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# **Ethnobotanical Study of South Eastern Foothills of Bhutan**

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### **Author's contribution**

*The sole author designed, analysed, interpreted and prepared the manuscript.*

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## **ABSTRACT**

Ninety three plant species from 82 genera and 44 families with their ethnomedicinal uses were enumerated along with 3 genera of different families of Pteridophytes. Preference ranking of the medicinal plants used for treating 7 different diseases indicated 1<sup>st</sup> as the most effective treatment. Direct matrix ranking of 12 medicinal plants suggest that people have preference over the highest ranked species for their multipurpose uses besides medicinal use. Use value ( $UV_{is}$ ) of *Tinospora cordifolia* (Willd.) Miers, *Saccharum officinarum* with honey and *Gmelina arborea* Roxb. is 2, 1.5 and 1.7 respectively.

**Keywords:** *Ethnomedicines; preference ranking; direct matrix ranking; use value; traditional knowledge.*

## **1. INTRODUCTION**

More than 600 medicinal plants have been identified in Bhutan, mostly from higher elevations [1,2,3,4,5,6,7,8,9,10,11,12] and not

much ethnobotanical works have been reported from the southern foothills where diseases like malaria, jaundice, typhoid and witch craft related illnesses are common. Ethnobotany defined [13], and its study is timelessly important to identify

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plants with therapeutic potential [14]. Therefore to document ethnobotanical data and traditional knowledge (TK) of local healers related to use medicinal plants from Pemathang and Phuntshothang *gewogs* (village blocks) of Samdrup Jonkhar, Bhutan, to treat different type of diseases, to add on to the list of medicinal plants from lower altitude to be used in Bhutanese Traditional Medicines and record most popular medicinal plants repeatedly used to cure commonly occurring diseases in the locality of the study area was imperative. As many as 300 species of medicinal plants, which grow in diverse ecological zones of the country, have been identified so far and more than 200 of them are currently used by the Institute of Traditional Medicine Services (ITMS) in *g.so-ba-rig-pa* (traditional medical system) are effective [15]. The collection, conservation and sustainable utilization of medicinal and aromatic plants (MAPs) in Bhutan are guided by sound legal frameworks and acts: Forest Act 1969, Plant Quarantine Act of Bhutan 1993, Forest and Nature Conservation Act of Bhutan 1995, Environmental Assessment Act 2000 and Biodiversity Act and Framework of Bhutan 2003 and 2006 [16,17,18]. 108 Medicinal plants have been reported from the low altitude areas of Bhutan [19] and 116 from high altitude [20]. Total of 81 medicinal plants have been reported from Trashigang *Dzonkhag* [5]. Recently 113 medicinal plants belonging to 68 families and 103 genera were reported from lower elevations of Bhutan [10]. The remoteness of a few rural places always has resulted in continued use of plants as their medicines by local people along with modern health care and therefore widening scope of ethnobotanical study in the region [4]. Therefore this study was carried to document such information related to medicinal plants from the study area where ethnomedicinal practices are still popular amongst local healers and elders.

## 2. MATERIALS AND METHODS

A prior permission from the *Dungkhag* (sub district) administration was sought and accordingly the most popular local practitioners and informants through *gewog* office were selected for documenting TK on plants. The Free listing (FL) by informants in their local dialect, Preference Ranking (PR), Direct Matrix Ranking (DMR) and Use Value (UV) of medicinal plants were carried out and interpreted [21]. This has helped the researchers to identify specific and the most commonly used plants against cure for

different locally known diseases. Simple approach was used for data collection and compilation.

### 2.1 Methodology

The *gup* (*gewog* head) and *mangmis* (*gup* assistant) were approached. Key informants, shaman and women healers were identified. Prior consent was sought from each key informant before interview and they are properly acknowledged. The techniques [22,23] used allowed informants and researchers to see the plants in their natural state, which minimized the risk of misidentification during the interview. Most of the time informal talks were preferred to collect information about the plants with regards to their local names, plant part(s) used, process of preparation of medicine (either individually or in combination with other plant parts) and mode of application and doses for the treatment of a particular disease(s) [21]. The collected specimens were identified using flora of Bhutan [24-32] and internet sources. The herbarium and voucher specimens processed as per [33] and deposited at herbarium, Sherubtse College, Kanglung.

### 2.2 Study Area

Pemathang *gewog* (Fig. 1) has a total area of 76.54 square kilometers [34] is located in the altitude of 600 to 1200 meters above sea level. It is hanging plateaus of southern foothills which drops down and extend up to Assam Plain. The *gewog* lies in the south eastern part of Bhutan between latitude of 26°50'N to 26°57'N and longitude of 91°42'E to 91°48'E bordering the Indian state to the south and is bordered by Phuntshothang *gewog* in the West, Samrang *gewog* in the East, Martshalla *gewog* in the North and Indian State of Assam in the South.

### 2.3 Justification for the Work

Bhutanese people from south, still practices home remedies and local healing for treating different diseases. No study of this kind was carried out earlier in these *gewogs* as far as literature review is concerned. As rural-urban migration trend being comparatively high in recent years and young generation undervaluing the TK transmitted orally from their village elders, it was crucial to document the TK on medicinal plants from this study area.



Fig. 1. Map showing two gewogs (study area) of Samdrupjhonekhar Dzongkhag

### 3. RESULTS AND DISCUSSION

Ninety three plant species from 82 genera and 44 families are recorded with their ethnomedicinal uses by the local healers against various diseases besides the 3 genera under 3 different families of Pteridophytes (Table 1, Plates 1, 2 and 3). This study reports comparatively higher traditional uses of plants to 62 enumerated medicinal plants [4] and 81 reported species from Trashigang region [5].

Similarly 42 plant species with ethnobotanical uses reported [2] and 67 species in 37 families from Bumdeling [11]. 153 MAPs species reported

from different parts of Bhutan without including the local healers [10,19,20]. The specimens collected were either domesticated by the people for their day-to-day use found in their field or from the nearby forest. Most of the specimens were found abundantly in their locality, which is a testimony of the area with good plant diversity that supports the local community's health welfare and preservation of local knowledge [23,35]. It has been observed that either single plant or its parts are used to treat single ailment and sometimes combinations of more than one plant or part(s) are used for single or multiple treatments.

Table 1a. List of medicinal plants used by local people with their ethnomedicinal preparation and uses

Sl.#	Botanical name	Family	Ethnomedicinal preparation	Treatment [s]
1	<i>Caulokaempferia sikkimensis</i> (King ex Baker) K. Larsen	Acanthaceae	Extract of leaves is applied topically on affected part	Body/Lymph inflammation
2	<i>Justicia adhatoda</i> L.		Crushed roots are applied as poultice after every 3 days for a month	Fracture and broken bones
3	<i>Phlogacanthus thyriformis</i> (Roxb. ex Hardw.) Mabb.		A glass of decoction from flower is orally consumed once a week	Lowers blood pressure
4	<i>Achyranthes aspera</i> L.	Amaranthaceae	Leaves and root are crushed and extract is taken orally mixing with a glass of water	Pneumonia
5	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	The whole plant is chewed or eaten as vegetable as one likes	Appetizer
6	<i>Eryngium foetidum</i> L.		Leaves are boiled and drank as soup	Stomach ache
7	<i>Foeniculum vulgare</i> Mill.		Seeds are boiled in water and drink frequently as soup for a week.	Body ache and common cold
8	<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae	Baked and warmed leaves are directly applied to swollen part morning and evening	Fracture and Sprain
9	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz		Crushed root mixed with water and decoction is orally taken as frequently as possible for a week	Malarial fever
10	<i>Rhaphidophora decursiva</i> (Roxb.) Schott	Araceae	Infusion from crushed stem drank; also a cattle fodder	Piles/Harsa
11	<i>Aloe vera</i> (L.) Burm.f.	Asparagaceae	Shoot crushed and directly applied to affected part	Sunburn, burn
12	<i>Sansevieria trifasciata</i> Prain		Juice prepared from leaves also applied on body	Inflammation of lymph/body
13	<i>Chromolaena odorata</i> (L.) R. M. King & H. Rob	Asteraceae	Leaves are crushed and applied externally as poultice	Haemostasis/Fresh cut bleeding
14	<i>Ageratina adenophora</i> (Spreng.) R. M. King & H. Rob.		Leaves and stem are crushed and applied topically on the body	Fresh cut bleeding and antimicrobial
15	<i>Ageratum conyzoides</i> (L.) L		Leaves are crushed and applied directly on cuts to stop bleeding	Fresh cut bleeding and pneumonia
16	<i>Artemisia</i> sp.		Whole leafy part is used under mattresses and also rubbed externally on the body	Insects repellent. Skin diseases.
17	<i>Galinsoga parviflora</i> Cav.		Leaves and stem are crushed and applied externally to the body	Skin diseases

Sl.#	Botanical name	Family	Ethnomedicinal preparation	Treatment [s]
18	<i>Tagetes erecta</i> L.		A tablespoon of decoction from young flower is drank	Pneumonia
19	<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae	Fruit and ash derived from fruit is used to heal deep cuts	Deep cuts and wounds
20	<i>Lobelia</i>	Campanulaceae	Extract of roots applied externally	Wounds
21	<i>Drymaria cordata</i> (L.) Wild. ex Schult.	Caryophyllaceae	Baked leaves are sniffed by wrapping in piece of cloth	Sinusitis and nasal congestion
22	<i>Cuscuta reflexa</i> Roxb.	Convolvulaceae	Directly fed to cattle	Flukes ( <i>namely</i> ) in cattle
23	<i>Poranopsis paniculata</i> (Roxb.) Roberty		Roots used as poultice	Join the fractured and broken bones
24	<i>Costus speciosus</i>	Costaceae	Infusion; stem juice drank directly.	Cools stomach/ Cooling effect
25	<i>Kalanchoe Integra</i> (Medik.) Kuntze	Crassulaceae	Leaves extract applied externally	Wounds
26	<i>Luffa cylindrica</i> (L.) M.Roem.	Cucurbitaceae	Root extracts given at appropriate dose; poisonous if consumed more than recommended dose by the healer	Detoxification
27	<i>Dillenia indica</i> L	Dilleniaceae	Juice extract from the fruits	Anti-dandruff
28	<i>Dioscorea deltoidea</i> Wall. ex Griseb.	Dioscoreaceae	Tuber is used as poultice	Join the broken/ fractured body parts
29	<i>Rhododendron arboreum</i>	Ericaceae	Flowers are crushed and eaten	Dysentery
30	<i>Euphorbia hirta</i> L	Euphorbiaceae	Tender stems are chewed	Appetizer
31	<i>E. royleana</i> Boiss.		Latex of leaves	Eye infection in cattle ( <i>Phulo</i> )
32	<i>E. tithymaloides</i> L		Delicate bark roasted and eaten in small dose	Appetizer
33	<i>Jatropha curcas</i> L.		Stem or branch is used to brush teeth	Cure gum and mouth infection
34	<i>Mallotus philippensis</i> (Lam.) Müll.Arg.		A glass of decoction is drank	Gastric
35	<i>Ricinus communis</i> L.		Seeds are crushed into paste and applied externally on affected part	Chicken pox, foot infection/Broken parts
36	<i>Sapium laurifolium</i> (A.Rich.) Griseb.		Latex/Khira ko chop	Deworming in cattle and applied in wound
37	<i>Cynodon dactylon</i> (L.) Pers	Gramineae	Crushed leaves extract is applied externally to affected skin	Skin diseases/ white patch skin
38	<i>Imperata cylindrica</i> (L.) Raeusch.		A tablespoon of root extract is taken orally	De-worming in children
39	<i>Saccharum officinarum</i> L.		Stem Juice taken orally	UTI and cooling stomach

Sl.#	Botanical name	Family	Ethnomedicinal preparation	Treatment [s]
40	<i>Thysanolaena latifolia</i> (Roxb. ex Hornem.) Honda		Crushed root applied as paste	Cure boils
41	<i>Mentha spicata</i> L.	Lamiaceae	Leaves are rubbed on skin rashes	Anti-allergy/ antirashes
42	<i>Clerodendrum infortunatum</i> L.		leaves are crushed and fed	Lantana poisoning <i>Bokrey</i> in cattle
43	<i>Ocimum gratissimum</i> L.		A glass of decoction of leaves	Pneumonia
44	<i>Ocimum sanctum</i> L.		Leaves and tender twigs are boiled with water and taken as tea	Common cold, sore throat and headache
45	<i>Plectranthus scutellarioides</i> (L.) R.Br.		Crushed leaves are rubbed on affected skin; juice prepared from leaves also apply on body	To subsidize swollen lymph/ body parts
46	<i>Vitex negundo</i> L.		Crushed leaves rubbed on affected area	Ringworms
47	<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees & Eberm.	Lauraceae	A tablespoon of decoction of leaves and bark	Urinary tract infection (UTI)
48	<i>Litsea cubeba</i> (Lour.) Pers.		Leaves extract or juice is drank	Jaundice
49	<i>Acacia catechu</i> (L.f.) Wild.	Leguminosae	Bark is crushed and infusion is drank	Pneumonia
50	<i>Entada rheedii</i> Spreng.		Boiled fruit is crushed and its endosperm is applied to head	Antidandruff, scabies
51	<i>Mimosa pudica</i> L.		Roots are crushed and infusion is given to patient	Pneumonia
52	<i>Senna alata</i> (L.) Roxb.		Leaves are crushed and applied externally	Ringworm, insect and snake bite
53	<i>Punica granatum</i> L.	Lythraceae	Roasted bark is powdered and paste is applied	Foot infection
54	<i>Bombax ceiba</i> L.	Malvaceae	Concoction mixed with sugar is drank	Menstrual irregularity
55	<i>Hibiscus sabdariffa</i> L.		Infusion of crushed leaves and fruits	Dysentery
56	<i>Sida acuta</i> Burm.f.		Infusion from crushed roots	Cures constipation
57	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Leaves decoction is drank	Malarial fever and typhoid
58	<i>Stephania glabra</i> (Roxb.) Miers	Menispermaceae	Fed to weak cattle	Provides strength to cattle
59	<i>Tinospora cordifolia</i> (Wild.) Miers		A glass of decoction every morning	Blood pressure
60	<i>Ficus semicordata</i> Buch.-Ham. ex Sm.	Moraceae	Root paste applied topically	Suppress boil
61	<i>Ficus racemosa</i> L.		Bark is crushed and infusion is drank	Dysentery
62	<i>Ficus religiosa</i> L.		Apply latex on the area	Mumps
63	<i>Maclura cochinchinensis</i> (Lour.) Corner		Seed rubbed on area affected by venomous hair	Rashes/Skin infection

Sl.#	Botanical name	Family	Ethnomedicinal preparation	Treatment [s]
64	<i>Morus alba</i> L.		Concoction with alum ( <i>fetkeri</i> ) is orally administered to patient in a tablespoon	Jaundice
65	<i>Morus macroura</i> Miq.		Concoction with alum ( <i>fetkeri</i> ) is orally administered to patient	Jaundice
66	<i>Moringa oleifera</i> Lam.	Moringaceae	Roots extract applied on cattle wounds to kill maggots	Kill maggots of cattle wounds; Deadly poisonous and fatal if consumed.
67	<i>Musa balbisiana</i> Colla.	Musaceae	Latex from inflorescence and stalk	Stops and diarrhoea and vomiting; Food poisoning
68	<i>Psidium guajava</i> L.	Myrtaceae	Tender leaves Juice taken in a tablespoon	Diarrhea in infants
69	<i>Oxalis corniculata</i> L.	Oxalidaceae	Fruits' extract is applied in drops	Remove eyes dust
70	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Fruit juice taken in a tablespoon	A sore throat
71	<i>Piper rhytidocarpum</i> Hook. f.	Piperaceae	Locket out of these two is put around neck	Epilepsy ( <i>Chopwa</i> )
72	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Crushed roots with garlic is rubbed and applied	Skin diseases and ringworm
73	<i>Clematis buchananiana</i> DC.	Ranunculaceae	Leaves heated and wrapped in cloth piece and sniffed	Sinusitis and nasal congestion
74	<i>Paederia foetida</i> L.	Rubiaceae	Rub the leaves on skin	Lymph swell ( <i>Kalo bagay</i> )
75	<i>Uncaria acids</i> (Hunter) Roxb.		Crushed leaves applied as poultice; Used by shaman during ritual	Fractures/Broken bones; evil eye ( <i>Dewa</i> )
76	<i>Rubus ellipticus</i> Sm.	Rosaceae	Infusion from crushed roots	Gastric and diarrhoea
77	<i>Rosa</i> sp.		Petal extract is dropped in eyes	Clearing eye dust and infection
78	<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae	Juice mixed with coconut	Gastritis and dysentery
79	<i>Citrus aurantifolia</i> Swingle		Pickle is used treat diarrhea and dysentery/ juice is mixed with water, sugar and salt to bring cool our body and freshness in mind	Dysentery and diarrhoea, cooling the body, antidandruff, pimples and blemishes
80	<i>Citrus limon</i> (L.) Burm. f.		A tablespoon of concoction of root extract of <i>Morus's</i> and alum in appropriate dose	Strong medicine for treating Jaundice
81	<i>Citrus medica</i> L.		A tablespoon of concoction of root extract of <i>Morus's</i> and alum in appropriate dose	Strong medicine for treating Jaundice
82	<i>Zanthoxylum caribaeum</i> Lam.		Spines from bark is rubbed on affected skin till swollen part till it is subsided	Body/lymph swelling ( <i>bagay</i> )

Sl.#	Botanical name	Family	Ethnomedicinal preparation	Treatment [s]
83	<i>Toddalia asiatica</i> (L.) Lam		A glass of decoction of leaf is drank once a week	Treatment of severe gastritis
84	<i>Solanum viarum</i> Dunal	Solanaceae	Fruits are roasted and smoke from burned seed is inhaled to infected tooth through slim bamboo made pipe	Tooth decay
85	<i>Schima wallichii</i> Choisy	Theaceae	Paste from seed is applied to affected area	Scorpion stung and poisoning
86	<i>Urtica parviflora</i> Roxb.	Urticaceae	Leaves cooked with rice maize or finger millet flour and made to chapati.	Lowers or controls BP
87	<i>Gmelina arborea</i> Roxb.	Verbenaceae	Bark is crushed and fed to cattle along with fodder	Foot and mouth disease ( <i>Khorath</i> )
88	<i>Tetrastigma serrulatum</i> (Roxb.) Planch.	Vitaceae	Extracted juice orally administered to cattle in a bamboo made container.	Lantana poisoning <i>Bokrey</i> in cattle
89	<i>Alpinia nigra</i> (Gaertn.) Burtt	Zingiberaceae	Concoction from rhizomes extract and aurchal is taken orally in a tablespoon	Jaundice
90	<i>Curcuma caesia</i> Roxb.		Decoction from crushed roots; sliced roots are dried and chewed also whenever appetite is lost	Body ache; Appetizer and stomach disorder
91	<i>Equisetum arvense</i> L.	Equisetaceae	Poultice from the whole plant tied to injured part of the body	Fractured bone
92	<i>Drynaria quercifolia</i> (L.) J. Sm	Polypodiaceae	Root paste of a single plant is applied topically on affected part	Body ache and joint pains
93	<i>Pteris biaurita</i> L.	Pteridaceae	Fresh leaves extract and paste applied on cuts	Immediate stops bleeding



**Table 2 (a-e). PR of the use of medicinal plants for treating diseases by 7 informants (i). (Highest number is most preferred; lowest number is least preferred). Rank was determined based on the total score of each species and species with 1<sup>st</sup> rank given is indicated as most effective medicinal plant for respective treatment**

<b>a. Treatment: Deep cut/cuts</b>									
List of medicinal plants	i1	i2	i3	i4	i5	i6	i7	Total	Rank
<i>Ageratum conyzoides</i> (L.)	1	4	4	1	2	3	4	19	2 <sup>nd</sup>
<i>Pteris biaurita</i> L.	4	2	2	4	4	4	3	23	1 <sup>st</sup>
<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob	3	3	3	2	3	2	1	17	3 <sup>rd</sup>
<i>Ageratina adenophora</i> (Spreng.) R.M.King & H.Rob.	2	1	1	3	1	1	2	11	4 <sup>th</sup>
<b>b. Treatment: Body/lymph Inflammation (Bagay)</b>									
List of medicinal plants	i1	i2	i3	i4	i5	i6	i7	Total	Rank
<i>Paederia foetida</i> L (Biriko Gatho)	4	4	5	3	5	4	5	30	1 <sup>st</sup>
<i>Sansevieria trifasciata</i> Prain	3	5	3	5	4	5	4	29	2 <sup>nd</sup>
<i>Aegle marmelos</i> (L.) Corrêa	2	1	2	2	3	1	2	13	4 <sup>th</sup>
<i>Zanthoxylum caribaeum</i> Lam.	2	3	4	4	1	3	3	20	3 <sup>rd</sup>
<b>c. Treatment: Lantana camara L. poisoning (Bokrey) in cattle</b>									
List of medicinal plants	i1	i2	i3	i4	i5	i6	i7	Total	Rank
<i>Gmelina arborea</i> Roxb.	5	3	5	3	5	5	4	30	1 <sup>st</sup>
<i>Boehmeria penduliflora</i> Wedd. ex D.G.Long	4	5	3	5	2	4	3	26	3 <sup>rd</sup>
<i>Bombax ceiba</i> L.	3	4	4	4	4	3	5	27	2 <sup>nd</sup>
<i>Clerodendrum infortunatum</i> L.	2	1	2	2	3	1	1	12	4 <sup>th</sup>
<b>d. Treatment: Appetizer</b>									
List of medicinal plants	i1	i2	i3	i4	i5	i6	i7	Total	Rank
<i>Vitex negundo</i> L.	4	4	1	1	1	1	2	14	3 <sup>rd</sup>
<i>Curcuma caesia</i> Roxb.	2	2	5	4	5	4	3	25	2 <sup>nd</sup>
<i>Euphorbia royleana</i> Boiss.	1	1	2	2	2	2	1	11	4 <sup>th</sup>
<i>Euphorbia thymaloides</i> L.	3	5	3	5	5	5	5	31	1 <sup>st</sup>
<b>e. Treatment: Fracture/sprain</b>									
List of medicinal plants	i1	i2	i3	i4	i5	i6	i7	Total	Rank
<i>Poranopsis paniculata</i> (Roxb.) Roberty	1	1	2	1	2	2	1	10	3 <sup>rd</sup>
<i>Uncaria acida</i> (Hunter) Roxb. (Bhusey karo)	3	4	1	2	4	1	3	18	1 <sup>st</sup>
<i>Caulokaempferia sikkimensis</i> (King ex Baker) K.Larsen	2	3	4	3	1	3	2	18	2 <sup>nd</sup>
<i>Calotropis gigantea</i> (L.) Dryand.	1	1	1	2	1	1	1	8	4 <sup>th</sup>

**Table 3. DMR of multipurpose use of medicinal plants. Total score of 3 popular informants determined by '✓' as used and 'x' as not used respectively; Species with highest tick mark is ranked as A and most preferred species and D as less preferably used**

Species	<i>Gmelina arborea</i> Roxb.	<i>Oroxylum indicum</i> (L.) Kurz	<i>Bombax ceiba</i> L.	<i>Mallotus philippensis</i> (Lam.) Müll. Arg. (Sidurey)
Medicines	✓	✓	✓	✓
Timber	✓	x	✓	x
Articrafts	✓	✓	✓	x
Rituals	✓	✓	x	x
Firewood	✓	✓	x	✓
Fodder	✓	✓	✓	✓
Total	6	5	4	3
Rank	A	B	C	D
Species	<i>Prunus persica</i> (L.) Stokes	<i>Psidium guajava</i> L.	<i>Sapium laurifolium</i> (A. Rich.) Griseb.	<i>Aegle marmelos</i> (L.) Corrêa
Medicines	✓	✓	✓	✓
Timber	x	x	x	✓
Articrafts	x	✓	x	✓
Rituals	x	x	x	x
Firewood	✓	✓	x	✓
Fodder	x	x	x	x
Total	2	3	1	4
Rank	C	B	D	A
Species	<i>Ficus racemosa</i> L. Dumri	<i>Tinospora cordifolia</i> (Willd.) Miers	<i>Ricinus communis</i> L.	<i>Boehmeria penduliflora</i> Wedd. ex D. G. Long (Chipley)
Medicines	✓	✓	✓	✓
Timber	x	x	x	x
Articrafts	x	x	x	x
Rituals	✓	x	x	x
Firewood	✓	x	x	✓
Fodder	✓	✓	x	✓
Total	4	2	1	3
Rank	A	C	D	B

Different plant species are used for the treatment of different ailments. In such cases, local people show preference towards plant species on the basis of their healing power, against a given disease [36,37]. Medicinal plant species were collected through FL by 7 Informants (i) in their local language (*Lhotshamkha*) for both specific and combined treatment.

Most common diseases treated by 7 informants (local healers) in the 2 *gewogs* were listed against medicinal plants to verify the result of PR (Table 2. a-e) on use of medicinal plants. Species with the highest score (1<sup>st</sup> rank) is indicated as the most effective medicinal plant for respective treatment/s. This study shows that ethnomedicinal knowledge of the local healers about different plant species is very specific, also reported [35]. Ethnomedicinal preparation

methods used by informants is mostly by crushing and pounding (34.4%) followed by decoction (10.8%) and rubbing on the body (9.7%). The most effective treatment against jaundice is concoction made from *Morus alba*. root, alum powder and *Citrus* spp. with the knowledge of administering appropriate dose and consuming less oil during the treatment. Plants reported with medicinal value have other uses too. Therefore, DMR (Table 3) was used to assess the various uses of medicinal plants identified [38]. Total score of 3 popular informants determined by placing '✓' & 'x' mark as 'used' and 'not used' respectively. Species with highest '✓' mark is ranked as 'A' and most preferred species and 'D' as the least preferred with highest 'x' mark (Table 3). DMR was carried out basically to find out the local people's preference over use of plants for their multipurpose use, which has otherwise realized

local people to protect and conserve some of these plants high ranked plants owing to their daily use in preparing more remedies. The UV of different medicinal plants as informed was performed to cross verify the use of medicinal plants to treat disease done by PR and FL [13, 21]. The multipurpose uses of these medicinal plants in different occasions (no of events) were also recorded with their different uses.  $UV_{is}$  of *Tinospora cordifolia* (Willd.) Miers, *Saccharum officinarum* with honey from Melipona bees and *Gmelina arborea* Roxb. are 2, 1.5 and 1.7 respectively for treating various diseases (Table 4). Some local practitioners reported collecting medicinal plants/parts from nearby forest collections which to prepare concoctions with

locally available medicinal plants for treating their regular patients. Comparative study on use of the most common ethnomedicinal plants (73 species) reported from southern Bhutan [35] with nearby north east states of India was done to validate the use of same species and their uses for treating human and livestock diseases with similar kind of records [39,40]. It is also interesting to observe that some of the species have been recorded with same ethnomedicinal importance and many with different uses and with different part(s) used [39, 40, 41]. This study indicates TK of medicinal uses of plants are either entirely different in their uses or some time similar uses which gives an idea of knowledge transmission amongst the people [35].

**Table 4.  $UV_{is}$  stands for use value (UV) for a given species (s) by one informant (i) during number of events (n)**

<b>Estimating UV based on local perceptions</b>		$UV_{is} = \frac{\sum U_{is}}{n_{is}}$	<b>Estimating UV based on local perceptions</b>		$UV_{is} = \frac{\sum U_{is}}{n_{is}}$
<b>Name of the Informant: Khada Nanda Rizal</b>			<b>Name of the Informant: Narad Muni Dhungana</b>		
<b>Name of the species: <i>Saccharum officinarum</i> varieties with melipona honey</b>			<b>Name of the species: <i>Gmelina arborea</i> Roxb.</b>		
<b>Sl.#</b>	<b>Uses: Treatment</b>		<b>Sl.#</b>	<b>Uses: Treatment</b>	
1	Jaundice	1.5	1	Pneumonia (Khatira)	1.7
2	UTI/Niranjan/Garam		2	Evil eye ( <i>Bokshi</i> )	
Total	2+1		3	Appetizer ( <i>Nasko</i> )	
Uses			4	UTI/Garam	
No. of events	1+1		5	Skin disease in cattle ( <i>Bokrey</i> )	
			<b>Total Uses</b>	2+1+2	
			<b>No. of events</b>	1+1+1	
			<b>Estimating UV based on local perceptions</b>		$UV_{is} = \frac{\sum U_{is}}{n_{is}}$
			<b>Name of the Informant: Mitra Lal Dhungyal</b>		
			<b>Name of the species: <i>Tinospora cordifolia</i> (Willd.) Miers</b>		
			<b>Sl.#</b>	<b>Uses: Treatment</b>	
			1	Ulcer	
			2	Hypertension	
			3	Diabetes	2
			4	Gastritis	
			<b>Total Uses</b>	1+1+2	
			<b>No. of events</b>	1+1	

**Table 5 (a-g). FL of medicinal plants done by 7 Informants (i) in their local language (*Lhotshamkha*) for specific treatments. Most common diseases treated by informants in the 2 gewogs were identified and listed the medicinal plants used against each disease**

Medicinal plant	Part(s) used	Preparations/dosage
<b>a. Name of the disease/uses: Cut</b>		
<i>Ageratum conyzoides</i> (L.)	Leaves with tender stem	Poultice
<i>Pteris biaurita</i> L. (Unew)	Leaves with tender stem	Poultice & juices from green leaves
<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob	Leaves with tender stem	Poultice & juices from green leaves
<i>Tinospora cordifolia</i> (Willd.) Miers	Leaves with tender stem	Poultice & juices from green leaves
Informant's name: Pundari Timsina		<b>Date: 17/01/2013</b>
<b>b. Name of the disease: Swollen lymph/body (<i>Bagay</i>)</b>		
<i>Paederia foetida</i> L.	Swollen node	Rubbing extract
<i>Sansevieria trifasciata</i> Prain	Leaves	Juice drank and crushed leaves rubbed externally
<i>Aegle marmelos</i> (L.) Corrêa	Fruit	Juice from fruit
<i>Zanthoxylum caribaeum</i> Lam.	Spine/thorn	Infusion from thorn extract
Informant's name: Pundari Timsina		<b>Date: 17/01/2013</b>
<b>c. Name of the disease: Lantana poisoning (<i>Bokrey</i>) in cattle</b>		
<i>Gmelina arborea</i> Roxb.	Bark	Concoction with leaves
<i>Boehmeria penduliflora</i> Wedd. ex D.G.Long	Root	Infusion
<i>Bombax ceiba</i> L.	Bark	Rubbed on body
<i>Clerodendrum infortunatum</i> L.	Root	Leaves extract fed
<i>Citrus reticulata</i> Blanco	Bark	Concoction with leaves
Informant's name: OP Sharma		<b>Date: 17/01/2013</b>
<b>d. Name of the disease: Gastritis (<i>Gano</i>)</b>		
<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Bark	Decoction, boil and drink
<i>Tinospora cordifolia</i> (Willd.) Miers	Stem	Soak & drink
Informant's name: Mitra Lal Dhungyal		<b>Date: 17/01/2013</b>
<b>e. Name of the disease: Hypertension (High blood pressure)</b>		
<i>Urtica dioica</i> L.	Tender leaves	Broth from mixers of all
<i>Zea mays</i> L.	Flour	
<i>Eleusine coracana</i> (L.)	Flour	
<i>Tinospora cordifolia</i> (Willd.) Miers	Tender Leaves	
Informant's name: Pundari Timsina		<b>Date: 17/01/2013</b>

Medicinal plant	Part(s) used	Preparations/dosage
<b>f. Name of the disease: Joint sprain (Merkey ko)</b>		
<i>Uncaria acida</i> (Hunter) Roxb.	Root	Infusion/ apply externally
<i>Calotropis gigantea</i> (L.) Dryand.	Leaves	Baked leaves applied on joints
<i>Poranopsis paniculata</i> (Roxb.) Roberty	Stem	Poultice
<i>Lepidium sativum</i> L.	Seed	Soup drank
Informant's name: Pudari Timsina		<b>Date: 18/01/2013</b>
<b>g. Name of the disease: Tooth decay/carries (Dat ko kira)</b>		
<i>Solanum viarum</i> Dunal	Fruit	Smoke from burned seed to tooth through bamboo made pipe
<i>Drymaria cordata</i> (L.) Willd. ex Schult.	Whole plant	apply externally
<i>Morus macroura</i> Miq.	Roots	Decoction
<i>Citrus medica</i> L.	Roots	Root extract applied to affected teeth
Informant's name: Pundari Timsina		<b>Date: 18/01/2013</b>

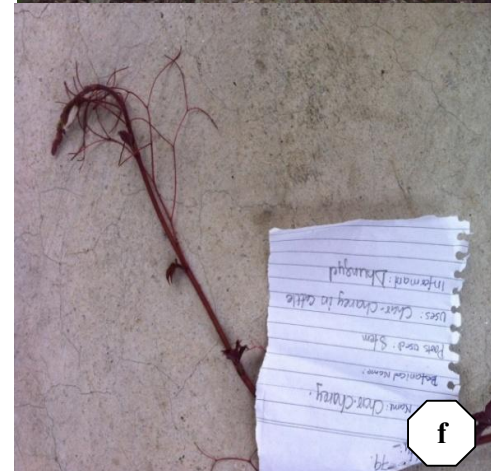
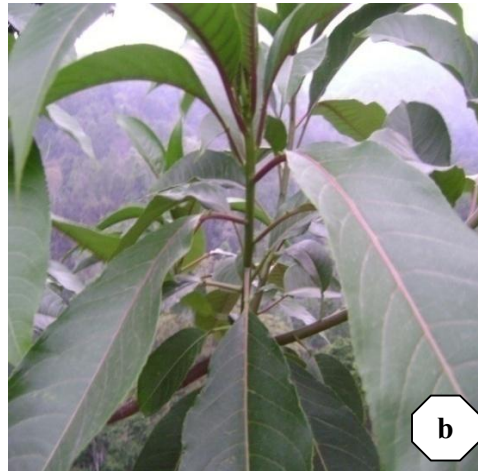
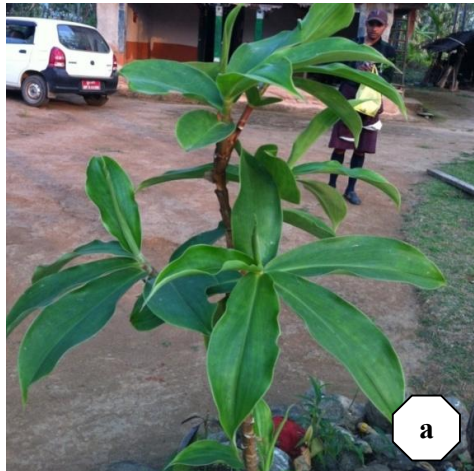


Plate 1. Medicinal plants: (a) *Costus speciosus*  
(d) *Rauwolfia serpentina* (L.) Benth. ex Kurz

(b) *Daphniphyllum himalayense* sub sp. *Himalayense* (c) *Aquilaria malaccensis* Lam.  
(e) *Zanthoxylum caribaeum* Lam. (f) *Tetrastigma serrulatum* (Roxb.) Planch.

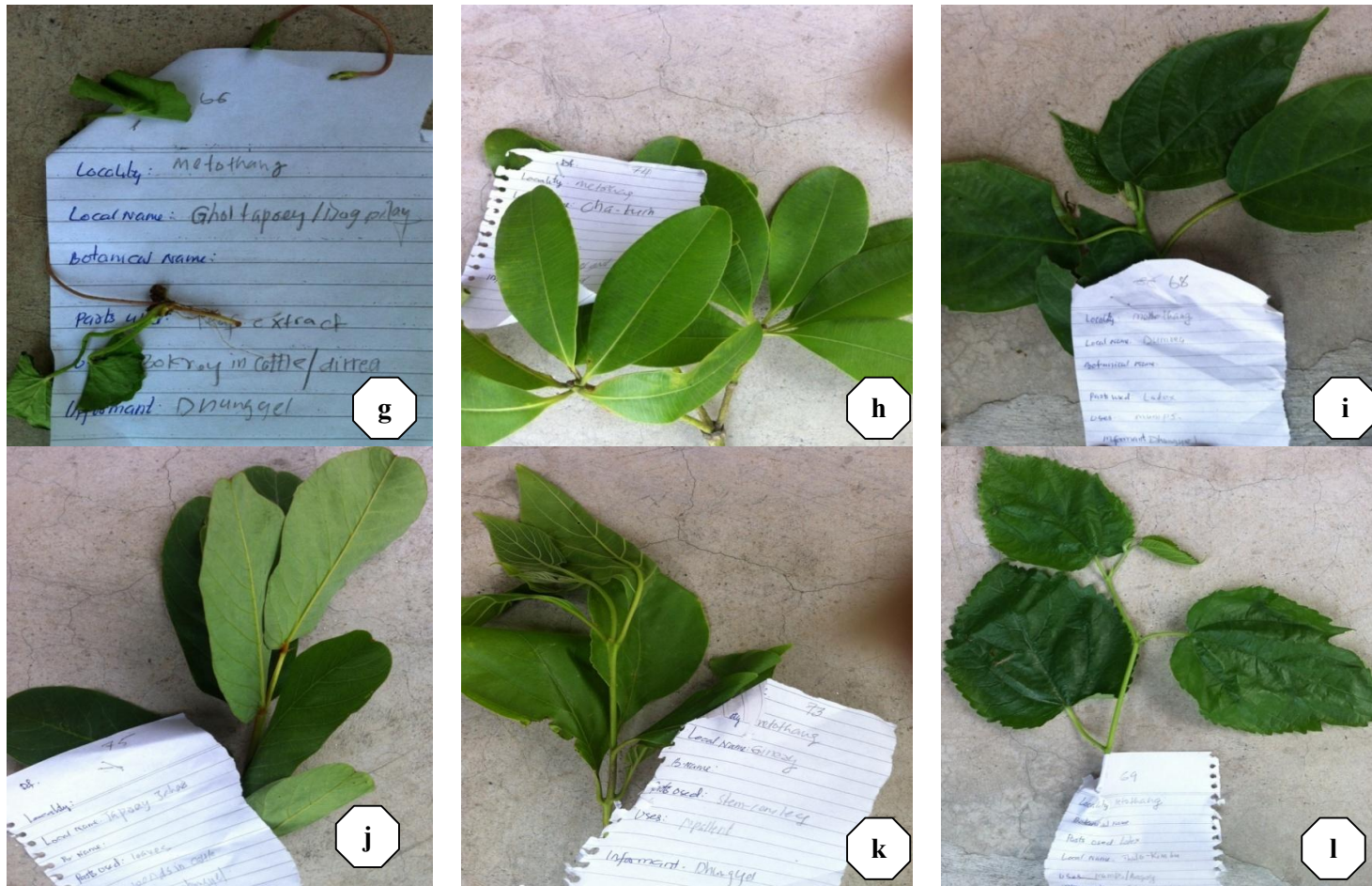


Plate 2. (g) *Centella asiatica* (L.) Urb. (h) *Sapium laurifolium* (A.Rich.) Griseb. (i) *Ficus racemosa* L. (j) *Cassia alata* (L.) Roxb. (k) *Tinospora cordifolia* (Willd.) Miers (l) *Urtica parviflora* Roxb.

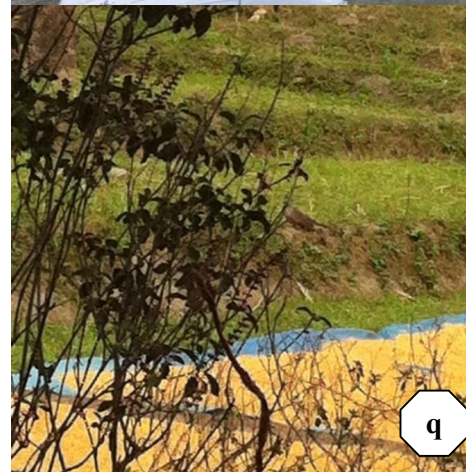
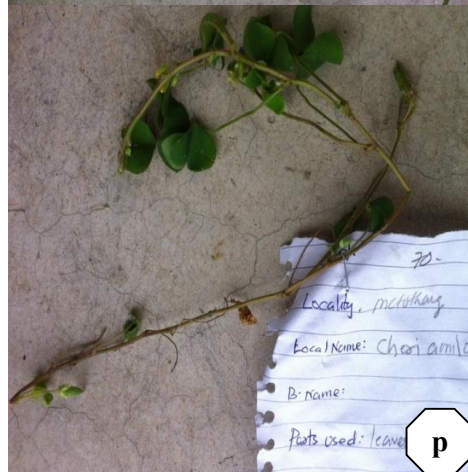
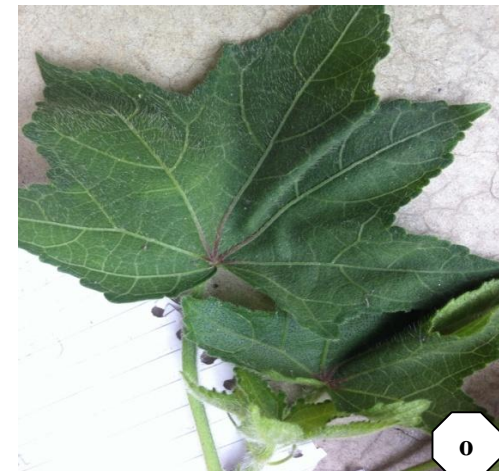
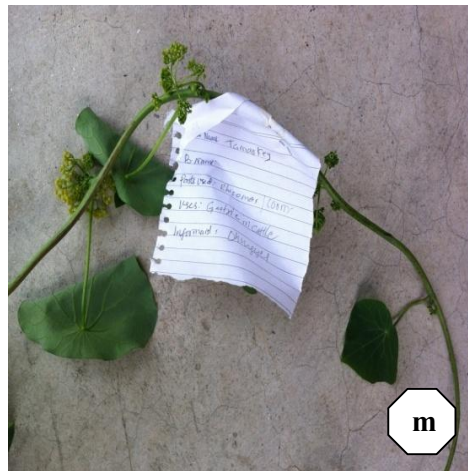


Plate 3. (m) *Stephania glabra* (Roxb.) Miers (n) *Euphorbia* sp. (o) *Ricinus communis* L. (p) *Drymaria cordata* (L.) Willd. ex Schult. (q) *Ocimum gratissimum* L. (r) *Tinospora cordifolia* (Willd.) Miers



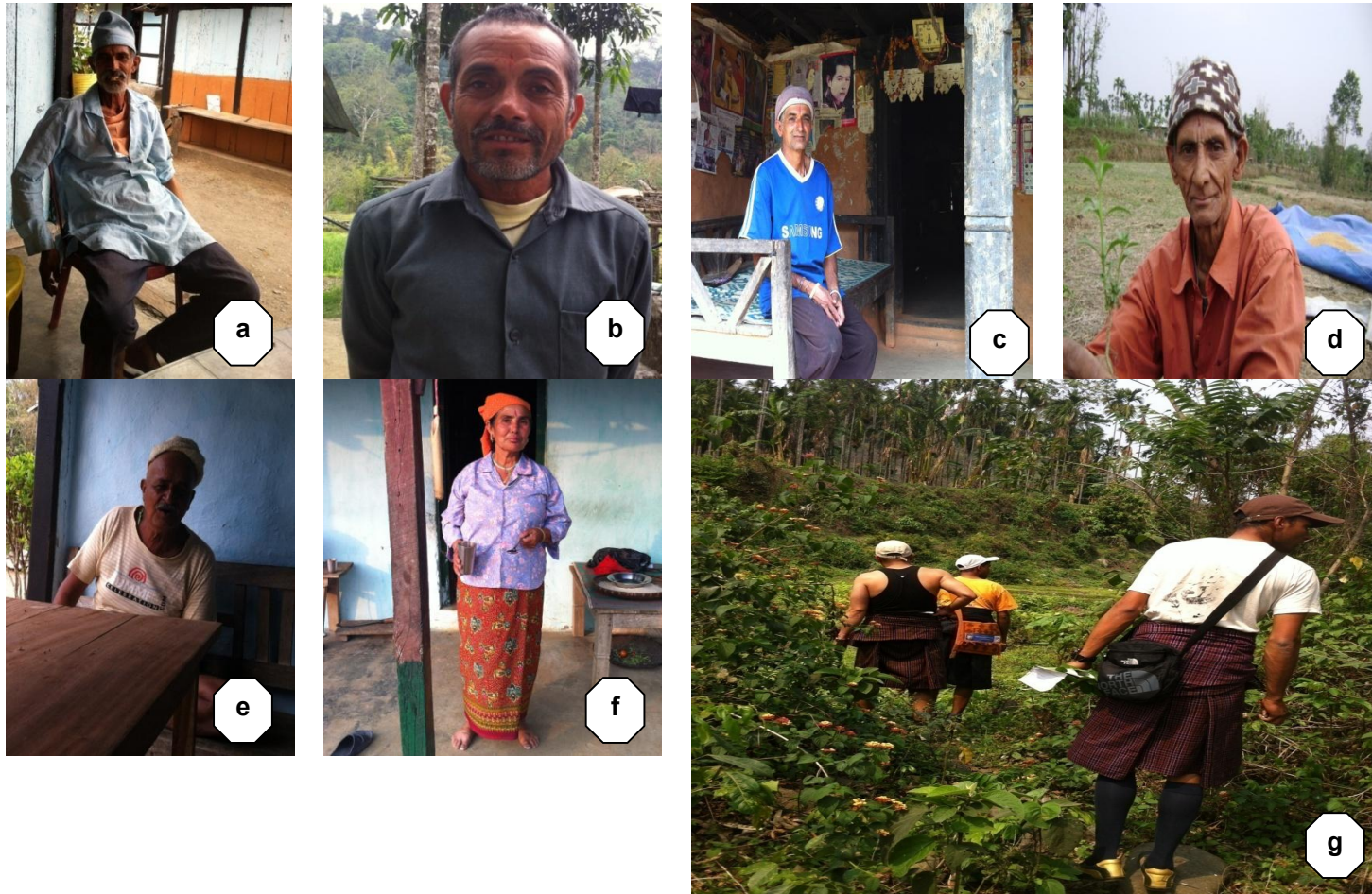


Plate 4. Informants (a) Dilli Ram Khatiwara (b) Dilli Prasad Khatiwara (c) Timsina Jhakri (d) Dharmananda Gautum (e) Narad Muni Dhungana (f) Tika Devi Adhikari (g) Research team collecting specimens with informant

#### 4. CONCLUSION

This study does not give an exhaustive ethnobotanical documentation of the study area because only 2 *gewogs* out of 11 *gewogs* of Samdrup Jonkhar District were studied. A comprehensive study from other southern parts of the country could reveal substantial ethnomedicinal and ethno-veterinary information for Bhutan which could be useful for carrying phytochemical studies in future and to add on to list of Bhutanese traditional medicines.

#### CONSENT

Prior consent was sought from each key informant before interview and they are properly acknowledged.

#### ETHICAL APPROVAL

It is not applicable.

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#### COMPETING INTERESTS

Author has declared that no competing interests exist.

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