

THREATENED PLANTS OF TUNGAL VALLEY. NORTH WESTERN HIMALAYAS: THEIR DIVERSITY, DISTRIBUTION, INDIGENOUS USES AND NEED OF CONSERVATION.

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ABSTRACT

Western Himalayas is a rich store house of plant diversity, radially utilized as a source of food, fodder, fuel, timber, medicine and materials by local communities due to tremendous nutritive, medicinal and economic values of these wild floral elements. From recent few years with advancement in technology, changed food habits and life style of even a common man, there is outbreak of many serious diseases. Therefore, search for medicinal plants, their processing, utilization and marketing has gained attention round the world. Himachal Pradesh being top repositories of medicinal herbs among the states lying in Western Himalaya is also one of the major sources of raw material of important medicinal plants to the global market. So, many important plants whose reproductive parts are utilized for medicinal purposes are harvested from natural habitat unsustainably. This unsustainable extraction of medicinal herbs has threatened several high value taxa. So present study has been undertaken to document threatened plants of the Tungal Valley lying Tungal Tehsil (31°75'70.3 " N latitudes and 76°87' 32.5" E longitudes) of Mandi district of Himachal Pradesh, North West Himalaya covering approximately 64.04 hectare land and 64 villages. The total human population of study area is 25,860. and altitudinal range varies from 1150-2100m. Threat categories of the species documented in present study have been calculated based on habitat, distributional range, nativity, wild status, UV and its DMR value of the plants, Total 30 plant species (Herbs=13, Shrubs= 6, Tree= 11) belonging to 21 families and 29 genera has been documented as threatened plants. Among families Liliaceae was found dominant represented by 3 spp and among genera *Polygonatum* was dominant represented by 2 spp. These plants were abundant in past but their natural population in natural habitat has declined significantly from last few years due to over exploitation, habitat fragmentation and climate change. All the threatened attributes were divided into three grades; highest (10 marks); subsequent (6 marks) and least (2 marks). The species fulfilling all the attributes in highest grade resulted in highest CU (cumulative values). On the basis of CU score plants were categorized as critically endangered (CR), endangered (EN) and vulnerable (VU). To ensure sustainable harvesting of assessed plants mass awareness and ex-situ cultivation through community involvement is looked as probable solution to meet raw material market demand and diluting in-situ extraction pressure.

KEYWORDS: Threatened, Tungal valley, unsustainable, extraction, conservation.

INTRODUCTION

Himalaya being a great reservoir of biological diversity is well known for floral elements which is Important from aesthetic, medicinal and nutritional points of view. According to estimate between 35,000 and 70,000 plant species are used in medicine worldwide^[1,2,3] from ancient time and many of them are still in use. But from last few decades we have witnessed exponential growth of industrial agriculture, rapid urbanization, modernization, increase in pollution, disease outbreak, population explosion, climate change, dwindling of forest and semi-forest lands etc. leading to loss of many of these

important wild floral element.^[4,5,6,7] The loss of habitats, especially the conversion of tropical forests into agricultural and urban areas, is the main driver of the biodiversity crisis we are observing today.^[8] The biodiversity studies all over the world has clearly indicated that we have entered into a phase of mass extinction^[9] and have altered half of the habitable earth surface. Over exploitation and habitat degradation are the two major factors responsible for the population depletion of species all across the IHR^[10,11] including Tungal Valley of District Mandi HP. Further during and after COVID-19 there will be a significant increase in

collection and harvesting practice of immunity boosting floral elements leading to risk of threatening of medicinal plants which are already in the list of threatened species and even to those which are abundant at present in natural habitat.^[11] In view of these ongoing threats, it is important to identify and prioritize the floral elements for conservation at local, regional and global levels. Such type of studies has not been attempted for Tungal Valley of Mandi district of HP Therefore present attempt has been made to access the threatened plants of Tungal area with following objectives.

METHODOLOGY

Study area



Fig.1: Google map and general view of study area.

The present study has been conducted in Tungal Valley (31°75'70.3" N latitudes and 76°87' 32.5" E longitudes) of Mandi district Himachal Pradesh. It covers approximately 64.04 hectare area comprising 16 panchayats and 64 villages with 5,775 households. The total human population of study area is 31,032 and livestock population is 2,216. Altitudinal range of study

1. To know diversity, distribution nativity and wild status of threatened plants of Tungal Valley of District Mandi HP.
2. To know the indigenous uses, plant parts utilized and their role in nutritional, medicinal and economic upliftment of rural community.
3. To list up the factors responsible for threatening of documented plants.
4. To ensure sustainable harvesting and conservation.
5. Conclusion and future prospectus.

area varies from 1150 -2100m. It supports diverse habitat, species, communities and ecosystems. The vegetation mainly is of sub- tropical and temperate types and mainly covered with lush green forests of oak and *Cedrus deodara*. Tungal Valley comprises kotli town and surrounding areas. Rachera Dev Temple, Mahan Dev Temple, Kali Mata Temple, Janitri Mata Temple, Nagan

Mata Temple, Jhumbari Jogni Mata Temple are the main temple of the area. Jhumbar Dhar located at an altitude of 2100m from sea level is highest peak of the area having plants of temperate region Fig.1. (Data collected from Panchayat Pradhan, Amar ujala E- paper 2017, DPF).

METHOD

On the basis of People's Biodiversity Registers studies of 16 panchayats falling in Tungal Valley 30 plants spp. were declined significantly from natural habitat and thus facing risk of extinction. So, these are further accessed for threat categorization in present study.

Survey and sampling of threatened plants was done (Rapid) between amsl 1150-2100m in the study area. 10 villages at different altitudinal range were selected to collect sample and information regarding threatened plants (Table 1 & Figure 1).

Identification of samples was done with the help of local and regional floras.^[12,13,14,15,16,17,18,19] The species indicating its first record/origin from the Himalayan Region have been considered as natives.

Threat categories of the species have been identified based on habitat, distributional range, nativity, wild status, UV and its DMR value, To know the multiple uses of plants, criteria for data collection and analysis was (0= not used, 1=least used, 2=less, 3=good, 4=very good, 5=best).

Use Value index (UV) was used to assess the relative use, importance and present or past status hence threat categorization of each plant listed in present study. Different types of UV was calculated: a General Use Value (UV general), based on citations of that species recorded in the interviews; a Current Use Value (UV current), based only on the citations of plants reported by the informants for uses still practiced at the present time; a Past Use Value (UVpast), based on the citations of plants reported by the informants as used only in the past.

Parameters used for the threat categorization

All the threatened attributes divided into three grades; highest (10 marks); subsequent 6 marks and least 2 marks. The species fulfilling all the attributes in highest grade resulted in highest CU(cumulative values) and one which falls in least grade for every attribute resulted in least cumulative values (Table 1.)

Table 1: Parameters used for the threat categorization.

Scores	Altitudinal Range (m)	H/Hs	Uv	Native & Endemic	DMR
10	1100-1400m	1	>0.5	Native & Endemic	20-30
6	1500-1700m	2-3	0.3-0.5	Non-native & Native	10-20
2	1800-2100m	>3	<0.3	Non-native	1-10

Abbreviation used: H/s= Habitat (s), Uv= Used value.

The species having ≥ 40 CU were considered as Critically Endangered; 20- 30 as Endangered; 10-20 as Vulnerable; and 0 -10 as Near threatened.

Table.2 : List of Villages selected at different altitudinal range for gathering information.

S. No.	Village Name	Altitude (m)	Latitude	Longitude
1.	Kushmal	1150	31°76'11.5"N	76°86'17.8"E
2.	Tungal	1245	31°75'99.0"N	76°87'11.8"E
3.	Nagan	1596	31°72'35.2"N	76°86'74.0"E
4.	Ropru	1665	31°71'99.5"N	76°85'22.2"E
5.	Janitri Dhar	1858	31°78'04.3"N	76°81'49.3"E
6.	Jhumbar dhar	2100	31°71'73.0"N	76°84'35.3"E
7.	Baggi	1330	31°72'37.2"N	76°87'92.7"E
8.	Kumharda	1380	31°78'81.0"N	76°81'17.9"E
9.	sain	1408	31°76'34.2"N	76°83'48.8"E
10.	Bhargaon	1268	31°78'42.6"N	76°86'55.3"E

Information on altitudinal range, habit, habitat (s) and utilization pattern of threatened plants was gathered by interviewing knowledgeable persons and Government officials of agriculture, horticulture and forest department through questionnaire (Table. 2, 3).

Table. 3: List of Key Informants of study area.

S. No.	Name	Age	Gender	Address	Occupation
1.	Bresti Devi	68	F	Village Kushmal, P.O- Saletar, Teh-Tungal	Hakim
2.	Churamani	65	M	Village Kushmal, P.O- Saletar, Teh-Tungal	Agriculture
3.	Balam Ram	59	M	Village Sain, P.O- Sain, The Tungal	Forest Guard
4.	Kusuma Devi	38	F	Village Kushmal, P.O- Saletar, Teh-Tungal	Panchayat pradhan
5.	Poonam Kumari	40	F	Village suradi, P.O.- Suradi , Teh- Tungal	Farmer
6.	Khem singh	48	M	V.P.O.- Bhargaon, Teh- Tungal	Agriculture
7.	Meena Kumari	38	F	V.P.O.- Dwahan, Teh- Tungal	Farming
8.	Surajmani	63	M	Village Kushmal, P.O- Saletar, Teh-Tungal	Agriculture
9.	Rewatu Ram	70	M	Village Dandhal, P.O.- Sain, Teh- Tungal	Farming
10.	Biri singh	57	M	Village Blahar P.O.- Tungal, Teh- Tungal	Farming

RESULT & ANALYSIS

1. Diversity, distribution, nativity and wild status, of threatened plants of Tungal Tehsil of District Mandi HP:

Total 30 plant species (Herbs=13, Shrubs= 6, Tree= 11) belonging to 21 families and 29 genera has been assessed for threat categorization. Among families Liliaceae was

found dominant represented by 3 spp and among genera *Polygonatum* was dominant represented by 2 spp. These plants were abundant in past but their natural population in natural habitat has declined significantly from last few years due to overexploitation, habitat fragmentation and climate change. (Table 4. Fig. 2, Fig. 6)

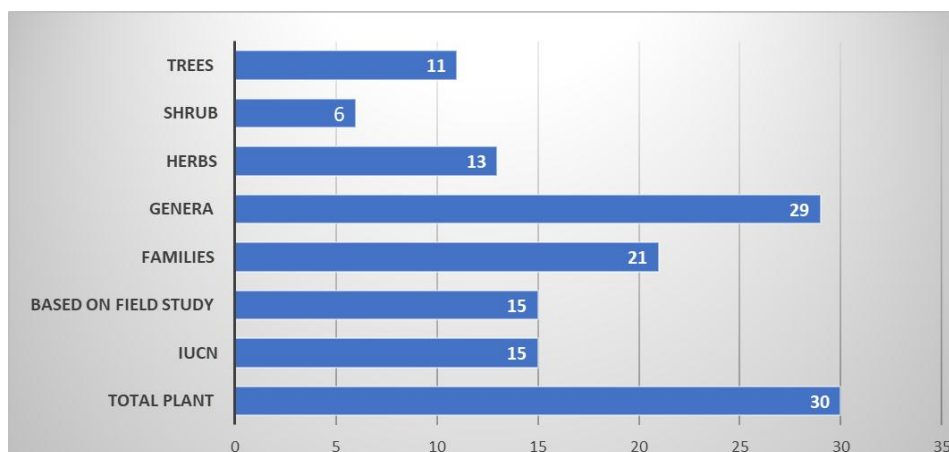


Fig. 2 Threatened plants and diversity of their life forms.

1.1: Distribution: 8 plants species were distributed between 1100-1400m, 7 spp from 1500-1700m and rest of 15 were distributed 1800-2100m (Table. 4).

1.2: Nativity: Out of total 30 plants 17 were native (Regional to Himalayas) and 13 were non-native. (Table. 4)

1.3: Threat categorization: Threatened plants of Tungal valley were into three main categories Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) on the basis of field study. (Table. 4, 5 & 6; Fig. 3 & 6).

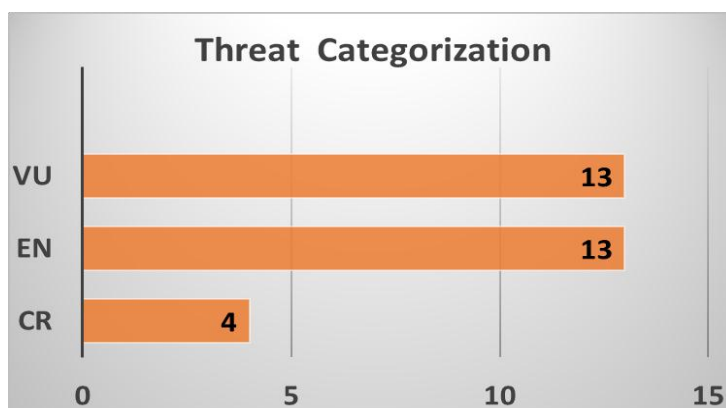


Fig 3: CR; Critically endangered, EN: endangered, VU: Vulnerable.

Table 4: Diversity, distribution, nativity and wild status, of threatened plants of Tungal Tehsil of District Mandi HP.

Family/ Botanical Name/ Common Name	Altitude/ Life Forms	Nativity	Parts used	Wild Status	Market Value	Indigenous Use
Acoraceae						
<i>Acorus calamus</i> (Bare)	Upto 2100m (H)	USA and canada	Wp	EN	Rt powder=1,225/kg	Md (Carminative, diaphoretic, anodyne, sedative, stimulant) Ed, Fd,
Araceae						
<i>Arisaema tortuosum</i> (Kedae ki chhali)	1150-1700m (H)	Reg Himal	Rt, Bu	EN	NA	Md (Body swelling in cattle)
Asparagaceae						
<i>Asparagus adscendens</i> (satawari, Sansarpali)	1150-1600m (S)	Reg Himal afgan	St, Lf, Rt	EN	Rt powder= 1,725/kg Wp powder=3,990/kg	Md (dysentery, tonic, veterinary); Ed; RI,
Asteraceae						
<i>Ageratum houstonianum</i> /goat weed/ Ujadu	1200-1800m (H)	Reg. Himal	Lf, Rt	EN	NA	Md (Antinematocidal, anti-inflammatory, anticoagulant, smooth muscle relaxant, haemostatic, analgesic, antifungal, antibacterial and hypothermic), Fd Ed,
<i>Circium arvense</i> (chuli)	1150-1500m (H)	New York	Rt	VU	NA	Md (Headache & giddiness) Ed, Fd.
Berberidaceae						
<i>Berberis aristate</i> /Kashmal	1800-2100m (S)	Ind oriental	St, Rt, Br, Lf	EN	(Fr)= 1000/kg (St)=375/kg (Rt) powder =1,225/kg	Md (Jaundice, eye disease); Edible (flower & fruits used as chatni), Ed, Fd,
<i>Podophyllum hexandrum</i> /Bankakari	Upto 2100 (H)	The Mediterranean and Western Asia	Lf, Fr	EN	Rt-1200/kg	Md (Rhizome and roots are hepatic stimulant, cholagogue, purgative, and bitter tonic. Anti-cancerous, anti-viral, anti-bacterial). (Astavagra) Ed, Fd
Bignoniaceae						
<i>Oroxylum indicum</i> / Tatpalanga	1150-1500m (T)	As Trop.	Lf, Fl, Fr& Sd	CR	NA	Md (Antidote to snake bite, body chest pain, cholera, colic, diarrhoea, dysentery, epilepsy, fever, headache, induce conception, jaundice, madness, miscarriage, piles, pimples, smallpox, sores, spleen complaints, scabies, stomachache, tonic, Induce conception, veterinary wounds); Ed; Fl, Fd,
Boraginaceae						
<i>Cynoglossum lanceolatum</i> (Hound's tongue)	1100-2100m (H)	Reg. Trop.	Lf	VU	NA	Md(diaphoretic, diuretic expectorant anfebrifuge).Fodder, Economic value, Religious value.
<i>Onsoma hispidum</i> / Gauzaban	1700-2000m (H)	U.S.	Rt	EN	Fl(dried)-6,900/kg	Md (Laxative, anthelmintic, treat eye disease, Anti-cancerous, anti diabetic, used for hair growth), Ed, Fd,

Colchicaceae						
<i>Gloriosa superba</i> (glory lily, flame lily)	Upto 2100m (H)	Trop and southern Afr and Asia	Tu, Fr, Lf	EN	Sd= 1800 /kg Rt dried= 3,850/kg	Md (anti- malarial, antifungal, Anthelmintic, purgative tonic), Ed, Fd,
Cupressaceae						
<i>Juniperus communis</i> / <i>Hauber</i>	1400-2100m (T)	Alaska east to Labrador and S. Greenland	Ap,	EN	Sd-3500/kg	Md (Aerial parts used for acute and chronic cystitis, albuminuria, catarrh of bladder, renal suppression, leucorrhoea, stimulant, disinfectant, dropsy, piles and painful swellings.), Fd, Fl,
Euphorbiaceae						
<i>Euphorbia roylaena</i> (Choochin)	1200-1400m (S)	Reg Himal	La	EN	NA	Md (Stop bleeding, cuts, skin disease) Ed,
<i>Ricinus communis</i> (Arandi)	1200-1500m (S)	Reg Trop	Sd, Lf	CR	Sd =1,750/kg Sd oil=1,295/l	Md (Abortifacient, skin problem, swelling), Ed
Fabaceae						
<i>Butea monosperma</i> (Palas)	Upto 1400m (T)	Ind Burma	Wp	EN	Fl(dried)=765 /kg Fl powder = 2,450/kg Sd= 479/kg Fl oil=1,995/kg	Md (Pimples cooling, gum, wounds, eye disease); Ed; Rl; Household, Fl.
Hypericaceae						
<i>Hypericum</i> <i>perforatum/ Basant</i>	1600-2100m (S)	Europe	Fl, Lf,	EN	Sd- 2,680/kg Hydrosol-800/l	Md, (Wounds, boils) Ed Fd, Rl.
Juglandaceae						
<i>Juglans regia</i> (akhrot) <i>Juglans</i> <i>regia</i> (akhrot)	1200-1700m (T)	Reg Himal	Br, Fr	EN	(Sd)=300-500/kg (Br)=250/kg (Fr)oil=4,050/L (Fr)powder=3,250/kg	Md (Frost bite, rheumatism, sores of toes, toothache); Ed; Rl; Insecticidal, Fl.
Lamiaceae						
<i>Hyssopus officinalis</i> / <i>Juffa</i>	Upto 2100m (H)	Southern Europe.	Lf	EN	Essential oil-13,060/l Hydrosol- 602/l Dry Lf-1,540/kg	Md (Antimicrobial, antioxidant, Anti viral . crude extract of the dried leaves of <i>H. officinalis</i> were also tested for its effectiveness on inhibition of HIV replication. It is also used to treat CNS disorders.), Fd
<i>Leucas lanata</i> (Ban- gugal dhooop)	1150-1700m (H)	Ind or China	Wp	EN	Wp powder=1,036/kg	Md (Headache, stomachache, wounds)Ed, Fd,
Liliaceae						
<i>Dioscorea deltoidea</i> / <i>Shingali mingali</i>	1400-2100m (H)	Ind Or	Lf	EN	(Rz)=1,022.61/kg (Tu)=8,750/kg	Md, Fd, Ed
<i>Polygonatum</i> <i>cirrhiifolium/Salam</i> <i>Mishri</i>	1700-2100m (H)	Europe, Asia.	Lf, Rt	EN	Lf Dried-2400/kg Raw herbs -1950/kg	Md (Cardiotonic, stimulant, tonic, carminative, Boost immune system, aphrodisiac, pain in kidneys and hips, skin eruption and coughs.) Ed, Fd
<i>Polygonatum</i> <i>verticillatum/ Salam</i> <i>Mishri</i>	1800-2100m (H)	Europe, Asia.	Lf, Rt	EN	(Rt)Dried= 2,184.30/kg (Sd)=60,000/kg (Lf)dried=37,500/kg	Md (Nervine tonic) Ed, Fd
Lauraceae						
<i>Cinnamomum</i> <i>tamala/Tejpatta</i>	Upto 2100m (T)	Reg Himal	Br, Lf	EN	(Lf)dried=350/kg (Lf)=650/kg	Md (Heart & throat problem); Ed, Fd,

					(Lf)powder=1400/kg (Lf)extract=9,950/L	
<i>Litsea glutinosa/ Meda lakri</i>	1150-1900m (T)	Ind Or Malaya	Rt, Br & Lf	CR	Wood powder- 1400/kg Essential oil- 9,990/l	Medicinal (Astringent, boils, rheumatism, veterinary sores, ulcer); Ed, Fl, Fd,,AT
Malvaceae						
<i>Sida rhombifolia (Broom jute)</i>	Upto 1200m (S)	Reg. Himal	Lf, Sd	EN	WP (Dried)= 4,960/kg	Md (The roots and leaves are bitter, sweet, emollient, cooling, aphrodisiac, unctuous, and vigour strengthening and promote sexual vigour and vital factor.), Ed,Fd, Rl
Meliaceae						
<i>Toona ciliate (Tooni)</i>	1300-1700m (T)	Malaya Austr	Br, Lf, St	EN	NA	Md(Antiseptic, fever, gastric Problems); Household (Construction purpose, furniture, other article) Fd, Fl, Rl.
Rutaceae						
<i>Citrus jambhiri (jhamiridi)</i>	1200-1400m (T)	Reg. Himal	Fr	CR	Hydrosol= 756/l Fruit peel= 495/kg	Medicinal (cure cold, astringent, bactericide) Ed, Fl, Rl .
<i>Zanthoxylum armatum/ Tirmira</i>	Upto 2100m (T)	Reg Himal China	Sd, Lf, St, Fr	EN	Sd-850/kg Sd oil- 15,440/l	Md (Cough, cholera, fever, eczema, itch, piles, tonic, toothache) Ed,
Styraceae						
<i>Symplocos paniculate/Lodh</i>	1150-2100m (T)	Reg Himal Burma China Japan	Fr, Fl, Br	EN	NA	Md (Astringent, diarrhoea); Fuel, Fodder, Edible, Economic value, Agricultural tools,
Taxaceae						
<i>Taxus contorta /Rakhal/ Birmi</i>	1600-2100m (T)	Himalayan parts of south east Asia	Br, Sd, fr	CR	NA	Md (Anticancerous , tinctures, antispasmodic, aphrodisiac, sedatives, asthma, bronchitis, epilepsy), Ed, Fd, Fl,

Abbreviation: Lf-leaf; Fr- fruit; Fl- flower; Sd- seed; St- stem; Rt- root; Br- bark; Ap- apical part; Wp- whole plant; Tu- tuber; Bu- bulb; H-herb; S- shrub; T- tree;

VU- vulnerable; CE- Critically endangered; EN- endangered e; VU- Vulnerable.

Table.5; Threat categorization based on threatened attributes.

Botanical Name	Used value (Uv)			Score for Uv	H/ Hs	Score for Habitat	Score of DMR	Score of Altitudinal score	CV value (Cumulative value) (Uv+Hs+DMR+AL)	Threat categorization
	General	Current	Past							
<i>Berberis aristate</i>	0.22	0.11	0.22	2	1,3,7	6	6	2	16	VU
<i>Cinnamomum tamala</i>	0.36	0.16	0.18	6	1,6,10	6	6	2	20	VU
<i>Dioscorea deltoidea</i>	0.45	0.20	0.36	6	6,3	6	6	2	20	VU
<i>Hypericum perforatum</i>	0.48	0.20	0.24	6	7,9	6	6	2	20	VU
<i>Hyssopus officinalis</i>	0.22	0.11	0.22	2	7	10	6	2	20	VU
<i>Juniperus communis</i>	0.36	0.18	0.36	6	6,10	6	6	6	24	EN

<i>Litsea glutinosari</i>	0.30	0.15	0.28	6	1	10	10	6	32	CR
<i>Onsoma hispidum</i>	0.22	0.18	0.20	2	1	10	6	2	20	EN
<i>Oroxylum indicum</i>	0.26	0.13	0.20	2	1	10	6	10	28	EN
<i>Podophyllum hexandrum</i>	0.40	0.20	0.30	6	6	10	6	2	14	EN
<i>Polygonatum cirrhifolium</i>	0.28	0.14	0.20	2	4,6,10	6	6	2	16	VU
<i>Polygonatum verticillatum</i>	0.24	0.12	0.20	2	4,6,10	6	6	2	16	EN
<i>Symplocos paniculate</i>	0.20	0.10	0.20	2	6,9	6	6	6	20	VU
<i>Taxus contorta</i>	0.25	0.11	0.20	2	6	10	10	6	34	CR
<i>Zanthoxylum armatum</i>	0.64	0.23	0.32	10	4,7,10	6	10	2	28	EN
<i>Arisaema tortuosum</i>	0.30	0.28	0.20	6	1,7	6	2	6	20	VU
<i>Asparagus adscendens</i>	0.54	0.23	0.40	10	1,7,9	6	6	6	28	EN
<i>Euphorbia roylaena</i>	0.60	0.20	0.30	10	1,4,7	6	2	6	24	EN
<i>Ricinus communis</i>	0.40	0.22	0.36	6	8	10	6	10	32	CR
<i>Butea monosperma</i>	0.45	0.23	0.36	6	6	10	6	6	28	EN
<i>Juglans regia</i>	0.64	0.32	0.64	10	1,6,8,10	2	10	6	28	EN
<i>Toona ciliate</i>	0.40	0.26	0.32	6	1,6,9	6	10	6	28	EN
<i>Circium arvense</i>	0.36	0.18	0.36	6	1,4,7,8,	2	6	2	16	VU
<i>Leucas lanata</i>	0.25	0.12	0.20	2	1,7	6	6	6	20	VU
<i>Acorus calamus</i>	0.45	0.18	0.40	6	1,9	6	6	2	20	VU
<i>Gloriosa superba</i>	0.34	0.17	0.20	6	1,8	6	6	2	20	VU
<i>Citrus jambhiri</i>	0.52	0.21	0.45	10	1,7,10	6	10	10	36	CR
<i>Ageratum houstonianum</i>	0.46	0.12	0.20	6	4,5,7,	6	10	6	28	EN
<i>Cynoglossum lanceolatum</i>	0.36	0.16	0.18	6	1,2,9	6	2	2	16	VU
<i>Sida rhombifolia</i>	0.50	0.23	0.32	6	3,5,7	6	6	10	28	EN

Abbreviation: UV= Used Value; H/Hs= Habitat. Habitats; DMR= Direct Matrix Ranking; CV Cumulative Value= ; VU- vulnerable; NT- near threatened; EN- endangered value; NA- not applicable.

2. To know the indigenous uses, plant parts utilized and their role in nutritional, medicinal and economic upliftment of rural community.

Local people depends on floristic diversity in fulfilling their basic needs of food, medicine and materials. 27

threatened plants in present study are rich in nutritive, medicinal and economic values, so useful plant parts of these plants like leaves, tender shoots, fruits, seeds, buds, flowers, roots or other underground parts are utilized as source of food, oil, fibre, fuel, fodder, timber, household items, medicine and materials. Among plant parts utilized maximum leaves (18) are utilized indigenously followed by roots (9) and Fr (8).

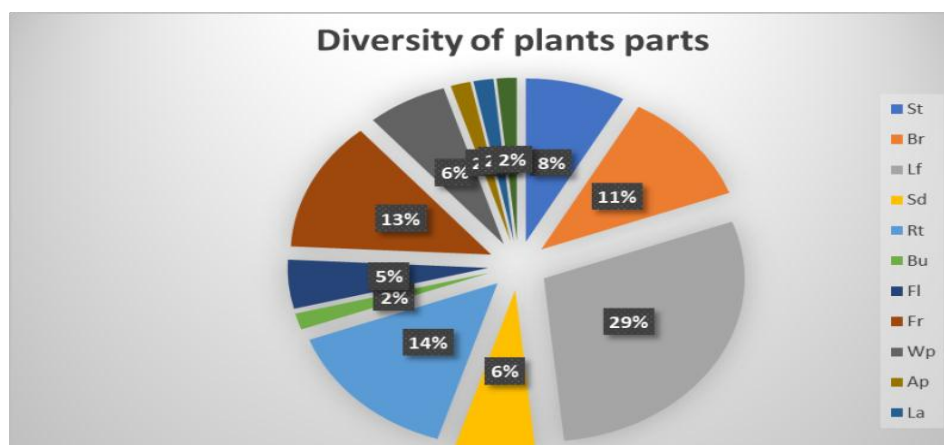


Fig 4: Diversity of plant parts used.

All the plants are traditionally used in one form or other and also harvested for income generation by selling their useful plant parts. Plants like *Polygonatum verticillatum*, *Dioscorea deltoidea*, *Berberis aristata*, *Cinnamomum tamala*, *Podophyllum hexandrum* are known to have market value and sold at high rate in local, national or International market, So, are good source of earning for local people. Woman and children are mainly involved in collection and selling of these plant parts.(Table. 4, 5 & 6; Fig. 4, 5 & 6.)

3. To list up the factors responsible for threatening of documented plants.

Out of total 30 plant all are known to have medicinal uses . 28 are known to have high market rate so, plants are heavily exploited for both personal and commercial

uses. Use value of *Juglans regia*, *Zanthoxylum armatum*, *Citrus jambhiri* was highest (Table. 5) showing high rate of their extraction from natural habitat. Most of the time plant parts are unsustainably harvested without ensuring their regeneration which is the major factor behind the risk of threatening.^[20] Other factors observed for threatening of useful plants are habitat fragmentation, urbanization and modernization, spread of Invasive species. *Citrus jambhiri* is facing high risk of extinction due to fragmentation, urbanization and modernization, *Ageratum houstonianum* which is used to be a widespread weed reduced significantly due to invasive spp *Ageratina adenophora*. Decline of traditional knowledge and religious belief among young generation has threatened sacred plants like *Asparagus adscendens*, *Leucas lanata* & *Zanthoxylum armatum* etc.

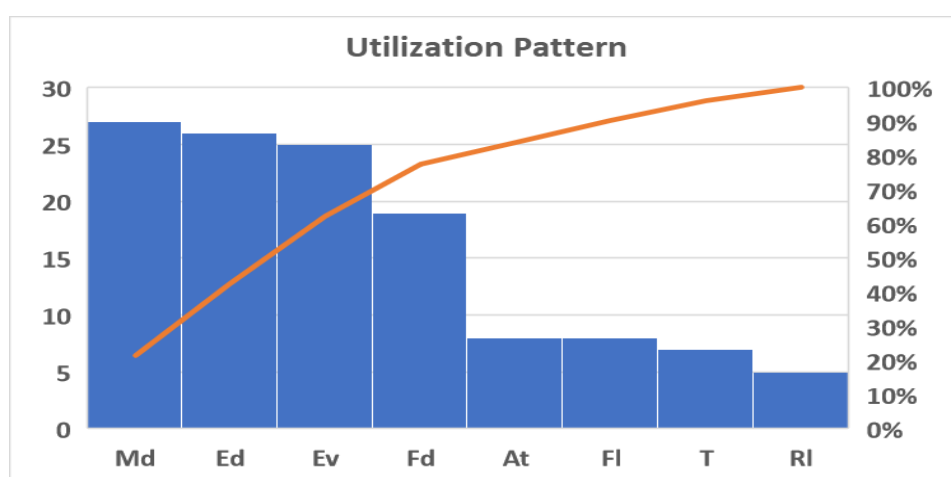


Fig-5; Utilization Pattern of Plants.

Table 6: DMR score of threatened plants species with their additional uses.

S.no.	Botanical name	At	Ed	Fd	FI	Md	RI	Ev	Rank
1.	<i>Berberis aristate</i> /Kashmal	0	0	2	0	5	0	5	12
2.	<i>Cinnamomum tamala</i> /Tejpatta	0	3	4	0	5	0	4	16
3.	<i>Dioscorea deltoidea</i> / Shingali mingali	0	3	1	0	5	0	5	15
4.	<i>Hypericum perforatum</i> / Basant	0	4	1	0	3	2	1	11
5.	<i>Hyssopus officinalis</i> / Juffa	0	0	2	0	5	0	5	12
6.	<i>Juniperus communis</i> / Hauber	0	2	0	1	5	0	4	12
7.	<i>Litsea glutinosa</i> / Meda lakri	5	5	3	5	3	0	5	26
8.	<i>Onsoma hispidum</i> / Gauzaban	0	1	2	0	5	0	3	11
9.	<i>Oroxylum indicum</i> / Tatpalanga	0	1	3	4	5	0	4	17
10.	<i>Podophyllum hexandrum</i> /Bankakari	0	1	4	0	5	0	4	14
11.	<i>Polygonatum cirrhifolium</i> /Salam Mishri	0	1	3	0	5	0	5	14
12.	<i>Polygonatum verticillatum</i> / Salam Mishri	0	1	2	0	5	0	5	13
13.	<i>Symplocos paniculate</i> /Lodh	1	4	2	2	4	0	3	16
14.	<i>Taxus contorta</i> /Rakhal/ Birmi	5	4	1	5	4	0	5	24
15.	<i>Zanthoxylum armatum</i> / Tirmira	3	4	0	0	5	5	5	22
16.	<i>Arisaema tortuosum</i> (Kedae ki chhali)	0	0	0	0	4	0	3	7
17.	<i>Asparagus adscendens</i> satawari, Sansarpali)	0	2	0	0	5	5	5	17

18.	<i>Euphorbia roylaena</i> (Choochin)	0	3	0	0	5	0	0	8
19.	<i>Ricinus communis</i> (Arandi)	0	3	0	0	5	0	2	10
20.	<i>Butea monosperma</i> (Palas)	4	1	2	5	5	0	2	19
21.	<i>Juglans regia</i> (akhrot)	5	5	0	4	5	5	5	29
22.	<i>Toona ciliate</i> (Tooni)	5	0	5	5	5	0	5	25
23.	<i>Circium arvense</i> (chuli)	0	3	2	0	5	0	0	10
24.	<i>Leucas lanata</i> (Ban-gugal dhooop)	0	4	4	0	4	0	4	16
25.	<i>Acorus calamus</i> (Bare)	0	2	1	0	4	2	4	13
26.	<i>Gloriosa superba</i> (glory lily, flame lily)	0	2	2	0	4	0	3	11
27.	<i>Citrus jambhiri</i> (jhamiridi)	4	3	0	2	5	5	5	24
28.	<i>Ageratum houstonianum</i> (Billy goat weed)	0	3	4	0	4	0	1	12
29.	<i>Cynoglossum lanceolatum</i> (Hound's tongue)	0	3	2	0	3	5	1	9
30.	<i>Sida rhombifolia</i> (Broom jute)	0	5	2	0	5	5	1	18

Abbreviation: Al-Agricultural tools; Ed- Edible; Fd- Fodder.; Fl-Fuel; Md- Medicinal, RI- Religious; Ev- Economical value.

To ensure sustainable harvesting and conservation.

To ensure sustainable development and conservation of threatened plants mentioned in present study, awareness for the sustainable harvesting, rich medicinal, edible and nutritive values is urgently required among inhabitants, women, young people and people involved in harvesting

and collection of useful plant parts. Sustainable harvesting can be done by habitat rotation, keeping some reproductive plant parts on parent plant especially when useful plant parts are harvested for commercial purposes. Large scale plantation programmes on private and community land and sustainable town planning is needed urgently. Our religious belief plays important role in conserving important plants, so need of hour is to engage young ones and children in religious fairs, festivals and rites.



Berberis aristata



Cinnamomum tamala



Arisaema tortuosum



Asparagus adscendens



Euphorbia roylaena



Circium arvense



Figure 6: Photographs of some threatened plants collected during field study.

DISCUSSION

From time immemorial the wild floral elements have been a source of 'hidden harvest' which had supplemented the community with food, medicine and income.^{[21], [22]} But unsustainable harvesting, habitat fragmentation, urbanization, modernization, spread of Invasive species has significantly threatened existence of

many useful floral elements from their natural habitat. Decline of traditional knowledge and religious belief among young generation has further threatened biodiversity. At present conservation of important plants has not been sincerely initiated till now. For successful mass cultivation through community involvement, the propagation and cultivation techniques have to be

standardized so that farmers can take up large scale cultivation. In this way, plant species will be conserved and same time industry can purchase the raw material from the farmers which reduces the pressure on natural wild population.^[23] This ex-situ cultivation through community involvement is looked as a probable solution to meet raw material market demand and diluting in-situ extraction pressure.^[24] For better outcome government and non-governmental organization should develop a strategy to regulate the trade.^[23] Species wise database on the available information on propagation and cultivation of threatened medicinal plant species needs to be developed and disseminated to different stakeholders^[25]. The information on habitat types and altitudinal range will be helpful in ex-situ conservation management and developing agro-techniques for the species which are high in risk and high in demand.

CONCLUSION AND FUTURE PROSPECTUS

Wild floral elements are important to fulfill basic necessities of life by supplying day to day life supporting commodities along with immense sources of germplasm for crop improvement and source of genes and traits for hybridisation and rootstock for grafting of commercial crops. So, need of hour is to sustainably harvest and utilize this natural wealth to overcome hunger crisis, ensure food securities and sustainable agriculture in following lines.

1. Awareness among inhabitants for sustainable harvesting and utilization of WEPs plants.
2. Large scale plantation and propagation.
3. Making a threatened plant nursery around 1800 m altitudinal range.
4. Domestication and provision for in-situ and ex-situ conservation.
5. Revival of our traditional customs, belief and culture so as to include as much religious plants as possible, so as to conserve these.
6. Enforcement of law strictly against illegal trading.
7. Facilities for research and development like establishing tissue culture lab, gene bank and seed bank etc.

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