An Overview of Nepalese Medicinal Plant Trade with China

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Abstract

Despite a thousand years of history in Nepalese medicinal plant trade to China, there has not been much comprehensive studies that overview the trade from past to present. This study explores the history of the Nepalese medicinal plant trade with China, providing a complete overview of the species involved, their conservation status, and demand drivers. Accordingly, in this study the literature on Sino-Nepal trade relations is reviewed, government reports and data tracked, and interviews conducted with forest officials and exporters trading with China. This study documents 54 medicinal plant species previously (or currently) traded with China. The value of medicinal plants traded with China is worth more than three times as much as the volume exported in percentage terms. Twenty-six species fall into national or international conservation categories. The industrialization of Tibetan medicine, access to modern transportation for the supply of medicinal ingredients and products, globalization of the medicinal plant market, and high per capita income of Chinese people have resulted in consumer behavior shifting toward herbal medication and an increase in the Nepalese medicinal plant trade with China. To mitigate the depletion of resources caused by high demand of medicinal plants, immediate action is required to address trade sustainability as well as prioritize local traditional knowledge and resource-based industry for the substantial socio-cultural and economic benefits both to the local people and nation.

Keywords: History; Industrialization; Medicinal plants; Traditional medicine; China

Introduction

Nepal and China have centuries-old social, cultural, and economic relations; the salt-grain trade through the trans-Himalayan silk route being an example [1,2]. Medicinal knowledge and medicinal plants formed a major part of the trans-Himalayan salt-grain trade. The medicinal plant trade from Nepal to China is currently on the rise, particularly after the industrialization of Tibetan medicine in the 1990s, and the introduction of Good Manufacturing Practice (GMP) standards for pharmaceuticals in 2001 [3]. For example, with an increase in the traditional medicine market, Tibetan medicine has grown tenfold between 2000 and 2017, producing pharmaceuticals worth 615.3 million USD in 2017, led in absolute and relative numbers by China [4]. The centuries-old Tibetan medicinal practice has flourished throughout the neighboring Himalayan regions of Bhutan, Nepal, and India among the Tibetan populations along the interwoven networks for trade, increasing the spread of Buddhism and other cultural exchanges, pilgrimage, and Tributum [5]. However, many raw materials used in Tibetan medicine are not native to Tibet, and medicinal plants imported from neighboring countries like India and Nepal constitute a considerable part of the Tibetan medicine system. For centuries, the cross-border movement of merchants and medicinal ingredients across spatial and conceptual borders has been essential to Tibetan medicine practice [3,6].

Nepalese medicinal plants have been exported for centuries [7], primarily to India and China [8,9]. With the industrialization of traditional medicine and globalization of the medicinal plant trade, the bulk of Nepalese medicinal plants are exported to India, China, and beyond [10-13], where they are the subject of increasing interest in the herbal curative system [14]. This high demand may be due to the significant efficiency [15] of bioconstituents in modern medicine, the proximity to centuries-old systems (Ayurveda, Tibetan Medicine and Traditional Chinese Medicine) [16] or their use in the preparation of aromatic products, cosmetics, plant fibers, herbal dyes, food flavoring [17].

From 11,971 species of flowering and non-flowering plants, including fungi and lichens [18] more than 2,300 have medicinal value [19] while 300 are traded and exported from Nepal [20]. About 39% of all traded medicinal plants are formally protected by...
the Government of Nepal or included in national and international conservation categories to control over and pre-harvesting [20]. The traditions and culture of Pan-Himalayan people are related to these plants for various purposes including household activities (fencing), religious beliefs (incense), medicinal purposes, etc. According to a recent study, Nepal supplies more than 50 countries worldwide with medical plans [11], 13 of which import every year [12]. Medicinal plant processing enterprises in Nepal are also experiencing continuous growth [21].

The most recent comprehensive study of the medicinal plant trade is that by Pyakurel et al. [20], although destination countries are not mentioned. Despite the historical and modern importance of trade in medicinal plants, there is no comprehensive list of the species traded from Nepal to China. Recent studies have estimated the number of traded species at about 17 [3:107,21-23]. Here, the historical trade information is combined with the contemporary to create a comprehensive overview of species previously or currently traded [20].

The present study aims to:

(i) explore the historical events initiating the trans-Himalayan medicinal plant trade,

(ii) create a comprehensive overview of species previously or currently traded from Nepal to China, to analyze their conservation status and present trade share, and

(iii) reveal the major demand drivers of Nepalese medicinal plants in China.

**Methodology**

Literature available on online journals and proceedings, published from 1995 to 2017 relating to the first International Medical Symposium in Tibet, the establishment of Tibetan medicine, and ancient trans-Himalayan trade from Nepal to Tibet, China [1,3,5,6,25-30] were searched using keywords like Tibetan Medicine History, Himalayan Medicinal Plants, Trans-Himalayan Trade, Nepal-China trade relations, and reviewed, and analyzed to explore the history of the medicinal plant trade from Nepal to Tibet, China.

A bibliography of 350 studies on medicinal plants, fungi, and lichens traded in and from Nepal compiled from 29 key resource institutions in Nepal [31] were reviewed to cover the period up to 2015. Existing literature and online journals relating to Nepal-China trade relations including medicinal plants were researched and reviewed to cover the period from 2015 to 2020. Government reports and data from Customs and Tibetan border districts were also reviewed.

To support secondary information and capture contemporary traded species, field surveys were carried out in major medicinal plant trade hubs and routes to China in 2016 (Tatopani Customs, Sindhupalchok, Tribhuvan International Airport, and exporters at Thamel, Kathmandu, number of species traded to China, n=33) [32] and in 2020 (Kimathanka-Chentang border crossing, Sandhuwasabha, n=8 [33] and the Divisional Forest Office, Kathmandu, n=24 [34]). Interviews were conducted on traded species (name, parts traded, uses, etc.) with officials and local Tibetan border exporters trading to China. The information on medicinal plants traded to China recorded from both primary and secondary sources were merged into a list, sorted, and any duplications removed. Finally, the listed species (n=54) were tabulated into families, recent scientific names with author citations; their English, Nepali, Tibetan, and Chinese names; life form; parts traded; occurrence; distribution in Nepal with altitudinal variation; conservation status, and source (Appendix I) following the Catalogue of Life [35], Plants of the World online [36], IUCN [37], CAMP[38], CITES [39], and Pyakurel et al. [20].

The present trade in medicinal plants was analyzed in terms of average net weight and trade value using the Harmonized System code 1211 of UN COMTRADE DATA from 2013 to 2017. The conservation status of investigated species was verified according to national [38,40] and international [37,39] conservation categories. The demand drivers of Nepalese medicinal plants in China were revealed during a review of contemporary literature on the modernization of the Tibetan medicine industry [3,4,6,25,41-43].

**Historical Events Initiating the Trans-Himalayan Medicinal Plant Trade to Tibet**

The trade in medicinal plants from Nepal to Tibet dates back to the eighth century (728 CE/AD) when Tibetan emperor Trisong Detsen (756–97) invited nine traditional doctors from neighboring regions in India, Kashmir, Tang, Persia, Drugu, East Turkestan, Mongolia, Dolpo, and Nepal to the first International Medical Symposium in Tibet [26-28]. The output of the conference played a directive role to unify the practise the traditional medicine. “The Four Medical Tantras” published during the twelfth to fourteenth century, marked the formation of Tibetan medical theory, combined with political and institutional influence which led in the establishment of unified version for the theory and practise of Buddhist medicine in Tibet [29,30]. This theory has since been studied in whole or part by practitioners during their medical training, serving as the manifestation of the school of Tibetan medicine [26-28,44]. Tibetan medicine consists of medical compounds derived from various medicinal systems, based on both native and raw non-native, mostly herbal but also mineral, and some animal-derived ingredients, along with therapies such as cupping and gold-needle moxibustion, related diagnostic modes of pulse and urine examination, breathing and physical exercises, as well as internal visualizations [5]. Tibetan medicine existentially depends on the translational flows of raw materials, knowledge and expertise, products, and people [45].

The main raw ingredients of Tibetan medicine are plants, minerals, and animal parts, mostly from natural and wild sources. Many raw materials used in Tibetan medicine are not native to Tibet and sourced at domestic as well as the cross-border level.
Medicinal plants imported from India and Nepal constitute a considerable part of Tibetan medicine's *materia medica*. Therefore, the cross-border movement of merchants [1] and medicinal plants across spatial and conceptual borders has been essential to Tibetan medicine since ancient times. As for domestic sourcing, traditional Tibetan medicinal practitioners (*Amchis*) used to collect wild medicinal plants from the Tibetan pastures, such as *Aconitum heterophyllum* Wall. ex Royle, *Rhodiola crenulata* (Hook. f. & Thomson) Saxifraga sp., *Nardostachys jatamansi* (D. Don) DC. [6].

Cross-border sourcing mostly occurred from the tropical and sub-tropical regions of Nepal and India via the trans-Himalayas for medicinal plants like *Terminalia chebula* Retz., *Terminalia bellirica* (Gaertn.) Roxb., and *Phyllanthus emblica* L. These three fruits collectively form an indispensable part of Tibetan pharmacy and can be found in the majority of Tibetan formulas [6]. *T. chebula*, the myrobalan fruit, is also the most widely used symbol in Tibetan medicine. Later, *Svertia chirayita* (Roxb.) Buch.-Ham.ex C.B. Clarke, red and white sandal wood, and other medicinal plant products were traded through cross-border sources including minerals like Shilajit (a black mineral available in the highest Himalayas) [6,46]. Wildlife products such as the skins and bones of leopards and tigers, otter pelts, musk pods, bear bile, and the gallstones of buffalo and elephants have been traded from the lower plains of Nepal and India via the trans-Himalayas to Tibet as medicinal ingredients [6]. Tibetans used to visit the Kathmandu Valley (Nepal) in the wintertime to exchange salt, yak tails, and woollen blankets for grain, and also dealt in gold dust, turquoise, agate, rubies, and other precious stones, together with medicinal plants [1].

During the eighth and seventeenth centuries, trans-Himalayan trade from Nepal to Tibet was conducted around 18 trans-Himalayan trade routes, and from 904–1962 via Sikkim, India [1,2,47,48,49]. The Kyirong Pass was the shortest route to the Tibetan capital, Lhasa [47]. Despite the adverse topography, weather conditions, and the constant threat of attack by gangs of armed bandits along the way, long caravans transported edible goods, cloth, metal utensils, and religious Buddhist items from Nepal. Silk, gold powder, yak tails, salt, etc. were transported from Lhasa and beyond [50]. Many Nepalese traders enjoyed certain privileges in Tibet like marrying Tibetan women. Their male children were regarded as Nepalese, whereas female children were acknowledged as Tibetan citizens [51].

Evidence of the centuries-old medicinal plant trade from Nepal to China has been provided by researchers such as Hamilton [8], Kirkpatrick [9], and Dobremez [7]. During the 1970s, the medicinal plant trade helped to increase foreign earnings with the main exporting countries being Belgium, France, the U.K., Canada, Hong Kong, Japan, and Singapore [14]. The continuous trade in medicinal plant from Nepal to China during the late twentieth and early twenty-first century has been evidenced by researchers like Edwards [1996], He et al. [22], Pyakurel & Panthi [23], Olsen [10], and Saxer [3].

The Nepal-China trade has a long history. Following the trading trajectories across the Himalayas, medicinal plant commodities were assembled and supplied from Nepal through the Himalayan land paths and sourced and consumed in Tibet within the complex channels of institutional and private trade. Due to its biodiversity and huge altitudinal range of 60-8848masl, many of the necessary ingredients of Tibetan medicine were available in Nepal. Consequently, a barter system for Himalayan trade existed between Nepal and Tibet. Generally, this consisted of animal products (silk, yak tails), salt (formed in natural lakes) from the Tibetan plateau, food grain, metal utensils, and religious Buddhist items including medicinal plants from Nepal. Such resource management in the past has led to medicinal plants becoming essential components of Himalayan trade from Nepal to China.

Comprehensive Overview of Species Traded from Nepal to China

According to the literature review, 13 studies mentioned the names and final destinations of species traded from Nepal to China. He et al. [22] (reported number of species traded to China, n=17); Pyakurel & Panthi [23], and Saxer [3] (each n=8); PSCN [24] (n= 6); Acharya [52] (n=3); Sherpa [53] and van Boeckel [54] (each n=2); Amatya [55]; Cunningham et al. [56]; Devkota & Shrestha [57]; GoN[58]; IFA [59], and Phoboo and Jha [60] (each n=1).

Overview of Nepalese medicinal plants traded to China

Fifty-four Nepalese medicinal plant species of 48 genera under 41 families are recorded as being traded to China since ancient times. Orchidaceae is the largest family with four species, followed by Asparagaceae and Ranunculaceae (each with three species) and Berberidaceae, Combretaceae, Elaeocarpaceae, Eleagnaceae, Gentianaceae, and Lauraceae (each with two species). The remaining 32 families have one species each (Appendix I). Most medicinal plants exported to China from Nepal are herbs (22 species contributing to 44.4%) (perennial herbs-1, annual herbs-1, herbaceous climbers-2, epiphytic herbs-1, saprophytic herbs-1), 14 are trees (25.9%) (small trees-8, trees-1, large trees-5), 10 are shrubs (18.5%) (small shrubs-2, shrubs-8), three are fungi (5.5%), 1 lichen (1.8 %), and 2 others (3.7%) (pteridophyte-1, small tree/shrub-1) (Figure 1).

About 80% of the investigated medicinal plant species grow in native wild form and 15% in native wild and cultivated form in Nepal. Two species are exotic cultivars and one a native cultivar (Appendix I).

Conservation status of investigated species

Generally, underground parts (roots, rhizomes, and bulbs), bark, fruits, seeds, flowers, leaves, and twigs are traded as medicinal plants. However, these are often harvested by uprooting...
the whole plant [61]. About 59% of the investigated medicinal plant species are harvested for the whole plant, underground parts, bark, wood, or stem, compared to 50% for the underground parts, whole plant, or bark [2019], and 41% harvested for leaves, twigs, fruit, seeds, flowers, or resin (Appendix I). The harvesting pattern of underground parts, the whole plant, or bark for the collection of large quantities of plant material is considered destructive [62] compared to the harvesting pattern of fruits, seeds, flowers, leaves, and twigs [63].

![Life Form](image)

**Figure 1:** Life form of investigated medicinal plants

Of the 54 investigated species traded from Nepal to China, 26 (48.15%) are included in one or more national (CAMP [38], n=16 and GoN [40], n=5) or international (IUCN [37], n=7 and CITES [39], n=4) conservation lists (Appendix I). Four species of orchids are traded, with all orchids kept under the CITES threat category (Appendix I). *Nardostachys jatamansi* (D. Don) DC. (jatamansi, bhutle/pangpö/spikenard) of the Valerianaceae family is listed in all four categories. *Dactylorhiza hatagirea* (D. Don) Soó (Panchaunle, Hatajadi/Salep, Marsh Orchid) of the Orchidaceae family is listed in three of the conservation categories. Four species are listed in two conservation categories and the remaining 20 species in at least one (Appendix I).

**Medicinal plant exports**

The medicinal plants exported from Nepal to China are proportionally high in both volume and value compared to India and other countries (Figure 2). This is due to the trade in *Yarsagumba* (*Ophiocordyceps sinensis*). Yarsagumba, also referred to as Himalayan Viagra, is a caterpillar fungus, endemic to the high Himalayas and Tibetan plateaus, used in Tibetan and Chinese medicine and in great demand by China [64]. Pouliot et al. [64] reported that a single 5 cm long piece of fungus-caterpillar, weighing a fraction of a gram, is being retained for as much as 50 USD in China, more than the price of gold on the international market. Due to its high demand and strict host-specificity deterioration, this species has been kept in the vulnerable category by IUCN for 2020. According to UN COMTRADE data from 2013 to 2017, on average, China imported 555.5 tons of medicinal plants annually, worth USD 3.34 million, India imported 3,633.3 tons worth USD 3.97 million, while other countries imported 382.2 tons worth USD 1.00 million.

**Enumerated species**

The medicinal plant species traded from Nepal to China, in increasing order, are almost twice the figures estimated by Saxer [3:107] and thrice that estimated by Pyakurel &Panthi [23] and He et al. [22]. China’s per capita income from 1996 to 2018 increased 13.8-fold [65] due to the continued consumer demand for medicinal plants, fungi, and lichen [20]. Some of this increase came from enumerating product groups at the species level, for example, the two species of *Polygonatum* traded as Setak Chini/Khiraula, similarly the two species of *Berberis* traded as Chutro, and the two species of *Hippophae* traded as sea buckthorn. The significant demand for new species such as the recently traded *Ganoderma lucidum* (Curtis) P. Karst, and *Dendrobium nobile* Lindl. [20,22] has also increased the number of medicinal plants traded from Nepal to China.
Demand Drivers of Nepalese Medicinal Plants in China

Industrialization of Tibetan Medicine

After the incorporation of Tibetan regions into the People’s Republic of China in 1949, the Tibetan culture, customs, and traditional medicine were destroyed during the Cultural Revolution. However, since 1975, with religious freedom alongside economic and other reforms, Tibetan medicine and pharmaceuticals have been revived in the Tibetan Autonomous Region (TAR) and western provinces of China, creating a medical treasure house for the motherland [42]. The revival of Tibetan medicine was based on the interests of the Chinese state to show respect for local culture and customs, with the added value of serving the primary health care needs of rural populations. Thus, the state did not simply rebuild previously destroyed medical establishments and support practitioners, but integrated Tibetan medicine with biomedicine [42].

The Chinese Medical Association Society in Lhasa organized the first modern conference during 1981 on the international exchange of theoretical and clinical experiences relating to Tibetan medical history, theory, clinical practice, various prescriptions, and the scientific research of experts and physicians. In 1991, the modern Tibetan Materia Medica codified the identification of raw medicinal plants and over 100 types of medicinal ingredients with 600 different Tibetan treatments. By the end of 1993, the PRC regulation of standards and quality control in production emerged as the Central Ministry of Health Drug Standards Office [43]. These measures led to the rapid process of modernization of traditional Tibetan medicine during the 1980s and 1990s with new theories and practices [3,41]. Tibetan medical efficacy is found to be equivalent to modern scientific methods [43]. Tibetan medical schools and family traditions outside China continued in much the same way as the pre-modern structure of Tibetan medical knowledge [5]. The state-sponsored revitalization of Tibetan medicine continued in hospitals and medical colleges, with production growing in urban centers, after China’s shift toward a “socialist market economy” in 1992 began to yield profit and a wider market [4:9]. Private Amchis actively contributed to re-establish meaningful social and medical networks, knowledge transmission, and practices. Some of them promoted government clinics and colleges and served as health workers in villages [42].

In 2001, a drug administration law was introduced for drug registration, with a mandate to implement GMP-certification for all commercial pharmaceutical producers. As a result, by the end of 2004, the establishment of GMP-certified Tibetan medicine industry resulted in the significant expansion of trans-Himalayan medicinal plant trade [3].

With the establishment of these policies for traditional medicine in China, the Tibetan medicine industry has become one of the most important resources in China, constituting an economic and public health backbone for entire regions since the early 2000s. According to Kloos et al. [4:10], 281 Tibetan medicine hospitals operate at various levels (e.g., international, national, provincial, county, and city) in China. China controls 97.74% of the Tibetan medicine industry in Asia, generating an annual sales value of 662.2 million USD in 2017 [4:7]. Over 40 GMP-certified Tibetan medicine pharmaceuticals established in China. The Tibet Autonomous Region (TAR) consists of 18 GMP-certified producers, generating about 236 million USD from...
China has the second largest economy. China’s high GDP annual growth rate (~6%) and high per capita income (9,770.85USD in 2018) [65] have resulted in consumer behavior changes and a shift to herbal from conventional medicine and an increase in the Nepalese medicinal plant trade with China.

However, medicinal plants exports to China are hampered by transportation costs, Chinese regulations (such as the 2008 licensing system established by Beijing, which requires a separate license to be obtained for each herb) and the inability to compete on price with similar local goods [67]. The governments of China and Nepal developed a set of strict rules and regulations, by which all the traders in the trans-Himalayan belt road had to abide. For instance, the provisions of Forest Regulation (1995) in Nepal included restrictive procedures such as permits for collection and release, certificates of origin, export licenses, export duty, and phytosanitary certificates from related government authorities for the export of medicinal plants. Besides, Nepal and China both signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 1975) to monitor and regulate international trade on endangered and rare species.

Recently, the numerous bilateral agreements on trans-border trade in traditional medicine have been initiated, and high medicinal plants are expected to experience high mobility due to the modernization of medicinal plant-based industries in China helping to maintain sustainable trade in Himalayan medicinal plants with equitable benefit sharing.

**Conclusion**

Medicinal plants from Nepal have been traded toward Tibet for centuries with more medicinal and cultural functions. In contrast, the present Nepalese medicinal plant trade to China is more economical due to the availability of high bioactive compounds, medicinal efficiency, ancient medication systems (Tibetan and traditional Chinese medicine), preparation of aromatic products, cosmetics, plant fibers, herbal dyes, food, flavors, gifts, etc.

The extensive trade in medicinal plants toward China is due to the industrialization of traditional medicine, interest in the herbal curative system which has few or no side effects and increased herbal market with modern technologies and infrastructures. The trade sustainability should be addressed considering the research and promotion on cultivation of high demand plants with certified medicinal efficiency, provisions on sustainable collection, transport, export and import regulation by both countries, research on alternative substitutes, utilization of local knowledge for resource-based industry, promotion of traditional medicine, markets and semi processed products.

With the industrialization of Tibetan medicine, globalization of the medicinal plant trade, growing Chinese traditional market and access to modern transportation (roadways, seaways, and airways), Nepalese medicinal plants are traded beyond Tibet for economic purposes. Improving Nepal-China relations with Nepal’s
agreement on the Chinese Belt and Road Initiative (BRI), Trans-Himalayan Multi-dimensional Connectivity Network (THMDNC) under BRI and its cooperation concerning the development of traditional medicine during President Xi’s state visit to Nepal in 2019 are expected to amplify the Nepalese medicinal plant trade, providing the opportunity for national economic development.

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**Appendix I: Medicinal Plant species traded from Nepal to China.**

| S.No. | Family      | Scientific Name                      | English Name | Nepali (N), Tibetan (T) and Chinese (C) Name | Life Form | Parts Traded | Occurrence Status | Distribution in Nepal (m) | Threat Status | Source                        |
|-------|-------------|--------------------------------------|--------------|---------------------------------------------|-----------|--------------|-------------------|---------------------------|--------------|--------------------------------|
| 1     | Anacardiaceae | Pistacia chinensis subsp. integerrima (J. L. Stewart) Rech. f. | Insect Gall in Pistacia Kakadsinghi (N) | ST Leaf, twig | Nat-W | W (600-2400) | Field Survey [32] |
| 2     | Araliaceae   | Panax pseudoginseng Wall. | Wild Potato Saargath / Ban Aalu (N) | PH Underground Part | Nat-W | CE (2100-3800) | DFO KTM [34] |
| 3     | Asparagaceae | Polygonatum cirrhifolium (Wall.) Boyle | Setakchini / Khiraulo (N) | PH Underground part | Nat-W | WCE (1230-4600) | DFO KTM [34] |
| 4     | Asparagaceae | Polygonatum verticillatum (L.) All. | Setakchini / Khiraulo (N) | PH Underground part | Nat-W | WCE (2700-4700) | DFO KTM [34] |
| 5     | Asparagaceae | Asparagus racemosus Willd. | Kurilo/Sa-tawari (N) | SSH Underground part | Nat-C&W | WCE (100-2200) | DFO KTM [34] |
| 6     | Asteraceae   | Artemisia indica Wild. | Titepati (N) | SSH Leaf, twig | Nat-W | (WCE 180-3100) | DFO KTM [34] |
| 7     | Berberidaceae | Berberis aristata DC. | Chutro (N) | SH Bark, Wood | Nat-W | WCE (1150-4000) | DFO KTM [34] |
| 8     | Berberidaceae | Berberis asiatica Roxb. ex DC. | Chutro (N) | SH Bark, Wood | Nat-W | WCE (650-3150) | Field Survey [32] |
| 9     | Bignoniaceae | Oroxylum indicum (L.) Kurz. | Tatelo (N) | ST Bark, Seed | Nat-W | WCE (300-1400) | DFO KTM [34] |
| 10    | Caprifoliaceae | Nardostachys jatamansi (D.Don) DC. Sym: Nardostachys grandiflora Wall. ex DC. grandiflora Wall. ex DC. | Spikenard Jatamansi / Bhutle (N); Pangpö, spang sapos (T); 甘松香 (C) | ST Und_prt, Rhizome | Nat-W | WCE (3200-5000) | GoN-RE, CAMP-V; IUCN-CR; CITES II Acharya [52]; Saxer [3]; He et al. [22] |
| 11    | Combretaceae | Terminalia bellirica (Gaertn.) Roxb. | Belleric Myrobolan Barro (N); Barura (T) | LT Fruit, Seed, Bark | Nat-W | CE (100-1100) | Saxer [3]; Field Survey [32] |
| 12 | Combretaceae | Terminalia chebula Retz. | Chebulic Myrobalan | Harro (N): Arura (T) | LT | Fruit, Seed | Nat-W | CE (100-1500) | Saxer [3], Field Survey [32] |
|-----|--------------|--------------------------|-------------------|---------------------|----|-------------|-------|--------------|-----------------------------|
| 13 | Compositae  | Saussurea gossypiphora D.Don | Yazem bawa/ Maikopilia/ Kapse phool (N); byargod-sag-po (T) | PH | Fruit, Seed | Nat-W | CE (3300-5700) | Sherpa [53] |
| 14 | Crassulaceae | Rhodiola crenulata (Hook.f. & Thomson) H. Ohba | Solomarpo (T) | PH | Underground part | Nat-W | E (4800-5300) | IUCN-EN Saxer [3] |
| 15 | Cucurbitaceae | Herpetospermum pedunculosum (Ser.) C. B. Clarke | Ban Karella (N) | HCL | Fruit, Seed | Nat-W | WCE (1500-3600) | DFO KTM [34] |
| 16 | Cunperaceae  | Juniperus indica Bertol. | Juniper / Dhupi (N); shug po (T) | ST | Leaves; Essential Oil | Nat-W | WCE (2800-4800) | IUCN-LC Field Survey [32], DFO KTM [34], Field Survey [33] |
| 17 | Dipterocarpaceae | Shorea robusta Gaertn. | Resin of Shorea robusta Saldhup (N) | LT | Resin | Nat-W | WCE (60-1500) | IUCN-LC; GoN-FTE Field Survey [32] |
| 18 | Elaeocarpaceae | Elaeocarpus angustifolius Bl.; Syn: Elaeocarpus sphaericus (Gaertn.) K. Schum | Utansum Bead Tree | T | Fruit, Seed | Nat-C | CE (700-1700) | IUCN-LC PSCN [24], Field Survey [32] Pyakurel [51], DFO KTM [34] |
| 19 | Elaeocarpaceae | Elaeocarpus lancifolius Roxb. | Bhadrakshya (N) | ST | Fruit, seed | Nat-C&W | E (1000-2010) | Field Survey [33] |
| 20 | Eoleagnaceae  | Hippophae salicifolia D. Don | Seabuckthorn | SH | Fruit, Seed | Nat-W | WCE (2200-3900) | Field Survey [32] |
| 21 | Eoleagnaceae  | Hippophae tibetana Schltdl. | Bhuin Chuk (N); star bu (T) | SH | Fruit, Seed | Nat-W | WCE (3300-4700) | Field Survey [32] |
| 22 | Ephedraceae  | Ephedra gerardiana Wall. ex Klotzsch & Garcke Garcke | Ephedra (N); Riwo Tse-dum (T); 山岭麻黄 (C) | SH | Branches, Leaf, twig | Nat-W | WCE (1100-5400) | CAMP-EN Field Survey [32] He et al. [22] |
| 23 | Ericaceae  | Rhododendron anthropogon D. Don. | Rhododendron | SH | Leaves, twig | Nat-W | WCE (2900-5500) | DFO KTM [34] |
| 24 | Ganodermataceae | Ganoderma lucidum (Curtis) P. Karst. | Livlile mushroom | SH | Leaves, twig | Nat-W | WCE (1600-3000) | Pyakurel and Panthi [23], He et al. [22], DFO KTM [34] |
| 25 | Gentianaceae | Gentiana urnula H. Smith | Gangachung (T) | PH | Whole plant | Nat-W | E (4700-6200) | IU/EN | Saxer [3] |
|----|--------------|-------------------------|----------------|----|-------------|-------|---------------|-------|-----------|
| 26 | Gentianaceae | Swertia chirayita (Roxb.) Buch.-Ham.ex C.B. Clarke | Chireeta | Chirayita, Tite (N); Gyatig, Tigta, Chaktig Nagpo (T); 龙胆 (C) | AH | Whole plant | Nat-G&W | WCE (1200-3000) | CAMP-V | Saxer [3], Phoboo & Jha [60], PSCN [24], Field Survey [32], Cunningham et al. [56], He et al. [22], Pyakurel [13], DFO KTM [34], Field Survey [33] |
| 27 | Hypocreaceae | Ophiocordyceps sinensis (Berk.) G.H.Sung, J.M.Sung, Hywel-Jones & Spatafora; Syn: Cordyceps sinensis (Berk.) Sacc. | Caterpillar fungus | Yarshagumna (N); Yartsa Gumba (T); dong chong xia cao / 里 草 (C) | Fungi | Whole part | Nat-W | CE (3500-5000) | IUCN-V | Amatya [55], Devkota & Shrestha [27], Saxer [3], PSCN [24], Field Survey [32], van Boeckel [54], He et al. [22], Pyakurel [13], DFO KTM [34], Field Survey [33] |
| 28 | Hypoxidaceae | Curculigo orchioides Gaertn. | Black Musli (N); 地棕 (C) | PH | Underground Part | Nat-W | CE (100-1700) | CAMP-V | Field Survey [32], He et al. [22] |
| 29 | Iridaceae | Crocus sativus L. | Saffron | Keshar (N); gur gum, Khache Shakam (T); 藏红花 (C) | PH | Flower | Exo-C | (1500-2500) | Field Survey [32], He et al. [22] |
| 30 | Lauraceae | Cinnamomum tamala (Buch.-Ham.) T.Nees | Dalchini / Tejpat (N); Shingtsa (T); 桂皮 (C) | ST | Leaf and Bark | Nat-G&W | WCE (400-2300) | He et al. [22] |
| 31 | Lauraceae | Machilus odoratissima Nees; Syn: Persea odoratissima (Nees) Kosterm. | Kaulo (N) | Bark of main stem | LT | Nat-W | WCE (300-2200) | Field Survey [32] |
| 32 | Leguminosae | Butea monosperma (Lam.) Taub. | Flame-of-the-forest, Bastard teak | Palas (N) | LT | Fruit, seed | Nat-W | WCE (150-1200) | CAMP-V | Field Survey [32] |
| 33 | Liliaceae | Fritillaria cirrhosa D.Don | Snake’s Head Fritillary | Ban Lasun / Kakoli (N); Aikhashapa (T); 川贝母 (C) | PH | Underground part | Nat-W | WCE (3000-4765) | CAMP-V | PSCN [24], Field Survey [32], He et al. [22], Pyakurel [13], DFO KTM [34], Field Survey [33] |
| No. | Family            | Scientific Name                                                                 | Common Name                    | Part/Parties       | Status/WCE/GoN | WCE Range (m) | Other Sources                                                                 |
|-----|-------------------|--------------------------------------------------------------------------------|--------------------------------|--------------------|----------------|----------------|-------------------------------------------------------------------------------|
| 34  | Lycopodiaceae     | *Lycopodium japonicum* Thunb. ex Murray; Syn: *Lycopodium clavatum var. wallichianum* Spring | Club Moss                      | Nagbri (N)         | Pteridophyta  |               | Nat-W 1600-3960                                                              | Field Survey [32] |
| 35  | Melanthiaceae     | *Paris polyphylla* Sm.                                                        | Love Apple                      | Satuw (N);         | PH             | Underground part | Nat-C&W 1300-3560                                                            | Field Survey [32], van Boeckel [54], He et al. [22], Pyakurel [13], DFO KTM [34], Field Survey [33] |
| 36  | Morchellaceae     | *Morchella esculenta* (L.) Pers.; Synonyms: *Morchella conica* Pers.; *Morchella umbrina* Boud.; *Morchella vulgaris* (Pers.) Gray | Gucci Chyau (N)                 | Fungi               | Whole part     | Nat-W 2000-3500 | Field Survey [32], DFO KTM [34]                                             |
| 37  | Orchidaceae       | *Brachycorythis obcordata* (Lindl.) Summerh.                                   | Gamdol (N)                      | PH                 | Underground part | Nat-W 5800-2600 | CITES II Field Survey [32]                                                   |
| 38  | Orchidaceae       | *Dactylorhiza hatagirea* (D. Don) Soo; Synonyms: *Orchis hatagirea* D.Don; *Orchis latifolia* var. *indica* Lindl. | Salep, Marsh Orchid             | Panchaunle / Hatajdi (N); dbang-lag (T) | PH             | Underground part | Nat-W 2800-4300; CITES II; CAMP-EN; GoN Ban Field Survey [32] |
| 39  | Orchidaceae       | *Dendrobium nobile* Lindl.                                                     | Noble dendrobium                | Sungava (N); PushelTse (T); Sho (C) | Epi H          | Stem             | Nat-W E 300-3400; CITES II; IUCN-VU He et al. [22] |
| 40  | Orchidaceae       | *Gastrodia elata* Blume                                                        | Orchid                          | Sungava (N); Dung phung (T); Thama (C) | Sp H           | Stem             | Nat-W CE 400-3200; CITES II; GoN-RE He et al. [22] |
| 41  | Parmeliaceae      | *Everniastrum nepalense* (Taylor) Hale ex Sipman; Synonyms: *Hypotrachyna nepalensis* (Taylor) Divakar; *Parmelia nepalensis* Taylor | Lichens                         | Jhyau (N); rdo dreg (T) | Lichen whole plant | Nat-W 1000-3000 | GoN-RE Field Survey [32]                                                   |
| 42  | Phyllanthaceae    | *Phyllanthus emblica* L.; Syn: *Emblica officinalis* Gaertn.                    | Emblic Myrobolan / Gooseberry   | Amala (N); Kyarura / Kyaru (T) | ST             | Fruit, Seed     | Nat-C&W 100-1400; Saser [3], DFO KTM [34]                                  |
| 43  | Plantaginaceae    | *Picrorhiza scrophulariiflora* Pennell; Syn: *Neopicrorhiza scrophulariiflora* (Pennell) D. Y. Hong | Gentian                         | Kutki (N); Honglen (T); Husedan (C) | PH             | Underground part | Nat-W WCE 3500-5300; CAMP-V; GoN-Conditonal ban Acharya [52], Sherpa [53], PSCN [24], Field Survey [32], He et al. [22], Pyakurel [13], Field Survey [33] |
| No. | Family       | Species Name                          | Author | Common Names                  | Part Used       | Nat & W | CAMP-V | Field Survey          | Notes on Species list appendix. |
|-----|--------------|---------------------------------------|--------|-------------------------------|----------------|---------|--------|-----------------------|----------------------------------|
| 44  | Polygonaceae | *Rheum australe* D. Don               | Himalayan Rhubarb  | Padmchaal (N); Chum Tsa (T); 紅邊大黃(C) | PH Underground part, Leaf, twig | Nat-W  | WCE (2700-4400) | Field Survey [32], He et al. [22] | a) Species name with author citation following http://www.catalogueoflife.org/col/search/all
b) Catalogue of Life: 2018 Annual Checklist (http://www.catalogueoflife.org/annual-checklist/2018/) for nomenclature of angiosperms, gymnosperms and pteridophytes; and mycobank database (mycobank.org) for fungi and lichens. |
| 45  | Primulaceae  | *Embelia ribes* Burm. F               | Kalikath ko geda, Bayobiding, Kaladan (N) | SH Fruit, Seed | Nat-W  | WCE (400-1600) | DFO KTM [34] | |
| 46  | Ranunculaceae| *Delphinium himalayae* Munz; Syn: *Delphinium himalayense* Chowdhury ex Mukerjee | Aconite Root | Atis Root (N); Bongkar, bya rkang (T) | PH Underground Part | Nat-W  | WCE (2000-4550) | CAMP-V; IUCN-R | Acharya [52], Field Survey [32], He et al. [22], DFO KTM [34] |
| 47  | Ranunculaceae| *Delphinium denudatum* Wall. ex Hook. F & Thomson | Larkspur | Nirmasi (N); bya rkang (T) | PH Underground Part | Nat-W  | WC (1500-3000) | Field Survey [32], DFO KTM [34] | |
| 48  | Ranunculaceae| *Aconitum palma-tatum* D. Don; Syn: *Aconitum bisma* (Buch.-Ham.) Rapaics |  | Bikhma (N) | PH Underground Part | Nat-W  | CE (3200-4500) | Field Survey [33] | |
| 49  | Rhamnaceae   | *Ziziphus xiang-chengensis* Y. L. Chen and P. K. Chou; Syn: *Ziziphus budhensis* K.R. Bhatarai and Pathak |  | Buddha Chitta, Bodhilchi-ta (N) | ST/SH Fruit, seed | Exo-C  | (1200-2000) | IFA [59], DFO KTM [34] | |
| 50  | Rosaceae     | *Argentina lineata* (Trevir) Soják; Synonyms: *Potentilla fulgens* Wall. ex Hook.; *Potentilla lineata* Trevir |  | Cinquefoil, Silver Leaf | PH Root | Nat-W  | WCE (1700-4100) | Field Survey [32], He et al. [22] | |
| 51  | Rubiaceae    | *Rubia manjith* Roxb. ex Fleming      |  | Majitho (N); Tsöpa (T); 茜草(C) | HCL Root, Stem | Nat-W  | WCE (1100-2900) | CAMP-V | Field Survey [32], He et al. [22], DFO KTM [34] |
| 52  | Rutaceae     | *Zanthoxylum armatum* DC.             | Nepalese Pepper | Timur (N) | SH Fruit, Seed | Nat-C & W | WCE (730-3100) | GoN [58], Pyakurel & Panthi [23], Field Survey [32], He et al. [22] |
| 53  | Sapindaceae  | *Sapindus mukorosi-si* Gaertn.        | Soapnut, Beads, Soapberry | Ritha (N) | ST Fruit, Seed | Nat-C & W | W (900-1700) | Field Survey [32] | |
| 54  | Saxifragaceae| *Bergenia cilata* (Haw.) Sternb.      | Rockfoil | Pakhanbed (N) | PH Underground Part | Nat-W  | WCE (900-2500) | Field Survey [32], DFO KTM [34] | |
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