravy	<i>Solanum tuberosum</i>	It is considered to cure throat infection
21	Chyun	It is a type of mushroom collected from the wild, which is cooked in water before shallow frying in oil. Salt, chillies and onion are added to it as per taste	<i>Agaricus</i> spp	It is recommended to treat weakness and fever
22	Guchhi	Guchhi is cooked in water before shallow frying in oil, garlic and onion. Salt, chillies, coriander and turmeric powder are added to it as per taste	<i>Morchella esculenta</i>	It is quite nutritious and costly food. It grows in the wild above 3000 m asl. It is recommended to treat weakness and mental fatigue
23	Parantha	Potato is boiled and crushed to paste. Chilli and coriander powder and salt are added to it. Wheat flour is kneaded and the dough is stuffed with potato paste. It is shallow fried in mustard oil or ghee	<i>Solanum tuberosum</i>	Considered an energy booster. Sometimes the parantha cooked without oil is considered to cure throat ache

Table 2 (continued)

Sl no	Local name of traditional dishes	Preparation style	Plant used as a major ingredient	Ethno-medicinal and cultural values
24	Urd ke Pakode	Urd is soaked overnight. The soaked urd is ground into a paste. Chopped onions, chillies, coriander leaves, jeera powder, and salt are mixed into the urd paste. Small balls are made of this paste, which is flattened and sesame seeds are decorated added in their centre before deep frying in the mustard oil	<i>Vigna mungo</i>	It is offered to relatives during celebrations, for example, marriage and other functions. Considered highly nutritious and also it is recommended to cure sinus Paste of urd was once a substitute for plaster and used to cure fractured bones
25	Bhang ke pakode	Hemp leaves are crushed and mixed up with chopped pieces of potato and flour of black chickpeas paste. Green chillies, turmeric and coriander powder and salt are added to the paste, which is deep-fried in mustard oil	<i>Cannabis sativa</i>	Sacred plant and offered to deities including Lord Shiva. It is recommended in limited quantity to cure fever, dysentery and stomach disorders
26	Bukhna	Freshly harvested paddy before de-husking is roasted. The husk is removed and the grains are ready to eat	<i>Oryza sativa</i>	It is prepared and stored for consumption during the lean period
27	Rot	A dough of wheat flour is made by mixing jaggery and water. A small palm-size flat and round piece of this dough are fried in mustard oil. Fennel and small pieces of dry coconut are added in it	<i>Triticum aestivum</i>	Traditional recipe. People of this remote state once used this recipe for giving gifts to their kith and kin
28	Aarsa	It is made of rice, jaggery and mustard oil. Rice is soaked for more than 3 h, and then kept in muslin cloth. Once the excess water drains out it is ground into powder. A thick syrup of jaggery is prepared in boiling water. The rice is mixed up with thick syrup of jaggery. Soft round balls are made of this dough and deep-fried in mustard oil	<i>Oryza sativa</i>	It is given as a gift to kith and kin during celebrations

Table 2 (continued)

Sl no	Local name of traditional dishes	Preparation style	Plant used as a major ingredient	Ethno-medicinal and cultural values
29	Paitud	The inner side of aarbi leaf is plastered with a paste made up of gram flour, salt, turmeric, chilli, garlic and coriander powder. It is rolled and steamed before shallow frying in mustard oil	<i>Colocasia himalayensis</i>	Once it was an endemic recipe to Uttarakhand. It is also considered to cure asthma and skin diseases
30	Patudi	Pumpkin flowers are mixed with salt, turmeric, chilli, garlic and coriander powder. It is fried lightly in mustard oil Gahath is soaked overnight. It is crushed and mixed up with spices before frying in mustard oil	<i>Cucurbita moschata</i> <i>Macrotyloma uniflorum</i>	It is used during celebrations, for example, marriage and other functions. Considered highly nutritious, it is recommended to cure sinus
31	Bhangjeera ki chamey	It is a sauce made up of bhangjeera seeds, cumin seeds, garlic leaves, tamarind, mint, salt and chillies. Bhangjeera seeds are roasted and then ground. Green chillies, lemon juice, mint leaves, water and salt are added and ground to make a paste	<i>Perilla frutescens</i>	It is an endemic recipe to Uttarakhand, and it is used to cure stomach aches, constipation and also vomiting due to stomach disorders
32	Mattha	It is a beverage made up of yoghurt. Salt and chillies are added to it, as per taste	–	It is used to keep the body temperature cool during summer. A good appetiser, as well
33	Raithu	Red pumpkin is cut into pieces and then boiled in water. The boiled pieces of pumpkin are mixed with curd. Salt and chillies are added as per taste	<i>Cucurbita moschata</i>	It is prepared during various cultural festivals. Considered very good for keeping stomach healthy. Also helpful in keeping body temperature cool
34	Jhangora ke Kheer	Jhangora is cooked in boiled milk. Sugar, cashews and other nuts are added	<i>Echinochloa frumentacea</i>	Used to cure constipation
35	Marsa ke laddu	Amaranthus is roasted with ghee and then jaggery is added to it	<i>Amaranthus paniculatus</i>	Highly nutritious, and also it is offered to the deities during various festivals. It is used to cure throat infections and fever

Table 2 (continued)

SI no	Local name of traditional dishes	Preparation style	Plant used as a major ingredient	Ethno-medicinal and cultural values
36	Singori	Khoya (condensed milk) flavoured with cardamom and coconut is wrapped into malu leaf	–	It is considered to cure throat aches and also stomach related disorders
37	Halua	Wheat flour is roasted with oil or ghee and then it is cooked with jaggery in water	<i>Triticum aestivum</i>	Highly energetic and while swallowing hot is considered as a medicine to cure throat ache and cold
38	Gulgula	Paste of wheat flour is made with jaggery. Crushed coconuts are also sometimes added to it. A tablespoonful of this is deep-fried in the mustard oil	<i>Triticum aestivum</i>	It has religious and cultural importance. Eating hot gulgule is considered to cure constipation

Table 2, chapattis of madua, baadi, jhangoru and kauni were frequently consumed dishes with fanu, chaisu, gathoni, thechwani, kaffi, kadhi, aloo ke gutke and bodi. Depending on the village locality as per elevation, the chapattis of jau, marsa, kuttu and phapar were also consumed. Kuttu (*Fagopyrum esculantum*) and phapar (*Fagopyrum tataricum*) were grown in the high altitude areas; therefore, they were consumed mainly by the community living in those areas. Chyun and guchhi, being wild mushrooms, were available during monsoon season and consumed during July and August with chapattis of wheat and finger millet. Kandali ke sabji, being seasonal, was also prepared during the season as the fresh sprouts, and mild leaves of *Urtica dioica* were used for making this vegetable. Chhachhindu was consumed alone, and stuffed parantha was eaten with curd or bhangjeera ki chatney. Generally, for breakfast, chapattis with vegetables and paranthas with curd and chutney were consumed. At lunch, boiled rice, boiled jhangora and boiled kauni were consumed either with chaisu or fanu or gathoni or thechwani or jholi or kadhi or kaffi or bodi. Sometimes, the local people cooked more than three dishes together. At dinner, chapattis of wheat and finger millet were consumed with vegetables. Mattha was consumed during daytime but was avoided after sunset. Raithu and bhangjeera ki chatney were the relish food items used as condiments to enhance the flavour of routine dishes (Table 2).

The local people made a variety of vegetable fritters which they used to eat at breakfast, lunch and dinner either alone or with the main meals. The vegetable fritters include urd ke pakode, bhang ke pakode, bukhna, rot, aarsa, paitud and patudi. Most of the vegetable fritters such as urd ke pakode, bhang ke pakode, paitud and patudi were salty, except rot and aarsa, which were sweet. The local people also used to make some interesting traditional desserts to conclude the meal. The present study documented five traditional desserts, viz. jhangora kee kheer, marsa ke laddu, singori, halua and gulgula. Besides use for medical and nutraceutical purposes, a large number of cultural and religious values were also associated with these traditional food dishes (Table 2).

Toppling of traditional practices

Over the years, drastic changes have crept into the TFK system in the present study area. Since the food system comprises both farming and supply systems, it is pertinent to examine the traditional farming, supply and related systems for understanding the causes of changes in the traditional food system. Traditionally, different combinations of crops grown by the local people are based on the type of terrain and availability of water. The irrigated land that is primarily in the valleys is used to grow mainly paddy and wheat. The unirrigated land, which is mainly on the slopes in the form of terraced farms, is used for cultivation of mixed crops, including millets, pulses, and cereals. The land around homestead, which is called kitchen garden, is used for production of seasonal vegetables. Similar observations on home gardens are reported from other States in India (Kala 2010a). The land use practices, in the present study area, also vary along the altitudinal gradient (Fig. 2). In high altitude region, the agriculture land remains fallow during winter due to heavy snowfall and subsequent severe cold climatic condition. At middle altitude, the villagers cultivate crops interchangeably below and above the village locality, which helps in maintaining soil fertility in fragile agro ecosystem. The crops, cropping patterns, crops rotations and crop composition practiced along the altitudinal gradient in agro ecosystems of Uttarakhand are given in Fig. 2.

Since most of the land area is rainfed, crop production is precarious and dependent on the amount of rainfall and other climatic conditions. In view of reducing the anticipated

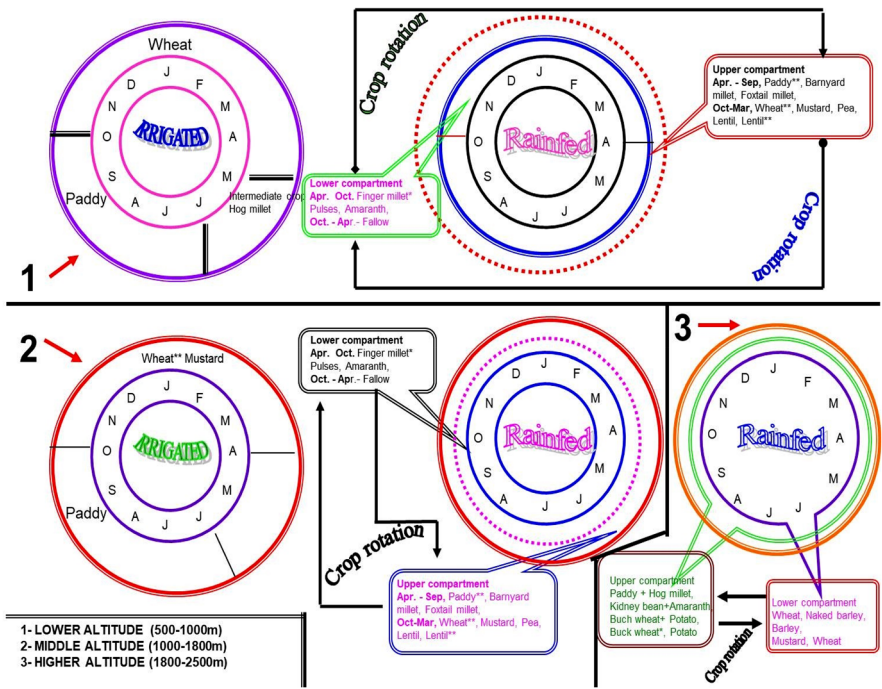


Fig. 2 Cropping patterns, crop compositions and crop rotations across an altitudinal gradient in the Uttarakhand State of India

risk, the farmers have increased the diversity of crops so that if one crop fails, the other crop may compensate the returns. This system of cropping is traditionally called as ‘baranaja system’ of cropping in which about 12 or more varieties of crops are grown together in view of maximising not only productivity but also maintaining soil fertility (Kala 2010b).

In Uttarakhand, traditional farming system that was completely organic in the past was closely connected with animal husbandry. The dung of domestic animals was scattered in the agriculture land for maintaining or enhancing land fertility, and in return, most of the crop residues were supplied to animals as feed (Kala 2004). This arrangement not only helped in declining the pressures on the pasturelands and nearby forests, but also supported the stability of natural ecosystem and environment (Kala 2014). However, over a period of time, a large part of the agriculture land has been left abandoned and animal husbandry declined drastically due to several reasons, including migration of local people and subsequent increase in vermin (wild animals that are believed to be harmful to crops). Besides, out migration has brought in severe changes in social, economic and environmental spheres (Farooquee et al. 2004; Nautiyal et al. 2007).

There have been drastic changes in the traditional practices and knowledge systems. With the shrinking of agricultural land, farming of many species, including *Echinochloa frumentacea*, *Eleusine coracana*, *Setaria italic*, *Amaranthus viridis*, *Colocasia himalayensis* and *Perilla frutescens*, have been drastically reduced. Earlier, about 100 varieties of paddy, 170 varieties of kidney beans, eight varieties of wheat, four varieties of barley and many varieties of pulses and oil seeds were grown annually by local farmers of

Uttarakhand in their traditional mixed farming system (Zardhari 2000). Depending on the suitability of climatic conditions, earlier they began to sow seeds and plant and also refilled the gaps. Either unavailability or low availability of food plant species has declined the traditional cuisines and the knowledge interwoven with such traditional cuisines. *Macrotyloma uniflorum*, locally called as gathath or kulath, is one such species that was quite popular in traditional cuisines. It was even gifted to the relatives and friends as a local souvenir (Kala 2018).

Traditionally, local people believed that most foods either have heating or cooling effects on our bodies. *Macrotyloma uniflorum* is believed to help in keeping the body warm, and hence, a delicacy called gathoni is consumed with rice or chapattis during the harsh winters to keep the body warm. However, when the seeds of *Macrotyloma uniflorum* are soaked in water overnight, it is used to make a different delicacy called phanu consumed even during summer due to its cooling or neutral effects (Kala 2018). Besides being a good source of proteins, carbohydrates and minerals for humans, its stems and leaves are widely used as good-quality fodder for domestic animals.

Like other traditional crops, the farming of *Macrotyloma uniflorum* has reduced manifold in different areas even though it was one of the most preferred pulses in Uttarakhand (Kala 2018). Earlier, *Eleusine coracana* or finger millet was one of the most consumed millets in the Uttarakhand region and it was cultivated extensively. Still, Uttarakhand is the largest producer of finger millet after Karnataka in India. However, at present, its cultivation has declined sharply due to a fall in local consumption. Making round chapattis of its flour was always a tedious task; therefore, local people used to mix up some amount of wheat flour, which helped in rolling its dough for making round chapattis. Since many people use to avoid mixing wheat flour, they rely on a dish called baadi, in which the finger millet flour is cooked alone in boiled water. Encountering difficulty in making its chapattis and developing change in taste might have discouraged its large scale production.

Likewise, in finger millet, the production of most of the millets has declined over the years in the study area. The decline in diversity of crops grown in the traditional mixed farming system has impacted the overall productivity of traditional crops and finally the traditional food system. Besides outmigration, crop-raiding by monkeys and wild boars are held responsible for discouraging farmers from raising crops (Kala 2014). The traditional crops have mostly been replaced by high-yielding varieties and cash crops like potato, soybean, kidney bean and pigeon pea (Maikhuri et al. 1997; Nautiyal et al. 2007, 2013, 2017). Moreover, many people in Uttarakhand have considered their traditional food systems as underprivileged; hence, they began to adopt the food systems from the nearby states, including Punjab.

The local people also perceive that modern education and employment have shifted their dependency on the market forces and global mode of production, on which they have no control. The traditional system of crop diversification that was focused on the subsistence system and also reducing risk has been transformed largely to a much more uniform one, focused mainly on cash cropping. Over a period of time, the changes in raising food crops differ from one area to another. Some of the areas continue farming traditional crops while others either introduced partial changes or largely switched over to commercial crops. In some villages situated in the valleys, the local people began to replace staple crops largely from vegetables, especially pea and tomato in their farmlands. Earlier, a few plants of pea and tomato were grown by villagers in their home gardens only.

Similarly, there have been changes in the preparation of food. Burning wood and charcoal for cooking food were one of the traditional practices that kept the food's nutritional contents intact. The utensils used for cooking and serving food have also changed over

the years. Replacement of traditional utensils, mainly by pressure cooker for cooking, has become prevalent, which is also associated with a change in traditional food flavour.

Sustainable development

Environmental sustainability

The practices for raising crop diversity, their sustained availability and using them for preparing a variety of traditional cuisines have evolved and matured over years of experimentation. Since most of the land area is rainfed in Central Himalayan region, most of the crops, as selected by the local people, could have tolerated the low amount of rainfall and other vagaries of climatic conditions. *Macrotyloma uniflorum* grows well in dry areas, and it does not require much water. Such trait has made it a quite useful crop for growing in the rainfed hill terrain (Kala 2018). It can also be grown in low fertility areas not suitable for a variety of other crops. Once sown, it becomes ready for harvesting within four to five months depending on the altitude. After decades of trial and error, *Macrotyloma uniflorum* has been chosen as one of the best crops by the mountain farmers. Moreover, there were crops generally avoided by wild animals. *Macrotyloma uniflorum* is one such crop that is not raided by monkeys.

The crop diversity has been maintained traditionally by using various methods, including range of crop compositions, cropping patterns, crop rotations, and selection of terrain and availability of moisture contents. In valleys, since the cropping season varies from mountain slopes due to high temperature, the species are selected for farming accordingly. Being hardy species, many traditional crops, especially millets, can cope up with the negative impacts of climate change to a certain extent. Millets can be grown under marginal conditions of soil fertility and moisture content; therefore, they are grown in the rainfed areas. *Eleusine coracana* is one such species that is grown easily in rainfed areas with minimum interventions and farm inputs, which make its farming environmental friendly.

Economic viability

Earlier, money was not involved in traditionally designed crop production system. The method of crop production, resource utilisation and barter exchange of goods and services were intermingled with the social and cultural system. People supported each other in raising crops as a community. However, at present, the control as a community over decision-making has weakened. The alterations of selection of crops, decline in crop diversity and changes in social and cultural milieu have weakened the economic viability of traditional food system. The homogenisation of once heterogeneous system evolved over the centuries of trial and errors with the suitability of geographical, geological, climatic and hydrological factors has resulted in loss and, or, decline in traditional food systems, collective concern for food resources and alteration of subsistence economy to cash-oriented economy.

Social acceptability and security

The diversity of crops, as raised due to the traditional system of farming, has built up social security in terms of per family adequate production of a variety of crops. Major millets such as *Echinochloa frumentacea*, *Eleusine coracana*, and *Setaria italic* and some pulses of previous seasons or years remained available for making dishes even during famine and

lean period due to their yearly adequate production. Moreover, the dishes made up of these crops were quite rich in carbohydrates, proteins and other essential nutrients.

Many dishes prepared by using local millets and cereals had strong linkages with local traditions, cultures, rituals and festivals. Some of the festivals and traditions remained incomplete without the use of such traditional dishes. During the marriage, aarsa and rot were gifted to the bridegroom from the parents and relatives of the bride, as these two dishes were considered quite auspicious dishes. Urd ke pakode or fritters of black gram was another local dish that was prepared during auspicious days, like birthdays and weddings. Besides distributing to relatives and friends, they were also offered to the local deity. Generally, the offering of cereals and millets to the local deity was also depended on the locality-specific farming of such species. For instance, ogal or buckwheat, phaper or Tartary buckwheat and the dishes made up of these pseudo-cereals were offered to the deity residing in the high altitude areas as these species mainly grow in higher reaches of Uttarakhand. Gulgule made up of wheat flour was offered to Gaura Devi, the consort of Hindu God Lord Shiva. The variety of traditional dishes and the natural resources used in their preparation, therefore, have social acceptability, which invited the social sustainability. However, the farmers have lost a variety of foods, and so the taste in their plates has changed over the years.

Since the traditional food system has linkages with the broader economic, societal and natural environments, the structural changes in the traditional food system might originate from a change in another associated system. Given the continuing sustainability of traditional food system, its social, economic and environmental bases should be examined and promulgated in the context of food security and nutrition for future generations. The dishes made up of locally grown crop species are highly nutritious, and this fact needs to be disseminated properly for maintaining health of the future generations. Unfortunately, many indigenous crops grown in the past are either not grown at present or their cultivation has declined sharply. They may be reintroduced as the nutritious foods, which have the potential to diversify the human diets, as well.

The farmers of Uttarakhand have developed subsistence farming systems that have the potential to ensure socio-ecological sustainability in the long run (Maikhuri et al. 1996, 1997; Nautiyal et al. 2000, 2002, 2007; Negi et al. 2003; Bisht et al. 2006; Nautiyal and Kaechele 2007). Traditional crop diversity that farmers maintain in the Himalayan agro-ecosystems has been proved to be the most effective way for maintaining the sustainable flow of resources among various ecosystems that are dependent on each other to sustain the Himalayan environment.

As far as economic output is concerned traditional crop cultivars/ landraces having potential to produce good output along with manifold uses, besides, staple food needs policy support for their conservation in situ (on-farm) in Uttarakhand (Nautiyal and Kaechele 2007). The local people need proper awareness and encouragement to continue growing the traditional crops and their distinct landraces. Lack of economic incentives for promotion of conservation of traditional crop germplasm has been an important factor for the erosion of traditional landrace farming systems. A participatory approach, through institutional and policy support, is required for developing new strategies and approaches for landrace utilisation, adding new dimensions to its enhancement efforts, including the promotion of elite landraces selected and enhanced on the basis of growing urban consumption needs. Urban demand for landraces would provide market incentives for farmers to produce indigenous seeds beyond the subsistence level. There is a need to identify the elite germplasm with the potential for use in food industry and multiplication of these seed types for both local and urban consumption. Institutional support is also required for creation of specialised

niche markets for biodiverse foods. Increasing the value of elite landraces for direct sale as genetic resources, either under contract or intellectual property, is another incentive to farmers as policy support. Community-based seed supply system also needs to be strengthened. In a study conducted in Germany on community-based traditional on-farm germplasm management by Frese and Kfken (2002) has demonstrated that community-based seed supply systems have been almost lost in highly industrialised countries due to lack of economic incentives.

The traditional agricultural system is characterised by its dependence on local resources and locally developed technologies. In order to optimise food production in these low-input farming systems, farmers possess a considerable knowledge both of the nature and characteristics of the resources available, and of the methods suitable for sustainable crop production under conditions which are often marginal for agricultural productivity. The traditional knowledge regarding the cropping potential of different agro-ecological niches, as well as methods of animal husbandry used to optimise long-term crop productivity and also the role of local botanical knowledge in maintaining stocks of high-quality germplasm, which are able to meet the changing environmental and cultural demands, is of paramount importance (Nautiyal et al. 2008).

A way ahead

In the past few decades, there has been large-scale development in Uttarakhand, including improved road connectivity and better availability of market and resources. This has finally led to availability of rice, wheat, pulses and vegetables grown outside of the native villages and towns. Meantime, there has been a large-scale outmigration. The range of factors, including unplanned education, outmigration, unconsolidated and scanty land holdings, have made traditional farming a less attractive and unsustainable profession. This has resulted in drastic changes in the traditional food systems and the resources required to sustain this traditional system.

Historically, Uttarakhand is well known for its beautiful landscapes, rich cultural diversity, and places of religious significance. A large number of tourists, mainly pilgrims, from far and wide visit the state, annually, which provide a readymade market for the local cuisines, if concerted efforts are implemented. The entire traditional food system needs to be revived right from the farming of cereals, millets and pulses organically, including the species that are in peril such as *Echinochloa frumentacea*, *Eleusine coracana*, *Setaria italica*, *Amaranthus viridis* and *Perilla frutescens*.

Interestingly, there has been some reverse migration to the Uttarakhand region due to the sudden outbreak of the COVID 19 pandemic and subsequent lockdown. There are reports on a probable revamping of traditional farming to a certain extent by those people coming back to their villages. There is a lot of potential with the traditional food system, as has been reflected through horse gram, which was once used for making delicious cuisines, had lost its glory for years and now has again made a comeback in some localities. A locality lying between Teen Dhara and Saknidhar in middle altitude has become popular for raising pulses, including horse gram, and is rightly called Dal Ghati (valley of pulses). The travellers plying on the national highway between Rishikesh and Devprayag towns are the main customers of these pulses. The agricultural land abandoned due to outmigration may be restored for farming, which may help to revive the traditional food system.

Traditional foods provide a range of health benefits. However, the present generation is less exposed to the health benefits of traditional foods which need to be educated properly. Besides, the significance of traditional food crops, including millets, as their resilience to climate change and associated impacts in the present context, needs to be recognised for food security and the health of the natural ecosystem and environment.

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Conflict of interest The authors declare that they have no competing interests.

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