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Threatened ethnomedicinal plants of Dodra-Kwar region of Himachal Pradesh, NW Himalaya

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Abstract
Himachal Pradesh has rich diversity of medicinal flora right from its drier foothills to the high alpine moist meadows. This medicinal flora has been in use from generations for the basic therapeutic purposes by the local communities. Every region of the state has their own healthcare system and the local communities know how to use and conserve these useful natural resources for their future use in a sustainable manner. But, during the last decade a trend of collection of medicinal plants for economic purposes created an extra pressure on the existing wild populations. The present study has been carried out in the remote Dodra-Kwar tehsil of Shimla district. The region is bestowed with rich forests, stocked with a wealth of medicinal flora. The ethno medicinal information about the use of plants was collected from the local people with the aid of semi-structured interviews. The information was collected for the threatened ethnomedicinal flora of the region. A total of 28 Threatened Ethnomedicinal Plants (TEMPs) have been identified from the study region. Among them 8 plant species are IUCN (International Union for Conservation of Nature) Red listed.

Keywords: TEMPs, Ethnomedicinal plants, IUCN, Threatened

1. Introduction
The Himalaya is considered as a rich repository of biological and cultural diversity. The region is one of the most complex and diverse ecosystems due to tremendous variations in eco-climatic conditions, topography and habitat types [1]. It has great floristic wealth and its forest vegetation ranges from tropical dry deciduous forests in the foothills to the moist alpine meadows in the high mountains. A large number of ethnic communities are residing in this region with various dialects, cultures and religions, having core dependency over local forest resources. People in the different parts of the world, by means of trial and error or experimentations and empirical reasoning, have selected and made use of nearby natural resources to meet their day-to-day requirements of life [2]. Apart from the natural resources, the biological, geological and cultural diversity of these specific areas has promoted the creation of vast ethnomedicinal knowledge systems, especially highly developed in relation to human health [3]. Many communities modified their available information on healthcare practices due to several reasons such as invasion of people, trade relations, etc [4]. Such modifications were constantly being revised as per the requirements of the community with time. However, these went undocumented, although it was being passed on successfully from one generation to the next orally, by the means of folklore, odes, etc. With passage of time, the necessity was visualized to document the knowledge that many cultures inherited. The knowledge related to medicinal properties of plants is approximately as old as the human race itself. However, credits of an organized beginning of plant resources as medicine may be attributed to Ayurveda, about 5000 years ago [5]. In South Asia, in addition to Ayurveda, other healthcare systems such as Unani, Siddha, Chinese, Amchi as well as Homeopathy are still under practice, which make use of about 9000 plant species [6]. In India alone, about 2000 species of plants are used in the classical healthcare system; Ayurveda (900), Siddha (800), Unani (700) and Amchi (300) [7]. The use of plants in local traditional medicine for treatment of various diseases is a common practice in most of the rural households living in close proximity to the forest. The major part of traditional medicine is the herbal medicine that is used by 75–80 % of the world's population especially in developing countries as it is considered safer than synthetic drugs [8, 9] and cheaper with easy accessibility too. Globally, around 60,000 have been evaluated for conservation related issues and status by using internationally accepted criteria, out of which

34,000 are classified as threatened with extinction globally [10]. The Botanical Survey of India (BSI) has published Red Data Books [11, 12, 13] using the same accepted criteria which summarise information on 622 threatened Indian Plant species. Apart from this, Rao *et al*. (2003) reported 1255 species of vascular plants under various threats in India [14].

Conservation of medicinal and aromatic plants is also essential as near about 70% of India's medicinal and aromatic plants are collected mostly from wild. The Indian Himalayan Region (IHR), which constitutes around 16 % geographical area of India, contributes over 1750 species of medicinal and aromatic plants i.e., nearly 32 per cent of MAPs found in India[15,16]. In India, only around 2,000 Plants have been studied which are frequently used and traded as Medicinal Plants and only about 500 plants are used in various herbal drugs by pharmaceutical companies [17, 18]. Two-third, of the total estimated Medicinal Plants, are still harvested either from the wild. It is estimated that the wild collection ranges from 80% in counties like China where focus has been shifted on cultivation, to near total wild collection in countries like South Africa (Hamilton 2004). Due to which around the globe, nearly 15,000 species may have been put under IUCN's threatened categories [19, 20, 21]. In India also over 90% of the traded Medicinal Plants are harvested from wild, most of them in an unsustainable manner [22, 23]. Owing to increasing demand for Medicinal Plants, loss and fragmentation of natural habitats, it is feared that about 15-20% of the total vascular flora of India may come under various threat categories of IUCN [24].

Production and development of medicinal and aromatic plants in the state is closely linked with the rural livelihood and traditional healthcare systems, growth of pharmaceutical industries and conservation. In Himachal Pradesh, several previous studies prioritized medicinal and aromatic plants on the basis of their geographical distribution and rarity [25, 26, 27]. Furthermore, some species were prioritized for conservation based on their occurrences in the wild and their uses [27, 28]. Therefore, an attempt was carried to document the traditional knowledge on the use of Threatened ethnomedicinal plants of the region. The study was conducted over a period of five years, from April, 2014 - December, 2019.

2. Materials and Methods

2.1 Study Area

The present study was carried out in the far-flung area of Shimla district in Himachal Pradesh, North West Himalaya also known as the Rupin Valley. Geographically, this region lies between 31°17' to 31°38'North latitudes and 77°99' to 78°29' East longitudes and is bestowed with pristine natural beauty and rich cultural diversity (Figure 1). The entire terrain of the valley is mountainous, being bordered with Uttarkashi district of Uttarakhand in the eastern and southern directions, Chirgaon Tehsil of district Shimla in the west and Sangla Tehsil of Kinnaur district in the far north. Since ancient times, Dodra-Kwar has remained isolated from the outside world due to its difficult geographical conditions and inaccessibility.

Fig 1: Geographical location of the study area

It was during 1988, that the government decided to promote this developmental block into a sub-division, considering the remoteness, inaccessibility and hardships of the area. The area lacked motorable connectivity, and it was only recently

during 2009, that the motorable road reached upto Kwar via Dodra by crossing the mighty Chanshal pass from Rohru via Chirgaon. The elevation of the valley ranges from 1600m to more than 5500m at high peaks such as the lofty Rupin Pass. The high peaks of the valley are covered with snow throughout the year. The climate of the valley is temperate in the summers, with high humidity in the rainy season and harsh winters with heavy snowfall and cold. The high peaks in the valley remains perennially under snow cover representing alpine type of climate. Winters are severe with frosts and snowfalls common during December to February in the middle and upper elevations. The valley receives maximum rainfall in August and September months and rapidly decreases after September. The winter precipitation is mainly in the form of snowfall. The average mean temperature of the valley varies approximately from -10°C to 30°C. The area is a drainage basin of the Rupin River which ultimately carries water to the Tons River.

The valley has about 20 hamlets out of which two are the major villages *viz*., Dodra and Kwar. Other villages of significance are Jiskun, Jhakha, Pujarli and the very remote Pandhar. All the villages are located at about 1700 - 3000 m height amsl. Dodra is located at 2674 m, Kwar at 2590 m, Jakha at 2743 m, Pujarli at 1770 m and Pandhar at 2895 m amsl. As per present day settlements predominantly two communities are residing in the valley and these are mainly Thakurs and Schedule Castes. These are involved in various occupations such as carpentry, weaving, lohar along with farming and shepherds. As per the 2011 census the total number of households was 1215 with a population of 6372.

The forests of the area are the part of Dodra-Kwar forest range under Rohru Forest Division of Shimla Forest circle of Himachal Pradesh. The lower part of the valley is occupied by the broad-leaved trees, while the middle portion is having majority of evergreen coniferous trees and the upper portion is having majority of herbs and grasses. Predominantly three major forest types are observed *i.e.*, Himalayan Moist Temperate Forests, Sub-alpine forests and Moist Alpine Scrubs.

The traditional knowledge regarding Threatened Ethnomedicinal Plants of the region was collected through the semi-structured interviews and informal discussion with the local people [29]. Snowball sampling was also used to locate the particular persons having significantly higher knowledge about the use of these resources. Frequent field visits were carried out in the study area for the collection of requisite data on Threatened Ethnomedicinal Plants for the proper identification and collection of the plant samples. Reconnaissance surveys were conducted for the selection of villages for ethnobotanical information but as the number of villages in the study area are very less (only six), thus all the villages were surveyed. Approximately 15% of the population was interviewed including both the genders with different age classes, with special attention towards elder people and shepherds. Door to Door survey has been carried out in all the villages to collect maximum information, maintaining the distance of roughly 3-4 households between two persons. Field visits were undertaken with few respondents in order to verify the plant species mentioned by the respondents in their interviews. The plant specimens have been collected and identified with the help of various floras [30-36]. The availability of these species in N-W Himalaya (Himachal Pradesh and Uttarakhand) has been confirmed by citing the earlier records [29, 37, 38, 39, 49].

3. Results and Discussion

As per the results obtained, 28 species (Table-1) of the TEMPs are being used in the Dodra-Kwar region for the treatment of various ailments. Out of these only *Saussurea costus* is the cultivated one while all other are collected as wild resource. People of the area have been using these resources for many generations. The elder people have good knowledge about the use and know the probable locations of the occurrence of these species in wild. This indigenous traditional knowledge of the TEMPs has been passed orally from one generation to next without any written documentation. All these species of TEMPs were collected by local inhabitants from surrounding areas of villages, forests and alpine areas within the valley.

As per the present analysis, these 28 TEMPs are being used for the treatment of more than 25 ailments including stomach related disorders, wounds, cuts and burns, headache and dizziness, joint pain, fever, etc (Figure-5). Out of these 8 species are globally identified as threatened by IUCN while 26 are accessed regionally by the Shimla CAMP (Figure-2). As *Saussurea costus* is a cultivated species in the state of Himachal Pradesh, it was not assessed by the CAMP, Shimla. Similarly, *Trillium govanianum* too was not assessed by the CAMP, Shimla as its large scale extraction from the wild was a recent activity, but presently, the rate of its extraction has increased significantly due to its sudden market demand, which has resulted in the reduction of its wild populations. Out of these 28 TEMPs, 61% of the species have not been assessed by the IUCN at global level yet (Fig-3). As per the regional assessments by the CAMP, Shimla only 7% species are not assessed (Figure-4) and *T. govanianum* which is collected from wild resources of the state need to be assessed at state level as its global status also changed as Endangered (EN) in the year 2020.

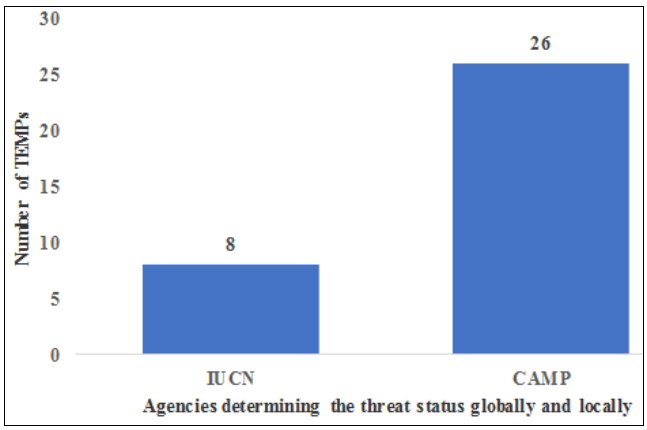

Fig 2: Number of TEMPs as per IUCN and locally at state level as per CAMP, Shimla

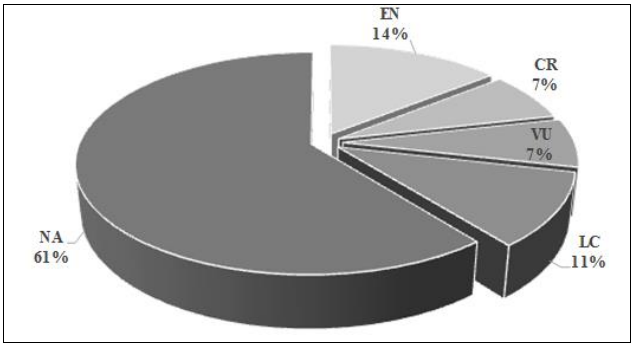

Fig 3: Threat categories of TEMPs in Dodra-Kwar region as per of IUCN at global level

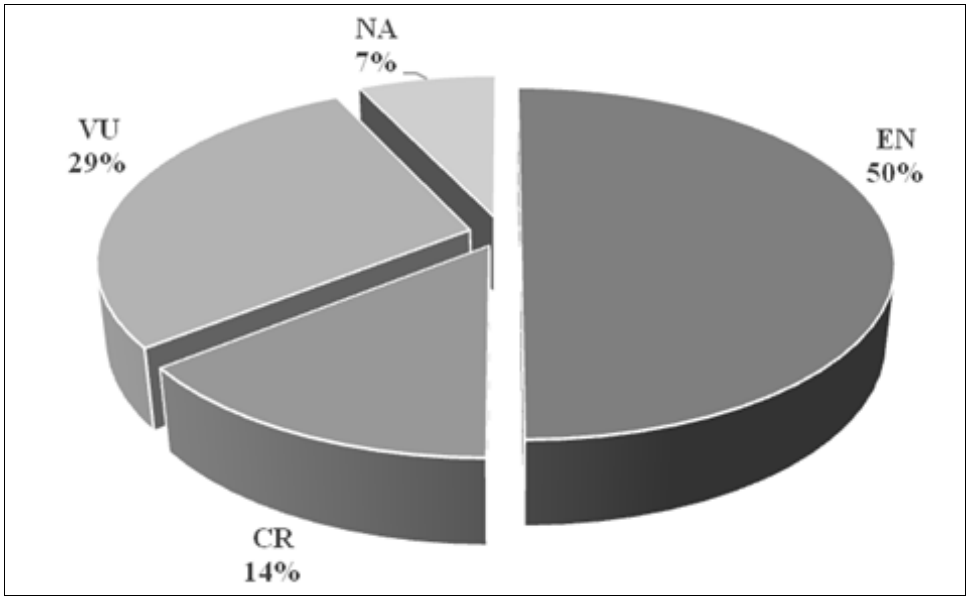

Fig 4: Threat categories of TEMPs of Dodra-Kwar region as per CAMP, Shimla carried out locally at state level

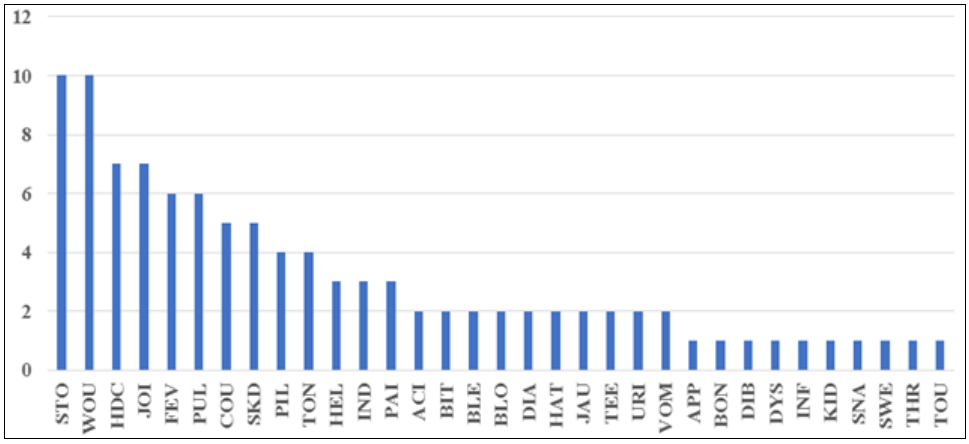

Fig 5: Number of TEMPs used to cure various diseases/remedies in study area

Abbreviations used: WOU= Wound/Cut/Internal injury/Burn, BIT= Animal Bite/Dog Bite, PAI= Pain killer/Body Pain/Leg pain, JOI= Joint pain/Arthritis/ Rheumatism/Knee pain, TEE= Teeth Pain/Teeth problems/Gum problems/Teeth disorder/Mouthwash, PUL= Pulmonary disorder/Chest Pain/Asthma/Chest congestion/Asthmatic problems/Lung pain, URI= Urinary disorder, TON= Health tonic/Body Weight Gain/Against general weakness, DIA= Diarrhoea, COU= Cough/Cold, THR= Throat infection/Throat Pain/Sore throat, VOM= Vomiting, SWE= Body swellings/Muscle sprain, HEL= Anti-helminthic (Intestinal worms), IND= Indigestion/Dyspepsia/Constipation, STO= Stomach disorder/Gastric troubles/Stomachic/ Abdominal pain, TOU= Tongue Ulcer/Tongue deposition/Mouth ulcer, FEV= Fever/High fever/Typhoid like fever, HAT= Hair tonic/Hair dye/Anti hair fall agent, SKD= Body ulcer/Skin diseases/ Boils/Itching/Chickenpox/Allergy, JAU= Jaundice, HDC= Headache/Dizziness, PIL= Piles/Haemorrhoids, BLE= Bleeding/Nasal Bleeding/Extra bleeding in menstruation, DIB= Diabetes, SNA= Snake repellent/Snake bite, KID= Kidney stone, BLO= Blood purifier, DYS= Dysentery, ACI= Acidity, EYE= Eye reddishness/Eye irritation, INF= Infection, BON= Bone Fracture, APP= Appetizer.

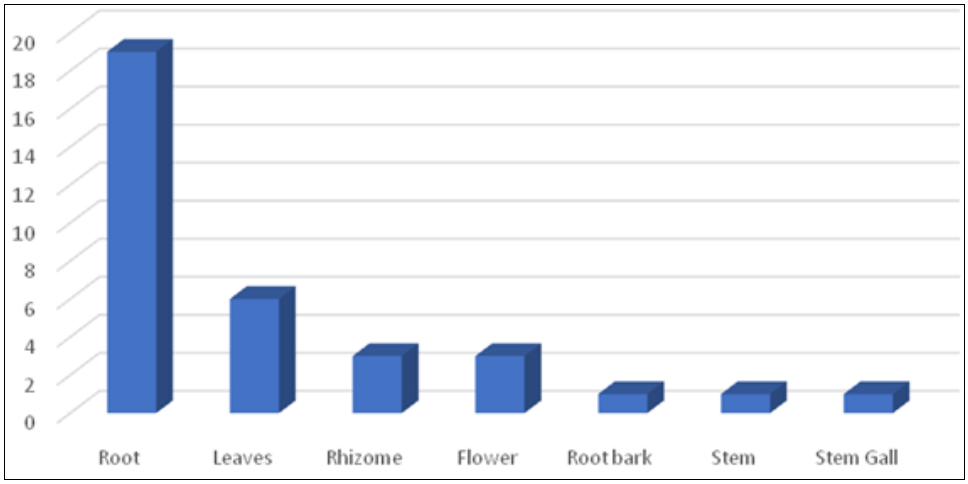

Fig 6: Use of various plant parts of TEMPs to cure various diseases/remedies in study area

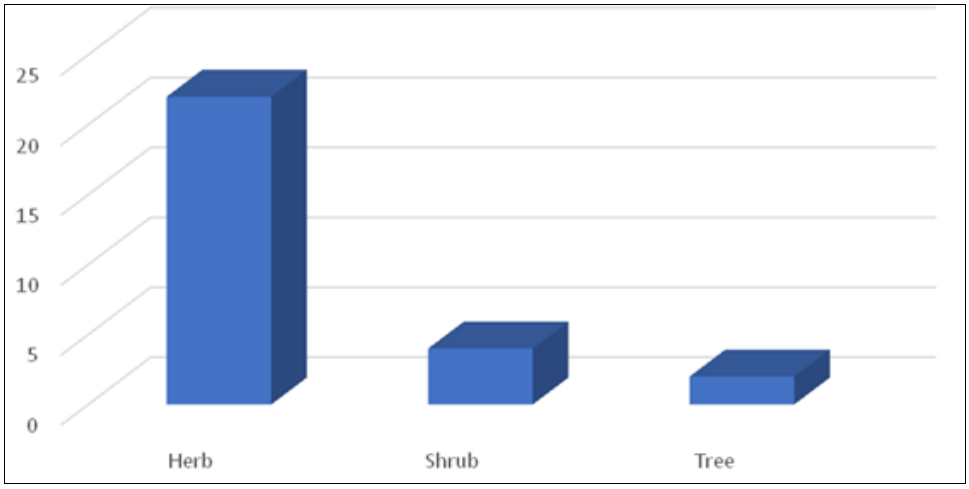

Fig 7: Life forms of TEMPs used to cure various diseases/remedies in study area

As per the analysis, TEMPs of the region are used for a total of 33 diseases/ailments, out of these stomach related problems (STO) and wounds, cuts and burns (WOU) have been treated by maximum number (10) followed by 7 for headache and dizziness (HDC) and joint pain (JOI), 6 for fever (FEV) and pulmonary problems, chest pain and asthmatic problems (PUL), etc (Figure-5). Upon comparisons for the use of various plant parts, the use of underground parts (root, rhizome and root bark) is more in comparison with areal parts (leaves, flower, stem, stem gall) (Figure-6). As per life forms of TEMPs identified, 22 species of these are herbs, 4 shrubs and 2 tree species (Figure-7). When these are observed as per the families, maximum 3 species belong to Apiaceae and Ranunculaceae followed by 2 species each to Asparagaceae, Ericaceae, Melanthiaceae, Polygonaceae and Valerianaceae; followed by other 12 families having single species each (Figure-8). Genera wise only Genus *Aconitum* has 3 species followed by *Polygonatum*, *Rheum* and *Rhododendron*, which has 2 species each, followed by other 19 genera with only single species under the threatened category for Dodra-Kwar (Figure-9).

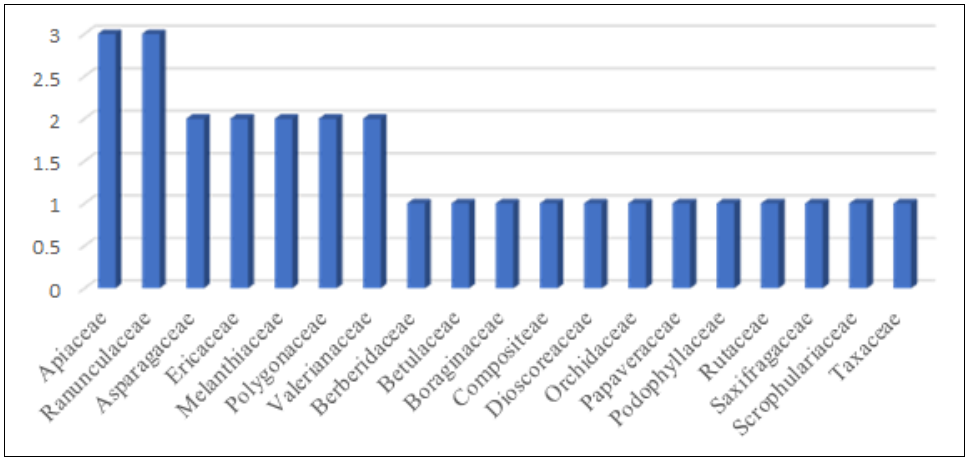

Fig 8: Family wise number of TEMPs species in study area

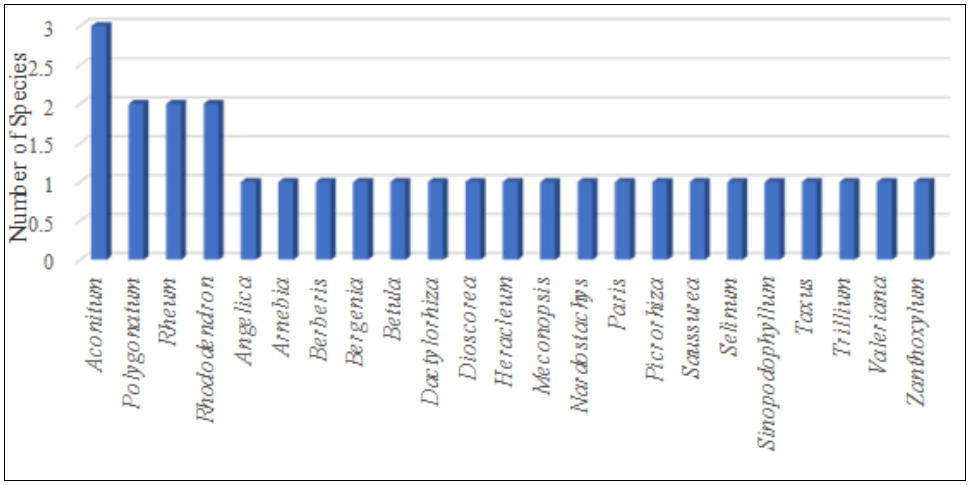

Fig 9: Genera wise number of species of TEMPs in the study area

As per the estimates for the year 2014-15 many of these species are under trade and their respective figures for annual consumption, Annual trade and market prices of these species in Indian market are summarized in Table-2. Out of the 28 species of TEMPs identified in the study area, many species are categorized and banned for trade/conservation concern at national and international level by various agencies (Table-3). Agencies such as IUCN, CITES, Shimla CAMP, worked in this direction to prioritize certain species for conservation.

Table 1: Threatened Ethnomedicinal Plants (TEMPs) with threat status and year of assessment in study area

Scientific name	Family	Vernacular name/s	Habit	Parts used	Diseases/ailments	Collection	IUCN status	CAMP Shimla
Aconitum heterophylloides (Brühl) Stapf	Ranunculaceae	Mohra, Mohrabish, Meetha	H	Rt	Piles, wounds, animal bite, pain killer, joint pain, arthritis, teeth pain, pulmonary disorder, infection, chest pain, urinary disorders	W	NA	CR (2010)
Aconitum heterophyllum Wall. ex Royle	Ranunculaceae	Atish, Patish	H	Rt	Health tonic, diarrhoea, cough, throat infection, vomiting, abdominal pain, intestinal worms, dyspepsia and diabetes	W	EN (2014)	CR (2010)
Aconitum violaceum Jac. ex Stapf	Ranunculaceae	Dudhiyamohra	H	Rt	Rheumatism, piles, stomach disorders in children, tongue ulcers in children, high fever and chest congestion in children	W	VU (2014)	VU (2010)
Angelica glauca Edgew.	Apiaceae	Chora	H	Rt	Stomach disorder, gastric troubles, intestinal worms and snake repellent	W	EN (2014)	EN (2010)
Arnebia benthamii (Wall. ex G. Don) I. M. Johnst.	Boraginaceae	Massarohini, Massaroen	H	Rt	Burns, cuts, wounds, hair tonic and hair dye	W	NA	EN (2010)
Berberis aristata DC.	Berberidaceae	Chotre, Kashmal	S	Rt	Stomachic	W	LC (2018)	EN (2010)
Bergenia stracheyi (Hook. f. & Th.) Engl.	Saxifragaceae	Dhekdu, Pashanbhed	H	Rt, Lv	Kidney stone, piles, burns, indigestion, fever and jaundice	W	NA	VU (2003)
Betula utilis D. Don	Betulaceae	Bhojlu, Bhuj, Bhojpatra	T	Sg	Blood purifier, internal wounds and chest pain	W	LC (2014)	EN (2010)
Dactylorhiza hatagirea(D. Don) Soo	Orchidaceae	Hathajodi, Punja	H	Rt	Wounds, cuts, burns, bone fractures, haemorrhoids, itching, fever, stomachic, constipation, nasal bleeding, health tonic and to gain body weight	W	NA	CR (2010)
*Dioscorea deltoidea*Wall. ex Griseb.	Dioscoreaceae	Ganj, ShingliMingli	H	Rz	Gastric complaints	W	NA	EN (2003)
Heracleum lanatum Michx.	Apiaceae	Osheelo, Harshila	H	Lv, Fl	Headache	W	NA	VU (2003)
Meconopsis aculeata Royle.	Papaveraceae	Jungliaphim	H	Lv	Fever and chickenpox	W	NA	EN (2003)
Nardostachys jatamansi(D. Don) DC.	Valerianaceae	Balchhad	H	Rt, Lv	Anti- hair fall agent	W	CR (2014)	EN (2010)
*Paris polyphylla*Sm.	Melanthiaceae	Satva, Gathiyakuth	H	Rt	Stomach disorder, fever, joint pain, cough and cold	W	VU (2020)	EN (2010)
Picrorhiza kurroa Royle ex Benth.	Scrophulariaceae	Kadwi	H	Rt	Jaundice, dizziness, blood purifier, expectorant in cough, stomach disorder, urinary disorder, vomiting, intestinal worms, appetizer and acidity	W	NA	CR (2010)
Polygonatum cirrhifolium Royle	Asparagaceae	Devninghal	H	Rz	Health tonic	W	NA	EN (2010)
Polygonatum verticillatum (L.) All.	Asparagaceae	Devninghal	H	Rz, Lv	Health tonic and burns	W	NA	EN (2010)
Rheum australe D. Don	Polygonaceae	Aarchha, Chukri	H	Rt	Wounds, cuts, headache, body pain, joint pain, bleeding, joint pain, pulmonary disorders and acidity	W	NA	VU (2010)
Rheum webbianum Royle	Polygonaceae	Aarchha, Chukri	H	Rt	Wounds, headache, body pain and joint pain	W	NA	EN (2010)
Rhododendron anthopogon D. Don	Ericaceae	Thochat	S	Fl	Asthmatic problems	W	NA	VU (2003)
Rhododendron campanulatum D. Don	Ericaceae	Shimrath, Simar	S	Rt, Lv, Fl	Headache, dog bite, itching, boils and dysentery	W	NA	VU (2003)
Saussurea costus (Falc.) Lipsch.	Compositeae	Kuth	H	Rt	Stomach disorders, fever, boils, cough and cold	C	CR (2014)	NA
Selinum tenuifolium Salisb.	Apiaceae	Bhootkeshi	H	Rt	Swellings and knee pain	W	NA	VU (2010)
Sinopodophyllum hexandrum(Royle) T.S. Ying	Podophyllaceae	Bankakri, Kokakri	H	Rt	Body ulcers, cuts, wounds and skin diseases	W	NA	EN (2010)
Taxus wallichiana Zucc.	Taxaceae	Thuna, Thunder, Burmi	T	Rb, Lv, Sh	Asthma and internal defects, headache, cough, cold, asthma and diarrhoea	W	EN (2010)	EN (2010)
Trillium govanianum Wall. ex D. Don	Melanthiaceae	Nagchhatri	H	Rt	Dizziness and joint pain	W	EN (2020)	NA
Valeriana jatamansi Jones	Valerianaceae	Sugandhbala, Mushkbala	H	Rt	Gastric problems	W	NA	VU (2003)
Zanthoxylum armatum DC.	Rutaceae	Timru	S	St	Teeth and gum related troubles	W	LC (2019)	EN (2010)

Table 2: Annual consumption, trade and market values of TEMPs in Indian market

Species name	Annual consumption (MT)		Annual Trade (MT)	Price (Rs./Kg)
	Domestic Herbal industry	Rural Households		
Aconitum heterophylloides	-	-	10-50	-
Aconitum heterophyllum	127.65	25.80	100-200	3500-10500
Aconitum violaceum	-	3.01	10-50	-
Angelica glauca	-	8.17	10-50	-
Arnebia benthamii	-	7.31	100-200	150-220
Berberis aristata	1046.66	49.95	1000-2000	15-55
Bergenia stracheyi	-	-	<10	-
Betula utilis	-	-	100-200	125-300
Dactylorhiza hatagirea	-	9.03	10-50	-
Dioscorea deltoidea	-	-	10-50	-
Heracleum lanatum	-	-	-	-
Meconopsis aculeata	-	-	-	-
Nardostachys jatamansi	528.11	11.14	500-1000	850-900
Paris polyphylla	-	5.57	10-50	-
Picrorhiza kurroa	568.61	15.05	1000-2000	800-900
Polygonatum cirrhifolium	-	-	100-200	250-350
Polygonatum verticillatum	-	-	<10	-
Rheum australe	158.27	33.39	100-200	100-250
Rheum webbianum	-	-	<10	-
Rhododendron anthopogon	-	-	-	-
Rhododendron campanulatum	-	3.22	10-50	-
Saussurea costus	164.65	-	100-200	250-350
Selinum tenuifolium	-	-	-	-
Sinopodophyllum hexandrum	-	0.10	10-50	-
Taxus wallichiana	-	-	100-200	45-50
Trillium govanianum	-	-	200-500	2000-2500
Valeriana jatamansi	207.53	1.28	1000-2000	370-425
Zanthoxylum armatum	237.78	219.19	200-500	100-200
	Source: Goraya and Ved, (2017)			

Table 3: Status of the TEMPs sorted by various agencies for threat categories and trade

Sr. No.	Species	IUCN	CITES	CAMP	Export-ve list	MoEF&CC	FRLHT	Trade Rank
1.	*Aconitum heterophylloides*	-	-	CR	Y	Y	EN	LT
2.	*Aconitum heterophyllum*	EN	-	CR	Y	Y	CR	HT
3.	*Aconitum violaceum*	VU	-	VU	Y	Y	-	-
4.	*Angelica glauca*	EN	-	EN	-	Y	EN	LT
5.	*Arnebia benthamii*	-	-	EN	-	Y	CR	HT
6.	*Berberis aristata*	LC	-	EN	-	Y	-	-
7.	*Bergenia stracheyi*	-	-	VU	-	-	-	-
8.	*Betula utilis*	LC	-	EN	-	-	CR	HT
9.	*Dactylorhiza hatagirea*	-	-	CR	Y	-	CR	LT
10.	*Dioscorea deltoidea*	-	II	EN	Y	Y	EN	LT
11.	*Heracleum lanatum*	-	-	VU	-	-	-	-
12.	*Meconopsis aculeata*	-	-	EN	-	Y	EN	LT
13.	*Nardostachys jatamansi*	CR	-	EN	-	Y	CR	HT
14.	*Paris polyphylla*	VU	-	EN	-	-	EN	LT
15.	*Picrorhiza kurroa*	-	II	CR	Y	Y	CR	HT
16.	*Polygonatum cirrhifolium*	-	-	EN	-	-	EN	HT
17.	*Polygonatum verticillatum*	-	-	EN	-	-	-	-
18.	*Rheum australe*	-	II	VU	-	-	EN	HT
19.	*Rheum webbianum*	-	-	EN	-	-	EN	LT
20.	*Rhododendron anthopogon*	-	-	VU	-	Y	EN	LT
21	*Rhododendron campanulatum*	-	-	VU	-	Y	-	-
22.	*Saussurea costus*	CR	I	-	Y	-	CR	-
23.	*Selinum tenuifolium*	-	-	VU	-	-	-	-
24.	*Sinopodophyllum hexandrum*	-	II	EN	Y	Y	CR	LT
25.	*Taxus wallichiana*	EN	II	EN	Y	Y	CR	HT
26.	*Trillium govanianum*	EN	-	-	-	-	-	LT
27.	*Valeriana jatamansi*	-	-	VU	-	Y	VU	HT
28.	*Zanthoxylum armatum*	LC	-	EN	-	-	EN	HT

4. Conclusion

TEMPs of the Dodra-Kwar region have been traditionally gathered and used by the locals for more than 25 diseases/remedies, but for now, the trend has been changed and these species are gathered more prominently for economic gains rather than their daily household needs. This unsustainable extraction of medicinal plants has created unnecessary pressure on the natural populations of these

species in the wild, bracing them in the category which is designated as threatened. As per the present study, 28 TEMPs species were reported with their use documented, but further studies for accessing their population sizes needs to be undertaken so that future conservation and management approaches or strategies for the protection of these TEMPs can be planned. Their mapping with advanced GIS tools will also be an added benefit to the managers/planners. Species such as *T. govanianum* which was not considered by the CAMP, Shimla for assessment at the state level should be assessed in the future CAMP workshops, as its global status has been changed to Endangered by IUCN.

Declaration of competing interest

The authors declare no conflict of interest.

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