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Ethnobotanical survey of threatened medicinal plants of West Sikkim

[*1] Mahendra Tamang, [2] Krishan Pal, [3] Santosh Kumar Rai, [4] Abul Kalam, [5] S Rehan Ahmad
[1, 2] Department of Botany, Sri venkateshwara University, Gajraula, Uttar Pradesh, India
[3] Department of Botany, Sikkim University, Sikkim, Gangtok, Sikkim, India
[4, 5] Department of Microbiology, Bidhannagar College, Salt Lake, West Bengal, India
*(Corresponding Author): Mahendra Tamang

Abstract
Ethnobotanical studies provide useful information about a wide variety of taxa that are used locally by indigenous peoples for various purposes. Present study was carried out in West Sikkim considering its richness in ethnic and floral diversity as well as due to the location of the Kanchendzonga National park which is a world heritage site. The stpudy was conducted between October 2015-September 2017 to understand and assess the present status of local ethno-medicinal plants. Data was collected by interviewing 80 informants that included traditional healers, dhami, bijua, bongthing, vaidyas, Jhakri, lama, farmers and elderly peoples by employing semi-structured and structured interviews. Information such as local name, parts used, diseases treated, present status, etc. were collected which was then followed by voucher specimen collection and assessment of the plant status by organizing regular field trips. The study revealed 54 medicinal plants whose population has dramatically decreased and are found sporadically only in restricted distribution. Applying the criteria of CAMP guidelines of IUCN it was found that out of 54 threatened plants, 24 medicinal plants have become vulnerable contributing 44.44% (VU) followed by 12 endangered species (22.22% EN), 9 species near threatened (16.66% NT), 5 species least concern (9.25% LC), 2 species rare (3.70% RR) and 1 species data is deficient (1.85% DD). Herbs constituted the most dominant plant (55.55%), followed by trees (27.77%), shrubs (9.25%), and climbers (7.40%). West Sikkim harbours rich wealth of medicinal plants diversity. However, due to poor scientific approach towards utilization of such resource they are facing a varying degree of threat hence, this information serves great importance in the process of its conservation.

Keywords: ethnobotany, indigenous knowledge, threatened medicinal plants, West Sikkim

Introduction: Background

Plant has always remained an inevitable part in human life since the time of human civilization. It has become the indispensable source of food, medicine, fiber, fuel, fodder, dye, construction material, etc. This knowledge has been evolved through trial and error methods for ages and has passed down from generation to the next and led to the birth of ethnobotany. The term "ethnobotany" was coined in 1885 by John.

William Harshberger to study the inter-relationship between plants and people, (White, 1931). Plants are used as a source of medicine in traditional healthcare dates back to 1000 BC and as described in Vedic literature it has immense medicinal properties to treat many human diseases and in the development of different types of new medicines. According to WHO (2000), about 80% world's population depends on indigenous medicine for their healthcare. Wild plants especially the medicinal plants are the primary source of livelihood of the rural communities as it forms the integral part for their sustenance (Zemede & Mesfin, 2001). Many drugs that are in the market today have come to us from these indigenous uses by the native people. These drugs are being used in some way in modern medicine and not necessarily for the same purpose as they were used by the native cultures in the past (Prance, 1994). One of the greatest economic values of ethnobotany is that the medicines that are being derived from the natural ecosystems are discovered by those living in close proximity to the plants dealing with illness (Young, 2006). More than 10,000 medicinal plants are reported from the Himalayan region which sustains the livelihood of about 100 million rural peoples (Shengji, 2001). For centuries a vast amount of ethnomedicine and ethnobotanical knowledge has existed in India. Except for the Indian traditional system of medicine, other aspects of ethnobotanical riches are vanishing in urban parts of the country due to the influence of western culture and lifestyle. However, a substantial amount of ethnobotanical knowledge is still being preserved by certain tribes located in various regions of India (Taylor & Francis, 1997).

Sikkim is a small hilly but naturally very beautiful northeastern state of India. It measures 7,069 sq. km. in size and ranges between 300m to 8,568m above sea level. Due to the varied topography, Sikkim is known for harboring a great deal of biodiversity and is said to be a biodiversity hotspot (Hajra & Verma, 1996). The state has about 80% of its geographical area under forest with an estimated of over 4500 species of flowering plants consisting of many medicinally important plants. Much of the threatened medicinal plants of West Sikkim are found in the Kanchendzonga National Park. The KNP comprises of 1,784 sq. km. in area.

The Kanchendzonga National Park is the only national park in Sikkim which is named after the lofty snow peak, the worlds 3rd highest mountain peak Kanchendzonga which is spread in the North and West district of Sikkim. It is inscribed as a world heritage site in the mixed categories by UNESCO in 2016. It occupies 25% of the total geographical area of the State of Sikkim.

The ethnobotanical studies of Sikkim was first promulgated by Atkinson (1882) [1], followed by Biswas (1956) [4], Hajra & Chakraborty (1981) [7], Biswas & Chopra (1982), Bennet (1983, 1985) [2, 3], Krishna and Singh (1987), Rai & Sharma (1994), Jana & Chauhan (2000) [9], Maiti *et al.* (2003) [6, 13], Dash *et al.* (2003) [6], Pradhan & Badola (2008). Singh *et al.* (2002) reported that the 64 species of medicinal plants belonging to 42 families and 57 genera treating several diseases are among the ethnic groups in Sikkim. Panda (2007) presented 30 medicinal plants which have high medicinal values in Ayurveda. These plants have Rasayana and tridoshagna properties which are commonly used in treating common health problems in Sikkim. Das (2009) discussed with the 225 different uses of 167 plants species belonging to 84 families for the treatment of 27 major ailments among ten rural communities of Sikkim. Out of the total uses of plants, herbs constituted 50%, trees by 25 % and shrubs by 17 % while climbers, the lowest category, constituted 8%. Idrisi *et al*. (2010) documented 45 medicinal plant species, distributed across 36 families used by local communities of the Rangit Valley for curing over 20 human ailments. Out of these 45 species, 08 are used in treating fever, 07 species in diarrhea and dysentery, 02 in bone related problems, 06 in stomach related problems, 10 in cough, cold and throat problems, 07 in cuts, wounds and burns, 07 in bronchitis and respiratory disorders, 03 in piles and 05 species in other health problems. Jha and Jha, (2016) reported that 10 medicinal plants used by Sherpas in Sikkim are also used in traditional Tibetan medicines (Amchi) as well as in the modern medical systems.

Today, this rich wealth is exceedingly depleted due to over harvesting, rapid urbanization, unsustainable land use practices and habitat degradation which may lead to adverse effects on rare or endangered species (Krishna, Chhetri & Singh, 2002) [12].

Materials and Method

Study area

The present investigation was carried out in West district of Sikkim. West district is the second largest district of Sikkim situated in the south western part of the State between $27^0$00'46" -$28^0$07'48" N latitude and $88^0$00'58- $88^0$55'25" longitude covering an area of 1166 Sq. Km. The district is bordered by Nepal in the West, North district of Sikkim in North, South district of Sikkim in the east and Darjeeling district of West Bengal in the South. The altitude ranges from 300m to 8,568m above sea level. Temperature varies sharply with altitude and slope. The mean temperature varies from about 26.8^{0}C in September to 20.7^{0}C in the month of January. Mean daily minimum temperatures are around 7.5^{0}C in January to 13.3^{0}C in October. The mean monthly wind speed varies from as low as 43.52 km/day from July to September to high of 98.4 km/day in the month of April. The area experiences a heavy rainfall during the monsoon season due to it being very close to the Bay of Bengal. The annual rainfall ranges from less than 5 mm to nearly 4000 mm. For most of the period in a year, the climate is cold and humid as rainfall occurs in each month. The river Rangit and its tributaries are the main channels of drainage, run nearly north-south. The valleys cut by this river and their chief feeders are very deep. District is mainly formed of Precambrian rock of young age constituting hard massive gneissose rocks. The total forest cover of the district is 56.31 per cent of the total geographical area (Envis).

Five broad vegetation types have been demarcated for Sikkim according to Champion and Seth, 1968 (Sikkimforest).

1. Tropical Moist deciduous-Semi evergreen Forest (alt. 300-900 m)
2. Eastern Himalayan Sub-tropical Broad-leaved Hill Forests (alt. 900-1800 m)
3. Himalayan Wet Temperate Forests (alt. 1800-3000 m)]
4. Sub-alpine Forests (alt. 3000-3700 m) and
5. Alpine Forests (alt. 3700-4500 m)

The total population of the district is 1,36,435 consisting of 70,238 Male and 66,197 female with the population density of 117 (census 2011). The district comprises of two sub-division viz., Soreng and Gyalshing and nine blocks. The major ethnic communities of district are Lepcha, Bhutia and Nepali. Lepchas are considered to be the original inhabitants of Sikkim (Lepcha and their Tradition, (SikkimNIC). A Nepali community forms the bulk of the population Bahun, Pradhan, Rai, Gurung, Mangar, Kami, Damai, Etc. Sherpa, and consists of Limboo, Tamang, Chhetri,

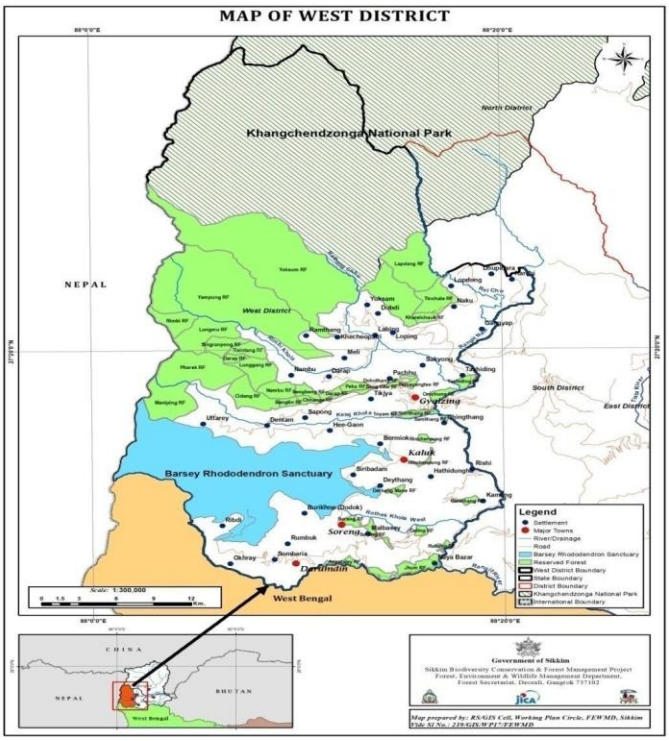

Fig 1

Method

Extensive ethnobotanical study was conducted in the whole west district of Sikkim covering all the areas. In the preliminary stage, the local peoples having ethnomedicinal

knowledge were identified by consultation with the village heads that include elderly peoples, farmers, traditional healers such as *dhami, bijua, Jhakri, Bongthing, Lama,* local medicine men, *vaidyas*, etc. The total of 80 informants consisting of both men and women were interviewed. The data was collected between October 2015- September 2017 by selecting key informants using semi-structured and structured questionnaire. During the course of field survey, the information such as plant species, local name, plants parts, mode of administration, name of the diseases treated, time of harvesting, place of availability, present status, were collected from the informants. The reports of one informant were cross checked with the others to validate the information. This was then followed by collection of voucher specimens from the study area with the involvement of highly knowledged local medicine men. Regular field trips were organized in different seasons extending from low elevation to high elevation. Study was carried out along with collection of voucher specimens, recording their GPS data, distribution, frequency and density. The collected plant specimens were properly processed and identified with the help of Flora of Bhutan (Notlite, 1994 & 2000), Flowers of the Himalaya (Stainton & Polunin, 1997) and other regional literatures and their authentication was done by comparing with the deposited specimens in Herbarium and consulting the experts of Botanical Survey of India, Gangtok, Sikkim. The herbarium specimens were finally deposited in herbaria at BSI, Gangtok, Sikkim. The IUCN status of the species was determined on the basis of the occurrence in natural habitats. The result of the present study is presented in the table no.1.

Table 1: List of Threatened medicinal plants of West Sikkim (NT= Near Threatened, VU= Vulnerable, EN= Endangered, LC= Least Concern, DD= Data deficient, RR= Rare and CR= Critical)

S No.	Botanical Name	Family	Local Name	Habit	Distributional range	Parts used	Uses	Present Status
1	Abrus precatorius L.	Fabaceae	Lalgedi	Climber	300-1100m	Roots, leaves and fruits	Tonsil, pneumonia, skin disease, cough, cold, menstrual problems, abortion, urinary disorders and sore throat.	NT
2	Aconitum ferox Wall.ex Ser.	Ranunculaceae	Bikhma	Herb	2700-3800m	Rhizomes	Asthma, blood clots, cough, diabetes, rheumatism, snake bite, stomach ache and toothache.	VU
3	Aconitum heterophyllum Wall.ex Royle	Ranuncu laceae	Bikh	Herb	3200-3700m	Rhizomes	Antidote for snakebite, food poisoning, stomachache, antiperiodic, piles, body ache, cold, cough, nose discharge, sore throat and antifertility.	VU
4	Acorus calamus L.	Araceae	Bojho	Herb	600-2100m	Rhizomes and leaves	Asthma, epilepsy, fever, pneumonia, bronchitis, gastritis, sore throat, body pain, cuts, wounds and skin problems. Rhizome decoction is given to cattle to treat diarrhea and leaf paste in wound.	NT
5	Allium wallichi Kunth	Alliaceae	Banlasun	Herb	2800-4300m	Bulbs	Cholera, dysentery, cold and cough and reducing altitude sickness.	EN
6	Berberis aristata DC.	Berberidaceae	Chutro	Tree	1700-3500m	Roots, stems, leaves, Bark and flowers	Fever, jaundice, malaria, diarrhea swelling, eye problems and rabies.	DD
7	Bergenia ciliate (Haw.) Sternb.	Saxifrag aceae	Pakhanbed	Herb	1800-4400m	Whole plant	Juice of whole plant is used in treating urinary problems, leaf juice is used in treating earaches, root is used in fever and diarrhea, root juice is used in cold, cough and asthma.	VU
8	Betula utilis D. Don	Betulaceae	Bhojpatra	Tree	2700-4200m	Bark and branches	Decoction used for cleaning wounds as antiseptic.	NT
9	Calamus erectus Roxb.	Arecaceae	Phyakre	Tree	700-1300m	Fruit	Diabetes.	VU
10	Cardiocrinum giganteum (Wall.)	Liliaceae	Chameli phul	Shrub	2400-3600m	Leaves and tubers	Leaves are used as cooling agent to reduce pains of wounds and bruises. Roots paste is used as	VU

	Makino						poultice in bone dislocation.	
11	Dactylorhiza hatagirea (D. Don) Soo	Orchidaceae	Panchamle	Herb	2900-4200m	Tubers and shoots	Diarrhea, dysentery, fever, diabetes. Paste used in cuts and wounds, body ache, gastritis and bone fracture.	CR
12	Dioscorea deltoidea Wall.ex Griseb.	Dioscoreaceae	Bantarul	Climber	450-3000m	Tubers	Oral contraceptives and lice problems.	VU
13	Ephedra gerardiana Wall.ex Stapf	Ephedraceae	Somlata	Herb	2000-5200m	Stem and fruits	Low blood pressure, fever, asthma, cuts, indigestion and headache.	VU
14	Evodia fraxinifolia (D. Don) Hook.f.	Rutaceae	Khanakpa	Tree	1000-2400m	Roots, bark, fruits And seeds	Dysentery and fever.	VU
15	Fraxinus floribunda Wall.	Oleaceae	Lakuri	Tree	1200-1900m	Bark	Gout and bone fractures.	EN
16	Hedgsonia heteroclite Hook.f. & Thomson	Cucurbitaceae	Ghuiphal	Climber	300-1500m	Leaves	Leaves smoke is inhaled to allay irritation from small insects, leaves boiled and liquid is taken for nose complaints and fever.	EN
17	Heracleum wallichii DC.	Apiaceae	Chimphing	Herb	1700-4000m	Seeds	Diarrhea and gastritis.	LC
18	Horsfieldia kingii (J. D. Hooker) Warburg	Myristicaceae	Ramguwa	Tree	300-1200m	Fruits	Piles.	EN
19	Juniperus recurva Buch.-Ham.ex D. Don	Cupressaceae	Sukpa	Shrub	3400-4600m	Aerial parts	Smoke inhaled in vomiting and headache.	NT
20	Chamaecostus cuspidatus (Nees & Mart.) C. Specht & D.W. Stev.	Costaceae	Insulin plant	Herb	600-2000m	Leaves	Diabetes, skin problems, fever, asthma, bronchitis and intestinal worm disease.	RR
21	Macropanax dispermus (Wallich ex G. Don) Seemann	Araliaceae	Chinde	Tree	700-2200m	Leaves and bark	Diabetes,	LC
22	Mahonia napaulensis DC.	Berberidaceae	Jamanemandro	Tree	1000-1800M	Bark and fruit	Dysentery, diarrhea and urinary disorders.	NT
23	Martynia annua L.	Martyniaceae	Gauphul	Herb	500-900m	Roots and leaves	Root decoction is used in snakebite, leaf juice in leprosy, tuberculosis and sore throat.	EN
24	Meconopsis horridula Hook.f. & Thomson	Papaver aceae	Kesar	Herb	3500-5500m	Whole plant	Bone fractures, fever, back pain, lung and skin diseases, sinusitis, bile disease and wounds.	NT
25	Mesua ferrea L.	Clusiaceae	Nageswari	Tree	300-1000M	Bark	Skin diseases, menstrual problems and paste applied in hydrocoel and wound.	VU
26	Nardostachys grandiflora DC.	Valerianaceae	Jatamasi	Herb	3200-5300m	Whole plant	Skin disease, leprosy, ulcers, cold, cough, fever, high blood pressure, stomach problems, dysentery and constipation.	VU
27	Nyctanthes arbor-tristis L.	Oleaceae	Parijat	Tree	200-1200m	Bark, leaves and flowers	Leaves decoction is take in malarial fever, bark paste is used in dislocated joints and leaves and flower infusion is given to cause expulsion of placenta in women.	LC

28	Panax sokpayensis Shiva K. Sharma & Pandit	Araliaceae	Panchpatre	Herb	1700-2300m	Tuber	Fever, weakness, liver disorders, Menstrual disorders indigestion and vomiting.	EN
29	Panax bipinnatifidum Seem.	Araliaceae	Panchpatre	Herb	1600-3800m	Tuber	Fever, weakness, liver disorders, menstrual disorders indigestion and vomiting.	EN
30	Paris polyphylla Smith	Liliaceae	Satuwa	Herb	1800-3500m	Tuber	Stomachache, fever, diarrhea and dysentery.	VU
31	Phlogocanthus thyrsiflora (Hardwicke.) Mabberley	Acanthaceae	Tusare	Shrub	300-1000m	Flower	Diabetes, cold and cough and fever.	LC
32	Picrorhiza kurrooa Royole ex Benth.	Plantaginaceae	Kutki	Herb	3800-4500m	Roots	Root paste applied in cuts, wounds and injuries.	VU
33	Rheum australe D. Don	Polygonaceae	Khokim	Herb	3600-4400m	Roots and petiole	Constipation, skin eruption, liver disorders, internal injuries, body pain, diarrhea, dysentery, ulcers, cuts and wounds.	VU
34	Rheum nobile Hook.f. & Thoms.	Polygonaceae	Padamchal	Herb	3800-5000m	Roots	Ulcers, bronchitis, fever, fractures, rheumatism arthritis, heart complaints, tonic after delivery of baby and swelling.	NT
35	Rhodiola himalensis (D.Don) S. H. Fu	Crassulaceae	Lakpaguru	Herb	3600-4600m	Roots	Kidney problem, urinary disorders, asthma, lung infection, poisoning, arthritis, fever, oral infection and to the women after child birth.	NT
36	Rhododendron anthopogon D. Don	Ericaceae	Sunpati	Shrub	3500-5000m	Leaves, twigs and flowers	Indigestion, vomiting, respiratory disorders, stomachache and dysentery.	VU
37	Rhododendron setosum D. Don	Ericaceae	Bhairungpate	Shrub	3700-5600m	Leaves, stems and flowers	Young leaves are used in wounds.	VU
38	Sapindus mukorossi Gaertn.	Sapindaceae	Ritha	Tree	1000-1200m	Roots,bark And fruits	Burns, epilepsy, tonic, anthelmintic, purgative, asthma and in removing dandruff and lice.	EN
39	Saussurea gossypiphora D.Don.	Asteraceae	Maikopila	Herb	4300-5600m	Whole plant	Wool is used in cuts and other parts are used in wounds.	VU
40	Saussurea tridactyla Sch.Bip.ex Hook.f.	Asteraceae	Kapasephul	Herb	3600-5800m	Whole plant	Used as a tonic for weakness, menstrual disorders and arthritis.	VU
41	Selinum tenuifolium (DC.) Raizada & Saxena	Apiaceae	Bhutkesh	Herb	2750-4600m	Roots and fruits	Hairy roots smoke is inhaled to relief from faint, headache and fever and leaves aromatic.	VU
42	Sinopodophyllum hexandrum (Royle) T.S.Ying	Berberid aceae	Laghu patra	Herb	800-1700m	Tubers	Diabetes.	RR
43	Swertia chirayita (Roxb.ex Fleming) Karsten	Gentianaceae	Chiraito	Herb	1200-3000m	Aerial parts	Plant infusion is used to treat fever, cold, cough, inflammation and dyspepsia.	EN
44	Swertia	Gentian	Sarmaguru	Herb	4000-	Roots	Decoction is used in fever,	VU

	multicaulis D. Don	aceae			4900m		cough, cold, bodyache and internal injuries and paste applied in cuts and wounds.	
45	Swertia hookeri C. B. Clarke	Gentian aceae	Lekhchiraito	Herb	3300-3900m	Roots	Jaundice.	EN
46	Taxus wallichiana Zucc.	Taxaceae	Dhengre salla	Tree	2100-3500m	Bark, leaves and fruits	Piles, muscular pain, fever, asthma, bronchitis, epilepsy, headache, giddiness diarrhea and liver disorders.	EN
47	Terminalia bellerica (Gaertn.) Roxb.	Combret aceae	Barra	Tree	300-1100m	Fruits and bark	Cough, sore throat, constipation, bronchitis, asthma, diarrhea, dysentery and respiratory disorders.	VU
48	Terminalia chebula Retz.	Combret aceae	Harra	Tree	150-1100m	Fruits and bark	Cough, sore throat, gastritis, mouth ulcers, diarrhea and dysentery, bark decoction is fed to cattle to treat diarrhea and dysentery.	VU
49	Thalictrum foliolosum DC.	Ranuncu laceae	Mirmire	Herb	1300-3400m	Roots, stems and leaves	Poisoning, fever, wounds and infection.	LC
50	Tinospora sinensis (Lour.) Merr.	Menispe rmaceae	Gurju Lahara	Climber	300-900m	Roots, stems, leaves and fruits	Diabetes, menstrual disorders, piles, fever, fractured and painful joint and tuberculosis.	NT
51	Ulmus lanceifolia Roxb.ex Wall	Ulmaceae	Chamlayo	Tree	700-1600m	Bark	Bone fracture.	EN
52	Valeriana jatamansii Jones	Valerianaceae	Jatamasi	Herb	1200-3600m	Rhizomes	Fever, cold, headache, sore throat, wounds, indigestion, hysteria, epilepsy, cough and asthma.	VU
53	Viscum articulatum Burm.f.	Santalaceae	Harchur	Herb	200-1700m	Whole plant	Bone fracture, body ache, fever, epilepsy and muscular pains.	VU
54	Zingiber cassumunar Roxb.	Zingiberaceae	Phachyang	Herb	600-1300m	Leaves and flowers	cough, fever, dyspepsia, sinusitis and stomachache.	VU

Result and Discussion

The present research was conducted in th West district of Sikkim keeping in mind the current trends of utilization of plant resources for the medicinal purposes, its geographical, cultural and ethnic diversity. West Sikkim is a hilly terrain district mostly covered by forest and large population is found settled in the forest fringe areas. People living in the rural areas largely rely on the traditional form of treatment. They either try on their own or approach the local practitioners for the help. A large proportion of the area falls under the jurisdiction of Forest Department and in the Kanchendzonga National Park. Due to the topographical, climatic and cultural diversity, this area is very rich in biodiversity. The study found that majority of village people largely rely on the traditional mode of treatment. The buffer zones of Kanchendzonga National Parks are the most ecologically sensitive area because tribal people living in this area largely use and hunt the forest products for their livelihood.

The present study revealed that the local ethnic communities are repository of rich knowledge of ethnomedicine and a large number of locally available plants is being used traditionally by indigenous peoples since time immemorial to cure various human ailments. This indigenous knowledge of local flora is inherited through a simple verbal communication from generations. This knowledge today is confined to only few people in the rural societies mostly to older people only. The reasons for such rapid reduction of this knowledge is many such as, modernization, allopathic medicine and also traditional healers have the belief that if the value of these plants are revealed they may be exploited by others and superstiously feel that the medicinal property in these plants will disappear. They prefer to keep this knowledge to themselves. So, there is a huge chance of such knowledge getting permanently lost in the future if this is not catalogued in time. In the present investigation, a total of 54 plants were recorded that were having varying degree of threat in the wild. They are distributed into 38 families and 45 genera. The families having maximum number of species were Araliaceae, Berberidaceae, Gentianaceae and Ranunculaceae with three species each followed by Apiaceae,

Asteraceae, Combretaceae, Ericaceae, Liliaceae, Oleaceae, Polygonaceae and Valerianaceae with two species each. Herbs

were the most dominant plant (55.55%), followed by trees (27.77%), shrubs (9.25%), and climbers (7.40%) Fig. 1.

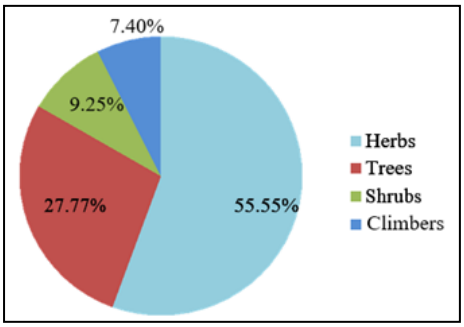

Fig 1: Percentage of Habits of Ethnomedicinal Plants.

Different plant parts are used in the preparation of local medicines for treating numerous diseases in human in which the leaf (44.44%) was used in the majority of the treatment, followed by bark (40.74%), fruits (38.88%), roots (37.03%), stems (29.62%), flowers (25.92%), seeds (18.51%) Tubers (11.11%), whole plants (11.11%), rhizome (7.40%) and bulbs (1.85%) Fig.2. local peoples prefer to use locally available medicinal plants to cure the disease.

Study also found that many of these plants have a very high demand and market value outside. As a result they are collected on a large scale from the wild and are sold to the undisclosed traders illegally.

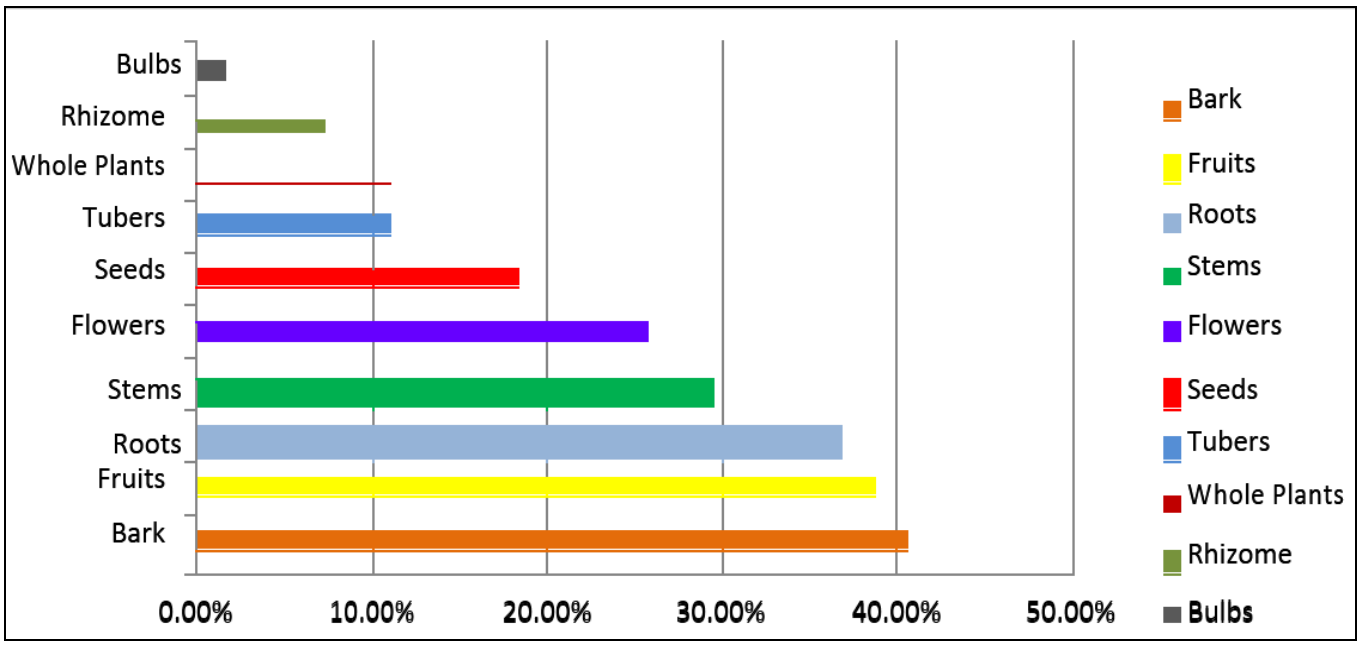

Fig 2: Pereentage of Plant parts used

The study revealed that these plants are widely used by the local peoples in treating diseases such as tonsil, pneumonia, skin disease, cough, cold, menstrual problems, in abortion, urinary disorders, sore throat, snakebite, food poisoning, stomachache, piles, body ache, nose discharge, antifertility, asthma, blood clots, diabetes, rheumatism, toothache, epilepsy, fever, pneumonia, bronchitis, gastritis, cuts, wounds, cholera, dysentery, altitude sickness, lice problems, jaundice, malaria, swelling, eye problems, rabies, earaches, tuberculosis, sinusitis, ulcers, high blood pressure, liver disorders, vomiting, skin eruption, internal injuries, heart complaints, Burns, dandruff, headache, hysteria, etc. Majority of these plants are used in combination for the effective treatment. The powder form is the most commonly used form of medication amongst the traditional healers. Due to low cost, distant location of hospitals and poor economic conditions, the some of the plants such as Aconitum heterophyllum, Nardostachys grandiflora and Picrorhiza kurooa are highly exploited and their existence is threatened (Sharma *et al.* 1995). Due to unsustainable collection practices plants of high therapeutic values have undergone huge depletion resulting into their severe threat. The regular field study and assessment of plant population revealed that some of the local medicinal plants have been reduced radically in the last few decades. Applying the criteria of CAMP guidelines of IUCN it is found that 24 medicinal plants have become vulnerable contributing 44.44% (VU) followed by 12 endangered species (22.22% EN), 9 species near threatened (16.66% NT), 5 species least concern (9.25% LC), 2 species rare (3.70% and 1 species data is deficient (1.85% Fig.3. 50.00%)

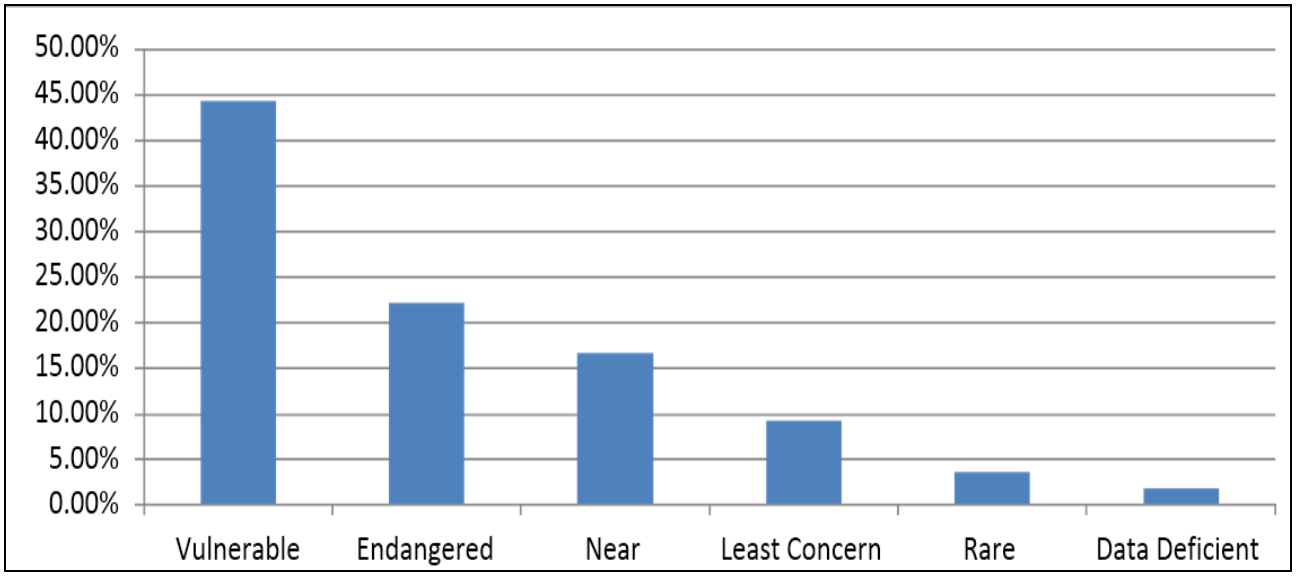

Fig 2: Pereentage of Present Status

Most of these plants are restricted in distribution and found only in few patches. Sinopodophyllum hexandrum was once common in the study area but now has become rare and is found sporadically only in one location.

Chamaecostus cuspidatus is found growing only in homestead garden. The illegal and unsystematic collection of these species has become a serious cause of concern.

Fig 4: Paris polyphylla Smith

Fig 5: Swertia hookeri C. B. Clarke

Fig 6: Panax sokpayensis Shiva K. Sharma & Pandit

Fig 7: Dactylorhiza hetagirea (D.Don.) Soo

Fig 8: Rheum nobile Hook F & Thoms.

Fig 9: Martynia annua L.

Fig 10: Photos of Vaidyas

Conclusion

Several ethno-medicinal research works have been done in Sikkim in the past by various researchers but less effort are being made to study and assess the current status of ethnobotanical plants in the region. The rate of development, urbanization, new pattern of agriculture, tourism, grazing of animals in alpine region, scattered and limited distribution of certain highly useful plants in few pockets, illegal collection of plant resources are causing rapid loss of these valuable plant species. The western part of the district is more prone to over-exploitation of resources because the district shares its boundary with Nepal. The study discovered that this border area falls in high elevation ranging from sub- temperate to alpine covered by rich floral diversity including the extremely valuable medicinal plants. People living in the vicinity of the border has free access and regularly graze their cattle and is also free to harvest the medicinal plants of great importance. Sinopodophyllum hexandrum a plant with high medicinal potentiality having its natural habitat around this belt has faced the same fate of threat and led to the trace existence. Due to cold climate and lack of proper Government mechanism to control the encroachment of collectors and cattle from outside, these habitats have become very vulnerable.

In the present survey, mostly the elderly people were involved in sharing the ethnobotanical information. This is indicative that this knowledge today is restricted to only a few people of the older generation and the younger generations are totally unaware of these valuable resources. This knowledge if not given importance is likely to fade away with the same old generation and the information about these resources will remain unknown.

In the present scenario, most of the local healers meet their herbal requirements just by extraction of plants or produces from the nearest natural source, since it is the easiest way to procure. The study showed that when the parts like underground parts (roots, tubers, rhizomes and bulb), bark and whole plants is used for herbal medication then there is either very low chances of regeneration of plants or it takes long time to regenerate. Only very few peoples grow them in their homestead garden but due to climatic difference in the homestead garden most of these plants fail to grow. Analysis of data reveals that an alternative approach should be taken urgently to reduce pressure on natural source. Government should formulate strict mechanism to put to an end to the illegal harvesting of certain products from the wild since resource once lost is difficult to replenish. Locals should be encouraged to cultivate them on their own agricultural field and some arrangements need to be made to motivate them.

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References

1. Atkinson ET. The Himalayan Gazetteer. 2 Reprint 1973, Delhi: Cosmos Publication, 1882.
2. Bennet SSR. Ethnobotanical Studies in Sikkim. Indian Forester. 1983; 109(7):477-481.
3. Bennet SSR. Ethnobotanical studies in West Sikkim. Journal of Economic and Taxonomic Botany. 1985; 7(2):317-321.
4. Biswas K. Common medicinal plants of Darjeeling and Sikkim Himalaya. West Bengal: Bengal Government Press, 1956.
5. Dash SS. Traditional Herbal Remedies used in Sikkim, India. Nelumbo, 2009; 51:123-156.
6. Dash SS, Maiti A, Rai SK. Traditional uses of plants among the urban population of Gangtok-Sikkim. Jour. Econ. Taxon. Bot. 2003; 27(2):317-324.
7. Hajra PK, Chakraborty P. A survey of wild plants sold in the Lal Market of Gangtok. Indian Journal Forester. 1981; 4(3):217-220.
8. Idris MS, Badola HK, Singh R. Indigenous knowledge and medicinal use of plants by local communities in

Rangit Valley, South Sikkim, India. NeBio. 2010; 1(2):34-35.
9. Jana SK, Chauhan AS. Ethnobatical Studies on Lepchas of Dzongu, North Sikkim, India. Annals Forestry. 2000; 8(1):131-144.
10. Jain SK. Dictionary of Indian Folk medicine and Ethnobotany. New Delhi, India: Deep Publication, 1991.
11. Jha A, Jha V, Jha A. Study on ethnomedicinal plants of Sherpas of Sikkim, Himalayas. J. Traditional and Fold Practices. 2016; 4(1):174-177.
12. Krishna AP, Chhetri S, Singh KK. Human dimensions of conservation in Kanchendzonga Biosphere Reserve. Mountain research and development. 2002; 22(4):328-331.
13. Maiti D, Pradhan N, Chauhan AS. Folk uses of medicinal plants from North Sikkim. Indian j. of Traditional knowledge. 2003; 3(1):66-71.