An Ethnobotany Survey of Wild Plants Used by the Tibetan People of the Yadong River Valley, Tibet, China

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Research Article

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Abstract

Introduction

Plant resources gathered from the wild are important sources of livelihood needs, especially for the low-income populations living in remote areas, who rely on these plants for food, fuelwood, medicine and building materials. Yadong County is a valley on the border of the three countries in southern Tibet. Yadong is rich in biodiversity and culture, but ethnobotanical knowledge has not been systematically studied. The purpose of this research is: to document the ethnobotanical knowledge of the Tibetans in Yadong County.

Methods

Ethnobotanical data were documented through free listing, key informant interviews, and semistructured interviews during field work. The CI (cultural importance index) and FIC (informant consensus factor index) were used as quantitative indices.

Results

163 informants (46 women and 117 men) were interviewed. In total, 3031 use reports and 121 plant species belonging to 52 families and 91 genera were included. Then these use reports were classified into 20 categories belonging to the nine major categories. The utilization categories that contained the most plant species were food, followed by economic, medicine, animal food, social uses, other uses, environmental uses, materials and fuels. Among the economic plants, thirty-two kinds of medicinal plants are traditionally used in the local region for sale. The plants with high CI were *Fritillaria cirrhosa*, *Neopicrorhiza scrophulariiflora*, *Betula utilis*, *Rheum nobile*, *Urtica hyperborean*.

Conclusion

This research demonstrates the diversity of types and functions of the Yadong Tibetan's traditional plant knowledge. Knowledge of edible and medicinal plants in this area is more prominent, reflecting the ability to cope with the lack of fruits and vegetables and basic family medical care. There were exchanges between the traditional plant culture of the study area and the surroundings. With the socioeconomic development, the commercial value of medicinal plants has been developed, and locals are also seeking a path of sustainable development to cope with excessive consumption of plant resources.

Introduction

Wild plant resources are important sources of food, fuelwood, medicine, forage and building materials for the livelihood, for especially poor people, living in remote areas[1]. However, traditional understanding of wild plants is rapidly lost due to the development of socioeconomic development[2]. Traditional knowledge depends on specific locations and memories passed down through generations[3]. Thus, documentation and evaluation of traditional ethnobotanical knowledge is urgently needed[4].

Yadong County is located on the edge of biodiversity hotspots in eastern Himalayas, India and Myanmar[5]. The Yadong River runs through Yadong County and presents a valley topography, such that Yadong County is

also called Yadong River Valley. Yadong County is an important border in southern Tibet. It borders Bhutan and Sikkim on the east, west, and south, and has 41 mountain passes connecting Yadong with Bhutan and Sikkim. Because of its proximity to the sea and its superior border trade environment, it once became the largest port for border trade in Tibet. Trade between Nepal, India and China is very active here[6].

Tibetans live mainly on the Qinghai-Tibet Plateau. They have a long history and have rich traditional cultural knowledge in many aspects such as meals, medicine, religion, architecture, and handicrafts[7]. Although Tibetans are classified in China as a minority, they consist of several Tibetan languages, dialects and ways of life, with six main groups/dialects, of which three occur in China classified as Ü-Tsang, Kham and Amdo[8]. The language used by the Tibetans in Yadong belongs to the Ü-Tsang dialect in the Tibetan branch of the Tibeto-Burman language group[9]. The main income for the local population grazing and gathering of herbs. Nomads seasonally migrate to high altitudes during the summer with their yaks and return to permanent settlements before the onset of winter. Herbal gatherers usually harvest during the spring and summer, when plants are growing. Seasonal labour across altitudes is part of their life.

The main Tibetan settlements abroad are in India, Nepal, and Bhutan, most of them in the southern foothills of the Himalayas. Foreign ethnobotanical research on Tibetans is also mainly concentrated in these countries and regions, and related research involves the utilization of edible plants, medicinal plants, handicrafts, dyeing, feed, and fibers. In China, Tibetans live in a vast area, including Tibet, Qinghai, western Sichuan, and northwestern Yunnan. However, the ethnobotany research of Tibetans in China is mainly concentrated in some provinces and cities in the eastern Tibetan area. In most Tibetan areas, the ethnobotany research is still blank.

Tibetans have rich and unique knowledge of the local environment, such as climate, soil, wildlife, vegetation, and plant utilization[10]. This traditional knowledge stems from the interrelationships between humans, plants, animals and natural phenomena, as well as from religious beliefs. Predecessors have conducted surveys in Tibet and other areas where Tibetans live, and have found that some wild plants have provided many products and services for locals. Traditional Tibetan medicine has been the main disease treatment in many remote areas, relying on a large number of wild plants as well as traditional treatment methods [11-24] and some of these medicinal plants are also collected for trade [25-27]. Various wild edible plants are collected for food [23, 24, 26-33]. Tibetans also place flowers collected from the wild on the altars of houses and temples or collect some Tibetan incense plants to worship the gods. [34]. In addition, there is a wealth of knowledge in forage, house building, tool, fuel, dyes and seasoning, etc [11, 35].

However, to date, the traditional knowledge of plants used by Tibetans in Yadong has been unexplored. This research aims to document the ethnobotanical knowledge of Tibetans in Yadong County.

Method

Study area

Yadong County, which belongs to Shigatse City, Tibet, located in the southern Himalayan mountains and borders India and Bhutan (**Fig. 1**). The altitude ranges from 1600 m to 7300 m. The annual average temperature is 0 °C, the average temperature of the coldest month is - 5 °C, and the average temperature of the

hottest month is 10 °C [36]. The terrain is high in the north and low in the south. The northern part of Yadong is an important plateau pasture in Tibet, mainly composed of alpine ecosystems. The southern part of Yadong has a large area of virgin forest, which has a mild climate and abundant water resources, which is a green treasure house in the Himalayas. The total population of Yadong County is 13992, among which Tibetans account for 98%, Han 1.5% and other minorities 0.5% [36]. Economically, the Yadong district can be defined as a rural area based on agricultural and livestock activities. *Hordeum vulgare* var. *coeleste* is the predominant crops, and *Bos grunniens* is the main livestock [37-39].

Data collection

In August 2020 and May 2021, our ethnobotany fieldwork was conducted on 12 villages of 7 townships in Yadong (**Fig. 1**). First, field study permission was obtained from the local community committee and government authority. We explained our purpose to local governments and requested assistance from them. All our fieldwork was conducted with informed consent.

The snowball sampling method was used to select the key informants, such as veterinarians and herdsman. Other informants were selected by the randomized household interview method. In total, traditional knowledge was collected from 163 informants. Ethnobotanical knowledge was collected by semistructured face to face interviews. Because many Tibetans in the study area cannot speak Mandarin fluently, the field work was performed with the assistance of local guides who were employed with the help of local community leaders. All interviews were conducted in the Tibetan language, which was translated into Mandarin by local guides. All field studies were conducted with the consent of informants. According to the commonly used 5 w+1 h (What, Where, When, Who, Why, How) principle in ethnobotany, this study designed the following questions for semistructured interviews:

1. Would you mind listing some wild plants you have used?
2. How to use this plant?
3. Which plant parts were used, roots, stems, leaves or other parts?
4. Why do you use this species?
5. What time do you collect this plant?

The questions were designed to collect data on the (i) vernacular name of the plants, (ii) category of use, (iii) parts used, (iv) methods for preparation and administration, (v) characteristics of the plant material (dried or fresh) and (vi) collection time.

The specimens were collected from the field of survey with the help of the key informants and all materials are labelled with numbers and names. Photographs of each plant were taken. All specimens were kept in the herbarium of Kunming Institute of Botany (KUN). The Flora of China was used to help identify the plants [40] and The Plant List was used to ensure the Latin name of the plants [41].

Data analysis

We adopted the Use report (UR), cultural important index (CI) and informant consensus factor index (FIC) as ethnobotanical indices. All information about the use of local plants was organized into a “use report” list

consisting of three parts: informant, used plant and used category[42, 43].

The cultural important index(CI)[44] was the sum of the proportion of informants that mentioned each of the use categories for a given species. This index is used to quantitatively evaluate the importance of a certain plant to Yadong Tibetans from the perspective of comprehensive value. In other words, CI represents the diversity of plant uses and the degree of recognition of information sources for each use category. The calculation formula is as follows:

$$CI = \sum_{U=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} \frac{UR_{ui}}{N}$$

NC was the total number of use categories and N was the total number of informants. CI ranges between 0 and the number of all utilization categories. A higher CI value indicated the multiple uses of a species and a higher degree of recognition.

The informant consensus factor index (FIC) was developed by Robert T. Trotter[45]. FIC was used to evaluate the degree of consensus among the population about how to treat a particular disease. The calculation formula is as follows:

$$FIC = \frac{Nur - Nt}{Nur - 1}$$

where Nur is the number of use reports from the informants for a particular disease and Nt is the total number of plant species used to treat the disease. The FIC values range between 0 and 1. A higher FIC means that different herbalists have a higher consensus on the plant species used to treat certain diseases.

Results And Discussion

Distribution of knowledge among informants

This study documented a total of 3031 use reports from 163 informants. Among the informants, 46 were female and 117 were male. The selection of our information reporter was random, but resulted in more men and fewer women participants. The reason may be that the right to speak is mainly in the hands of men, who are mainly responsible for external affairs and livelihoods in most families, and women are mainly responsible for household affairs[46]. The informants were aged from 7 to 81 years old, the average age of all was 52, the average age of men was 53 and the average age of women was 49. Middle-aged people (40~59) have provided more use reports of plants. Young people under thirty years old and elderly people over 70 years old provide less UR than middle-aged people. (Fig. 2)

In the past, living conditions were relatively poor, and young people often followed their elders to gather food, medicine, fuelwood, etc. in the wild. However, today's rapid economic development has significantly supplemented material resources, and the collection of wild plants has become less necessary. More children now go to boarding schools in the county, and more young people go to more developed areas to make a living. Elderly individuals may be slowly losing their memory on wild plant uses because of the

socioeconomic changes over the years. These reasons have caused obstacles to the inheritance of traditional knowledge, and these memories passed down from generation to generation have become blurred[23, 24].

Taxonomic diversity of wild plants used by locals

A total of 121 plant species belonging to 52 families and 91 genera were documented in the study area. The most cited family was Compositae (16 species), followed by Rosaceae (9), Polygonaceae (7), Ericaceae (6), Apiaceae (5) and Lamiaceae (5) (**Table 1**). Among the plants, 89 were herbaceous, 20 were shrubs, 10 were trees and 2 species were vines (**Table 1**).

In our survey, the most frequently used parts of these plants were whole plant (37), followed by fruits (27), roots (27), leaves (23), stems (16), aerial parts (13), flowers (12), bulbs (1), seeds (1), and burls (1). The prominently used parts were the whole plant, fruits, roots and leaves (**Table 1**).

The diversity of use categories

The interviewed informants referred to 3028 use reports (UR), 1177 (38.8%) food uses, 805 (26.6%) for medicinal uses, 560 (18.5%) for economic plants and 486 (16.1%) for other categories. There were 53 species of edible plants, 53 economic plants, 46 medicinal plants and 50 plants used for other categories, including animal food (18), social uses (12), environmental uses (6), materials (5), fuel (4) and other uses (10) (**Table 2**). Many plants have multiple utilization categories. There are 30 kinds of plants with three or more uses, 12 medicinal and edible homologous plants, 32 plants that can be used both as a source of income and as medicinal plants, and 15 plants that can be used as both a source of income and food (**Table 1**).

Tibetans have unique eating habits in special geographical environments and climatic conditions. Highland barley powder and ghee are the main foods of farmers and herdsman, supplemented by dairy products such as yogurt and milk residue, and meat of mostly beef and lamb[47]. Fruits and vegetables are rare, but in Yadong, there are many wild vegetables and fruits used, and these two parts account for 80% of wild edible plants. With the increasing demand for medicinal plants in Tibetan traditional medicine or Chinese medicine, the commercial value of medicinal plants has increased. Yadong County is rich in medicinal plant resources, so economic utilization has become an important category of plant utilization there. In addition, animal husbandry is the main source of livelihood for local people and fermented yogurt plants, animal food, and seasoning plants related to animal husbandry are also frequently used in the local Yadong.

Food

Wild edible plants (WEPS) play an important role in food supplementation under normal circumstances[48] and are an important source, in addition to cultivated plants, for people to obtain nutrients, vitamins, minerals and other biologically active compounds[40, 49]. Food categories in Yadong include fruits (28 species), vegetables (16), seasoning (7), starches (3) and beverages (1). The most widely used part is the fruit. There are very few gardens and woodlands available for planting fruit trees in the local area, and the yield of local fruit tree varieties is extremely low. This may be one of the main reasons why the locals collect wild fruits from the wild as a nutritional supplement.

Fruits with high CI values are *Rheum nobile* ($CI_{\text{fruit}} = 0.4663$) and *Rosa omeiensis* (0.3988). The tender stem of *R. nobile* are peeled and eaten raw as snacks by locals. The plant is mainly distributed on the local high mountains above 4000 m above sea level [40]. The use of plants of the same genus is very abundant in other Tibetan areas. Tibetans from Lithang collect and eat these plants on the spot, and after removing the skin, the stem of the two species of *Rheum*, chukyur (*R. alexandrae*) and chum (*R. palmatum*) [29]. Tibetans eat the tender stems of *R. officinale* and *R. palmatum* in Zagana, Gansu, China [30]. The Tibetans of Shangri-La, Yunnan, China eat the tender leaves of raw *R. likiangense* [26]. The ripe fruit of *R. omeiensis*, *R. macrophylla* var. *glandulifera* and *R. sericea* are wild fruits that locals, especially children, like to eat very much. *R. omeiensis* is also eaten as a fruit by Tibetans in Lithang, Sichuan, Zhagana, Gansu, China and Shangri-La, Yunnan, China [26, 29, 30]. In addition, the Luoba people in Douyu village, in southeastern Tibet, use it as a medicinal plant to treat anaemia and maintain youth [50]. *F. nubicola* can be eaten raw or made into jams and eaten with shaved ice. Tibetans of Mustan District in Nepal also eat this plant as fresh fruit [29].

The *Urtica hyperborea* ($CI_{\text{vegetable}} = 0.5644$) and *Pteridium aquilinum* (0.4294) are vegetables with high CI values. The tender leaves of *U. hyperborea* were locally eaten as a wild vegetable. It was consumed in spring and stored as a reserve vegetable during the winter. Boiling with rice or tsampa is the main processing method by which the locals detoxify the plant. The tender stems of this plant are used to stew soup by Tibetans in Sapi, Ladakh, Jammu and Kashmir, India [29]. A study showed that its extract has the effect to lower uric acid [51]. Hyperuricaemia and gout affecting human globally [52]. There are abundant resources of *U. hyperborea* in China [53]. Therefore, *U. hyperborea* is expected to develop into a healthy food in plateau areas. The young leaves of *P. aquilinum* are collected by the local population, where they are blanched and soaked overnight. After soaking, it can be stir fried as seasonal vegetables. Locals say that soaking overnight is to remove the bitterness and to improve the taste of the young leaves. However, this plant contains a toxic compound ptaquiloside (PT), a compound that is carcinogenic [54]. Fortunately, this soaking process removes the toxic substance carcinogenic contained in this plant [55]. *P. aquilinum* is also eaten as wild vegetable by Tibetans in Zhagana in Gansu, China and Shangri-La in Yunnan, China [26, 30]. In addition, it has a high commercial value in Gongba, Gansu, China [28].

The top two popular seasoning species are *Carum carvi* ($CI_{\text{seasoning}} = 0.2270$) and *Nepeta discolor* (0.2147). *C. carvi*, called “kuo nie” is the most frequently mentioned spice in Yadong. Local Tibetans collect its young leaves in May or June and fruit in August or September to consume. The fruits of *C. carvi* have a pungent, coriander-like flavor and aroma that comes from essential oils, mostly carvone, limonene and anethole [56, 57]. *C. carvi* are the sources of cumin and caraway seeds respectively, which have been used since antiquity for the treatment of various indications in traditional healing systems in wide geographical areas [58]. Europe has used *C. carvi* as a seasoning spice and aromatic repellent since ancient times. It can not only improve eyesight but also, make the breath more fragrant. The seeds of this plant are also used as seasoning by Tibetans in Lithang, Sichuan, China and Mustang, Nepal [29]. In addition, the seed of *C. carvi* is also used as a cure for poisoning and fever, promotes appetite and improve digestive health in Lithang, Sichuan, China [59]. The local people collect the above-ground parts of *N. discolor*, and eat them as condiments after they are dried in the shade.

The locals mentioned three important starch supplement plants, *Potentilla anserina* ($CI_{\text{starch}} = 0.2638$), *Polygonum macrophyllum* (0.1902). Chuoma (*P. anserina*) was frequently used as staple in premodern Tibet. Roots of *P. anserina* are boiled and eaten with butter and sugar. This is a traditional dish served on important Tibetan holidays[28, 30]. Compared with traditional root foods such as *Solanum tuberosum*, *Ipomoea batatas*, *Colocasia esculenta*, the ratio of nutrients in this plant is more healthy and reasonable[60]. This plant is also eaten as a substitute for tsampa by the Tibetans of Litang in Sichuan, Zhagana in Gansu and Shangri-La in Yunnan, China[26, 29, 30]. In addition, the local people mixed the seeds of *P. macrophyllum* and *Hordeum vulgare* var. *coeleste* and grind them into flour. The Tibetans in Zhagana, Gansu, China have similar usages[30]. The wild starch plants have become an important source of supplementary starch.

Medicinal plant use

Different sociolinguistic groups in China have their own indigenous and traditional medical systems and unique knowledge of medicinal plants[61]. A total of 43 traditional medicinal plants belongs to 24 families and 39 genera were documented for treating 14 different disease types of human diseases, such as dermatologic disorders, gastrointestinal problems, respiratory diseases, diarrhea, arthritis. The most cited families of the medicinal plants were Compositae (7 species), followed by Polygonaceae (4), Gentianaceae (4), Lamiaceae (3). Plant parts most commonly used for remedies preparation are the root with which accounts for 45.5% of the total medicinal plants. In addition, there are 10 veterinary medicines used to treat 4 kinds of animal diseases(**Table 1**).

The FIC of 14 diseases ranged from 0.67 to 1, and the values of the FIC were the highest for toothache (1.00) and hypoimmunity (1.00), followed by inflammations (0.98), Skeleto-muscular system disorders (0.98) and respiratory complaints (0.97). The values of the FIC were the lowest for Infections (0.67). The most cited disease was respiratory complaints (321 use reports), followed by inflammations (142), gastrointestinal (118) and dermatopathya (116) (**Table 3**).

Based on the information provided by the informants, we conducted a quantitative analysis. The five most cited species are *Gentiana veitchiorum* ($CI_{\text{medicine}} = 0.5767$), *Neopicrorhiza scrophulariiflora* (0.5215), *Fritillaria cirrhosa* (0.4969), *Taraxacum tibetanum* (0.3436), *Fraxinus paxiana* (0.3006) (**Table 1**).

It is worth noting that the top three cited medicine plants are all used to treat respiratory diseases and are usually stocked in the homes of locals to meet daily needs, much like a medical kit in a city family (**Fig. 5**). These plant species all were traditional Tibetan medicines [40, 41] and used to treat common ailments such as inflammation colds, coughs, diarrhea. The whole plant body of *G. veitchiorum* is used locally to treat colds and bronchitis and relevant studies have shown that plant species has antibacterial, antiviral and pharmacological activities for treating bronchitis[62-64]. The roots of *N. scrophulariiflora* were widely used by the locals as a medicine to treat cold. According to the Chinese Pharmacopoeia, this plant can treat many diseases [44]. However, there is no documented treatment for the common cold and veterinary medicine use. The bulbs of *F. cirrhosa* were used by the locals as a medicine to treat tracheitis, and this species is also rich in pharmacologically active compounds that have antitussive activity[65, 66].

T. tibetanum whole plant is used to boil water for drinking, to treat various inflammations, such as upper respiratory tract infections, pharyngitis, etc. The young leaves can be collected and used as wild vegetables, and they have a bitter taste. Locals say that this vegetable can “clear the heat and remove the fire” and act a supplement nutrition. Plants of the same genus are also used by the Sherpas in Chentang, China as medicines for cancer and gynaecological diseases, and the Tibetans in Shangri-La, China and Nepal are also used as wild vegetables[29, 67]. The dandelion plant has a variety of anti-inflammatory active ingredients, and contains various nutrients such as protein, sugar, vitamins, etc. required by the human body. It is a kind of medicinal and food homologous plant with great development value[68].

The bark of *F. paxiana* can be soaked in water to treat fractures, and it can be used by both humans and livestock. In addition, during the collection process, the local people do not girdling, which is also an important manifestation of sustainable collection (**Fig. 4**). The same usage is also available in Bhutan[69]. People in Nepal use plants of the same genus to treat body aches[70]. *F. paxiana* is mainly distributed in the subtropical rainforest below 2000 m above sea level in the Yadong River Valley, where the population is very small. The main source of *F. paxiana* is Bhutan, where the private sector exchanges and purchases them through trade channels. Local merchants also buy the bark of the plant from Bhutan and supply it to drugstores for trading. Although the plant is locally widely used, there is no similar documentation of it in traditional Tibetan medicine, and there is no documentation of its efficacy in treating fractures in Chinese medicine[71]. We theorize that the traditional knowledge of this plant was obtained by the locals in Bhutan's trade and cultural exchanges.

Economic plants

Yadong County is rich in medicinal materials and non timber forest products[72]. In the study area, we found 53 plants having commercial value. These plants mainly were sold to Tibetan doctors or Hui merchants. Among them, 32 species are used as medicinal plants by the locals (**Table 1**). The most frequently mentioned economic plant was *Fritillaria cirrhosa* ($CI_{\text{economic}} = 0.3374$), followed by *Saussurea tridactyla* (0.3313), *Rhodiola himalensis* (0.3252), *Angelica paeoniifolia* (0.2454), *Panax pseudoginseng* (0.1779) (**Table 1**). In addition, the local people also collect *Cordyceps sinensis* or *Exidia sp.* as important source of income. In the local region, except for a small amount of wild economic plants that are directly used by collectors, most of the plants enter the local or foreign market in some way (**Fig. 5**).

In recent years, because Tibetan and Hui medicinal material merchants have collected a large number of medicinal plants in Yadong, a large number of medicinal species have been collected. The informants informed us that the collection of economic plants has become more intensive compared to approximately 10-20 years ago. However, with the development of commerce, the excessive collection of plants has caused a certain degree of damage to the local ecological environment[73]. The degree of collection and dependence on wild plants has a lot to do with the economic status of the local people. It is generally believed that when a certain plant has a high economic value, it may lead to the depletion of the plant resources due to excessive collection[74, 75]. For example, *F. paxiana*, which have high commercial value, have been excessively and indiscriminately excavated. Its resources are declining sharply and are on the verge of extinction[76].

The local government is also aware of the impact of this uncontrolled gathering on the natural vegetation. For example, locals realized that the excavation of *Rhodiola himalensis* will lead to soil erosion, and now the excavation of *Rhodiola himalensis* has been banned. *Rhododendron anthopogon*, *A. paeoniifolia* and *F. nubicola*, were introduced to cultivated as a commercial crop in Kangbu Township and Shangyadong Township. The hope is that this will increase local revenues while reducing the damage to natural resources.

Animal food

Livestock are a critical source of nutrition and a major means of sustenance for the Tibetan population in Yadong. Locals have a wealth of plant knowledge associated with yak breeding. A total of 18 species of wild plants are used as animal food. Among these 18 species, 16 are herbs, and 2 are woody plants. These include *Heracleum nyalamense* ($CI_{\text{animal food}} = 0.1840$), *Thermopsis barbata* (0.0798), *Polygonum macrophyllum* (0.0613), *P. tortuosum* (0.0552), and *Cirsium eriophoroides* (0.0429). *H. Nyalamense* is the most popular animal food plant for locals. Local people say cattle can grow stronger after feeding this grass.

The locals gathered large amounts of animal food plants during the summer and fed them to cattle in the winter. *H. nyalamense* is an important animal food plant for locals. Compared to animal grass food, tree fodder is very important in providing livestock with food during the dry season when other feed sources are in limited supply [54]. *R. glaciale*, *R. takare* var. *desmocarum* are important woody animal food plants. Their thin branches and leaves are used by locals as a substitute for grass. This can slow down the degradation of grassland to a certain extent [23].

Social uses

Social uses are divided into two categories, one is ritual plants (11 species), and the other is tobacco substitutes (1). Tibetan people convey their wishes to the gods through various sacrificial activities, and offer many items to the gods, thus praying for happiness and well-being. A total of 11 species of plants are used in social uses activities. Among them, 9 species are used for incense, such as *Rhododendron anthopogon* ($CI_{\text{Social uses}} = 0.4417$), *Nardostachys jatamansi* (0.2147), *Juniperus indica* (0.1840). Two species are used in funerals. The local people use purple pigment on root of *Onosma hookeri* (0.0675) to decorate the offerings. After a person has passed away, the sticks of *Myricaria rosea* (0.0123) were burned to pay homage to the deceased.

Tibetan incense is an important social use activity related to plants. Most social used plants are commonly used as incense materials, such as *R. anthopogon* and *J. indica* (**Fig. 6**), and dry sticks of these species are burned in a censer, which is placed on the flat roof of a house or at the entrance to the village. These plants usually burned in the early morning to pray for the gods' blessing and good luck for the day. "Sang" is a kind of sacrificial social use method that prevails in Tibetan areas and has a long history[77]. In ancient society, when the men of the tribe returned after expeditions, hunting, or funerals, people thought that they were contaminated with all kinds of filth. Therefore, their family members used cypress branches and fireworks burned with various herbs to dispel filth for them to prevent its spread that could in turn bring disaster to the family[77].

The preference of local Tibetans to choose plants is influenced by the following factors: First, most of the plants burned in simmering mulberries have a fragrance. After these plants are burned, they give off a strong fragrance. The scent drift in all directions with the wind, so more gods can be reached, thereby winning the entertainment of these gods and providing better protection to the family. Second, most of the plants used for this ceremony are common things in people's lives and surroundings.

Materials

A total of 5 kinds of plants are used as raw materials for dyeing (3), papermaking (1) and crafts (1). The frequency of mention for this type of utilization is very low, which may indicate that the local area is losing traditional handicraft knowledge or that this knowledge is in the hands of only a few people.

Rheum acuminatum, *R. nobile*, and *Polygonum tortuosum* are used for traditional dyeing. The roots of *R. acuminatum* and *R. nobile* were crushed and boiled in water and used as yellow dye. The colours of Tibetan costumes are composed of red, yellow, white, blue, and green. These five colours represent the folk customs and religious beliefs of the Tibetan people. However, few people in Yadong make a set of traditional Tibetan clothing by hand, and most people get it through purchase. Because of the rapid economic development of Yadong and the complexity of traditional dyeing processes, this dyeing knowledge is disappearing quickly.

In Yadong, *Stellera chamaejasme* is used as a material to make paper, which has the characteristics of insect repellent, antiseptic, and flexibility. The preliminary preparation process is to use a knife to tear the roots into filaments along the fibre direction, and then put the paper into a wooden barrel and mash it with a wooden stick. The production stage involves placing the paper curtain in a pool filled with water and using a spoon to scoop an appropriate amount of pulp into a wooden flat mould. Then, stir and pat with your hands to make the pulp evenly suspended. Lift the paper curtain from the water and place in the sun with a wooden stick. After drying, peel off the paper after drying.

The old stems of *Aristolochia griffithii* were picked up by locals and polished into ornaments or stools. Because the Tibetan *Aristolochia* plant grows in dense forests at a lower altitude, very few people tend to collect it specifically. In recent years, due to road construction, part of the forest has been cut down, and part of this plant sometimes appears on the road. Locals say that the number of plants used has also increased.

Environmental uses

In the local region, milk collection also shows seasonal characteristics. Wild plants can be used for climate prediction [78]. A total of 3 plant species were mentioned during the interviews. The most frequently mentioned was *Primula sikkimensis* Hook, followed by *P. concinna* Watt and *Caltha palustris* L. When the flowers of *P. sikkimensis* and *C. palustris* are in bloom, the yield and quality of yak milk is high. The flowering of *P. concinna* heralds the arrival of the rainy season, and it is also the time for planting and grazing activities. These plants have some common characteristics. These plants tend to grow around pastures and farmlands. In addition, flowering was considered by most respondents to be a climate predictor.

Other uses

A total of 10 kinds of plants were used for other purposes (9 tools, 1 repellent). 5 plant species are used to make cooking tools. For example, the sticks of *Betula utilis* are used to make spoons or shovels. The sticks of *Potentilla fruticosa* var. *arbuscula* are used to make brooms for washing pots. The branches of *Enkianthus deflexus* are used to make a blender, which is used to make milk tea.

Local Tibetans like to eat a fermented milk product (Pilu) with a special taste. Its fermentation process is also very interesting. The locals collected the branches of *Betula utilis*, *Salix myrtillacea* and *Salix daltoniana*, boiled, peeled, and put them in a bucket, poured raw milk over them, and sealed them to prevent mosquitoes from entering. This bucket was rotated and shaken daily, so that the raw milk was evenly attached to the branches. After 15 days, the local specialty food Pilu (a smelly cheese) is made. Pilu needs to be cooked with yak butter before it can be eaten (Fig 7). In the process of Pilu, there is a critical step. The first step is to put branches in the bucket. If branches are not added, the water loss will be slow and the milk will spoil. When asked why they chose the three trees mentioned above, the locals gave the following answers: they are easier to obtain, nontoxic and easier to peel their bark and most importantly, their branches are not easily corroded and can be reused many times.

Conclusion

This study demonstrates that the diversity of wild plants used by the Tibetan people in Yadong is reflected not only in the number of species but also in the diversified functions of wild plants, including edible plants, medicinal plants, animal food, social uses, tools, dye, paper making and other aspects. In this study, reports on the use of edible plants and medicinal plants were more prominent, in the years when modern transportation was underdeveloped, food supplies were insufficient. The locals have accumulated much experience in the use of wild edible plants, and these plants provide locals with a large amount of nutritional supplements and food supply.

With the development of the social economy, the demand for medicinal materials in Tibetan and traditional Chinese medicine industries has increased, and the commercial value of many local medicinal plants has been excavated. This has brought opportunities for local development, but also has a negative impact on the environment. Locals are trying to use artificial planting methods to reduce the hazards of overharvesting. Local traditional plant knowledge has also been affected by the surrounding areas. This is likely because the Yadong River Valley has been an important trade channel since ancient times, and frequent cultural and trade exchanges have taken place in here.

In the future, more in-depth research can be conducted on the nutritional components and pharmacological activities of these plants. In addition, resource assessments of local plants with high commercial value can be conducted, and reasonable development strategies should be proposed for species whose survival is significantly threatened.

Declarations

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Authors' contributions

WYH organized the study team and provided technical support. GCA and DXY executed the research plan. GCA identified the specimen and wrote the manuscript. GCA, DXY, ZY, ADYW, ZXQ and ZHF collected the data. WYH and DXY reviewed the manuscript. All authors took part in the field works. All authors were involved in the drafting and revision of the manuscript and approved the final revision.

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Availability of data and to participate

Please contact the corresponding author for data requests.

Ethics approval and consent to participate

The authors asked for permission from the local authorities and the people interviewed to carry out the study.

Consent for publication

The people interviewed were informed about the study's objectives and the eventual publication of the information gathered, and they were assured that the informants' identities would remain undisclosed.

Competing interests

The authors declare that they have no competing interests

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Tables

Table 1 The wild plants used by the Yadong Tibetan

Botanical family	Local name(s)	Botanical taxon	Voucher number	Local use (parts used) (UR)	CI
Adoxaceae	Na li mo	<i>Viburnum grandiflorum</i> Wall. ex DC.	QTP-EBT-4013	Food (fruits): raw, fresh fruit (16)	0.0982
Amaranthaceae	Lei	<i>Chenopodium album</i> L.	QTP-EBT-3073	Food (leaves): cooked vegetable (40)	0.2454
Amaryllidaceae	Ri guo	<i>Allium fasciculatum</i> Rendle	QTP-EBT-3050	Food (whole plants): cooked vegetable (63)	0.3926
Amaryllidaceae	Ri guo	<i>Allium prattii</i> C.H.Wright	QTP-EBT-3009	Food (whole plants): cooked vegetable (32)	0.1902
Amaryllidaceae	Zen bu	<i>Allium przewalskianum</i> Regel	QTP-EBT-3200	Food (leaves): seasoning (31)	0.1902
Amaryllidaceae	guo guo la mo	<i>Allium wallichii</i> Kunth	QTP-EBT-3108	Food (whole plants): cooked vegetable (29)	0.1779
Apiaceae	Dang gui	<i>Angelica paeoniifolia</i> R.H.Shan & C.C.Yuan	QTP-EBT-3077	1.Medicine (roots): soak in wine, stew in soup, to nourish the body (11) 2.Economic (roots) (40)	0.3006
Apiaceae	Kuo nie	<i>Carum carvi</i> L.	QTP-EBT-3137	1.Food (leaves and fruits): cooked vegetable; seasoning (40) 2.Economic (leaves and fruits) (2)	0.2577
Apiaceae	Dong	<i>Heracleum nyalamense</i> Shan & T.S. Wang	QTP-EBT-3075	Animal food (whole plants) (30): fodder	0.1840
Apiaceae	Jia	<i>Trachydium subnudum</i> C.B. Clarke ex H. Wolff	QTP-EBT-3206	Food (tender leaves): seasoning (21)	0.1288
Apiaceae	Jia,Xia guo tang jie	<i>Heracleum millefolium</i> Diels	QTP-EBT-3202	Food (leaves): seasoning (5)	0.0307
Araceae	Tuo	<i>Arisaema erubescens</i> (Wall.) Schott	QTP-EBT-4040	1.Food (tubers): mash it and mix it with flour to ferment (12) 2. Animal food (tuber) (2): fodder	0.0920
Araliaceae	San qi	<i>Panax pseudo-ginseng</i> Wall. var. <i>angustifolius</i> (Burkill)	QTP-EBT-3084	Economic (roots) (29)	0.1779

Arecaceae		<i>Plectocomia himalayana</i> Griff.	QTP-EBT-4111	Other uses (stems): tools, used to make containers, crutches, etc. (1)	0.0061
Aristolochiaceae	Ri gei	<i>Aristolochia griffithii</i> Hook.f. & Thomson ex Duch.	QTP-EBT-3166	Materials (stems): crafts, the old stems are spiraling and can be used as decorations (1)	0.0061
Asparagaceae	Ga le mu xia,Zhong ge zhi ba	<i>Polygonatum verticillatum</i> (L.) All.	QTP-EBT-3087	1.Medicine (roots): decoction, tonic (2) 2. Economic(roots) (4)	0.0368
Asparagaceae	Jiong ge lei bu	<i>Polygonatum cirrhifolium</i> (Wall.) Royle	QTP-EBT-3156	1.Medicine (roots): decoction, tonic (1) 2. Economic(roots) (1)	0.0123
Balsaminaceae	Tong qia	<i>Impatiens sulcata</i> Wall.	QTP-EBT-3047	1.Food(fruits): fresh fruit (36)2. Animal food (aerial parts) (6)	0.2577
Berberidaceae	You mu sei sei	<i>Sinopodophyllum hexandrum</i> (Royle) T.S.Ying	QTP-EBT-3065	1.Medicine (fruits): raw, gastropathy (6) 2.Food (fruits): fresh fruit (30) 3.Economic (fruits) (17)	0.3252
Berberidaceae	Ren bu	<i>Berberis kongboensis</i> Ahrendt	QTP-EBT-3038	1.Medicine(roots): decoction, diarrhea (8) 2.Food (fruits): raw, fresh fruit(8)	0.0982
Betulaceae	Da gua	<i>Betula utilis</i> D.Don	QTP-EBT-3068	1.Medicine(burls):decoction, to regulate blood pressure (6) 2.Other use (stems): making yogurt after peeling (43) 3.Food (stems): poke a hole, drink the water inside (2)4.Fuelwood (sticks) (9)5.Economic (burls) (2)	0.3804
Betulaceae	Suo jie ,Cei pei	<i>Corylus ferox</i> Wall.	QTP-EBT-3151	Food (fruits): raw, fresh fruit (5)	0.0307
Boraginaceae	A mu you lu	<i>Microula sikkimensis</i> (C.B. Clarke) Hemsl.	QTP-EBT-3034	1.Medicine (leaves): rub with fresh leaves to relieve pain (12) 2.Animal food (whole plants) (3) 3.Food (tender leaves):cooked vegetables (38)	0.3252
Boraginaceae	Mu zi	<i>Onosma hookeri</i> C.B. Clarke	QTP-EBT-3052	1.Medicine (roots): soak it in canola oil, smears, to treat hemorrhoids, acne, inflammation, eczema and promotes hair growth (26) 2.Social uses (roots):the red substance on the roots is embellished on the cakes as a sacrifice for the dead (14)3.Economic (roots)	0.3190

				(8)4.Food (flowers):fresh nectar (3)	
Brassicaceae	Jia bie ga,Pie ga,Gei mu	<i>Thlaspi arvense</i> L.	QTP-EBT-3064	Economic (whole plants) (7)	0.0429
Brassicaceae	Qu ru guo	<i>Pegaeophyton scapiflorum</i> (Hook.f. & Thomson) C.Marquand & Airy Shaw	QTP-EBT-3016	Food (leaves): cooked vegetable (3)	0.0184
Brassicaceae	Bo guo guo,Bo bo lei zhu	<i>Capsella bursa-pastoris</i> (L.) Medik.	QTP-EBT-3067	Food(leaves): cooked vegetable(3)	0.0184
Campanulaceae	Lu bu ji duo ji	<i>Codonopsis foetens</i> Hook.f. & Thomson	QTP-EBT-3029	1.Medicine (roots): decoction, gastropathy (8)2.Economic (roots) (28)3.Food (flowers): fresh nectar (2)	0.2331
Campanulaceae	Qiong long mei duo	<i>Cyananthus lobatus</i> Wall. ex Benth.	QTP-EBT-3058	Medicine (flowers): apply fresh petals to prevent dry lips (28)	0.1718
Campanulaceae	Qiong long mei duo	<i>Cyananthus pedunculatus</i> C.B.Clarke	QTP-EBT-3090	Medicine (flowers): apply fresh petals to prevent dry lips (26)	0.1595
Cannabaceae	Suo ma la za	<i>Cannabis sativa</i> L.	QTP-EBT-3074	Animal food (aerial parts): fodder (5)	0.0307
Caprifoliaceae	Bang bu	<i>Nardostachys jatamansi</i> (D.Don) DC.	QTP-EBT-3051	1.Economic (rhizomes) (5) 2.Social uses (rhizomes): ritual use, incense (35)	0.2454
Caprifoliaceae	Bang zi tou	<i>Pterocephalus hookeri</i> (C.B.Clarke) E.Pritz.	QTP-EBT-3053	Economic (whole plants) (21)	0.1227
Caprifoliaceae	You mu diu diu	<i>Triosteum himalayanum</i> Wall.	QTP-EBT-3083	Food (fruits): raw, fresh fruit (13)	0.0798
Compositae	Kuo ma	<i>Taraxacum tibetanum</i> Hand.-Mazz.	QTP-EBT-3020	1.Medicine(whole plants): decoction,used to eliminate fire-evil and treat gynecological diseases (56)2.Food (leaves): cooked vegetable (6) 3.Economic (whole plants) (3)	0.3988
Compositae	Ka la mei duo	<i>Saussurea tridactyla</i> Sch.Bip. ex Hook.f.	EBT-PL-23	Economic (whole plants) (54)	0.3313

Compositae	Zha	<i>Leontopodium calocephalum</i> (Franch.) Beauverd	QTP-JPG-0208	Other use (leaves): tool, ignite fire (24)	0.1472
Compositae	Lu mei mei duo	<i>Aster diplostephioides</i> (DC.) C.B.Clarke	QTP-EBT-3056	Economic (whole plants) (23)	0.1472
Compositae	Ou ma ji bu ji	<i>Soroseris erysimoides</i> (Hand.-Mazz.) C.Shih	QTP-EBT-3011	1.Veterinary medicine: decoction, eye diseases (1) 2.Animal food (Whole plants)(2) 3.Economic (whole plants) (18)	0.1288
Compositae	Da sei ma	<i>Cirsium eriophoroides</i> (Hook.f.) Petr.	QTP-EBT-3072	1.Veterinary medicine: decoction, ascaricide (10) 2.Economic (roots) (2) 3.Animal food (whole plants) (7)	0.1166
Compositae	Ong ji ji	<i>Saussurea topkegolensis</i> H.Ohba & S.Akiyama	QTP-EBT-3021	Economic (whole plants) (15)	0.0982
Compositae	Lu mei,Jie bu mei duo	<i>Aster albescens</i> (DC.) Wall. ex Hand.-Mazz.	QTP-JPG-70834	Economic (whole plants) (12)	0.0736
Compositae	Qi mei,Lu mei	<i>Aster flaccidus</i> Bunge	QTP-EBT-3112	Economic (whole plants) (10)	0.0613
Compositae	Sei bu gu zhu,Cei jia mei duo	<i>Senecio raphanifolius</i> Wall. ex DC.	QTP-EBT-3066	1.Medicine (whole plants): decoction, used to treat cold (3) 2.Economic (whole plants) (6)	0.0552
Compositae	Ru da,Pang xia mei duo	<i>Arctium lappa</i> L.	QTP-JPG-102600	1.Medicine (roots): decoction, used to treat cold (5) 2.Other uses (fruits): tools, used to stick mice (1) 3.Animal food (whole plants) (2)	0.0491
Compositae	King ba	<i>Artemisia argyi</i> H.Lév. & Vaniot	QTP-EBT-3154	1.Medicine (aerial parts): bath, used to treat chicken pox (2) 2.Other uses (aerial parts): mosquito repellent (2)	0.0245
Compositae	Qia guo bu	<i>Cremanthodium reniforme</i> (DC.) Benth.	QTP-EBT-3132	1.Medicine (leaves): smear, used to treat dermatopathya (1) 2. Economic (whole plants) (3)	0.0245
Compositae	Cuo sa,King ga	<i>Artemisia younghusbandii</i>	QTP-EBT-3208	Social uses (aerial parts): incense (3)	0.0184

		J.R.Drumm. ex Pamp.			
Compositae	Zha	<i>Anaphalis nepalensis</i> (Spreng.) Hand.-Mazz.	QTP-EBT-3123	Economic (whole plants) (1)	0.0061
Compositae	Kang lin xia	<i>Cremanthodium decaisnei</i> C.B.Clarke	QTP-EBT-3132	Economic (flowers) (1)	0.0061
Coriariaceae	Zuo mu,Tong ru,Tong lei,Bi jiu	<i>Coriaria terminalis</i> Hemsl.	QTP-EBT-3005	Food (fruits): raw, fresh fruit (7)	0.0429
Crassulaceae	Duo jie suo la ma bu	<i>Rhodiola himalensis</i> (D. Don) S.H. Fu	QTP-EBT-3017	1.Medicine (roots): slice and decoction, to enhance immunity, regulate blood pressure, treat altitude sickness (8) 2.Economic (roots) (52)	0.3742
Cupressaceae	Xiu bo	<i>Juniperus indica</i> Bertol.	QTP-EBT-3023	Social uses (leaves and stems): ritual use, incense (30)	0.1840
Cupressaceae	Bang ma	<i>Juniperus tibetica</i> Kom.	QTP-EBT-4000	1.Social uses (stems and leaves): ritual use, incense (5) 2.Food (fruits): raw, fresh fruit (1)	0.0368
Dennstaedtiaceae	Jie ma	<i>Pteridium aquilinum</i> (L.) Kuhn	QTP-EBT-3035	Food (tender leaves): cooked vegetables (69)	0.4479
Dryopteridaceae	Nu jie ma,	<i>Dryopteris chrysocoma</i> (Christ) C. Chr.	QTP-EBT-3127	Food (tender leaves): cooked vegetable (20)	0.1227
Elaeagnaceae	Bi jiu	<i>Elaeagnus umbellata</i> Thunb.	QTP-EBT-3036	Food (fruits): raw, fresh fruit (3)	0.0184
Ephedraceae	Ci long	<i>Ephedra monosperma</i> J.G.Gmel. ex C.A.Mey.	QTP-JPG-140937	1.Medicine (aerial parts): decoction, used to treat cold (3) 2. Social uses (aerial parts): ritual uses, incense (1)	0.0245
Ericaceae	Po lu	<i>Rhododendron anthopogon</i> D. Don	QTP-EBT-4005	1.Medicine (roots): soak it in canola oil, use oil to smears hair, cure gray hair (1) 2.Social uses (aerial parts):ritual uses, incense(68)	0.4294
Ericaceae	Su du	<i>Rhododendron setosum</i> D. Don	QTP-EBT-3019	1.Food(leaves): beverage (1) 2.Fuel wood(aerial parts)(35)3.Social uses	0.2454

				(aerial parts):ritual uses, incense(4)	
Ericaceae	A xia xia mu ,Ji wu ke long	<i>Enkianthus deflexus</i> (Griff.) C.K.Schneid.	QTP- EBT- 121625	1.Materials (stems): tools, used to stir (3) 2.Food (flowers): raw, nectar (4)	0.0429
Ericaceae	Kei xiu	<i>Rhododendron leucaspis</i> Tagg	QTP- IMG- 0207	Medicine (flowers): poison (1)	0.0061
Ericaceae	Xiao xiu	<i>Rhododendron wallichii</i> Hook. f.	QTP- EBT- 70828	Fuelwood (aerial parts) (1)	0.0061
Ericaceae	Ye jiu	<i>Rhododendron cinnabarinum</i> Hook. f.	QTP- EBT- 4003	Food (flowers): raw (22)	0.1350
Gentianaceae	Bang jie mei duo	<i>Gentiana veitchiorum</i> Hemsl.	QTP- EBT- 3024	Medicine (whole plants): decoction, used to treat cold, diarrhea, tracheitis (94)	0.5767
Gentianaceae	Qi xiong,	<i>Gentiana tibetica</i> King ex Hook.f.	QTP- EBT- 3057	1.Medicine (leaves): incineration, smear the wound to stop bleeding, veterinary medicine (37) 2.Economic (leaves) (17) 3.Veterinary medicine (leaves) :decorantion, epilepsy(4)	0.3558
Gentianaceae	Ou long gang jia	<i>Halenia elliptica</i> D.Don	QTP- EBT- 3059	1.Veterinary medicine (whole plants): decoction, used to treat diarrhea (2) 2.Economic (whole plants) (11)	0.0798
Gentianaceae	Di ge da,Jia di	<i>Swertia bifolia</i> Batalin	QTP- EBT- 3111	1.Medicine (whole plants): decoction, used to treat cold (5) 2.Veterinary medicine (whole plants): raw, dental ulcer (1) 2.Economic (whole plants) (5)	0.0675
Geraniaceae	Li ka tu	<i>Geranium nepalense</i> Sweet	QTP- EBT- 3061	Economic (whole plants) (2)	0.0123
Grossulariaceae	Ren bu	<i>Ribes glaciale</i> Wall.	QTP- EBT- 3082	1.Food(fruit): fresh fruit (36) 2.Animal food (leaves and stems): browse (3)	0.2393
Grossulariaceae	Ren bu	<i>Ribes takare</i> var. <i>desmocarpum</i> (Hook. f. & Thomson) L.T. Lu	QTP- EBT- 3037	1.Food (fruit): fresh fruit (25) 2. Animal food (stems and leaves): browse (3)	0.1718
Juglandaceae	Da ga	<i>Juglans sigillata</i> Dode	QTP- EBT-	Food (Fruits): raw, nut (1)	0.0061

			3161		
Lamiaceae	Xia guo tang jie	<i>Nepeta discolor</i> Royle ex Benth.	QTP-EBT-3135	Food (whole plants): seasoning (33)	0.2147
Lamiaceae	Luo suo mei duo	<i>Phlomoides rotata</i> (Benth. ex Hook.f.) Mathiesen	QTP-EBT-3095	1.Medicine (root): incineration, smear to promote wound healing (22) 2.Animal food (aerial parts) (7) 3.Economic (roots) (3)	0.1963
Lamiaceae	Jia	<i>Dracocephalum tanguticum</i> Maxim.	QTP-EBT-3207	1.Medicine (whole plants): decoction, gastropathy (11) 2. Food (aerial parts): seasoning (15) 3.Economic (whole plants)(1)	0.1656
Lamiaceae	Lu lu	<i>Marmoritis complanata</i> (Dunn) A.L.Budantzev	QTP-EBT-3213	Medicine (whole plants): decoction,used to treat cold (2)	0.0123
Lamiaceae	Ha xia ga	<i>Nepeta laevigata</i> (D.Don) Hand.-Mazz.	QTP-EBT-3060	Economic (Whole plants) (2)	0.0123
Leguminosae	Jia xie guo guo	<i>Thermopsis barbata</i> Benth.	QTP-EBT-3101	1.Medicine (stems): decoction, hypertension (1) 2.Animal food (aerial parts): fodder(11) 3.Economic (stems) (2)	0.0859
Liliaceae	Zi ga	<i>Fritillaria cirrhosa</i> D.Don	QTP-EBT-3012	1.Medicine (bulbs): boiled in water, used to treat cold and tracheitis (81)2.Food (fruits): fruit(5) 3.Economic (bulbs) (57)	0.8896
Melanthiaceae	Qi ye yi zhi hua	<i>Paris polyphylla</i> Sm.	QTP-EBT-4060	1.Medicine (whole plants): decoction and smear, used to treat dermatopathya (4) 2.Economic (whole plants) (6) 3.Food(whole plants): cooked vegetable (3)	0.0798
Oleaceae	Zi bu xun	<i>Fraxinus paxiana</i> Lingelsh.	QTP-EBT-3150	1.Medicine (barks): decoction, fracture (49) 2.Veterinary medicine (barks): decoction (4) 3.Economic (barks) (1)	0.3313
Orchidaceae	Wang la	<i>Gymnadenia conopsea</i> (L.) R.Br.	QTP-EBT-3080	1.Medicine (roots): decoration, cold (18) 2.Economic (roots) (9) 3.Social uses(roots): ritual uses, incense(1)	0.1718
Orchidaceae	Tian ma	<i>Gastrodia elata</i> Blume	QTP-JPG-3292	1.Food (rhizomes): used to make soup (2) 2.Economic (rhizomes) (16)	0.1104

Orobanchaceae	Jie qiu mei duo	<i>Pedicularis siphonantha</i> D.Don	QTP-EBT-3093	1.Medicine (whole plants): decoction, used to treat cold (3) 2.Economic (whole plants) (2)	0.0307
Papaveraceae	Lu mei mei duo	<i>Meconopsis simplicifolia</i> (D. Don) Walp.	QTP-EBT-3028	Economic (whole plants) (27)	0.1656
Papaveraceae	Pe jiu ke long	<i>Corydalis casimiriana</i> Duthie & Prain ex Prain	QTP-EBT-3054	Economic (root) (1)	0.0061
Pinaceae	Guo ju la	<i>Pinus wallichiana</i> A.B.Jacks.	QTB-JL-39	Food (fruits): raw, nut (2)	0.0123
Plantaginaceae	Hong lei	<i>Neopicrorhiza scrophulariiflora</i> (Pennell) D.Y.Hong	QTP-EBT-3022	1.Medicine (roots): decoction, used to treat cold (85) 2.Social uses (roots): ritual uses, incense (1) 3.Veterinary medicine(roots):decocotion, diarrhea (3) 4.Economic roots) (9)	0.6012
Plantaginaceae	Kei ma	<i>Plantago asiatica</i> L.	QTP-EBT-3117	1.Medicine (whole plants): decoction, used to treat chicken pox (2) 2.Animal food (whole plants): fodder (2) 3.Economic (whole plants) (2)	0.0368
Polygonaceae	Qu ga	<i>Rheum nobile</i> Hook. f. & Thomson	QTP-EBT-3010	1.Food (stems): fresh fruits, to be eaten directly after peeling (76) 2.Materials (roots): dye (2) 3.Social uses (leaves):tobacco substitute (1)	0.4847
Polygonaceae	Qu qiu	<i>Rheum acuminatum</i> Hook. f. & Thomson	QTP-EBT-3107	1.Food (stems): fresh fruits, to be eaten directly after peeling (51) 2.Materials (roots): dye:mash it, then boil the water, dye kimchi and clothes (9) 3.Economic (roots) (1)	0.3742
Polygonaceae	Ban jia lin bu	<i>Polygonum macrophyllum</i> D. Don	QTP-EBT-3116	1.Medicine (roots): decoction, diarrhea(5) 2.Environmental uses (flowers): decoration(1) 3.Animal food (whole plants) (10) 4.Food (seeds): staple food (31) 5. Economic (roots) (5)	0.3129
Polygonaceae	Qu jiu	<i>Oxyria digyna</i> (L.) Hill	QTP-EBT-3081	1.Medicine (whole plants): decoction, cholecystitis (2)	0.0859

				2.Economic (roots) (1) 3. Food (fruits) (11)	
Polygonaceae	Nia lu	<i>Polygonum tortuosum</i> D. Don	QTP-EBT-3041	1.Medicine (aerial parts): decoction, used to treat diarrhea (2) 2.Animal food (aerial parts): fodder (9)	0.0675
Polygonaceae	Nia lu,Pang xia mei duo	<i>Polygonum polystachyum</i> Wall. ex Meisn.	QTP-EBT-3120	1.Food (tender leaves): cooked vegetable (2) 2. Economic (whole plants) (1) 3.Animal food (whole plants): fodder (5) 4.Materials(whole plants): dye (1)	0.0552
Polygonaceae	Qu jiu,He lei ni xiao	<i>Rheum palmatum</i> L.	QTP-JPG-0385	1.Medicine (roots): decoction, used to treat constipate (5) 2.Economic (roots) (3)	0.0491
Primulaceae	Xue di mei duo	<i>Primula sikkimensis</i> Hook.	QTP-EBT-3119	1.Environmental use (flowers): season indicators, when flowers bloom, yak milk yields high (7), ornamental plant (10)	0.1043
Primulaceae	Ha lu mei duo	<i>Primula concinna</i> Watt	QTP-EBT-3124	Environmental uses (flowers): season indicators, when the flowers bloom, the rainy season arrives (3)	0.0184
Primulaceae	Jie ga mei duo	<i>Primula denticulata</i> Sm.	QTP-EBT-4047	Environmental uses (flowers): oramental plant (2)	0.0123
Ranunculaceae	Peng a	<i>Aconitum orochryseum</i> Stapf	QTP-EBT-3165	1.Medicine (roots): decoction, inflammation, diarrhea, cold (44) 2.Veterinary medicine (roots) :decoction, fever and diarrhea(5)	0.2945
Ranunculaceae	Zen du	<i>Aconitum spicatum</i> Stapf	QTP-EBT-3008	1.Medicine (roots): soak in water and apply it to the joints to treat arthritis (17) 2.Veterinary medicine (roots) :decoction, diarrhea(1)3.Economic (roots)(1)	0.1166
Ranunculaceae	Sei jie mei duo	<i>Caltha palustris</i> L.	QTP-EBT-3043	1. Environmental uses (flowers): when flowers bloom, the quality of ghee is good (1) 2.Economic (whole plants)(2)	0.0184
Ranunculaceae	Su guo	<i>Thalictrum reniforme</i> Wall.	QTP-EBT-3062	Materials(roots): dye (2)	0.0123
Rosaceae	Sei zhu	<i>Rosa omeiensis</i>	QTP-	Food (fruit): fresh fruits (65)	0.3988

		Rolfe	EBT-3033		
Rosaceae	A long ca long	<i>Fragaria nubicola</i> (Lindl. ex Hook.f.) Lacaita	QTP-EBT-3049	1.Food(fruits): fresh fruit (49) 2. Economic (stems) (5)	0.3313
Rosaceae	Sei la	<i>Rosa macrophylla</i> var. <i>glandulifera</i> Yu et Ku	QTP-EBT-3003	Food(fruit): fresh fruits (49)	0.2822
Rosaceae	Chuo ma	<i>Potentilla anserina</i> L.	QTP-EBT-3055	Food(roots): boiled in water or raw, staple food (45)	0.2638
Rosaceae	Su mu	<i>Potentilla fruticosa</i> var. <i>arbuscula</i> (D.Don) Maxim.	QTP-EBT-3092	Other uses: tool, to make brush (18)	0.1104
Rosaceae	Tuo cei long	<i>Rubus austrotibetanus</i> T.T.Yu & L.T.Lu	QTP-EBT-3006	Food(fruit): raw, fresh fruits (10)	0.0613
Rosaceae	Ca ge ba,A mu lu	<i>Sorbus albopilosa</i> T.T.Yu & L.T.Lu	QTP-EBT-3100	1.Tool (roots): used to make farm tools (1) 2. Food (fruits): raw, fresh fruits (2)	0.0184
Rosaceae	Ca ci zhu	<i>Rosa sericea</i> Wall. ex Lindl.	QTP-EBT-3004	Food(fruits): raw, fresh fruits(3)	0.0184
Rosaceae	Qia xiong,Jia da	<i>Sanguisorba diandra</i> (Hook.f.) Nordborg	QTP-EBT-3113	1.Medicine(roots): decoction, used to treat diarrhea (1) 2. Economic (roots) (1)	0.0123
Rutaceae	Ting yi	<i>Zanthoxylum oxyphyllum</i> Edgew.	QTP-EBT-4065	Food (Fruits): seasoning (4)	0.0245
Salicaceae	La ma	<i>Salix myrtilleacea</i> Andersson	QTP-EBT-3110	Other uses (stems): tools, making yogurt after peeling (19)	0.1166
Salicaceae	La ma	<i>Salix daltoniana</i> Andersson	QTP-EBT-3103	Other uses (stems): tools, making yogurt after peeling (7)	0.0429
Saxifragaceae	Ma xiao	<i>Bergenia purpurascens</i> (Hook.f. & Thomson) Engl.	QTP-EBT-3013	1.Medicine (roots): decoction,diarrhea(37) 2.Veterinary medicine (roots): decoction, diarrhea(13) 3.Economic (roots) (6)	0.3436
Solanaceae	Gen die,Jin den	<i>Anisodus luridus</i> Link	QTP-EBT-3153	1.Medicine (fruits): smudging, toothache (15) 2. Animal food (whole plants) (2): fodder	0.1043

Tamaricaceae	A mu	<i>Myricaria rosea</i> W.W. Sm.	QTP- EBT- 3079	Social uses (whole plants): ritual uses, incense, used in funeral rites(2)	0.0123
Taxaceae	A chen ba	<i>Taxus wallichiana</i> Zucc.	QTP- EBT- 3169	Fuelwood (stems and leaves) (4)	0.0245
Thymelaeaceae	Ga mu mei duo	<i>Stellera chamaejasme</i> L.	QTP- EBT- 3205	Materials: paper making (roots) (5)	0.0307
Urticaceae	Sa bu jiu	<i>Urtica hyperborea</i> Jacq. ex Wedd.	QTP- EBT- 3040	1.Food (leaves): cooked vegetables (92) 2.Animal food (aerial parts): fodder (3)	0.5828

Table 2 Use categories and use reports

The first category	The second category	Criteria	No.of species	Use reports
Food	Fruits	Fruits that were only eaten when they were ripe, such as apple, pear, strawberry	28	534
	Vegetable	Plants material what were used to cook dishes (including making salads directly with raw plant material)	15	408
	Seasoning	Plants that could be added to dishes or soups to increase the flavour of food	7	148
	Starches	Plants that could be used as a direct starch supplement (e.g., tuberous or rhizome of some plants) or processed into starch	3	86
	Beverages	Plants that could be processed into homemade liqueurs or alcoholic beverages and processed into herbal teas	1	1
Economic plant		The living plant, plant part, or derived product that can be traded	53	560
Medicine	Medicine for human	Plants that could be used by local people to treat diseases of human	43	761
	Veterinary medicine	Plants that could be used by local people to treat diseases of animals	10	44
Animal food	Fodder	Food (herb) for horses and farm animals	16	107
	Browse	Food (leaves of wooden plants) for horses and farm animals	2	6
Social uses	Ritual uses	Plants used in social scenarios, such as incense	11	165
	Somoking substitute	Plants that are substitutes for tobacco	1	1
Fuel	Fuelwood	Wood used for fuel	4	49
Materials	Dyes	Plants that can be used to dye something	3	13
	Crafts	Plants for making crafts, such as wooden bowls	1	1
	Paper making	Raw materials for papermaking	1	1
Environmental uses	Oranmentals	Plants that can be used for ornamental purposes, such as potted plants, headdresses	3	13
	Season indicators	Plants that can indicate the arrival of the season	3	11
Other uses	Tools	Plants that can be used to make tools, such as containers, cookware	9	117
	Repellent	Plants used to repel mosquitoes	1	2

Table 3 Informant consensus factor for traditional medicinal plant use categories

Secondary category of use	Tertiary category of use	Number of use reports(Nur)	Number of taxa (Nt)	Informant consensus index factor (FIC)
Cardiovascular disease	Hyperglycaemia, hypertension, anaemia	35	7	0.82
Dermatopathya	Burn, bleeding, acne	116	6	0.96
Gastrointestinal problems	Constipation, diarrhea,gastralgia	118	10	0.92
Infections	Chicken pox	4	2	0.67
Poisons	Poisons	1	1	—
Respiratory complaints	Cold, begma	321	11	0.97
Skeleto-muscular system	Fractures, arthralgia	66	2	0.98
Toothache and mouth	Toothache	15	1	1.00
	Chapped lips	54	2	0.98
Hypoimmunity	Hypoimmunity	2	1	1.00
Inflammations	Inflammations	142	4	0.98
Hair follicle	Promote hair growth, hair darkening	14	2	0.92
Cholecystitis	Cholecystitis	2	1	1.00
Veterinary medicinal	Ulcer, parasites, eyesache, fractures diarrhea	48	10	0.81

Figures

Figure 1

Map of the study area

Figure 2

Characteristics of informants: The line represents the average number of URs provided by local people of each age group

Figure 3

The top three medicinal plants. **1** Medicines stored in the home **2** *Fritillaria cirrhosa* D.Don **3** *Neopicrorhiza scrophulariiflora* (Pennell) D.Y.Hong **4** *Gentiana veitchiorum* Hemsl.

Figure 4

The process from collection to utilization of *Fraxinus paxiana* Lingelsh. **1** the tree. **2** leaves. **3** bark. **4 & 5** The bark turns the water blue.

Figure 5

Several ways of economic plants from collection to utilization. **1** *Fritillaria cirrhosa* D.Don. **2** *Saussurea tridactyla* Sch.Bip. ex Hook.f. **3** *Rhodiola himalensis* (D. Don) S.H. Fu. **4** Locals drying herbs in the garden. **5 & 6** Tibetan medicine products.

Figure 6

Some Tibetan incense plants and incense burner **1** The incense burner, used to burn Tibetan incense plants. **2** *Juniperus indica* Bertol. **3** *Onosma hookeri* C.B. Clarke. **4** *Nardostachys jatamansi* (D.Don) DC. **5** *Rhododendron anthopogon* D. Don. **6** *Juniperus tibetica* Kom. **7** *Neopicrorhiza scrophulariiflora* (Pennell) D.Y.Hong.

Figure 7

Tibetan cheese fermentation process **1.** *Salix daltoniana* **2.** *Salix myrtillacea* **3.** *Betula utilis* **4** Soak branches in boiling water, wash and peel **5.** The branches that have been cleaned **6.** Set up the branches in the bucket, pour the milk, shake the bucket to make it adhere to branches **7.** Put the fermented cheese into the pot, add ghee and fry until it is cooked