

## CHAPTER 6

### 6. DISCUSSION

#### 6.1 Taxonomic diversity of local medicinal flora

The study area is found to be affluent with vast floristic diversity of ethnobotanical plants. A total of 401 ethnobotanical plant species belonging to 289 genera under 114 botanical families were collected. Herbs (186 species) represented the highest proportion of medicinal plant species followed by trees (98 species), shrubs (90 species) and climbers (27 species). It may have been due to the fact that the study sites were located in high elevation ranges where herbs were higher in number than trees, shrubs and climbers. Similar observation were made in the studies of life form of ethnobotanical plants in Nepal (Shrestha & Dhillion, 2003; Bhattarai & Ghimire, 2006; Rokaya *et al.*, 2010; Uprety *et al.*, 2010; Simbo, 2010; Singh *et al.*, 2012; Luitel *et al.*, 2014; Abera, 2014). In some studies, shrubs, trees and climbers were observed to be in descending proportion after herbs (Bhattarai *et al.*, 2010; Uprety *et al.*, 2012; Bhat *et al.*, 2013). Ghimire *et al.* (2008) revealed that 45-70% of the total naturally growing species are long lived herbaceous perennials followed by shrubs (16.6%), annual or biennials herbs (15.6%), trees (13.6%), woody climbers (6.5%) and herbaceous climbers (2.3%). Whereas Rijal (2008) on his research found that out of 115 species, 36 were shrubs, 29 trees, 25 herbs, 21 climbers, 3 ferns and 1 fungus (mushroom).

Out of 401 plants identified in this study, 16 species of 8 families were pteridophytes; 8 species belonging to 4 families were gymnosperm; 313 species from 86 families were dicotyledons and 64 species belonging to 16 families were monocotyledons.

**Table 17** Habits of plants

Habit of plants	No. of species	Percentage
Herbs	186	46
Trees	98	24
Shrubs	90	23
Climbers	27	7
<b>Total</b>	<b>401</b>	<b>100</b>

**Table 18** Groups of plant species

Plant Groups	No. of Families	No. of Species	Percentage
Pteridophytes	8	16	7
Gymnosperms	4	8	3
Monocotyledons	16	64	15
Dicotyledons	86	313	75
<b>Total</b>	<b>114</b>	<b>401</b>	<b>100</b>

Among 114 families noted in this study, Asteraceae was found to be the most dominant family having highest number of plants i.e., 20 species (4.98%) followed by Fabaceae with 18 species (4.48%), and Orchidaceae with 17 species (4.23%) is the third dominant family. The dominant prevalence of Asteraceae was reported in previous researches as well (Della *et al.*, 2006; Teklehaymanot & Giday, 2007; Bhattarai *et al.*, 2010). Other 48 families from Lamiaceae to Oxalidaceae have the species ranging from 3-15 in number and 63 families contributing 83 species have the least species i.e., two or one species (Table 19).

**Table 19** Taxonomic diversity of medicinal plants in Parbat district

S.N	Family	Plant species	No. of genera	% of genera	Plant species	% of species
1	Asteraceae	<i>Anaphalis busua</i> , <i>Anaphalis margaritacea</i> , <i>Anaphalis triplinervis</i> , <i>Rhynchospermum verticillatum</i> , <i>Senecio scandens</i> , <i>Ageratum conyzoides</i> , <i>Ageratum houstonianum</i> , <i>Anaphalis contorta</i> , <i>Artemisia indica</i> , <i>Aster diplostephioides</i> , <i>Bidens pilosa</i> , <i>Cirsium verutum</i> , <i>Eupatorium adenophorum</i> , <i>Eupatorium odoratum</i> , <i>Galinsoga parviflora</i> , <i>Gnaphalium affine</i> , <i>Gnaphalium luteoalbum</i> , <i>Launaea aspleniifolia</i> , <i>Spilanthes paniculata</i> , <i>Taraxacum officinale</i>	14	4.84	20	4.98
2	Fabaceae	<i>Desmodium heterocarpon</i> , <i>Glycyrrhiza glabra</i> , <i>Indigofera bracteata</i> , <i>Parochetus communis</i> , <i>Abrus precatorius</i> , <i>Butea minor</i> , <i>Dalbergia sissoo</i> , <i>Desmodium gangeticum</i> , <i>Desmodium multiflorum</i> , <i>Erythrina arborescens</i> , <i>Erythrina stricta</i> , <i>Flemingia marcophylla</i> , <i>Mucuna nigricans</i> , <i>Mucuna pruriens</i> , <i>Tamarindus indica</i> , <i>Trifolium repens</i> , <i>Desmodium concinnum</i> , <i>Dolichos stantonii</i>	13	4.49	18	4.48
3	Orchidaceae	<i>Acampe papillosa</i> , <i>Chrysoglossum ornatum</i> , <i>Coelogyne corymbosa</i> , <i>Arundina graminifolia</i> , <i>Herminium lanceum</i> , <i>Pleione Praecox</i> , <i>Pleione humilis</i> , <i>Satyrium nepalense</i> , <i>Spiranthes sinensis</i> , <i>Rhynchostylis retusa</i> , <i>Dendrobium aphyllum</i> , <i>Dendrobium moschatum</i> , <i>Oberonia ensiformis</i> , <i>Thunia alba</i> , <i>Platanthera latilabris</i> , <i>Otochilus lancilabius</i> , <i>Dactylorhiza hatagirea</i>	15	5.19	17	4.23
4	Lamiaceae	<i>Nepeta lamiopsis</i> , <i>Notochaete hamosa</i> , <i>Isodon coetsa</i> , <i>Calamintha umbrosa</i> , <i>Salvia campanulata</i> , <i>Colebrookea oppositifolia</i> , <i>Elsholtzia blanda</i> , <i>Mentha arvensis</i> , <i>Mentha spicata</i> , <i>Ocimum basilicum</i> , <i>Ocimum scantum</i> , <i>Pogostemon benghalensis</i> , <i>Pogostemon glaber</i> , <i>Salvia plebeia</i> , <i>Thymus linearis</i>	11	3.80	15	3.74
5	Moraceae	<i>Morus australis</i> , <i>Artocarpus lakoocha</i> , <i>Ficus auricula</i> , <i>Ficus benghalensis</i> , <i>Ficus benjamina</i> , <i>Ficus glaberrima</i> , <i>Ficus hirta</i> , <i>Ficus hispida</i> , <i>Ficus lacor</i> , <i>Ficus neriifolia</i> , <i>Ficus religiosa</i> , <i>Ficus roxburghii</i> , <i>Ficus semicordata</i> , <i>Ficus subincisa</i>	3	1.03	14	3.49
6	Poaceae	<i>Cymbopogon flexuosus</i> , <i>Desmostachya bipinnata</i> , <i>Arundinaria falcata</i> , <i>Cynodon dactylon</i> , <i>Dendrocalamus hamiltonii</i> , <i>Drepanostachyum falcatum</i> , <i>Eulaliopsis binata</i> , <i>Imperata cylindrica</i> , <i>Phragmites karka</i> , <i>Saccharum spontaneum</i> , <i>Thysanolaena maxima</i> , <i>Eleusine indica</i> , <i>Narenga porphyrocoma</i>	13	4.49	13	3.24
7	Euphorbiaceae	<i>Euphorbia heterophylla</i> , <i>Bridelia retusa</i> , <i>Euphorbia hirta</i> , <i>Euphorbia pulcherrima</i> , <i>Euphorbia royleana</i> , <i>Euphorbia thymifolia</i> , <i>Jatropha curcas</i> , <i>Phyllanthus amarus</i> , <i>Phyllanthus emblica</i> , <i>Phyllanthus parvifolius</i> , <i>Ricinus communis</i> , <i>Sapium insigne</i> , <i>Trewia nudiflora</i>	7	2.42	13	3.24
8	Polygonaceae	<i>Bistorta amplexicaulis</i> , <i>Bistorta macrophylla</i> , <i>Persicaria runcinata</i> , <i>Fagopyrum dibotrys</i> , <i>Aconogonum molle</i> , <i>Fagopyrum esculentum</i> , <i>Persicaria perfoliata</i> , <i>Rumex nepalensis</i> , <i>Rheum australe</i> , <i>Rheum moorcroftianum</i>	6	2.07	10	2.49
9	Rosaceae	<i>Pyracantha crenulata</i> , <i>Rubus nepalensis</i> , <i>Fragaria nuicola</i> , <i>Prunus cerasoides</i> , <i>Pyrus</i>	6	2.07	9	2.24

		<i>pashia, Rubus ellipticus, Rubus hoffmeisterianus, Potentilla fulgens, Potentilla polyphylla</i>				
10	Urticaceae	<i>Boehmeria ternifolia, Lecanthus peduncularis, Boehmeria macrophylla, Boehmeria platyphylla, Boehmeria rugulosa, Debregeasia longifolia, Debregeasia salicifolia, Girardinia diversifolia, Urtica dioica</i>	5	1.73	9	2.24
11	Rubiaceae	<i>Galium asparine, Galium mollugo, Mussaenda frondosa, Neohymenopogon parasiticus, Neanotis ingrata, Anthocephalus cadamba, Luculia gratissima, Rubia manjith</i>	7	2.42	8	2.00
12	Araceae	<i>Arisaema concinnum, Arisaema costatum, Arisaema flavum, Arisaema tortuosum, Acorus calamus, Colocasia esculenta, Arisaema griffithii</i>	3	1.03	7	1.75
13	Caesalpiniaceae	<i>Bauhinia purpurea, Bauhinia vahlii, Bauhinia variegata, Cassia mimosoides, Cassia occidentalis, Cassia tora, Cassia fistula</i>	2	0.69	7	1.75
14	Anacardiaceae	<i>Choerospondias axillaris, Lannea coromandelica, Rhus javanica, Rhus succedanea, Semecarpus anacardium, Spondias pinnata</i>	5	1.73	6	1.50
15	Ranunculaceae	<i>Anemone vitifolia, Anemone rivularis, Clematis gouriana, Delphinium altissimum, Ranunculus laetus, Thalictrum reniforme</i>	5	1.73	6	1.50
16	Verbenaceae	<i>Callicarpa macrophylla, Caryopteris nepalensis, Callicarpa arborea, Duranta repens, Lantana camara, Vitex negundo</i>	5	1.73	6	1.50
17	Lauraceae	<i>Litsea cubeba, Neolitsea pallens, Cinnamomum camphora, Cinnamomum tamala, Lindera neesiana, Litsea monopetala</i>	4	1.38	6	1.50
18	Zingiberaceae	<i>Cautleya spicata, Hedychium spicatum, Hedychium ellipticum, Hedychium coccineum, Roscoea capitata, Curcuma angustifolia</i>	4	1.38	6	1.50
19	Amaranthaceae	<i>Amaranthus caudatus, Cyathula tomentosa, Achyranthes aspera, Achyranthes bidentata, Amaranthus viridis, Amaranthus spinosus</i>	3	1.03	6	1.50
20	Cucurbitaceae	<i>Herpetospermum pedunculatum, Benincasa hispida, Coccinia grandis, Trichosanthes tricuspidata, Solena amplexicaulis</i>	5	1.73	5	1.25
21	Meliaceae	<i>Azadirachta indica, Cipadessa baccifera, Cipadessa fruticosa, Melia azedarach, Toona ciliata</i>	4	1.38	5	1.25
22	Pinaceae	<i>Abies spectabilis, Pinus roxburghii, Pinus wallichiana, Cedrus deodara, Tsuga dumosa</i>	4	1.38	5	1.25
23	Scrophulariaceae	<i>Hemiphragma heterophyllum, Mazus surculosus, Pedicularis gracilis, Neopicrorhiza scrophulariiflora, Pedicularis scullyana</i>	4	1.38	5	1.25
24	Solanaceae	<i>Cestrum nocturnum, Datura stramonium, Nicandra physalodes, Solanum nigrum, Solanum aculeatissimum</i>	4	1.38	5	1.25
25	Gentianaceae	<i>Halenia elliptica, Swertia nervosa, Gentiana ornate, Swertia angustifolia, Swertia chirayita</i>	3	1.03	5	1.25
26	Dioscoreaceae	<i>Dioscorea bulbifera, Dioscorea deltoidea, Dioscorea esculenta, Dioscorea pentaphylla, Dioscorea alata</i>	1	0.34	5	1.25
27	Hypericaceae	<i>Hypericum elodeoides, Hypericum oblongifolium, Hypericum cordifolium, Hypericum japonicum, Hypericum uralum</i>	1	0.34	5	1.25
28	Apiaceae	<i>Eryngium foetidum, Angelica archangelica, Hydrocotyle nepalensis, Centella asiatica</i>	4	1.38	4	1.00
29	Liliaceae	<i>Campylandra aurantiaca, Aloe vera, Chlorophytum nepalense, Paris polyphylla</i>	4	1.38	4	1.00

30	Papaveraceae	<i>Corydalis megacalyx, Dactylicapnos scandens, Dicentra macrocapnos, Meconopsis regia</i>	4	1.38	4	1.00
31	Asclepiadaceae	<i>Ceropegia pubescens, Calotropis gigantea, Calotropis procera, Cryptolepis buchananii</i>	3	1.03	4	1.00
32	Berberidaceae	<i>Berberis aristata, Berberis asiatica, Mahonia napaulensis, Podophyllum hexandrum</i>	3	1.03	4	1.00
33	Melastomataceae	<i>Melastoma normale, Osbeckia nepalensis, Osbeckia stellata, Oxyspora paniculata</i>	3	1.03	4	1.00
34	Rutaceae	<i>Boenninghausenia albiflora, Murraya paniculata, Zanthoxylum acanthopodium, Zanthoxylum armatum</i>	3	1.03	4	1.00
35	Adoxaceae	<i>Viburnum erubescens, Sambucus adnata, Sambucus canadensis, Sambucus hookeri</i>	2	0.69	4	1.00
36	Fagaceae	<i>Castanopsis indica, Castanopsis tribuloides, Quercus glauca, Quercus semecarpifolia</i>	2	0.69	4	1.00
37	Convolvulaceae	<i>Ipomoea purpurea, Ipomoea carnea, Ipomoea cairica, Ipomoea nil</i>	1	0.34	4	1.00
38	Ericaceae	<i>Gaultheria fragrantissima, Lyonia ovalifolia, Rhododendron arboretum</i>	3	1.03	3	0.74
39	Mimosaceae	<i>Albizia chinensis, Mimosa pudica, Acacia catechu</i>	3	1.03	3	0.74
40	Oleaceae	<i>Fraxinus floribunda, Jasminum officinale, Nyctanthes arbor-tristis</i>	3	1.03	3	0.74
41	Polypodiaceae	<i>Drynaria propinqua, Lepisorus thunbergianus, Loxogramme involuta</i>	3	1.03	3	0.74
42	Theaceae	<i>Camellia kissi, Eurya acuminata, Schima wallichii</i>	3	1.03	3	0.74
43	Acanthaceae	<i>Asystasia macrocarpa, Justicia procumbens, Justicia adhatoda</i>	2	0.69	3	0.74
44	Betulaceae	<i>Alnus nepalensis, Betula alnoides, Betula utilis</i>	2	0.69	3	0.74
45	Caryophyllaceae	<i>Drymaria cordata, Drymaria villosa, Sparganium arvensis</i>	2	0.69	3	0.74
46	Davalliaceae	<i>Araiostegia pulchra, Nephrolepis auriculata, Nephrolepis cordifolia</i>	2	0.69	3	0.74
47	Lycopodiaceae	<i>Lycopodium cernuum, Lycopodium clavatum, Lygodium japonicum</i>	2	0.69	3	0.74
48	Balsaminaceae	<i>Impatiens bicornuta, Impatiens puberula, Impatiens urticifolia</i>	1	0.34	3	0.74
49	Magnoliaceae	<i>Michelia kisopa, Michelia champaca, Michelia doltsopa</i>	1	0.34	3	0.74
50	Oxalidaceae	<i>Oxalis debilis, Oxalis corniculata, Oxalis latifolia</i>	1	0.34	3	0.74
51	Agavaceae	<i>Agave Americana, Agave sisalana</i>	1	0.34	2	0.50
52	Alliaceae	<i>Allium hypsistum, Allium wallichii</i>	1	0.34	2	0.50
53	Aspidiaceae	<i>Diplazium polypodioides, Diplazium stoliczkae</i>	1	0.34	2	0.50
54	Apocynaceae	<i>Chonemorpha fragrans, Rauwolfia serpentina</i>	2	0.69	2	0.50
55	Boraginaceae	<i>Cynoglossum amabile, Cynoglossum zeylanicum</i>	1	0.34	2	0.50
56	Capparaceae	<i>Cleome viscosa, Crateva unilocularis</i>	2	0.69	2	0.50
57	Chenopodiaceae	<i>Chenopodium album, Chenopodium ambrosioides</i>	1	0.34	2	0.50
58	Combretaceae	<i>Terminalia bellirica, Terminalia chebula</i>	1	0.34	2	0.50
59	Crassulaceae	<i>Bryophyllum pinnatum, Kalanchoe spathulata</i>	2	0.69	2	0.50
60	Equisetaceae	<i>Equisetum debile, Equisetum diffusum</i>	1	0.34	2	0.50
61	Gesneriaceae	<i>Aeschynanthus sikkimensis, Chirita urticifolia</i>	2	0.69	2	0.50
62	Juglandaceae	<i>Engelhardia spicata, Juglans regia</i>	2	0.69	2	0.50
63	Lythraceae	<i>Lagerstroemia indica, Woodfordia fruticosa</i>	2	0.69	2	0.50
64	Malvaceae	<i>Gossypium herbaceum, Urena lobata</i>	2	0.69	2	0.50
65	Menispermaceae	<i>Cissampelos pareira, Tinospora sinensis</i>	2	0.69	2	0.50
66	Myrtaceae	<i>Cleistocalyx operculatus, Syzygium cumini</i>	2	0.69	2	0.50
67	Piperaceae	<i>Piper longum, Piper chaba</i>	1	0.34	2	0.50
68	Rhamnaceae	<i>Ziziphus incurve, Ziziphus mauritiana</i>	1	0.34	2	0.50
69	Saxifragaceae	<i>Astilbe rivularis, Bergenia ciliata</i>	2	0.69	2	0.50
70	Smilacaceae	<i>Smilax aspera, Smilax ovalifolia</i>	1	0.34	2	0.50
71	Thymelaeaceae	<i>Wikstroemia canescens, Daphne bholua</i>	2	0.69	2	0.50
72	Valerianaceae	<i>Valeriana hardwickii, Valeriana jatamansii</i>	1	0.34	2	0.50

73	Asparagaceae	<i>Asparagus racemous</i>	1	0.34	1	0.25
74	Begoniaceae	<i>Begonia picta</i>	1	0.34	1	0.25
75	Bignoniaceae	<i>Oroxylum indicum</i>	1	0.34	1	0.25
76	Bombacaceae	<i>Bombax ceiba</i>	1	0.34	1	0.25
77	Brassicaceae	<i>Rorippa nasturtium-aquaticum</i>	1	0.34	1	0.25
78	Burseraceae	<i>Garuga pinnata</i>	1	0.34	1	0.25
79	Campanulaceae	<i>Campanula pallida</i>	1	0.34	1	0.25
80	Cannabinaceae	<i>Cannabis sativa</i>	1	0.34	1	0.25
81	Commelinaceae	<i>Commelina maculata</i>	1	0.34	1	0.25
82	Cupressaceae	<i>Juniperus indica</i>	1	0.34	1	0.25
83	Cuscutaceae	<i>Cuscuta reflexa</i>	1	0.34	1	0.25
84	Cyperaceae	<i>Cyperus cyperoides</i>	1	0.34	1	0.25
85	Daphniphyllaceae	<i>Daphniphyllum himalense</i>	1	0.34	1	0.25
86	Dipterocarpaceae	<i>Shorea robusta</i>	1	0.34	1	0.25
87	Ebenaceae	<i>Diospyros lancifolia</i>	1	0.34	1	0.25
88	Elaeocarpaceae	<i>Elaeocarpus sphaericus</i>	1	0.34	1	0.25
89	Geraniaceae	<i>Geranium nepalense</i>	1	0.34	1	0.25
90	Hypoxidaceae	<i>Curculigocrassifolia</i>	1	0.34	1	0.25
91	Iridaceae	<i>Iris clarkei</i>	1	0.34	1	0.25
92	Juncaceae	<i>Juncus concinnus</i>	1	0.34	1	0.25
93	Linaceae	<i>Reinwardtia indica</i>	1	0.34	1	0.25
94	Lindsaeaceae	<i>Sphenomeris chinensis</i>	1	0.34	1	0.25
95	Loganiaceae	<i>Buddleja asiatica</i>	1	0.34	1	0.25
96	Loranthaceae	<i>Taxillus umbellifer</i>	1	0.34	1	0.25
97	Marattiaceae	<i>Angiopteris evicata</i>	1	0.34	1	0.25
98	Myricaceae	<i>Myrica esculenta</i>	1	0.34	1	0.25
99	Myrsinaceae	<i>Maesa chisia</i>	1	0.34	1	0.25
100	Nyctaginaceae	<i>Mirabilis jalapa</i>	1	0.34	1	0.25
101	Oleandraceae	<i>Oleandra wallichii</i>	1	0.34	1	0.25
102	Pandanaceae	<i>Pandanus nepalensis</i>	1	0.34	1	0.25
103	Parnassiaceae	<i>Parnassia wightiana</i>	1	0.34	1	0.25
104	Plantaginaceae	<i>Plantago major</i>	1	0.34	1	0.25
105	Podocarpaceae	<i>Podocarpus neriifolius</i>	1	0.34	1	0.25
106	Polygalaceae	<i>Polygala arillata</i>	1	0.34	1	0.25
107	Salicaceae	<i>Salix babylonica</i>	1	0.34	1	0.25
108	Sapindaceae	<i>Sapindus mukorossi</i>	1	0.34	1	0.25
109	Sapotaceae	<i>Dplokema butyracea</i>	1	0.34	1	0.25
110	Saurauiaceae	<i>Saurauia napaulensis</i>	1	0.34	1	0.25
111	Sonneratiaceae	<i>Duabanga grandiflora</i>	1	0.34	1	0.25
112	Taxaceae	<i>Taxus wallichiana</i>	1	0.34	1	0.25
113	Ulmaceae	<i>Celtis australis</i>	1	0.34	1	0.25
114	Vitaceae	<i>Cissus repens</i>	1	0.34	1	0.25
	<b>Total</b>		<b>289</b>	<b>99.42</b>	<b>401</b>	<b>99.99</b>

## 6.2 Indigenous knowledge transfer and practice

Indigenous knowledge is the local knowledge that is unique to a given culture or society; it is the basis for local-level decision making in agricultural or traditional method of preparing medicine, healthcare, food preparation etc. As Pushpangadan *et al.* (2013) deduced traditional knowledge serves as a powerful tool for bio-prospecting of plant wealth and also for converting into value added products. Such a valuable knowledge is often transferred from one generation to another orally. According to Gispert and Campos (1986), indigenous knowledge is transmitted vertically, *i.e.*, from elders to the younger family members and horizontally, *i.e.*, through oral communication, imitation and participation in communal activities. Socio-economic influences are also found to be

accountable for the depletion of indigenous knowledge; their lifestyle is socially and economically influenced by the in-migrated ethnic tribes that hold the influence of an introduced culture results in loss of knowledge (Stamm *et al.*, 2004). Many other factors are believed to effect transmission of knowledge. According to Rijal (2008), loss of species, change in social practices, age difference, influence of migrated culture, influence of development activities, influence of market, change in lifestyle and policy problem have bearence over knowledge transmission. It was inferred from some studies in India that knowledge of herbal medicine remained locked with a few experts alone: Kumar and Yadav (2010) found that large number of old and experienced medicine men never disclosed their knowledge to others. Parabia and Pathak (2008) observed that indigenous knowledge was scattered among the tribal men and women, and all tribes were not experts on medicines.

Most interviewed ethnic people of this study were found to be quite familiar with the plant species used to cure different ailments such as cough and cold, diarrhoea and dysentery, digestive problems, fever, headache, cuts and wounds, skin infection (Table 20). But, in some cases, they were very less familiar with the plant species; sometimes they are even unknown about the species. This observation resembled previous study which concluded that only local healers in the community and medicinal practitioners (*Baidhya, Dhami, Jhakri*) knew more about the plants and their uses (Luitel & Pathak, 2013). Although the number of medicinal plants reported by men were more than those reported by women, the difference was not significant when the average number of medicinal plants reported by each group was compared. This study also revealed that specific knowledge on the use of medicinal plants was common among both sexes. However, it was noted that women were more knowledgeable about the local names of the plants than males but had less knowledge on their uses. This finding was established in the study carried out by Parajuli (2012); it found that elderly women had more knowledge about the medicinal use of plants. This may be because women in rural societies worldwide are often primarily responsible to their household food security, health and family continuity (Howard-Borjas, 1999; Saul, 1992), and thus richer than men in ethnomedicinal indigenous knowledge (Anguilar, 2004; Latoya *et al.*, 2003; Wayland, 2001; Voeks and Leony, 2004; Saul, 1992). Previous studies also observed that men were more knowledgeable than women in the homogenous community, while women were more knowledgeable than men in the heterogeneous community (Rijal, 2008). The reason, men being more knowledgeable than women could be because most of the healers were men (Gurung, 1995).

In terms of age group, a significant difference was observed in the number of medicinal plants reported by senior members of the community (50-79 years) compared to that of middle aged members (30-49 years) (Table 9). A larger number of medicinal plants were reported by elders ( $\geq$

50 years) than young and middle aged informants. Contrarily, Uprety *et al.* (2012) observed that young people (12-25 years) possessed more knowledge pertaining to wild fruit whereas older females (> 35 years) had more knowledge about vegetable plants. No significant difference was observed in the number of medicinal plants listed by informants living around health centers and those living relatively far.

The study discerned that indigenous knowledge was handed over orally by medicinal healers and elders. This was in no way different from what previous researcher's observed (Sacherer, 1979; Singh *et al.*, 1979; Joshi & Edington, 1990; Shrestha & Dhillion, 2003; Bhattarai *et al.*, 2006 a&b; Gronhaug *et al.*, 2008). Apprenticeship as the most dominant mode of knowledge transfer (65%) (Mootoosamy & Mahomoodally, 2014), however, was not observed at all in the studied area. Contrarily, family as inheriter of knowledge (30%) as reported in the study of Mootoosamy and Mahomoodally (2014) was found dominant in this study. In the cases of complicated problems such as poisoning, gynaecological problems, heart problems, urinary problems, knowledge was transferred only to the family members and local healers. Similar observations were made in studies carried out in Nepal (Singh *et al.*, 1979; Chhetri & Gauchan, 2008; Lohani *et al.*, 2008; Rokaya *et al.*, 2010; Uprety *et al.*, 2010), in India (Jain & Saklani, 1991; Kumar & Yadav, 2010; Parabia & Pathak, 2008; Sharma & Pegu, 2011) and other countries (Gispert & Campos, 1986; Bhat *et al.*, 1990; Bhat & Jacobs, 1995). Going further, Shrestha and Dhillion (2003) reasoned that such practices were kept with sanctity and secrecy so as to save the medicines from losing their potency.

The major way of indigenous knowledge transfer among the traditional healers of the ethnic communities of Parbat district was verbal. None of the participants had written documents whereas all healers reported that they received the knowledge from their parents or grandparents orally. It was also found that there was maximum secrecy in passing the knowledge within the family circle. Priority was exclusively given to senior family member, especially an elder son, if not, other interested sons by their seniority, and hardly to daughter. The daughters were informed only if they were unmarried. Among *Magars*, very contradictory tendencies were found; some waited till their last breath to produce in written form about vital diseases whereas some shared their knowledge if they got paid. *Majhis* were observed to be comparatively reserved; they did not want to share their indigenous knowledge outside their community at all. It may be because they believed that if they shared information, the efficacy of the drugs will be lost (Sharma & Pegu, 2011). As Uprety also found traditional healers preferred to keep secrecy because they believed the medicines would lose their potency if revealed to other people (Uprety *et al.*, 2010). As the indigenous knowledge on the usage of plant is transmitted without any systematic process, there is the maximum probability that such knowledge is at risk of disappearance in the future, as seen in Ecuador, where original

knowledge on the usage of plants has declined due to the lack of systematic knowledge transmission (Bussmann & Sharon, 2006).

### **6.3 Ailment types, number of plant species and treatment methods**

Medicinal plants have been used throughout human history because they have a wide variety of chemical compounds usable to defend against attack from various diseases. The World Health Organization (WHO, 2002) estimated that 80% of the people in Asian and African countries use herbal medicines for some aspects of primary health.

In the study area, out of 401, 397 medicinal plant species were used to treat 114 different types of diseases/ailments (Table 20) categorized into 17 different categories (Table 23) whereas four plant species have other uses besides medicinal use *i.e.* *Cyperus cyperoides*, *Platanthera latilabris*, *Chrysoglossum orantum* and *Hedychium coccineum*. This study recognized 98 plant species used to cure fever, 85 species to treat cuts and wounds as well as whitlow, and 76 species to cure dysentery whereas seventeen plant species used solely for one disease (Table 20). Some plant species have capacity to treat multiple ailments/diseases for example *Calotropis gigantea* (16 diseases), *Benincasa hispida* and *Cassia fistula* (12 diseases), *Kalanchoe spathulata* (11 diseases) respectively. Kunwar *et al.* (2006) had found that maximum species were used to treat fever followed by cough and cold, indigestion, and diarrhoea. Previously, Bhattarai *et al.* (2013) had recorded 45 medicinal plants in Panchase area to treat 34 different ailments.

Depending on types of reported ailments, traditional healers diagnosed patients through an interview, which was followed by inspection of eyes, skin colour, tongue, throat, status of sores, bleeding, infections and body temperature through bare hands. Patients with skin infections were treated by rubbing and pasting herbal preparations whereas sores were treated by spitting the chewed part of medicinal plants on the sore. For internal ailments, herbal preparations were mainly administered orally whereas general malaise was treated with steam bath and vapour inhalation. Overall, healers from different communities had their own way of treatment methods even for identical problems.

The treatment of many diseases was noted to be rarely done in the cases of hesitation from patients. Similar was observed during the survey in Uttar Pradesh in cases of women's gynaecological problems (Tiwari & Pandey, 2012).

**Table 20** Different human diseases treated by the different plant species

S.N	Human Diseases	Medicinal Plants used in Treatment	Number of Species
1	Abdominal pain	<i>Calotropis gigantea, Thalictum reniforme, Zanthoxylum acanthopodium, Juniperus indica, Angelica archangelica, Cirsium verutum</i>	6
2	Abortification	<i>Buddleja asiatica, Prunus cerasoides, Jatropha curcas, Cassia fistula, Ocimum scantum, Gossypium herbaceum, Hypericum uralum</i>	7
3	Abscesses	<i>Michelia champaca, Ficus benghalensis, Michelia kisopa</i>	3
4	Anaemia	<i>Gossypium herbaceum</i>	1
5	Aphrodisiac	<i>Cannabis sativa, Dactylorhiza hatagirea, Curculigo crassifolia, Thymus linearis, Desmodium gangeticum</i>	5
6	Appetizer	<i>Camellia kissi, Rhus javanica, Cannabis sativa, Commelina maculata, Thymus linearis</i>	5
7	Asthma	<i>Abies spectabilis, Garuga pinnata, Semecarpus anacardium, Tamarindus indica, Mimosa pudica, Bergenia ciliata, Syzygium cumini, Senecio scandens, Artemisia indica, Calotropis gigantea, Calotropis procera, Taxus wallichiana, Cassia fistula, Justicia adhatoda, Salvia campanulata, Piper chaba, Piper longum, Euphorbia hirta, Urtica dioica, Cannabis sativa, Myrica esculenta, Eleusine indica, Juniperus indica, Dolichos staintonii</i>	24
8	Backache	<i>Drynaria propinqua, Hypericum cordifolium, Zizyphus mauritiana, Prunus cerasoides, Aster diplostephioides, Gnaphalium luteo-album, Cryptolepis buchananii, Justicia procumbens, Persicaria perfoliata, Acampe papillosa, Arisaema costatum</i>	11
9	Bee stings	<i>Impatiens puberula, Hypericum uralum</i>	2
10	Beriberi	<i>Cynoglossum amabile</i>	1
11	Bladder stones	<i>Crateva unilocularis</i>	1
12	Bleeding	<i>Cissampelos pareira, Boenninghausenia albiflora, Cipadessa fruticosa, Herminium lanceum, Dactylorhiza hatagirea</i>	5
13	Blood coagulant	<i>Galinsoga parviflora, Boehmeria rugulosa</i>	2
14	Blood pressure	<i>Corydalis megacalyx, Elaeocarpus sphaericus, Valeriana hardwickii, Rauwolfia serpentina, Crateva unilocularis, Swertia chirayita, Calamintha umbrosa, Urtica dioica, Mentha arvensis, Mentha spicata, Aloe vera, Camellia kissi, Terminalia bellirica, Swertia angustifolia, Neopicrorhiza scrophulariiflora</i>	15
15	Blood purification	<i>Thalictum reniforme, Bauhinia variegata, Swertia angustifolia, Swertia chirayita, Berberis aristata, Thymus linearis</i>	6
16	Body pain	<i>Lycopodium cernuum, Lycopodium clavatum, Hypericum japonicum, Azadirachta indica, Oroxyllum indicum, Mussaenda frondosa, Gaultheria fragrantissima, Calotropis gigantea, Cuscuta reflexa, Aeschynanthus sikkimensis, Lindera neesiana, Litsea monopetala, Boehmeria rugulosa, Celtis australis, Cannabis sativa, Ficus benghalensis, Smilax ovalifolia, Araiostegia pulchra, Rumex nepalensis, Dactylicapnos scandens, Thymus linearis, Oberonia ensiformis, Litsea cubeba</i>	23
17	Boils	<i>Lygodium japonicum, Cleome viscosa, Drymaria cordata, Reinwardtia indica, Toona ciliata, Parochetus communis, Abrus precatorius, Erythrina arborescens, Tamarindus indica, Bauhinia vahlii, Bryophyllum pinnatum, Kalanchoe spathulata, Trichosanthes tricuspidata, Valeriana jatamansii, Anaphalis margaritacea, Ageratum conyzoides, Anaphalis contorta, Eupatorium adenophorum, Eupatorium odoratum, Launaea aspleniifolia, Ceropogia pubescens, Calotropis gigantea, Buddleja asiatica, Cynoglossum zeylanicum, Datura stramonium, Spargula arvensis, Sapindus mukorossi, Hydrocotyle nepalensis, Callicarpa arborea, Isodon coetsa, Plantago major, Mirabilis jalapa, Achyranthes aspera, Achyranthes bidentata, Rumex nepalensis, Euphorbia heterophylla, Euphorbia pulcherrima, Phyllanthus parvifolius, Daphniphyllum himalense, Boehmeria ternifolia, Engelhardia spicata, Ficus benjamina, Ficus lacor, Coelogyne corymbosa, Dioscorea pentaphylla, Thysanolaena maxima, Spiranthes sinensis, Betula utilis, Oberonia ensiformis</i>	49
18	Bronchitis	<i>Abies spectabilis, Syzygium cumini, Ipomoea purpurea, Lepisorus thunbergianus, Taxus wallichiana, Anemone rivularis, Justicia adhatoda, Ocimum scantum, Euphorbia hirta, Phyllanthus emblica, Myrica esculenta,</i>	16

		<i>Piper chaba, Dolichos staintonii, Cleistocalyx operculatus, Ipomoea nil, Tsuga dumosa</i>	
19	Burns	<i>Equisetum diffusum, Angiopteris evecata, Impatiens urticifolia, Sapindus mukorossi, Bryophyllum pinnatum, Kalanchoe spathulata, Oroxylum indicum, Eryngium foetidum, Alnus nepalensis, Aloe vera, Cynodon dactylon, Betula utilis</i>	12
20	Cancer	<i>Taxus wallichiana, Kalanchoe spathulata, Podophyllum hexandrum, Bergenia ciliata</i>	4
21	Chest pain	<i>Aster diplostephioides, Trichosanthes tricuspidata, Arisaema griffithii, Calamintha umbrosa, Calotropis gigantea</i>	5
22	Chicken pox	<i>Allium wallichii, Aster diplostephioides</i>	2
23	Cholera	<i>Zanthoxylum armatum, Allium wallichii</i>	2
24	Colic pain	<i>Michelia champaca, Michelia doltsopa, Commelina maculata, Dactylorhiza hatagirea, Benincasa hispida</i>	5
25	Constipation	<i>Trichosanthes tricuspidata, Chonemorpha fragrans, Parnassia wightiana, Piper longum, Phyllanthus emblica, Girardinia diversifolia, Dioscorea deltoidea, Piper chaba, Amaranthus caudatus (pd), Dioscorea alata, Rheum moorcroftianum, Rheum australe, Rumex nepalensis, Rorippa nasturtium-aquaticum, Cassia tora</i>	15
26	Convulsion (epileptic seizure)	<i>Asystasia macrocarpa (pd)</i>	1
27	Cough and cold	<i>Nephrolepis auriculata, Nephrolepis cordifolia, Abies spectabilis, Azadirachta indica, Cipadessa baccifera, Zizyphus mauritiana, Desmodium heterocarpon, Glycyrrhiza glabra, Abrus precatorius, Mucuna nigricans, Tamarindus indica, Mimosa pudica, Potentilla polyphylla, Bergenia ciliata, Terminalia bellirica, Cleistocalyx operculatus, Benincasa hispida, Trichosanthes tricuspidata, Hydrocotyle nepalensis, Sambucus hookeri, Mussaenda frondosa, Anaphalis margaritacea, Anaphalis contorta, Gaultheria fragrantissima, Rhododendron arboreum, Calotropis gigantea, Halenia elliptica, Gentiana ornata, Cynoglossum amabile, Taxus wallichiana, Melastoma normale, Justicia procumbens, Duranta repens, Lantana camara, Elsholtzia blanda, Pogostemon benghalensis, Piper longum, Cinnamomum camphora, Lindera neesiana, Euphorbia hirta, Urtica dioica, Cannabis sativa (pd), Englehardia spicata, Roscoea capitata, Allium wallichii, Saurauia napaulensis, Rumex nepalensis, Ocimum basilicum, Eleusine indica, Justicia adhatoda, Mazus surculosus, Podophyllum hexandrum, Allium hysistum, Neopicrorhiza scrophulariiflora, Podocarpus neriifoliu, Vitex negundo</i>	56
28	Cracks	<i>Lycopodium clavatum, Diploknema butyracea, Michelia champaca, Michelia doltsopa, Cissus repens, Artocarpus lakoocha</i>	6
29	Cuts and wounds, Whitlow	<i>Lycopodium clavatum, Lygodium japonicum, Loxogramme involuta, Diplazium polypodioides, Pinus roxburghii, Pinus wallichiana, Shorea robusta, Bombax ceiba, Garuga pinnata, Rhus javanica, Parochetus communis, Bauhinia variegata, Albizia chinensis, Potentilla polyphylla, Rubus ellipticus, Parnassia wightiana, Bryophyllum pinnatum, Osbeckia nepalensis, Lagerstroemia indica, Benincasa hispida, Trichosanthes tricuspidata, Oroxylum indicum, Galium aparine, Anthocephalus cadamba, Luculia gratissima, Anaphalis busua, Anaphalis margaritacea, Anaphalis triplinervis, Ageratum conyzoides, Ageratum houstonianum, Anaphalis contorta, Aster diplostephioides, Bidens pilosa, Eupatorium adenophorum, Eupatorium odoratum, Galinsoga parviflora, Launaea aspleniifolia, Chonemorpha fragrans, Ceropogia pubescens, Cynoglossum zeylanicum, Cuscuta reflexa, Ipomoea carnea, Artemisia indica, Hemiphragma heterophyllum, Mazus surculosus, Justicia procumbens, Callicarpa macrophylla, Elsholtzia blanda, Salvia plebeia, Achyranthes aspera, Bistorta amplexicaulis, Euphorbia heterophylla, Euphorbia hirta, Euphorbia royleana, Phyllanthus amarus, Phyllanthus emblica, Phyllanthus parvifolius, Boehmeria rugulosa, Boehmeria ternifolia, Artocarpus lakoocha, Ficus auriculata, Ficus benjamina, Ficus hirta, Ficus hispida, Ficus roxburghii, Ficus subincisa, Pleione praecox, Satyrium nepalense, Dioscorea pentaphylla, Paris polyphylla, Cynodon dactylon, Imperata cylindrica, Saccharum spontaneum, Daphniphyllum himalense, Rhynchosstylis retusa, Boeninghausenia albiflora, Iris clarkei, Jatropha curcas, Dactylicapnos scandens, Arisaema griffithii, Eleusine indica, Betula utilis, Juglans regia, Arisaema tortuosum, Pleione</i>	85

		<i>humilis</i>	
30	Diabetes	<i>Coccinia grandis, Jasminum officinale, Nyctanthes arbor-tristis, Chonemorpha fragrans, Cassia fistula, Urtica dioica, Engelhardia spicata, Ficus benghalensis, Herminium lanceum, Dactylorhiza hatagirea</i>	10
31	Diarrhoea	<i>Diplazium stoliczkae, Cissampelos pareira, Mahonia napaulensis, Hypericum cordifolium, Shorea robusta, Bombax ceiba, Zizyphus incurva, Zizyphus mauritiana, Rhus javanica, Rhus succedanea, Semecarpus anacardium, Acacia catechu, Desmodium heterocarpon, Tamarindus indica, Bauhinia purpurea, Bauhinia vahlii, Pyrus pashia, Rubus ellipticus, Astilbe rivularis, Bryophyllum pinnatum, Kalanchoe spathulata, Melastoma normale, Osbeckia stellata, Oxyspora paniculata, Woodfordia fruticosa, Oroxylum indicum, Mussaenda frondosa, Anthocephalus cadamba, Anaphalis margaritacea, Artemisia indica, Campanula pallida, Rhododendron arboreum, Calotropis gigantea, Ipomoea purpurea, Prunus cerasoides, Eurya acuminata, Cassia fistula, Gnaphalium affine (pd), Callicarpa macrophylla, Mentha arvensis, Mentha spicata, Ocimum basilicum, Amaranthus caudatus, Achyranthes aspera, Amaranthus viridis, Chenopodium album, Bistorta macrophylla, Aconogonum molle, Cinnamomum tamala, Lindera neesiana, Litsea monopetala, Bridelia retusa, Phyllanthus emblica, Trewia nudiflora, Debregeasia salicifolia, Myrica esculenta, Ficus auriculata, Ficus benghalensis, Ficus glaberrima, Ficus lacor, Ficus roxburghii, Alnus nepalensis, Colocasia esculenta, Cymbopogon flexuosus, Imperata cylindrica, Piper chaba, Allium wallichii, Urena lobata, Quercus glauca, Juniperus indica, Ipomoea nil, Podocarpus neriifolius, Campylandra aurantiaca, Oxalis corymbosa</i>	74
32	Dislocation of Bones and Fracture	<i>Oleandra wallichii, Drynaria propinqua, Cissampelos pareira, Hypericum cordifolium, Shorea robusta, Garuga pinnata, Ageratum conyzoides, Cissus repens, Rumex nepalensis, Curcuma angustifolia, Fraxinus floribunda, Otochilus lancilabius,</i>	12
33	Dysentery	<i>Lycopodium cernuum, Lycopodium clavatum, Diplazium stoliczkae, Hypericum japonicum, Hypericum cordifolium, Anemone vitifolia, Tinospora sinensis, Berberis aristata, Berberis asiatica, Mahonia napaulensis, Shorea robusta (pd), Gossypium herbaceum, Bombax ceiba, Toona ciliata, Zizyphus incurva, Zizyphus mauritiana, Rhus javanica, Rhus succedanea, Semecarpus anacardium, Acacia catechu, Mucuna pruriens, Bauhinia purpurea, Bauhinia vahlii, Pyracantha crenulata, Pyrus pashia, Rubus ellipticus, Astilbe rivularis, Bryophyllum pinnatum, Kalanchoe spathulata, Melastoma normale, Osbeckia stellata, Oxyspora paniculata, Woodfordia fruticosa, Oroxylum indicum, Mussaenda frondosa, Anthocephalus cadamba, Campanula pallida, Rhododendron arboreum, Rauwolfia serpentina, Calotropis gigantea, Solanum nigrum, Lepisorus thunbergianus, Prunus cerasoides, Murraya paniculata, Cassia fistula, Callicarpa macrophylla, Mentha spicata, Ocimum basilicum, Achyranthes aspera, Amaranthus viridis, Chenopodium album, Bistorta macrophylla, Aconogonum molle, Litsea monopetala, Phyllanthus emblica, Trewia nudiflora, Debregeasia salicifolia, Ficus benghalensis, Ficus glaberrima, Ficus lacor, Ficus roxburghii, Alnus nepalensis, Satyrium nepalense, Dioscorea bulbifera, Smilax ovalifolia, Desmostachya bipinnata, Eulaliopsis binata, Imperata cylindrica, Bridelia retusa, Urena lobata, Quercus glauca, Dactylicapnos scandens, Centella asiatica, Podocarpus neriifolius, Campylandra aurantiaca, Oxalis corymbosa</i>	76
34	Earache	<i>Cleome viscosa, Oxalis corymbosa, Calotropis gigantea, Datura stramonium, Anemone rivularis, Solena amplexicaulis, Eryngium foetidum, Ocimum scantum, Euphorbia hirta, Acampe papillosa, Dendrobium moschatum, Arisaema flavum, Bryophyllum pinnatum, Betula utilis, Juniperus indica</i>	15
35	Eczema	<i>Cassia occidentalis, Swertia chirayita, Lantana camara, Neolitsea pallens, Girardinia diversifolia, Cassia fistula, Duabanga grandiflora</i>	7
36	Epilepsy	<i>Sambucus hookeri, Valeriana hardwickii, Cestrum nocturnum, Colebrookea oppositifolia, Asparagus racemosus, Juniperus indica, Benincasa hispida</i>	7
37	Eye infection	<i>Equisetum debile, Berberis asiatica, Coccinia grandis, Valeriana jatamansii, Cynoglossum zeylanicum, Justicia procumbens, Isodon coetsa, Terminalia bellirica, Terminalia chebula, Begonia picta, Oxalis corymbosa</i>	11
38	Fever	<i>Equisetum debile, Equisetum diffusum, Nephrolepis auriculata, Nephrolepis cordifolia, Berberis aristata, Corydalis megacalyx, Drymaria cordata,</i>	98

		<i>Hypericum elodeoides, Reinwardtia indica, Oxalis corniculata, Oxalis latifolia, Zanthoxylum armatum, Azadirachta indica, Zizyphus incurva, Zizyphus mauritiana, Semecarpus anacardium, Abrus precatorius, Tamarindus indica, Trifolium repens, Cassia occidentalis, Cassia tora, Mimosa pudica, Rubus nepalensis, Rubus ellipticus, Woodfordia fruticosa, Oroxylum indicum, Hydrocotyle nepalensis (pd), Centella asiatica, Sambucus adnata, Sambucus canadensis, Sambucus hookeri, Artemisia indica, Cirsium verutum, Eupatorium adenophorum, Eupatorium odoratum, Chonemorpha fragrans, Rauwolfia serpentina, Halenia elliptica, Swertia nervosa, Swertia angustifolia, Swertia chirayita, Cynoglossum amabile, Nicandra physalodes, Solanum nigrum, Boenninghausenia albiflora, Aeschynanthus sikkimensis, Justicia adhatoda, Justicia procumbens, Callicarpa arborea, Callicarpa macrophylla, Durlanta repens, Vitex negundo, Isodon coetsa, Colebrookea oppositifolia, Elsholtzia blanda, Ocimum scantum, Pogostemon benghalensis (pd), Plantago major, Mirabilis jalapa, Amaranthus caudatus, Amaranthus spinosus, Daphne bholua, Euphorbia hirta, Euphorbia royleana, Phyllanthus amarus, Lecanthus peduncularis, Ficus hirta, Ficus hispida, Salix babylonica, Herminium lanceum, Satyrium nepalense, Hedychium spicatum, Hedychium ellipticum, Roscoea capitata, Acorus calamus, Pogostemon glaber, Ricinus communis, Saurauia napaulensis, Araiostegia pulchra, Clematis gouriana, Tinospora sinensis, Murraya paniculata, Terminalia chebula, Duabanga grandiflora, Eleusine indica, Dioscorea alata, Taxillus umbellifer, Mazus surculosus (pd), Cedrus deodara, Cissampelos pareira, Neopicrorhiza scrophulariiflora, Campylandra aurantiaca, Girardinia diversifolia, Oxalis corymbosa, Hypericum japonicum, Anthocephalus cadamba, Impatiens urticifolia, Coelogyne corymbosa</i>	
39	Flatulence	<i>Justicia procumbens</i>	1
40	Gastritis	<i>Lycopodium clavatum, Pinus roxburghii, Drymaria villosa, Semecarpus anacardium, Desmodium gangeticum, Rubus nepalensis, Rubus ellipticus, Senecio scandens, Callicarpa arborea, Colebrookea oppositifolia, Mentha arvensis, Ocimum scantum (pd), Daphne bholua, Trewia nudiflora, Girardinia diversifolia, Myrica esculenta, Betula alnoides, Paris polyphylla, Commelina maculata, Arundinaria falcata, Imperata cylindrica, Vitex negundo, Cleome viscosa, Allium hypsistum, Rauwolfia serpentina (pd), Betula utilis</i>	26
41	Gonorrhoea	<i>Equisetum debile, Michelia champaca, Shorea robusta, Ocimum basilicum, Ficus religiosa, Michelia kisopa, Dioscorea alata, Cissampelos pareira</i>	8
42	Gout	<i>Ricinus communis, Chlorophytum nepalense, Podocarpus nerifolius</i>	3
43	Gum bleeding	<i>Cipadessa baccifera, Cipadessa fruticosa, Achyranthes bidentata, Rumex nepalensis, Morus australis, Ficus religiosa, Bergenia ciliata, Thymus linearis, Potentilla fulgens</i>	9
44	Gynaecological problems	<i>Angiopteris evicata, Podophyllum hexandrum, Bergenia ciliata, Nephrolepis cordifolia, Rheum moorcroftianum, Betula utilis</i>	6
45	Headache	<i>Equisetum diffusum, Oleandra wallichii, Drynaria propinqua, Nephrolepis cordifolia, Anemone vitifolia, Dactylicapnos scandens, Polygala arillata, Drymaria cordata, Reinwardtia indica, Oxalis latifolia, Azadirachta indica, Melia azedarach, Zizyphus incurva, Trifolium repens, Begonia picta, Luculia gratissima, Valeriana jatamansii, Artemisia indica, Buddleja asiatica, Halenia elliptica, Swertia chirayita, Cuscuta reflexa, Cestrum nocturnum, Solanum nigrum, Boenninghausenia albiflora, Terminalia chebula, Solanum aculeatissimum, Vitex negundo, Colebrookea oppositifolia, Elsholtzia blanda, Amaranthus viridis, Ricinus communis, Girardinia diversifolia, Ficus semicordata, Castanopsis indica, Coelogyne corymbosa, Spiranthes sinensis, Pogostemon glaber, Rumex nepalensis, Bryophyllum pinnatum, Cedrus deodara, Podocarpus nerifolius</i>	42
46	Heart problems	<i>Bergenia ciliata, Persicaria runcinata, Dolichos staintonii, Benincasa hispida, Rheum moorcroftianum, Ipomoea cairica</i>	6
47	Hemiplegia	<i>Dactylorhiza hatagirea</i>	1
48	Hemorrhage	<i>Quercus glauca, Cedrus deodara</i>	2
49	Hepatitis	<i>Equisetum debile</i>	1
50	Hypertension	<i>Angelica archangelica, Centella asiatica, Achyranthes bidentata</i>	3
51	Hysteria (psychological)	<i>Valeriana hardwickii, Betula utilis</i>	2
52	Ill waist	<i>Diospyros lancifolia</i>	1

53	Indigestion	<i>Nephrolepis auriculata, Nephrolepis cordifolia, Drymaria cordata, Reinwardtia indica, Cipadessa fruticosa, Desmodium concinnum, Cassia tora, Angelica archangelica, Galium aparine, Anaphalis margaritacea, Diploknema butyracea, Cynoglossum zeylanicum, Ranunculus laetus, Camellia kissi, Callicarpa macrophylla, Callicarpa arborea, Notochaete hamosa, Cyathula tomentosa, Achyranthes bidentata, Sapium insigne, Trewia nudiflora, Castanopsis indica, Castanopsis tribuloides, Hedychium spicatum, Desmostachya bipinnata, Cynodon dactylon, Imperata cylindrica, Pogostemon glaber, Impatiens puberula, Cymbopogon flexuosus, Cissampelos pareira, Centella asiatica, Hypericum japonicum</i>	33
54	Infertility complication	<i>Eryngium foetidum</i>	1
55	Inflammation	<i>Eryngium foetidum, Calamintha umbrosa, Aeschynanthus sikkimensis, Mentha arvensis, Mentha spicata, Piper chaba, Impatiens bicornuta, Kalanchoe spathulata, Narenga porphyrocoma, Hemiphragma heterophyllum, Polygala arillata</i>	11
56	Influenza	<i>Equisetum debile, Lantana camara</i>	2
57	Insect bites	<i>Impatiens puberula, Kalanchoe spathulata, Neanotis ingrata, Paris polyphylla</i>	4
58	Intestinal diseases	<i>Solanum aculeatissimum, Neopicrorhiza scrophulariiflora</i>	2
59	Intestinal ulcer	<i>Angiopteris evicata</i>	1
60	Itches	<i>Cuscuta reflexa, Lyonia ovalifolia, Dioscorea alata, Lygodium japonicum</i>	4
61	Jaundice	<i>Corydalis megacalyx, Abrus precatorius, Tamarindus indica, Centella asiatica, Mussaenda frondosa, Chonemorpha fragrans, Ipomoea purpurea, Cuscuta reflexa, Oroxylum indicum, Lantana camara, Phyllanthus emblica, Aloe vera, Eleusine indica, Cymbopogon flexuosus, Betula utilis, Ipomoea nil</i>	16
62	Joint ache	<i>Lygodium japonicum, Cleome viscosa, Impatiens bicornuta, Rhynchospermum verticillatum, Gossypium herbaceum, Ipomoea carnea, Justicia adhatoda, Litsea cubeba, Taxillus umbellifer, Girardinia diversifolia, Cedrus deodara, Centella asiatica</i>	12
63	Kidney problems	<i>Crateva unilocularis, Mimosa pudica, Geranium nepalense, Terminalia chebula, Rubia manjith, Asparagus racemosus, Aloe vera, Juncus concinnus, Bergenia ciliata, Podophyllum hexandrum</i>	10
64	Leprosy	<i>Melia azedarach, Indigofera bracteata, Cassia mimosoides, Kalanchoe spathulata, Calotropis gigantea, Calotropis procera, Ficus semicordata, Dioscorea alata, Podocarpus neriifolius</i>	9
65	Leucorrhoea	<i>Murraya paniculata, Acacia catechu, Thalictrum reniforme, Gossypium herbaceum,</i>	4
66	Liver disorders	<i>Nephrolepis cordifolia, Halenia elliptica, Solanum nigrum, Ficus hispida, Asparagus racemosus, Eleusine indica, Thymus linearis, Herpetospermum pedunculatum, Neopicrorhiza scrophulariiflora, Podophyllum hexandrum</i>	10
67	Lungs problems	<i>Bergenia ciliata, Benincasa hispida, Myrica esculenta, Cedrus deodara, Meconopsis regia</i>	5
68	Malaria	<i>Taxillus umbellifer, Terminalia bellirica, Azadirachta indica</i>	3
69	Measles	<i>Sambucus canadensis</i>	1
70	Menstrual problems	<i>Hypericum cordifolium, Rhus javanica, Indigofera bracteata, Fragaria nubicola, Astilbe rivularis, Rhododendron arboreum, Murraya paniculata, Solena amplexicaulis, Ficus semicordata, Paris polyphylla, Arisaema concinnum, Hemiphragma heterophyllum, Rheum australe, Zizyphus mauritiana</i>	14
71	Mental disorders	<i>Elaeocarpus sphaericus</i>	1
72	Mouth and tongue problems	<i>Callicarpa macrophylla, Caryopteris nepalensis, Callicarpa arborea, Mentha spicata, Ficus neriifolia, Ficus semicordata, Arisaema flavum, Fragaria nubicola, Woodfordia fruticosa, Mussaenda frondosa, Cynoglossum zeylanicum</i>	11
73	Mumps	<i>Lantana camara, Euphorbia royleana</i>	2
74	Muscular pain	<i>Hypericum cordifolium, Clematis gouriana, Gaultheria fragrantissima, Commelina maculata, Quercus semecarpifolia</i>	5
75	Nasal congestion	<i>Abies spectabilis</i>	1
76	Nausea	<i>Mentha spicata, Cinnamomum tamala</i>	2
77	Nervous Imbalance	<i>Cestrum nocturnum, Dolichos staintonii, Benincasa hispida, Dactylorhiza hatagirea (pd), Centella asiatica (pd), Galium mollugo, Abrus precatorius,</i>	8

		<i>Dendrobium aphyllum</i> (pd)	
78	Neuralgia	<i>Acampe papillosa</i>	1
79	Nose bleeding	<i>Acacia catechu</i> , <i>Ageratum conyzoides</i> , <i>Ageratum houstonianum</i> , <i>Artemisia indica</i> , <i>Cirsium verutum</i> , <i>Salvia campanulata</i> , <i>Wikstroemia canescens</i> , <i>Urtica dioica</i> , <i>Cynodon dactylon</i>	9
80	Paralysis	<i>Aster diplostephioides</i>	1
81	Peptic ulcer	<i>Potentilla polyphylla</i> , <i>Rubus ellipticus</i> , <i>Begonia picta</i> , <i>Cyathula tomentosa</i> , <i>Chenopodium ambrosioides</i> , <i>Bridelia retusa</i> , <i>Oxalis corymbosa</i>	7
82	Piles	<i>Thalictrum reniforme</i> , <i>Berberis aristata</i> , <i>Berberis asiatica</i> , <i>Bauhinia variegata</i> , <i>Bergenia ciliata</i> , <i>Terminalia chebula</i> , <i>Achyranthes aspera</i> , <i>Achyranthes bidentata</i> , <i>Dioscorea bulbifera</i> , <i>Eulaliopsis binata</i> , <i>Salvia plebeia</i> , <i>Dioscorea alata</i> , <i>Mimosa pudica</i> , <i>Acacia catechu</i> , <i>Oxalis corymbosa</i> , <i>Ipomoea nil</i> , <i>Iris clarkei</i>	17
83	Pimple problems	<i>Valeriana jatamansii</i> , <i>Ceropegia pubescens</i> , <i>Calotropis gigantea</i> , <i>Swertia chirayita</i> , <i>Euphorbia royleana</i> , <i>Phyllanthus amarus</i> , <i>Phyllanthusparvifolius</i> , <i>Artocarpus lakoocha</i> , <i>Pedicularis scullyana</i>	9
84	Pneumonia	<i>Jatropha curcas</i> , <i>Curculigo crassifolia</i> (pd)	2
85	Pregnancy	<i>Astilbe rivularis</i> , <i>Dioscorea alata</i> , <i>Asparagus racemosus</i> , <i>Euphorbia pulcherrima</i> , <i>Dalbergia sissoo</i> , <i>Murraya paniculata</i>	6
86	Proliferation	<i>Cuscuta reflexa</i> , <i>Rorippa nasturtium-aquaticum</i>	2
87	Rabies	<i>Datura stramonium</i> , <i>Hypericum uralum</i>	2
88	Respiratory problems	<i>Viburnum erubescens</i> , <i>Garuga pinnata</i> , <i>Glycyrrhiza glabra</i>	3
89	Rheumatism	<i>Lycopodium clavatum</i> , <i>Abies spectabilis</i> , <i>Crateva unilocularis</i> , <i>Urena lobata</i> , <i>Semecarpus anacardium</i> , <i>Spondias pinnata</i> , <i>Tamarindus indica</i> , <i>Valeriana hardwickii</i> , <i>Valeriana jatamansii</i> , <i>Diploknema butyracea</i> , <i>Cuscuta reflexa</i> , <i>Ipomoea cairica</i> , <i>Lepisorus thunbergianus</i> , <i>Melia azedarach</i> , <i>Justicia procumbens</i> , <i>Lantana camara</i> , <i>Vitex negundo</i> , <i>Fagopyrum esculentum</i> , <i>Jatropha curcas</i> , <i>Ricinus communis</i> , <i>Juglans regia</i> , <i>Ficus benghalensis</i> , <i>Acampe papillosa</i> , <i>Asparagus racemosus</i> , <i>Aloe vera</i> , <i>Smilax ovalifolia</i> , <i>Hemiphragma heterophyllum</i> , <i>Piper chaba</i> , <i>Cedrus deodara</i> , <i>Podophyllum hexandrum</i> , <i>Podocarpus neriifolius</i> , <i>Arisaema griffithii</i> , <i>Polygala arillata</i>	33
90	Ringworm	<i>Cassia occidentalis</i> , <i>Cassia tora</i> , <i>Maesa chisia</i> , <i>Cynoglossum zeylanicum</i> , <i>Jasminum officinale</i> , <i>Euphorbia thymifolia</i> , <i>Girardinia diversifolia</i> , <i>Tamarindus indica</i>	8
91	Scabies	<i>Equisetum diffusum</i> , <i>Lygodium japonicum</i> , <i>Anemone vitifolia</i> , <i>Reinwardtia indica</i> , <i>Boeninghausenia albiflora</i> , <i>Albizia chinensis</i> , <i>Osbeckia stellata</i> , <i>Lyonia ovalifolia</i> , <i>Maesa chisia</i> , <i>Cryptolepis buchananii</i> , <i>Mirabilis jalapa</i> , <i>Neolitsea pallens</i> , <i>Debregeasia longifolia</i> , <i>Ficus lacor</i> , <i>Arundina graminifolia</i> , <i>Smilax aspera</i> , <i>Bistorta macrophylla</i> , <i>Dioscorea pentaphylla</i>	18
92	Scorpion sting	<i>Gossypium herbaceum</i> , <i>Semecarpus anacardium</i> , <i>Glycyrrhiza glabra</i> , <i>Rubia manjith</i> , <i>Mucuna pruriens</i> , <i>Neanotis ingrata</i> , <i>Ocimum scantum</i> , <i>Cassia fistula</i> , <i>Paris polyphylla</i> , <i>Oberonia ensiformis</i>	10
93	Scurvy	<i>Galium mollugo</i> (pd)	1
94	Seminal weakness	<i>Dactylorhiza hatagirea</i>	1
95	Sexual diseases	<i>Murraya paniculata</i>	1
96	Sinusitis	<i>Ranunculus laetus</i> , <i>Cleistocalyx operculatus</i> , <i>Anemone rivularis</i> , <i>Vitex negundo</i> , <i>Rheum moorcroftianum</i>	5
97	Skin disease and cosmetics	<i>Cissampelos pareira</i> , <i>Berberis aristata</i> , <i>Urena lobata</i> , <i>Bombax ceiba</i> , <i>Garuga pinnata</i> , <i>Azadirachta indica</i> , <i>Melia azedarach</i> , <i>Rhus succedanea</i> , <i>Acacia catechu</i> , <i>Desmodium heterocarpon</i> , <i>Abrus precatorius</i> , <i>Cassia tora</i> , <i>Rubus hoffmeisterianus</i> , <i>Centella asiatica</i> , <i>Senecio scandens</i> , <i>Artemisia indica</i> , <i>Launnea aspleniifolia</i> , <i>Jasminum officinale</i> , <i>Buddleja asiatica</i> , <i>Calotropis gigantea</i> (pd), <i>Ranunculus laetus</i> , <i>Thalictrum reniforme</i> , <i>Cassia fistula</i> , <i>Bryophyllum pinnatum</i> , <i>Galium mollugo</i> , <i>Ipomoea carnea</i> , <i>Amaranthus caudatus</i> , <i>Litsea cubeba</i> , <i>Lindera neesiana</i> , <i>Taxillus umbellifer</i> , <i>Euphorbia pulcherrima</i> , <i>Euphorbia thymifolia</i> , <i>Ficus religiosa</i> , <i>Castanopsis indica</i> , <i>Dioscorea bulbifera</i> , <i>Cynodon dactylon</i> , <i>Phragmites karka</i> , <i>Arisaema flavum</i> , <i>Cedrus deodara</i> , <i>Duabanga grandiflora</i> , <i>Chonemorpha fragrans</i> , <i>Podophyllum hexandrum</i> , <i>Meconopsis regia</i> , <i>Pandanus nepalensis</i> , <i>Arundina graminifolia</i> , <i>Achyranthes aspera</i> (pd), <i>Pedicularis scullyana</i> , <i>Aloe vera</i> , <i>Michelia champaca</i> , <i>Michelia doltsopa</i>	50

98	Snakebites	<i>Cissampelos pareira</i> (pd), <i>Hypericum oblongifolium</i> , <i>Gossypium herbaceum</i> , <i>Semecarpus anacardium</i> , <i>Bryophyllum pinnatum</i> , <i>Spilanthes paniculata</i> , <i>Notochaete hamosa</i> , <i>Ocimum scantum</i> , <i>Neolitsea pallens</i> , <i>Arisaema tortuosum</i> , <i>Ficus religiosa</i> , <i>Meconopsis regia</i> , <i>Pandanus nepalensis</i> , <i>Cassia fistula</i> , <i>Urena lobata</i>	15
99	Sore nipples	<i>Begonia picta</i> , <i>Acacia catechu</i>	2
100	Sore throat	<i>Berberis aristata</i> , <i>Glycyrrhiza glabra</i> , <i>Abrus precatorius</i> , <i>Cassia occidentalis</i> , <i>Potentilla polyphylla</i> , <i>Syzygium cumini</i> , <i>Sambucus hookeri</i> , <i>Anthocephalus cadamba</i> , <i>Diospyros lancifolia</i> , <i>Cassia fistula</i> , <i>Achyranthes bidentata</i> , <i>Phyllanthus emblica</i> , <i>Juglans regia</i> , <i>Acorus calamus</i> , <i>Spiranthes sinensis</i> , <i>Asparagus racemosus</i> , <i>Rhododendron arboretum</i> , <i>Satyrium nepalense</i> , <i>Dilichos stantonii</i>	19
101	Sprains	<i>Calotropis gigantea</i> , <i>Drynaria propinqua</i> , <i>Astilbe rivularis</i> , <i>Parnassia wightiana</i> , <i>Lecanthus peduncularis</i> , <i>Sphenomeris chinensis</i> , <i>Rheum australe</i>	7
102	Stomach ache	<i>Angiopteris evecata</i> , <i>Tinospora sinensis</i> , <i>Dactylicapnos scandens</i> , <i>Oxalis corniculata</i> , <i>Rhus javanica</i> , <i>Cassia mimosoides</i> , <i>Spilanthes paniculata</i> , <i>Cuscuta reflexa</i> , <i>Clematis gouriana</i> , <i>Eurya acuminata</i> , <i>Pedicularis gracilis</i> , <i>Chirita urticifolia</i> , <i>Phyllanthus amarus</i> , <i>Dioscorea pentaphylla</i> , <i>Rheum australe</i> , <i>Rheum moorcroftianum</i> , <i>Neopicrorhiza scrophulariiflora</i> , <i>Campylandra aurantiaca</i> , <i>Rorippa nasturtium-aquaticum</i>	19
103	Stomach disorders	<i>Hypericum japonicum</i> , <i>Gossypium herbaceum</i> , <i>Urena lobata</i> , <i>Zanthoxylum armatum</i> , <i>Cipadessa fruticosa</i> , <i>Zizyphus incurva</i> , <i>Garuga pinnata</i> , <i>Desmodium multiflorum</i> , <i>Terminalia bellirica</i> , <i>Osbeckia nepalensis</i> , <i>Luculia gratissima</i> , <i>Cirsium verutum</i> , <i>Taraxacum officinale</i> , <i>Gaultheria fragrantissima</i> , <i>Nepeta lamiopsis</i> , <i>Celtis australis</i> , <i>Castanopsis indica</i> , <i>Cautleya spicata</i> , <i>Dactylorhiza hatagirea</i> , <i>Glycyrrhiza glabra</i> , <i>Thymus linearis</i> , <i>Mazus surculosus</i> , <i>Fraxinus floribunda</i> , <i>Hypericum uralum</i> , <i>Oxalis corymbosa</i>	25
104	Swellings	<i>Polygala arillata</i> , <i>Rhus javanica</i> , <i>Acacia catechu</i> , <i>Indigofera bracteata</i> , <i>Abrus precatorius</i> , <i>Flemingia marcophylla</i> , <i>Astilbe rivularis</i> , <i>Woodfordia fruticosa</i> , <i>Trichosanthes tricuspidata</i> , <i>Gaultheria fragrantissima</i> , <i>Mimosa pudica</i> (pd), <i>Vitex negundo</i> , <i>Mirabilis jalapa</i> , <i>Fagopyrum dibotrys</i> , <i>Rumex nepalensis</i> , <i>Ricinus communis</i> , <i>Trewia nudiflora</i> , <i>Sphenomeris chinensis</i> , <i>Centella asiatica</i> , <i>Neopicrorhiza scrophulariiflora</i>	20
105	Syphilis	<i>Cassia fistula</i> , <i>Agave americana</i> , <i>Agave sisalana</i> , <i>Dioscorea bulbifera</i> , <i>Sapium insigne</i> , <i>Jatropha curcas</i> , <i>Ipomoea purpurea</i>	7
106	Tonic (weakness and dizziness)	<i>Bauhinia variegata</i> , <i>Tinospora sinensis</i> , <i>Isodon coetsa</i> , <i>Rheum australe</i> , <i>Trewia nudiflora</i> , <i>Spiranthes sinensis</i> , <i>Paris polyphylla</i> , <i>Podocarpus neriifolius</i> , <i>Anthocephalus cadamba</i> , <i>Asparagus racemosus</i> , <i>Curculigo crassifolia</i> , <i>Valeriana hardwickii</i>	12
107	Tonsillitis	<i>Urena lobata</i> , <i>Terminalia chebula</i> , <i>Terminalia bellirica</i> , <i>Aeschynanthus sikkimensis</i>	4
108	Toothache	<i>Anemone vitifolia</i> , <i>Dactylicapnos scandens</i> , <i>Murraya paniculata</i> , <i>Zanthoxylum acanthopodium</i> , <i>Zanthoxylum armatum</i> , <i>Zizyphus mauritiana</i> , <i>Potentilla polyphylla</i> , <i>Potentilla fulgens</i> , <i>Neohymenopogon parasiticus</i> , <i>Anaphalis margaritacea</i> , <i>Spilanthes paniculata</i> , <i>Datura stramonium</i> , <i>Solanum aculeatissimum</i> , <i>Achyranthes bidentata</i> , <i>Lindera neesiana</i> , <i>Ficus benghalensis</i> , <i>Ficus religiosa</i> , <i>Desmostachya bipinnata</i> , <i>Thalictrum reniforme</i> , <i>Hemiphragma heterophyllum</i> , <i>Neanotis ingrata</i> , <i>Cymbopogon flexuosus</i> , <i>Juniperus indica</i> , <i>Thymus linearis</i> , <i>Arisaema griffithii</i> , <i>Desmostachys bipinnata</i>	26
109	Tuberculosis	<i>Bombax ceiba</i> , <i>Kalanchoe spathulata</i> , <i>Benincasa hispida</i> , <i>Rorippa nasturtium-aquaticum</i>	4
110	Ulcer	<i>Syzygium cumini</i> , <i>Shorea robusta</i> , <i>Azadirachta indica</i> , <i>Lannea coromandelica</i> , <i>Desmodium multiflorum</i> , <i>Parnassia wightiana</i> , <i>Jasminum officinale</i> , <i>Chonemorpha fragrans</i> , <i>Ficus lacor</i> , <i>Ficus neriifolia</i> , <i>Eulaliopsis binata</i> , <i>Dioscorea bulbifera</i>	12
111	Uric acid	<i>Mimosa pudica</i> , <i>Centella asiatica</i>	2

112	Urinary problems	<i>Equisetum diffusum, Lycopodium clavatum, Tinospora sinensis, Crateva unilocularis, Impatiens urticifolia, Azadirachta indica, Acacia catechu, Glycyrrhiza glabra, Abrus precatorius, Mucuna pruriens, Mimosa pudica, Bergenia ciliata, Kalanchoe spathulata, Benincasa hispida, Rubia manjith, Lepisorus thunbergianus, Cassia fistula, Duabanga grandiflora, Nepeta lamiopsis, Amaranthus caudatus, Amaranthus spinosus, Chenopodium album, Dactylorhiza hatagirea, Salvia plebeia, Eleusine indica, Dolichos staintonii, Pandanus nepalensis, Cassia occidentalis, Rorippa nasturtium-aquaticum, Juncus concinnus</i>	30
113	Vomiting	<i>Cynoglossum amabile, Ipomoea nil, Mentha arvensis, Mentha spicata, Iris clarkei</i>	5
114	Worms	<i>Cleome viscosa, Azadirachta indica, Cipadessa fruticosa, Butea minor, Erythrina arborescens, Benincasa hispida, Murraya paniculata, Chonemorpha fragrans, Rumex nepalensis, Morus australis, Dioscorea bulbifera, Dioscorea deltoidea, Dioscorea esculanta, Paris polyphylla, Salvia plebeia, Rheum moorcroftianum, Arisaema griffithii, Thymus linearis, Maesa chisia, Cassia occidentalis, Clematis gouriana, Anemone vitifolia</i>	22

\* (pd), pediatric

#### 6.4 Plant parts used for remedy preparation

The present investigation provides information about the traditional medicinal practice in the studied area. It was noted that the ethnic people commonly used plants and their parts such as roots, rhizomes, tubers, leaves, stem, wood, barks, flowers, seeds, latex, pseudobulb, cone, whole plant and fruits. The parts most commonly used as medicine were leaves (190 species) followed by roots/rhizomes/tubers (162 species), stems/barks/woods (115 species), fruits (98 species), whole plant (83 species), seeds (38 species), flowers (34 species), tubers (11 species), twigs (6 species), pseudobulbs (5 species), resins (4 species), corms, gums, inflorescences, needles and pods (2 species each) (Fig. 28). Our findings resembled conclusions based on the study of Chepang community in Chitwan district (Rijal, 2008), Rai and Tamang community in Sunsari district (Deokota & Chhetri, 2009), Tamang community in Rasuwa district (Uprety *et al.*, 2010), and Tharu and Magar community in Rupendehi district (Singh *et al.*, 2012). In other studies roots were observed to be the most commonly used parts (Poudel & Gautam, 2008; Bhattra *et al.*, 2010; Dangwal & Sharma, 2010); and in some fruit and fruit/seed (Uprety *et al.*, 2012; Luitel *et al.*, 2014). It explicates that diversity prevailed in the preparation methods and the use of plant parts.

The medical remedies were based on formulations ranging from preparation made out of a single plant for a single ailment or polyherbal formulations for single/multiple ailments. Sundrying of leaves was regarded as the cheapest and the most convenient form of preserving medicinal plants. It showed that the people were unaware of the loss of essential micronutrients such as vitamins A and C (Hoeven *et al.*, 2013) and availability of high concentration of bioactive compounds (Robinson, 1974; Moore, 1994; Basualdo *et al.*, 1995).

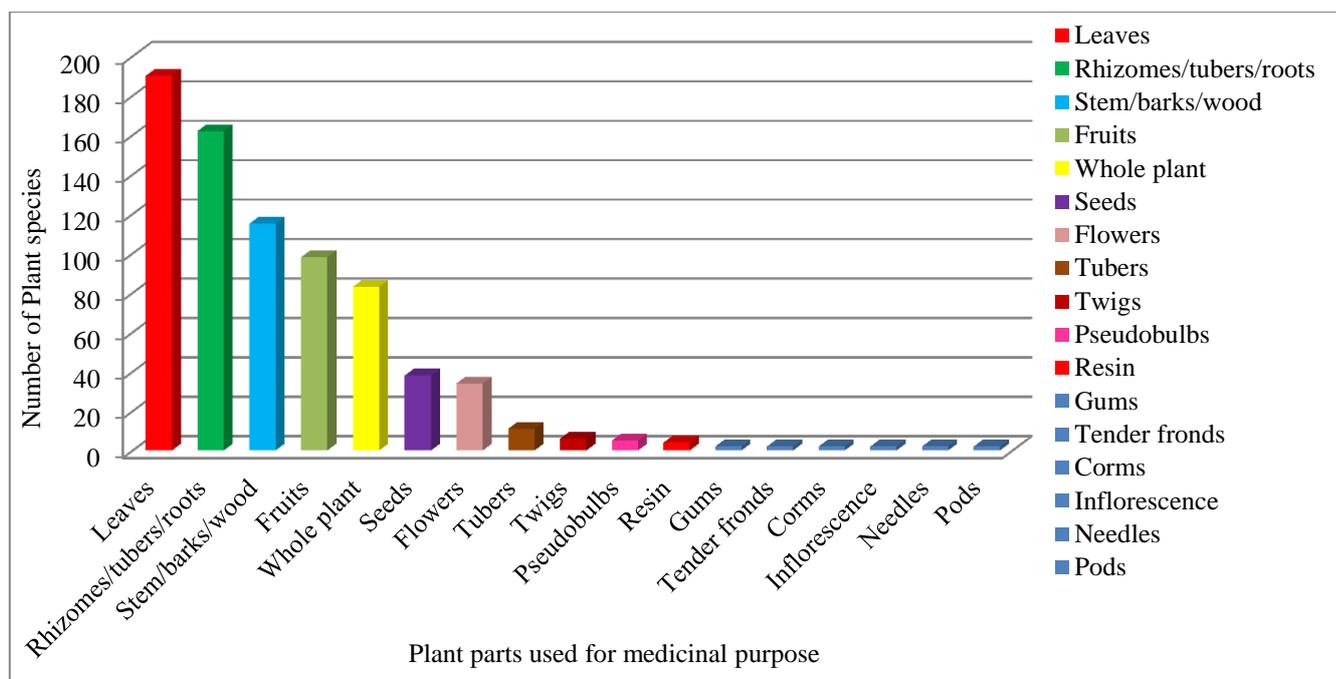


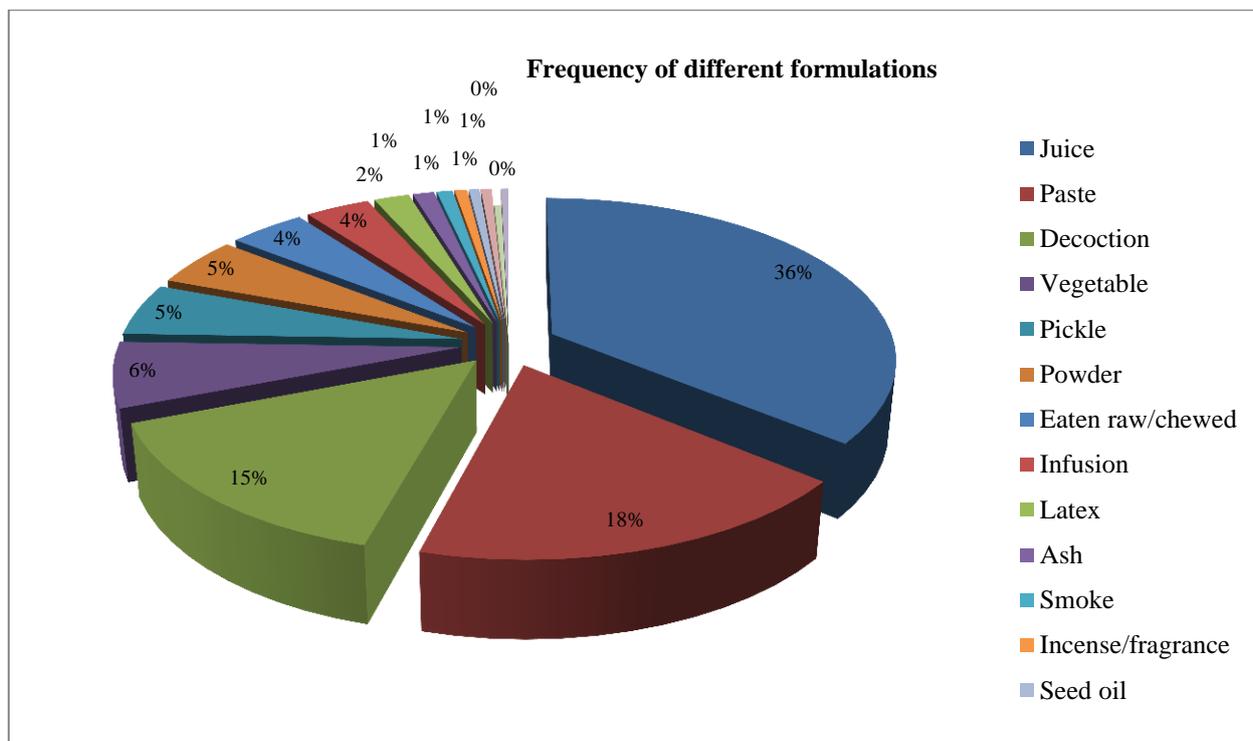
Fig. 28: Different plant parts used by Gurung, Magar and Majhi community in Parbat district

### 6.5 Modes of remedy preparation and application

The medicinal plants in the study area were noted to be used in various ways for remedy preparation. The modes of preparation of remedies were common in many places despite differences in which form of remedy was in maximum use. The most common preparation and administration methods were juice (36.61%) followed by paste (18.50%), decoction (15.12%), vegetables (6.56%), pickle (5.27%), powder (4.97%), eaten raw/chewed (4.27%), infusion (3.58%), latex (1.99%), ash (1.19%), smoke (0.89%), oil (0.59%), and pills/tablets (0.39%) (Fig.29). In previous studies, different modes of preparations, infusion (Bano *et al.*, 2014), juice (Kunwar *et al.*, 2006; Burlakoti & Kunwar, 2008), decoction (Shrestha & Dillion, 2003) and paste (Uprety *et al.*, 2010), were observed to be the most prominent.

Some healers were found to believe that mixing modes of preparation with animal parts, oil, food grains and soil maximized effectiveness of the medicine. Identical finding was documented previously by Poudel *et al.* (2010). In many instances, application of fresh parts of plant was observed because of the healers' belief regarding higher efficiency of the medicine made from fresh plants.

Plant parts were generally prepared as medicine using hot and cold water as the solvent; and occasionally, remedies were prepared with milk, honey, oil and ghee. Common use of water rather than ghee, milk, honey during the preparation of medicine may be because they are expensive to buy for those who do not have animals in home.



**Fig. 29:** Frequency of different formulations used by ethnic communities in Parbat district

### 6.6 Routes of administration

Various routes of administration were reported during the study. Most frequently administered route was oral (62.7%) followed by external (17.78%) and topical/dermal/cosmetics (14.48%). The other routes included nasal (1.29%), dental (1.43%), anal (0.64%), optical (0.79%), otic (0.93%); the least being internal (0.21%) (Fig.30). In a few other studies as well, oral mode of administration was found to be the most dominant (Mood, 2008; Brandao *et al.*, 2012; Luitel *et al.*, 2014). Contrarily, inhalation (Shrestha & Dhillon, 2003), concoction (Lulekal *et al.*, 2008), infusion (Panghal *et al.*, 2010), decoction (Singh *et al.*, 2012; Lulekal *et al.*, 2013) were observed to be the most dominant routes of administration. The finding of Teklay *et al.* (2013) differed more substantially from the above mentioned findings in the sense that it was observed that more than half (55%) remedy preparations were applied externally.

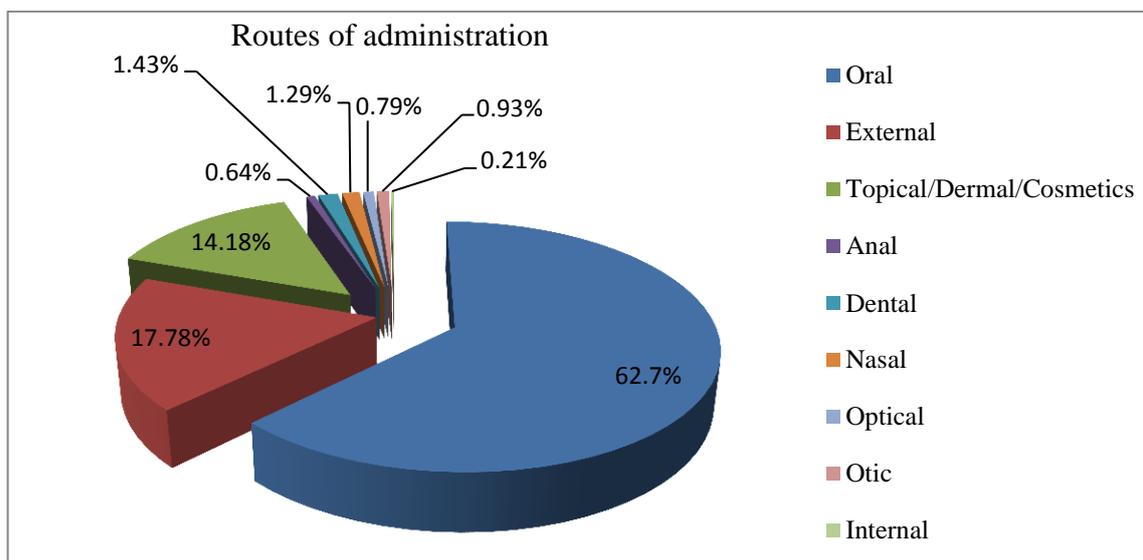


Fig. 30: Frequency of different routes of administration

### 6.7 Dosages and antidotes

The analysis of medicine prescription practice revealed that the prescribed quantity was always approximate. The measurements used by the informants were found to be non-uniform allowing the patients to understand in their own sense. It was observed that the same mode of medicine was mentioned in small cups locally called 'kachaura' while others were measured as handful, spoonful or size of fingers. The dosages were found to depend on herbal healers, disease types, duration of infection, and treatment method. It is also decided based on age groups, sex and physical appearance of the patients. The frequency of use is suggested with the terms like (x) number of times in a day, and the duration with (x) number of days/weeks/months.

A number of plant species were reported to have specific antidotes (Table 21). Among the three communities, *Majhi* and *Magar* used plants as antidotes to treat snake bites, scorpion stings, bee stings, insect bites and rabies. *Gurungs* were not found to use plants as antidotes for bee stings, insect bites and rabies. The number of plants used to treat snake bites was lowest among the *Gurungs* (2 species) whereas highest (7 species) among the *Magars* and *Majhis*.

Table 21 Plants used for antidotes

Antidotes	Gurung	Magar	Majhi
Snake bites	<i>Urena lobata</i> , <i>Arisaema tortuosum</i>	<i>Gossypium herbaceum</i> , <i>Notochaete hamosa</i> , <i>Ocimum scantum</i> , <i>Neolitsea pallens</i> , <i>Meconopsis regia</i> , <i>Cassia fistula</i> , <i>Urena lobata</i> ,	<i>Hypericum oblongifolium</i> , <i>Semecarpus anacardium</i> , <i>Bryophyllum pinnatum</i> , <i>Spilanthes paniculata</i> , <i>Ficus religiosa</i> , <i>Pandanus nepalensis</i> , <i>Urena lobata</i>
Scorpion stings	<i>Mucuna pruriens</i> , <i>Oberonia ensiformis</i>	<i>Gossypium herbaceum</i> , <i>Ocimum scantum</i> , <i>Cassia fistula</i> , <i>Glycyrrhiza glabra</i> , <i>Mucuna pruriens</i> , <i>Paris polyphylla</i> , <i>Oberonia ensiformis</i>	<i>Semecarpus anacardium</i> , <i>Rubia manjith</i> , <i>Neanotis ingrata</i>
Bee stings		<i>Hypericum uralum</i>	<i>Impatiens puberula</i> , <i>Hypericum uralum</i>
Insect bites		<i>Paris polyphylla</i>	<i>Impatiens puberula</i> , <i>Kalanchoe spathulata</i> , <i>Neanotis ingrata</i>
Rabies		<i>Datura stramonium</i> , <i>Hypericum uralum</i>	<i>Datura stramonium</i> , <i>Hypericum uralum</i>

The plant species like *Impatiens puberula*, *Hypericum uralum*, *Gossypium herbaceum*, *Semecarpus anacardium*, *Glycyrrhiza glabra*, *Rubia manjith*, *Mucuna pruriens*, *Neanotis ingrata*, *Ocimum scantum*, *Cassia fistula*, *Paris polyphylla*, *Oberonia ensiformis*, *Cissampelos pareira*, *Hypericum oblongifolium*, *Gossypium herbaceum*, *Semecarpus anacardium* were mostly used as the antidotes against various poisons by the three communities. Majority of the antidotes were reported to have no adverse effects except for *Lantana camara*, *Abrus precatorius*, *Iris clarkei*, *Prunus cerasoides*, *Euphorbia royleana*, *Ricinus communis*, *Engelhardia spicata*, and *Kalanchoe spathulata* (Table 21).

### 6.8 Ethnodomestication of medicinal plants

Domestication, one of the most essential developments in human history, is modeled by human culture, social needs and technology (Parra *et al.*, 2012). The process is also influenced by variable nature of ecosystems and populations of the managed organism (Doebley *et al.*, 1992). Plants are usually domesticated for medicine, fruits, vegetables, compost manure, furniture, spices and condiments, ornament, religious purpose. Such domestication indicates ethnic people's awareness of low cost conservation of economically important plants in a greater extent (Chhetri, 2006).

Nepal is rich in medicinal plant resources with greater potential to strengthen local economy, and contribute to subsistence health and natural resources management for national economy. As per the available statistics, about USD 10 million of medicinal and aromatic plants are exported legally from Nepal each year (UNEP, 2012). An average of 20,000 tons of raw materials are traded and/or exported annually from Nepal. The figure, researchers argued, demonstrate weak efforts of Nepal government to manage medicinal and aromatic plants (Magar, 2014) for the generation of substantial revenue (Rokaya *et al.*, 2012). Importantly, it was observed that marketable medicinal plants were mainly sold for their non-medicinal uses, and only applied as medicine when the need arose (Table 22).

**Table 22** Marketing value of the plants

S.N	Scientific name	Local name	Marketing purpose
1	<i>Allium hysistum</i>	Jimbu	As flavouring agent
2	<i>Asparagus racemosus</i>	Kurilo	Vegetable
3	<i>Azadirachta indica</i>	Neem	Medicinal value
4	<i>Bauhinia variegata</i>	Koiralo	Vegetable
5	<i>Benincasa hispida</i>	Kubhindo	Vegetable
5	<i>Berberis aristata</i>	Chutro	Medicinal, Fruits and to distill local alcohol
6	<i>Betula utilis</i>	Bhojapatra	Medicinal
7	<i>Begonia picta</i>	Magarkanche	Flavouring agent
8	<i>Bombax ceiba</i>	Simal	Furniture, cosmetic product and fruits
9	<i>Cannabis sativa</i>	Gaanja	Smoke, illegal trade
10	<i>Castanopsis indica</i>	Katus	Fruit nuts, traditional plates 'tapari' and 'duna'
11	<i>Choerospondias axillaris</i>	Lapsee	Pickle and chutney
12	<i>Cinnamomum camphora</i>	Kapur	Camphor
13	<i>Cinnamomum tamala</i>	Tejpat	Flavouring of food

14	<i>Cleistocalyx operculatus</i>	Kyamuno	Fruits and alcoholic beverages
15	<i>Colocasia esculenta</i>	Karkalo	Vegetable
16	<i>Dactylorhiza hatagirea</i>	Panchaunle	Medicinal
17	<i>Daphniphyllum himalense</i>	Rakta chandan	Artifacts and carving
18	<i>Datura stramonium</i>	Dhaturo	Flowers/ alcoholic beverages
19	<i>Dendrocalamus hamiltonii</i>	Tama/Tusa	Tama as pickle and vegetable
20	<i>Dioscorea alata</i>	Ban Tarul	Edible food
21	<i>Dioscorea bulbifera</i>	Githa	Vegetable
22	<i>Dioscorea deltoidea</i>	Bhayakur	Boiled and eaten as vegetable
23	<i>Diospyros lancifolia</i>	Khallu	Fruits, alcoholic beverages and agricultural tools
24	<i>Diplokenma butyracea</i>	Chyauree	Fruit and alcoholic beverages
25	<i>Fagopyrum esculentum</i>	Fapar	Alcoholic beverages
26	<i>Ficus auriculata</i>	Newaro	Vegetable
27	<i>Ficus glaberrima</i>	Pakhuri	Fruits
28	<i>Ficus roxburghii</i>	Newaro	Vegetable
29	<i>Ficus semicordata</i>	Khanayu	Medicinal and fruits
30	<i>Ficus subincisa</i>	Bedulo	Fruits
31	<i>Juglans regia</i>	Okhar	Fruits
32	<i>Lindera neesiana</i>	Siltimur	Fruits
33	<i>Mahonia napaulensis</i>	Jamanemandro	Flower and fruits
34	<i>Mentha arvensis</i>	Pudina	Pickle
35	<i>Morus australis</i>	Kimbu	Fruits
36	<i>Myrica esculenta</i>	Kaphal	Eaten fresh and pickled
37	<i>Neopicrorhiza scrophulariiflora</i>	Kutaki	Medicinal
38	<i>Ocimum scantum</i>	Tulsi	Medicinal
39	<i>Nephrolepis auriculata</i>	Pani amala	Eaten raw
40	<i>Pandanus nepalensis</i>	Tarika	Fruit and alcoholic beverages
41	<i>Phyllanthus emblica</i>	Amala	Fruit as vitamin C and sold for various purpose
42	<i>Piper longum</i>	Pipla	Fruits
43	<i>Potentilla fulgens</i>	Bajradanti	Toothbrush
44	<i>Potentilla polyphylla</i>	Bajradanti	Toothbrush
45	<i>Pyrus pashia</i>	Mayal	Fruit and alcoholic beverages
46	<i>Rheum moorcroftianum</i>	Padamchaal	Medicinal/Pickel
47	<i>Rhododendron arboreum</i>	Lali gurans	Medicinal/Pickel
48	<i>Rorippa nasturtium-aquaticum</i>	Khole sag	Vegetable
49	<i>Rubus ellipticus</i>	Ainselu	Fruits
50	<i>Rubus nepalensis</i>	Bhui kafal	Fruits
51	<i>Sapindus mukorossi</i>	Reetha	Soap/ International trade
52	<i>Saurauia napaulensis</i>	Gobino	Fruits
53	<i>Smilax aspera</i>	Kukurdaino	Vegetable and pickle
54	<i>Solena amplexicaulis</i>	Ban kankro	Fruits
55	<i>Swertia chirayita</i>	Chiraito	Medicinal
56	<i>Syzygium cumini</i>	Jamun	Pickled, alcoholic beverages and construction
57	<i>Tamarindus indica</i>	Imlee	Pickle and medicinal
58	<i>Terminalia bellirica</i>	Barro	Medicinal
59	<i>Terminalia chebula</i>	Harro	Medicinal
60	<i>Urtica dioica</i>	Sisnu	Vegetable
61	<i>Valeriana hardwickii</i>	Nakkali jatamansi	Medicinal
62	<i>Zanthoxylum armatum</i>	Timur	Fruits/ International trade
63	<i>Zizyphus incurva</i>	Hade bayer	Pickle, alcoholic beverages, medicinal value
64	<i>Zizyphus mauritiana</i>	Bayer	Fruits, pickle and alcoholic beverages

## 6.9 Plant species used for different purposes

The fact that plants contain beneficial properties as well as chemicals for natural remedies has long enticed people to find their use. In this study, a number of uses was identified and categorized based on the types in previous research (Changkija & Kumar, 1996; Sen & Batra, 1997; Kumar & Jain, 1998; Panthi & Chaudhary, 2002; Rijal, 2008; Malla & Chhetri, 2009; Aryal *et al.*, 2009; Bhattarai *et al.*, 2010; Srivastava, 2010; Volpato *et al.*, 2012; and Lulekal *et al.*, 2013). Out of 401 species, 397 were used for medicinal purpose, 161 species for fodder, 157 species for human consumption, 66 species for ornamental and ceremony. The detail list of species and the categories of utilization are shown in (Fig. 31).

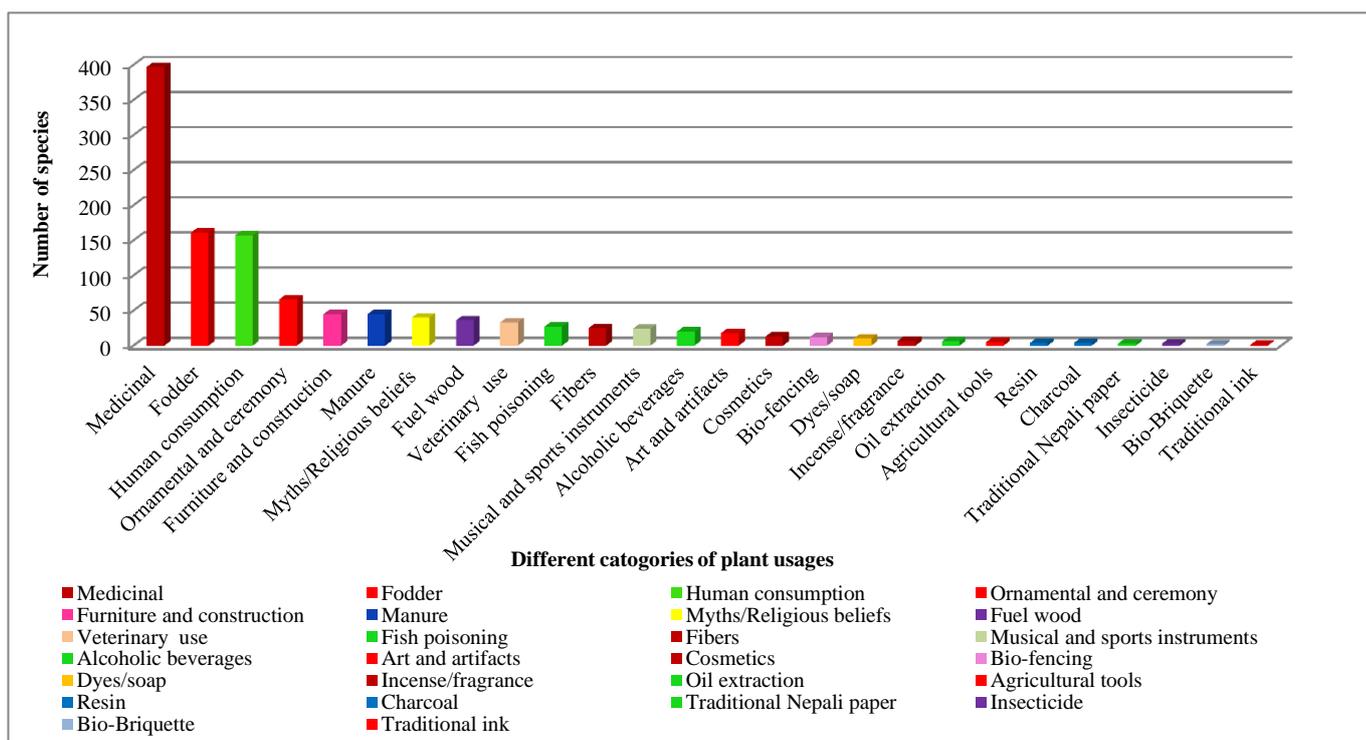


Fig. 31: Different categories of plant usages

## 6.10. Quantitative Analysis (Statistical analysis)

### 6.10.1 Informants consensus factor ( $F_{IC}$ )

Informants consensus factors ( $F_{IC}$ ) was calculated to identify ethnopharmacological importance of the collected plant species and to analyze the degree of agreement of the informant's knowledge about each category of ailments (Song *et al.*, 2013). In ethnomedicinal studies,  $F_{IC}$  provides a measure of reliable reliability for the given claim of evidence (Malla & Chhetri, 2012b).  $F_{IC}$  values are used as important tool for the ethnobotanical research works (Upriety *et al.*, 2010; Cheikhyousef *et al.*, 2011; Singh *et al.*, 2012; Megersa *et al.*, 2013; Lulekal *et al.*, 2013; Song *et al.*, 2013).

The different ailments and diseases were classified into 17 categories and  $F_{IC}$  value for each category was calculated. The result showed that cancer had the greatest agreement with  $F_{IC}$  of 0.98, followed by cardiovascular (0.93), pediatric diseases (0.92), and gynaecological disorders (0.90) (Table 23). The least agreement was recorded in the evil spirit and religious beliefs with  $F_{IC}$  of 0.55 followed by dermatological and cosmetics use with  $F_{IC}$  of 0.57. In another study, however, malaria and headache were found to have the highest  $F_{IC}$  value (0.85), and rabies had the lowest  $F_{IC}$  value (0.25) (Megersa *et al.*, 2013). According to Uprety *et al.* (2010), ophthalmological problems, tooth ache and kidney problems showed  $F_{IC}$  value 1 and 0.82 whereas gastro-intestinal disorders, fever and headache showed relatively low levels of consensus i.e.,  $F_{IC}$  value 0.53 and 0.61 respectively. Yet, gastro-intestinal disorders (Singh *et al.*, 2012; Lulekal *et al.*, 2013), cold/flu/fever (Sadeghi *et al.*, 2014) were found to have maximum  $F_{IC}$  value. The value was found to be relatively higher in the cases of single plant use (Kumar *et al.*, 2011).

**Table 23** Informant consensus factor ( $F_{IC}$ ) by categories of diseases

S.N.	Disease category	Use reports ( $N_{ur}$ )	Number of taxa ( $N_t$ )	$F_{IC}$
1	Gastro-intestinal, parasitic and hepatobiliary	1483	386	0.74
2	Blood and lymphatic system	27	11	0.61
3	Cardiovascular diseases	379	25	0.93
4	Hormonal disorders	58	12	0.81
5	Other (fever, headache, cough and cold)	997	212	0.78
6	Urinogenital and venereal	432	66	0.84
7	Oral, dental and ENT	396	97	0.75
8	External injuries and bleeding	291	90	0.69
9	Pulmonary diseases	189	64	0.66
10	Antidote	79	33	0.58
11	Dermatological and cosmetics	413	177	0.57
12	Musculoskeletal and nervous system	524	161	0.69
13	Ophthalmological problems	28	11	0.63
14	Cancer	157	4	0.98
15	Gynaecological disorders	333	34	0.90
16	Pediatric diseases	221	18	0.92
17	Evil spirit and religious beliefs	87	40	0.55

### 6.10.2 Fidelity level (FL) value

Fidelity level (FL) was used to identify the most preferred species for treating certain ailments by the informants. FL level shows the percentage of informants claiming the use of a certain plant species for the same major purpose (Khan *et al.*, 2014). In this analysis, FL values were calculated for medicinal plants which were mentioned by four or more informants. We found that the most important species, according to their FL, were *Centella asiatica* (100%) used for Musculoskeletal and nervous system, *Crateva unilocularis* (100%) used for cardiovascular disease, *Dactylorhiza hatagirea* (100%) used for urinogenital and venereal ailments, *Swertia chirayita* (100%) used for cardiovascular diseases, *Glycyrrhiza glabra* (96.77%) for urinogenital and venereal ailments, and *Juglans regia* (96.77%) for musculoskeletal and nervous system (Table 24). Studies carried out in

other places also revealed 100% FL value of four plant species i.e. *Achillea welhemsii*, *Caralluma tuberculata*, *Citrullus colocynthis* and *Seripidium quettense* (Bibi *et al.*, 2014). In terms of disease category, the plants used to treat gastro-intestinal and parasitic diseases (Srithi *et al.*, 2009; Rokaya *et al.*, 2010; Song *et al.*, 2013 and Lulekal *et al.*, 2013), and the plants used to treat blackleg and respiratory tract problems (Giday & Teklehaymanot, 2013) were found to have highest FL value.

**Table 24** Fidelity level (FL) value of medicinal plants against a given ailment category

S.N	Medicinal Plant	Therapeutic categories	I <sub>p</sub>	I <sub>n</sub>	FL Value (%)
1	<i>Abies spectabilis</i>	Pulmonary diseases	10	13	76.92
2	<i>Acampe papillosa</i>	Oral, dental and ENT	9	19	47.36
3	<i>Acorus calamus</i>	Pulmonary diseases	12	13	92.30
4	<i>Ageratum houstonianum</i>	External injuries and bleeding	17	21	80.95
5	<i>Arisaema tortuosum</i>	Antidote	9	13	69.23
6	<i>Artemisia indica</i>	Oral, dental and ENT	11	14	78.57
7	<i>Asparagus racemosus</i>	Gastro-intestinal, parasitic and hepatobiliary	17	18	94.44
8	<i>Begonia picta</i>	Ophthalmological problems	9	15	60.00
9	<i>Benincasa hispida</i>	Antidote	13	16	81.25
10	<i>Berberis aristata</i>	Gastro-intestinal, parasitic and hepatobiliary	14	19	73.68
11	<i>Bergenia ciliata</i>	Gynaecological disorders	19	20	95.00
12	<i>Bombax ceiba</i>	Pulmonary diseases (tuberculosis)	10	18	55.55
13	<i>Bryophyllum pinnatum</i>	External injuries and bleeding	10	11	90.90
14	<i>Camellia kissi</i>	Blood and lymphatic system	10	12	83.33
15	<i>Centella asiatica</i>	Musculoskeletal and nervous system	9	9	100.00
16	<i>Cestrum nocturnum</i>	Evil spirit and religious beliefs	8	10	80.00
17	<i>Chonemorpha fragrans</i>	Hormonal disorders	10	17	58.82
18	<i>Chlorophytum nepalense</i>	Urinogenital and venereal	5	13	38.46
19	<i>Cleistocalyx operculatus</i>	Other (fever, headache, cough and cold)	19	20	95.00
20	<i>Coelogyne corymbosa</i>	Dermatological and cosmetics	6	9	66.66
21	<i>Crateva unilocularis</i>	Cardiovascular disease	23	23	100.00
22	<i>Cuscuta reflexa</i>	Gastro-intestinal, parasitic and hepatobiliary	20	21	95.23
23	<i>Dactylorhiza hatagirea</i>	Urinogenital and venereal	21	21	100.00
24	<i>Dendrobium moschatum</i>	Oral, dental and ENT	5	8	62.50
25	<i>Dioscorea deltoidea</i>	Gastro-intestinal, parasitic and hepatobiliary	17	19	89.47
26	<i>Engelhardia spicata</i>	Hormonal disorders	13	15	86.66
27	<i>Gaultheria fragrantissima</i>	Musculoskeletal and nervous system	12	13	92.30
28	<i>Glycyrrhiza glabra</i>	Urinogenital and venereal	26	27	96.77
29	<i>Herminium lanceum</i>	Hormonal disorders	7	12	58.33
30	<i>Indigofera bracteata</i>	Gynaecological disorders	8	15	53.33
31	<i>Juglans regia</i>	Musculoskeletal and nervous system	30	31	96.77
32	<i>Justicia adhatoda</i>	Other (fever, headache, cough and cold)	15	17	88.23
33	<i>Litsea cubeba</i>	Dermatological and cosmetics	25	28	89.28
34	<i>Lycopodium clavatum</i>	Gastro-intestinal, parasitic and hepatobiliary	12	17	70.58
35	<i>Mahonia nepaulensis</i>	Gastro-intestinal, parasitic and hepatobiliary	14	15	93.33
36	<i>Mentha spicata</i>	Gastro-intestinal, parasitic and hepatobiliary	9	12	75.00
37	<i>Michelia doltsopa</i>	Evil spirit and religious beliefs	8	15	53.33
38	<i>Neanotis ingrata</i>	Evil spirit and religious beliefs	7	19	36.84
39	<i>Neolitsea pallens</i>	Antidote	4	17	23.52
30	<i>Neopicrorhiza scrophulariiflora</i>	Cardiovascular disease	23	24	95.83
41	<i>Nephrolepis auriculata</i>	Cardiovascular disease	5	8	62.50
42	<i>Paris polyphylla</i>	Gastro-intestinal, parasitic and hepatobiliary	24	25	96.00

43	<i>Piper longum</i>	Pulmonary diseases	12	16	75.00
44	<i>Pleione humilis</i>	External injuries and bleeding	9	10	90.00
45	<i>Podophyllum hexandrum</i>	Cancer	10	13	76.92
46	<i>Pogostemon glaber</i>	Other (fever, headache, cough and cold)	14	19	73.68
47	<i>Potentilla polyphylla</i>	External injuries and bleeding	23	25	92.00
48	<i>Rauvolfia serpentina</i>	Other (fever, headache, cough and cold)	7	8	87.50
49	<i>Rheum australe</i>	Gynaecological disorders	11	13	84.61
50	<i>Rheum moorcroftianum</i>	Gynaecological disorders	14	15	93.33
51	<i>Rhododendron arboreum</i>	Gastro-intestinal, parasitic and hepatobiliary	13	18	72.22
52	<i>Ricinus cuminus</i>	Musculoskeleton and nervous system	6	10	60.00
53	<i>Rubia manjith</i>	Urinogenital and veneral	15	29	51.72
54	<i>Sambucus adnata</i>	Common cold and cough	7	17	41.17
55	<i>Spilanthes paniculata</i>	Antidote	4	9	44.44
56	<i>Spiranthes sinensis</i>	Oral, dental and ENT	7	11	63.63
57	<i>Swertia angustifolia</i>	Cardiovascular disease	14	15	93.33
58	<i>Swertia chirayita</i>	Cardiovascular disease	12	12	100.00
59	<i>Taxus wallichiana</i>	Cancer	27	28	96.42
60	<i>Tinospora sinensis</i>	Gastro-intestinal, parasitic and hepatobiliary	11	17	64.70
61	<i>Urtica dioica</i>	Cardiovascular disease	17	21	80.95
62	<i>Valeriana hardwickii</i>	Blood and lymphatic system	15	19	78.94
63	<i>Valeriana jatamansii</i>	Ophthalmological problems	9	11	81.81
64	<i>Vitex negundo</i>	Pulmonary diseases	19	24	89.16
65	<i>Wikstroemia canescens</i>	Cardiovascular disease	15	18	83.33
66	<i>Zanthoxylum acanthopodium</i>	Musculoskeleton and nervous system	9	10	90.00
67	<i>Zanthoxylum armatum</i>	Gastro-intestinal, parasitic and hepatobiliary	17	27	62.96
68	<i>Zizyphus mauritiana</i>	Gastro-intestinal, parasitic and hepatobiliary	7	9	77.78

### 6.11 Cross-cultural pattern

Cross-cultural pattern demonstrates broad spectrum of comparative differences in ethnomedicinal use, *i.e.*, it shows the use of any single plant species for the treatment of various diseases/ailments, and various other purpose by different tribes. Such comparisons highlight common patterns from independent discoveries that can make the case for efficacy of certain taxa stronger (Heinrich *et al.*, 1998; Bletter, 2007; Roersch, 2010). Nevertheless, existing literature showed very less emphasis on cross-cultural comparison of medicinal plant species or other taxa (family, genera) (Heinrich, 1994; Moerman, 1996; Heinrich, 1998). Halberstein (2005) observed that two ethnomedicines – *Banisteriopsis inebrians* and *Cannabis sativa* – were prescribed for psychiatric disorders such as euphoria and mental stimulation.

Very recently, Pieroni *et al.* (2011) reinforced the hypothesis that cultural components played crucial role in determining how people used plants. Navaneethan *et al.* (2011) found that about 10 species were commonly used by different tribal people in Karnataka, India. Similarly, Saslis-lagoudakis *et al.* (2011) observed common pattern in ethnomedicinal uses of three independent ethnomedicinal floras in Nepal, New Zealand and South Africa. They claimed that the common use was the result of independent discovery in the three regions due to efficiency of local cultures in

identifying plants.

This research examined cross-cultural differences among the three ethnic communities. Some medicinal plants were found to be used commonly by all the three tribes. Differences were observed in the understanding of the concepts and treatment method used by the different ethnic communities. In some instances, similarities were minimal even within a single community based on gender, age, education, ethnicity and altitude of their living. Some medicinal plants were reported to treat common diseases in the different communities. Out of total plant species, it was observed that 83 ethnobotanical species were used by all the tribes whereas 45 ethnomedicinal species were used commonly by either two or all the three tribes (Table 25). Among total plant species reported, it was found that *Magar* tribe uses 301 plant species to cure 112 diseases, *Gurung* tribe uses 197 plant species to treat 88 diseases and *Majhi* tribe uses 126 plant species to administer 80 diseases. *Cedrus deodara*, *Centella asiatica*, *Dactylorhiza hatagirea* are the species commonly used by *Magar* tribes to cure 10 diseases, *Rumex nepalensis*, *Justicia procumbens*, *Dactylorhiza hatagirea* are the species that are used mostly by *Gurung* tribe to cure 8 diseases and *Calotropis gigantea* is the species that is used mostly by *Majhi* tribes to cure 12 diseases. *Choerospondias axillaris* was used by all as a source of vitamin C. It was also found that *Pyrus pashia* and *Bauhinia vahlii* were used to cure the same disease. Some plants, however, were used differently by different tribes. *Cassia fistula*, for example, was used by *Gurung* to cure hematuria, diarrhoea and dysentery; *Magar* used it to administer asthma, diabetes, eczema, abortification and gargling, and *Majhi* used it to treat skin diseases, syphilis, gargling to relieve sore throat, asthma, diabetes, eczema, abortification, scorpion stings and snake bites. *Cynodon dactylon* was commonly used by *Gurung* and *Majhi* to administer bleeding from nose, fresh cuts and wounds, burning sensation and skin diseases; but *Magar* used the plant to cure indigestion only. In some cases, two tribes were observed to use a plant for the same purpose totally different from that of the remaining one. *Ficus religiosa*, for instance, was used to cure gonorrhoea, toothache, gumache and skin diseases by *Gurung* and *Magar* whereas *Majhi* used the same plant to cure snakebites. Also, *Jatropha curcas* was used to cure rheumatism by *Gurung* and *Majhi*; but *Magar* used the plant to and syphilis, pneumonia, wounds and abortification. Most important of all differences was the use of same plant for different diseases/ailments: *Majhi* used *Mimosa pudica* to administer uric acid, asthma, fever, cough, and piles whereas *Magar* used it to administer uricacid, asthma, fever, cough, glandular swelling of childrens, kidney and urinary problem, and piles; and *Gurung* used the plant just to treat piles. Few plants like *Neopicrorhiza scrophulariiflora*, *Dactylorhiza hatagirea*, *Dioscorea deltoidea*, *Juglans regia*, *Acorus calamus*, *Bergenia ciliata* are used to treat various diseases by *Gurung* and *Magar* tribe whereas *Majhi* people donot have any idea about the use of such plants.

*Tinospora sinensis*, *Acampe papillosa*, *Asparagus racemosus* are the species used by *Magar* and *Majhi* tribes to cure diseases like Stomachache, urinary problems, to stimulate urination, kidney and liver troubles, sore throat, epilepsy, rheumatism, neuralgia, earache etc but *Gurung* tribe are not aware about the uses of these species. Living in the same community people have the cross cultural way of using the species whereas some are even completely unaware about the implication and identification of plant species.

**Table 25** Cross-cultural patterns in the use of ethnomedicinal plants by the three ethnic communities of Parbat district

S.N	Scientific name	Local name	Gurung	Magar	Majhi
1	<i>Acacia catechu</i> (Mimosaceae)	<i>Khayar</i> (N, G, M, Ma)	Nose bleeding, skin eruptions and sore nipples	Swellings pain or injury, diarrhoea, dysentery, hemorrhoids, leucorrhoea, uterine hemorrhage, nose bleeding, skin eruptions and sore nipples	Swellings pain or injury, diarrhoea, dysentery, hemorrhoids, leucorrhoea and uterine hemorrhage
2	<i>Acampe papillosa</i> (Orchidaceae)	<i>Sungava phul</i> (N, M, Ma)		Rheumatism, backache, neuralgia, earache	Rheumatism, backache, neuralgia, earache
3	<i>Achyranthes aspera</i> (Amaranthaceae)	<i>Utekuro</i> (N), <i>Tine</i> , <i>Ulte paju</i> (G), <i>Jamjite</i> (M), <i>Bipyu kanda</i> , <i>Chorato</i> (Ma)	Piles, cuts and boils and skin diseases of childrens	Diarrhoea, dysentery and skin diseases of childrens	Diarrhoea, dysentery and skin diseases of childrens
4	<i>Acorus calamus</i> (Araceae)	<i>Bojho</i> (N, M, G)	Fever and sore throat	Fever and sore throat	
5	<i>Anthocephalus cadamba</i> (Rubiaceae)	<i>Kadam</i> (N, G, M, Ma)	Gargling during throat infection, diarrhoea and dysentery	Gargling during throat infection, decoction diarrhoea and dysentery	Wounds, as antipyretic and tonic
6	<i>Asparagus racemosus</i> (Asparagaceae)	<i>Kurilo</i> , <i>Satawari</i> (N), <i>Kurilo</i> (M), <i>Kurila</i> (Ma)		Post-pregnancy period of woman, worms in the stomach of animals, expelling the placenta of animals after delivery, kidney and liver troubles, sore throat, epilepsy and rheumatism	Worms in the stomach of animals, expelling the placenta of animals after delivery, kidney and liver troubles, sore throat, epilepsy and rheumatism
7	<i>Bauhinia vahlii</i> (Caesalpinaceae)	<i>Bhorla</i> (N, M, Ma), <i>Malu, peli</i> (G)	Boils and dysentery	Diarrhoea and dysentery	Diarrhoea and dysentery
8	<i>Bergenia ciliata</i> (Saxifragaceae)	<i>Pakhanbed</i> (N), <i>Padambet</i> (G), <i>Silparo</i> (M)	Piles tumor, urinary trouble, kidney stone, heart disease, asthma and lungs problem	Piles tumor, urinary trouble, kidney stone, heart disease, asthma and lungs problem, cough and cold, post-partum women	
9	<i>Bombax ceiba</i> (Bombacaceae)	<i>Simal</i> (N, M, Ma), <i>Simaltun</i> (G)	Skin diseases	Diarrhoea, dysentery and tuberculosis, cuts and wounds	Diarrhoea, dysentery and tuberculosis
10	<i>Cannabis sativa</i> (Cannabaceae)	<i>Bhang</i> , <i>Gaanja</i> (N, G), <i>Bhango</i> (M, Ma)	To stimulate sexual desire	Stimulate sexual desire	Cold cough (children), asthma, severe body pain and as an appetizer
11	<i>Cassia fistula</i>	<i>Rajbriksha</i> (N,	Hematuria	Gargling to relieve sore	Skin diseases, syphilis,

	(Caesalpiniaceae)	M, G, Ma)	(presence of blood in urine), diarrhoea and dysentery	throat, asthma, diabetes, eczema and abortification	gargling to relieve sore throat, asthma, diabetes, eczema, scorpion stings, snake bite and abortification
12	<i>Chonemorpha fragrans</i> (Apocynaceae)	<i>Gothala phul</i> , <i>Ghurilo</i> (N, M, Ma), <i>Ghibinduri</i> (G)	Ulcers, fever, constipation, to remove intestinal worms	Diabetes and jaundice	Wounds and skin diseases
13	<i>Chenopodium album</i> (Chenopodiaceae)	<i>Bethe</i> (N, G, Ma), <i>Bethe gan</i> (M)	Diarrhoea and dysentery	Urinary trouble	Urinary trouble
14	<i>Cynodon dactylon</i> (Poaceae)	<i>Dubo</i> (N, M, Ma), <i>No dubo</i> (G)	Bleeding from nose, cuts and wounds, burning sensation and skin diseases	Indigestion	Bleeding from nose, fresh cuts and wounds, burning sensation and skin diseases
15	<i>Dactylorhiza hatagirea</i> (Orchidaceae)	<i>Panchaunle</i> (N, M), <i>Lob</i> , <i>Panchaule</i> (G)	nerve tonic, bleeding, colic pain, urinary problems, seminal weakness, diabetes and hemiplegia	Aphrodisiac, nerve tonic, bleeding, colic pain, urinary problems, seminal weakness, diabetes and hemiplegia	
16	<i>Dioscorea deltoidea</i> (Dioscoreaceae)	<i>Kukur tarul</i> (N, G, M)	Constipation, leprosy, piles, fever and gonorrhoea, labour pain, rashes and itches	Constipation, leprosy, piles, fever and gonorrhoea, labour pain, rashes and itches	
17	<i>Daphne bholua</i> (Thymelaeaceae)	<i>Lokta</i> (N, Ma), <i>Setabaduwa</i> , <i>Syugu mhendo</i> (G), <i>Logoto</i> (M)	Fever and gastric disorder	Gastric disorder	Gastric disorder
18	<i>Eryngium foetidum</i> (Apiaceae)	<i>Bandhaniya</i> , <i>Brahmdhaniya</i> (N, M, G, Ma)	Earache, inflammation and burns	Infertility complication, earache, inflammation and burns	Infertility complication
19	<i>Eupatorium adenophorum</i> (Asteraceae)	<i>Banmara</i> (N, M), <i>Banmasa</i> (G), <i>Sano banmara</i> (Ma)	Cuts, wounds and boils	Cuts, wounds and boils	Fever
20	<i>Euphorbia hirta</i> (Euphorbiaceae)	<i>Dudhejhar</i> (N), <i>Dudhi jhar</i> (M), <i>Dudhe aainar</i> (Ma), <i>Chimphar jhar</i> (G)	Cough, fever, asthma and bronchitis	Infected ear and cuts and wounds	Cough, fever, asthma and bronchitis
21	<i>Euphorbia royleana</i> (Euphorbiaceae)	<i>Siundee</i> (N), <i>Syuri</i> (G), <i>Dha</i> , <i>Mete</i> (M), <i>Kanpate</i> (Ma)	Fever, mumps, pimples and cuts	Wounds	Wounds
22	<i>Ficus benghalensis</i> (Moraceae)	<i>Bar</i> (N, M, G, Ma)	Dysentery, diarrhoea and diabetes	Dysentery, diarrhoea and diabetes	Rheumatism, toothache and as poultice to treat abscesses
23	<i>Ficus religiosa</i> (Moraceae)	<i>Peepal</i> (N, Ma), <i>Pipal</i> (G, M)	Gonorrhoea, toothache, gumache and skin disease	Gonorrhoea, toothache, gumache and skin disease	Snakebite
24	<i>Ficus roxburghii</i> (Moraceae)	<i>Newaro</i> (N, M, Ma), <i>Mako</i> (G)	Cuts and wounds, cure diarrhoea and dysentery	Cuts and wounds, cure diarrhoea and dysentery	Cuts and wounds, cure diarrhoea and dysentery
25	<i>Girardinia</i>	<i>Allo</i> , <i>Chanle</i>	Ringworm,	Antipyretic, headache and	Constipation and

	<i>diversifolia</i> (Urticaceae)	<i>sisno</i> (N, Ma), <i>Ghyo</i> (M), <i>Naipolo, Puwa</i> (G)	eczema, antipyretic, headache and joint aches	joint aches	gastric disorders
26	<i>Jatropha curcas</i> (Euphorbiaceae)	<i>Sajiwan</i> (N), <i>Aren, Aril</i> (Ma), <i>Rajani giri</i> (G), <i>Ratyun</i> (M)	Rheumatism	Syphilis, pneumonia, wounds and abortification	Rheumatism and abortification
27	<i>Juglans regia</i> (Juglandaceae)	<i>Okhar</i> (N, M), <i>Akhor, Katu</i> (G)	Rheumatism	Sore throat and wounds	
28	<i>Justicia adhatoda</i> (Acanthaceae)	<i>Asuro</i> (N, G, M, Ma)	Fever, cough, asthma, bronchitis, malarial fever and joint pain	Fever, cough and asthma	Bronchitis, malarial fever and joint pain
29	<i>Melia azedarach</i> (Meliaceae)	<i>Bakaino</i> (N), <i>Bakainu</i> (G, M, Ma)	Headache and rheumatic pain	Leprosy and skin diseases	Leprosy and skin diseases
30	<i>Mentha spicata</i> (Lamiaceae)	<i>Pudina</i> (N), <i>Daunne</i> (M), <i>Bawari</i> (G)	Cysts on the tongue, blood pressure and inflammation of the body	Nausea, diarrhoea, dysentery, vomiting, cysts on the tongue, blood pressure and inflammation of the body	
31	<i>Mimosa pudica</i> (Mimosaceae)	<i>Lajawati jhar</i> (N, M, Ma), <i>Mhaira</i> (G)	Piles	Uric acid, asthma, fever, cough, glandular swelling of childrens, kidney and urinary problem to remove kidney stone and piles	Uric acid, asthma, fever, cough and piles
32	<i>Neopicrorhiza scrophulariiflora</i> (Scrophulariaceae)	<i>Kutaki</i> (N, M, G)	Fever, stomachache, dropsy, cough and cold	Fever, stomachache and dropsy, cough and cold, bile diseases, intestinal pain and blood pressure	
33	<i>Oroxylum indicum</i> (Bignoniaceae)	<i>Talelo</i> (N, Ma), <i>Krimtata</i> (G), <i>Tatal</i> (M)	Diarrhoea, jaundice and dysentery	Body pain, fever, burns and wounds	Diarrhoea, jaundice and dysentery
34	<i>Phyllanthus emblica</i> (Euphorbiaceae)	<i>Amala</i> (N), <i>Kyun, Titi</i> (G), <i>Aaunlesa,</i> <i>Ghwarbhet</i> (M), <i>Amala</i> (Ma)	Diarrhoea, dysentery, sore throat, jaundice cuts and wounds, constipation and bronchitis	Diarrhoea, dysentery, sore throat, jaundice, cuts and wounds, constipation and bronchitis	Cuts and wounds, constipation and bronchitis
35	<i>Pyrus pashia</i> (Rosaceae)	<i>Mayal</i> (N,G), <i>Mel</i> (M, Ma)	Diarrhoea and dysentery	Diarrhoea and dysentery	Diarrhoea and dysentery
36	<i>Rheum moorcroftianum</i> (Polygonaceae)	<i>Padamchaal</i> (N, M), <i>Kesa,</i> <i>Keje</i> (G)	Constipation and antiseptic,	Sinusitis, constipation, antiseptic, stomachache, expel intestinal worm and to stimulate blood circulation	
37	<i>Rhododendron arboreum</i> (Ericaceae)	<i>Lali gurans</i> (N, Ma), <i>Porota,</i> <i>Pota</i> (G), <i>Lalisar</i> (M)	Menstrual disorder and chewed if fish bone is stuck up in the oesophagus	Menstrual disorder and fish bone is stuck up in the oesophagus	Cough and cold, dysentery and diarrhoea
38	<i>Rubus ellipticus</i> (Rosaceae)	<i>Ainselu</i> (N), <i>Palan</i> (G), <i>Dhewasi, Juis</i> (M), <i>Melanchi</i> (Ma)	Fever, gastric trouble, diarrhoea and dysentery	Wounds and peptic ulcer	Wounds and peptic ulcer
39	<i>Shorea robusta</i> (Dipterocarpaceae)	<i>Sal or Agrath</i> (N, Ma), <i>Jhesin</i> (G), <i>Agras,</i>	Ulcer, wounds, diarrhoea and dysentery	Ulcer, wounds, diarrhoea and dysentery	Dislocated bones as plaster, gonorrhoea, dysentery (child)

		<i>Phoksin</i> (M)			
40	<i>Solanum nigrum</i> (Solanaceae)	<i>Behi</i> (N), <i>Ninaura</i> , <i>Petimgan</i> (M), <i>Khursani jhar</i> , <i>Pimmendo</i> (G), <i>Kaligedi</i> (Ma)	Liver problem, fever and dysentery	Liver problem, fever and dysentery	Relieve pain
41	<i>Syzygium cumini</i> (Myrtaceae)	<i>Jamun</i> (N), <i>Jamuna</i> (G), <i>Jamunu</i> (M), <i>Phandil</i> (Ma)	Bronchitis and ulcer	Sore throat and asthma	Sore throat and asthma
42	<i>Tinospora sinensis</i> (Menispermaceae)	<i>Gurjo</i> (N, M), <i>Guruj</i> (Ma)		Stomachache, urinary problems and to stimulate urination	Dysentery, tonic and febrifuge
43	<i>Woodfordia fruticosa</i> (Lythraceae)	<i>Dhairo</i> (N), <i>Dhanyar</i> (G), <i>Dhainra</i> (M), <i>Dhauri</i> (Ma)	Swelling, fever and cysts on the tongue	Dysentery, diarrhoea, swelling, fever, and tongue cysts	Dysentery and diarrhoea
44	<i>Zanthoxylum armatum</i> (Rutaceae)	<i>Timur</i> (N, M, Ma), <i>Prumo</i> (G)	Fever, cholera and stomach disorder	Fever, cholera and stomach disorder	Toothache
45	<i>Zizyphus mauritiana</i> (Rhamnaceae)	<i>Bayer</i> (N, M), <i>Baher</i> (G), <i>Boyar</i> (Ma)	Fever, dysentery, diarrhoea and menstrual disorders	Toothache, cough and cold	Backache

Significant differences were observed regarding  $F_{IC}$  value of the plants and corresponding diseases. In *Magar* community, cancer had the highest  $F_{IC}$  value of 0.98 which in *Gurung* community had 0.88  $F_{IC}$ , and *Majhi* community had 0  $F_{IC}$ . Likewise, in case of *Majhi* community, ophthalmological disorders had 1  $F_{IC}$  value; the same had 0.50 and 0.63  $F_{IC}$  value in *Magar* and *Gurung* community respectively. Another significant observation was unanimous acceptance of some plant species use for certain disease in a particular community. Among *Majhi*, blood and lymphatic system and ophthalmological problem had  $F_{IC}$  value of 1 (Table 26). Variations were also observed regarding the number of plant species used by three ethnic groups.

**Table 26** Comparison of  $F_{IC}$  in three ethnic communities (*Gurung*, *Magar* and *Majhi*)

S.N	Disease categories	Gurung			Magar			Majhi		
		$N_{ur}$	$N_t$	$F_{IC}$	$N_{ur}$	$N_t$	$F_{IC}$	$N_{ur}$	$N_t$	$F_{IC}$
1	Gastro-intestinal, parasitic and hepatobiliary	523	167	0.68	827	253	0.69	233	111	0.52
2	Blood and lymphatic system	12	4	0.72	89	10	0.90	20	1	1
3	Cardiovascular diseases	79	9	0.90	125	23	0.82	175	5	0.98
4	Hormonal disorders	17	5	0.75	29	11	0.64	12	3	0.90
5	Other (fever, headache, cough and cold)	298	88	0.70	479	137	0.71	220	44	0.80
6	Urogenital and venereal	102	27	0.74	277	50	0.82	53	16	0.71
7	Oral, dental and ENT	97	24	0.77	218	68	0.70	81	26	0.79
8	External injuries and bleeding	109	42	0.62	157	51	0.68	55	27	0.51
9	Pulmonary diseases	72	21	0.71	91	45	0.51	32	21	0.36
10	Antidote	25	3	0.91	52	16	0.70	39	17	0.58
11	Dermatological and cosmetics	180	77	0.58	179	114	0.37	97	44	0.56
12	Musculoskeletal and nervous system	157	53	0.67	313	106	0.67	54	42	0.22
13	Ophthalmological problems	12	5	0.63	13	7	0.50	3	1	1
14	Cancer	9	2	0.88	148	4	0.98	----	----	----
15	Gynaecological disorders	103	10	0.91	172	28	0.84	37	6	0.87
16	Pediatric diseases	99	2	0.99	57	11	0.82	54	7	0.89
17	Evil spirit and religious beliefs	24	20	0.17	37	29	0.22	26	18	0.32

## 6.12 Veterinary medicines and insecticides

The three ethnic communities used 33 plant species from different families as veterinary medicine to treat 15 different types of diseases/ailments (Table 27). Likewise, 4 plant species were recorded for the treatment of different insect bites and 3 species were used as insecticides. It has been noted that leaves, stems, and fruits were the most frequently used parts. In many cases the whole plant parts were also used for the treatment of various veterinary ailments. The most common ailments in which plant parts were used included foot and mouth disease, food poisoning, ring worm, bone fracture, stomach disorder, conjunctivitis, muscular soiling and diarrhoea. The use of veterinary medicine indicates that the plant species in this area can be good source for pharmacological study. As Martinez and Lujan (2011) emphasized, ethnomedicine and ethnopharmacology in many developing countries for veterinary often provide the most cost-effective methods of obtaining effective remedies and adequate health coverage.

**Table 27** Veterinary uses of medicinal plants

S.N	Scientific Name	Administration	Disease Treated
1	<i>Abrus precatorius</i>	Oral	Constipation
2	<i>Acorus calamus</i>	External	Remove lice
3	<i>Anemone rivularis</i>	Oral	Poisoning
4	<i>Anemone vitifolia</i>	Oral	Poisoning
5	<i>Arisaema tortuosum</i>	Oral, dermal	Colic, Stomach disorders, Worms
6	<i>Asparagus racemosus</i>	Oral	Delivery, Stomach disorders, Worms
7	<i>Boehmeria macrophylla</i>	Oral	Poisoning, Stomach disorders
8	<i>Boehmeria platyphylla</i>	Dermal, Oral	Cuts and wounds, Injury, Stomach disorders, Urinary problems
9	<i>Boenninghausenia albiflora</i>	External, Oral	Remove lice, Worms
10	<i>Cleistocalyx operculatus</i>	External	Injury, Swelling
11	<i>Cuscuta reflexa</i>	External, Internal	Foot and mouth
12	<i>Delphinium altissimum</i>	Dermal	Worms
13	<i>Dendrocalamus hamiltonii</i>	Oral	Delivery
14	<i>Dioscorea esculanta</i>	External, Oral	Remove lice, Worms
15	<i>Drepanostachyum falcatum</i>	External	Bone fracture
16	<i>Erythrina stricta</i>	Dermal	Skin diseases
17	<i>Eulaliopsis binata</i>	External	Cuts and wounds, Injury
18	<i>Fraxinus floribunda</i>	External, Oral	Bone fracture, Poisoning
19	<i>Juglans regia</i>	External	Remove lice
20	<i>Juncus concinnus</i>	Oral	Poisoning
21	<i>Lindera neesiana</i>	Oral	Stomach disorders
22	<i>Litsea cubeba</i>	Oral	Stomach disorders
23	<i>Melia azedarach</i>	External	Remove lice
24	<i>Osbeckia stellata</i>	Oral	Poisoning
25	<i>Paris polyphylla</i>	Oral	Poisoning
26	<i>Phyllanthus parvifolius</i>	External	Remove lice
27	<i>Pogostemon benghalensis</i>	Oral	Stomach disorders
28	<i>Rhus javanica</i>	External, Internal	Foot and mouth
29	<i>Rumex nepalensis</i>	Oral	Poisoning
30	<i>Salvia plebeia</i>	External	Remove lice
31	<i>Sapium insigne</i>	Dermal, Oral	Cuts and wounds, Injury, Stomach disorders
32	<i>Schima wallichii</i>	Dermal, Oral	Cuts and wounds, Liver fluke
33	<i>Thunia alba</i>	External	Bone fracture

## 6.13 Fish stupefying

A wide prevalence of ethnobotanical plants to stupefy fish was observed among the ethnic communities in the studied area. A total of 27 plant species belonging to 23 genera and 17 families

were identified and used in different ways. This observation suggested that the ethnic people practiced this tradition with the belief of the plant species' effectiveness to stupefy. But, in the case of *Majhi*, who rely on fishing for their living, were not found to use the plants for stupefy while fishing in the running rivers. Similar observations were made in previous studies carried out in different location (Manandhar, 2002; Joshi & Joshi, 2005). The list of plant species used for fish poisoning is presented below:

*Agave americana*, *Agave sisalana*, *Ageratum conyzoides*, *Anemone vitifolia*, *Asystasia macrocarpa*, *Buddleja asiatica*, *Chenopodium ambrosioides*, *Daphne bholua*, *Dioscorea deltoidea*, *Dioscorea esculanta*, *Engelhardia spicata*, *Eupatorium odoratum*, *Euphorbia royleana*, *Euphorbia thymifolia*, *Gnaphalium luteo-album*, *Hypericum uralum*, *Juglans regia*, *Lindera neesiana*, *Litsea cubeba*, *Lyonia ovalifolia*, *Maesa chisia*, *Piper chaba*, *Piper longum*, *Sapium insigne*, *Schima wallichii*, *Spilanthes paniculata*, *Zanthoxylum armatum*

Plant species used in fish poisoning

#### 6.14 Wild edible plants

Plants contribute to a larger part of edibles used by human beings. Specially, in the case of aboriginal people, the plants are used without examining the potential hazards to their health. Any wild plant needs to be identified in terms of safety before it is used as edible. In the present study, high diversity of wild edible plants was recorded consisting 159 species from 64 families under 115 genera in which 75 species of plants' fruits were consumed. Among them, different parts of 66 species were used as vegetables; 53 species of plants were used to make pickles, and 20 species were utilized to produce alcoholic beverages. The list of some important plant species used as edible is given below:

*Asparagus racemosus*, *Bauhinia purpurea*, *Bauhinia variegata*, *Begonia picta*, *Berberis aristata*, *Boehmeria rugulosa*, *Bombax ceiba*, *Castanopsis indica*, *Choerospondias axillaris*, *Cleistocalyx operculatus*, *Colocasia esculenta*, *Dendrocalamus hamiltonii*, *Diploknema butyracea*, *Dioscorea alata*, *Dioscorea deltoidea*, *Dioscorea bulbifera*, *Diospyros lancifolia*, *Ficus auriculata*, *Ficus glaberrima*, *Ficus lacor*, *Ficus roxburghii*, *Ficus semicordata*, *Ficus subincisa*, *Lindera neesiana*, *Litsea monopetala*, *Mahonia napaulensis*, *Morus australis*, *Nephrolepis auriculata*, *Pandanus nepalensis*, *Phyllanthus emblica*, *Piper longum*, *Prunus cerasoides*, *Pyrus pashia*, *Rorippa nasturtium-aquaticum*, *Rubus ellipticus*, *Saurauia napaulensis*, *Smilax aspera*, *Solena amplexicaulis*, *Syzygium cumini*, *Zanthoxylum armatum*, *Zizyphus mauritiana*

List of wild and cultivated edible plant species

#### 6.15 Homegardens

Homegarden has proved very useful to avail healthy and organic food, and to save money. In the studied area, the ethnic people harvested plants for most essential needs like food, fodder, ornament, firewood, and fibers. The study revealed that 12 species were domesticated for bio-fencing. The cultivation of plants for their medicinal purpose was observed to be relatively less. The list of plant species observed in homegarden is given below:

*Acampe papillosa, Aloe vera, Bauhinia variegata, Benincasa hispida, Dactylorhiza hatagirea, Duabanga grandiflora, Erythrina stricta, Euphorbia pulcherrima, Ficus roxburghii, Girardinia diversifolia, Iris clarkei, Nymphaea arbor-tristis, Salvia campanulata, Urtica dioica, Zizyphus mauritiana, Mentha spicata*

List of some important plants grown in homegardens

### 6.16 Fodder yielding plants

The use of plant species as fodder, which is the agricultural foodstuffs for domestic animals, was found highly prevalent among the ethnic communities. During this study, 161 plant species were found to be used for fodder purposes. Most of the plants are abundant in wet season and scarce in dry season. It can be given to animals in the form of wet, dry, grain or tuber, or silage. Similar studies were carried out by Shrestha (1989) in Sindhupalchowk and Parajuli (2000) in Sankhuwasabha districts. Some important fodder yielding plants is given below:

*Bauhinia vahlii, Bauhinia variegata, Boehmeria rugulosa, Cyperus cyperoides, Ficus auriculata, Ficus benghalensis, Ficus benjamina, Ficus glaberrima, Ficus hirta, Ficus hispida, Ficus lacor, Ficus neriifolia, Ficus religiosa, Ficus roxburghii, Ficus semicordata, Ficus subincisa, Herminium lanceum, Litsea monopetala, Rhus succedanea, Rubus nepalensis, Schima wallichii, Saurauia napaulensis*

List of some important fodder yielding plants

### 6.17 Fiber yielding plants

The use of plants to yield fibers has been in practice because of their importance in a number of purposes. It was observed that different parts of the plants were used to obtain fibers. As per the information obtained during this study, 25 plant species were used to obtain fibers by the tribal people. Strong threads derived from the barks of *Boehmeria platyphylla* were used for making, fishnet, rope, bhangra, sacks and rough clothes. Similarly, coarse fiber extracted from the barks of *Girardinia diversifolia* is used to make threads, weaving ropes, porter's tumplines, mats, sacks, bags, coarse coats, fish nets and typical traditional clothing 'bhangra' (*Gurung* and *Magar*). The following plants were most frequently used to yield fiber:

*Agave americana, Agave sisalana, Boehmeria rugulosa, Boehmeria macrophylla, Butea minor, Calotropis gigantea, Calotropis procera, Chonemorpha fragrans, Cissampelos pareira, Cissus repens, Cryptolepis buchananii, Curculigo crassifolia, Debregeasia longifolia, Debregeasia salicifolia, Engelhardia spicata, Girardinia diversifolia, Ficus glaberrima, Wikstroemia canescens Gossypium, herbacium, Urena lobata*

Some important fiber yielding plants

### 6.18 Conservation practices/issues

Ethnomedicinal plants in Nepal are increasingly threatened due to variety of pressures. Moreover, effective and result oriented efforts for conservation have been put neither by the local inhabitants nor by Nepal government. Consequently, a large number of medicinal plants are at the verge of

extinction. Almost all the traditional healers of the study area were observed to depend on the wild to collect medicinal plants. Most of the plant species (395) were principally harvested from the wild; the plant species were collected from nearby forest as per the needs. Only a very few species (6) were cultivated. It was observed that there was a strong forest law and restrictions were put to collect threatened and endangered plant species from natural habitat.

The existing pattern of fresh plant use was observed to be highly threatening. Because the local healers and medicinal persons prepared different modes of medicine from fresh plants, this would threaten plant species (Megersa *et al.*, 2013). The ethnic people added that most of the medicinal plants were under threat due to increasing anthropogenic influence on natural habitat of the plants. Most of the informants agreed that deforestation (89%); agricultural expansion (80%), charcoal and firewood (33%), and overgrazing (29%) were the major factors affecting medicinal plant wealth. The origins of conservation were rooted in a general concern to protect nature because of its intrinsic and aesthetic values. Therefore conservation is very important prospect for the protection of plant for their utmost needs and importance.

#### **6.19 Socio-economic benefit of medicinal plants**

Medicinal plants have socio-economic potential. The fact that plants have diversity in terms of their potential use such as oil bearing plants, oil-seed plants, gums and resins, fruit and nuts, vegetables and the medicinal (Prana & Ahirwar, 2015) have generated great demand of medicinal plants. A few studies have come up with the finding that medicinal plants were alternative to conventional medicine, especially in rural areas having poor access to health services (Andriamparany *et al.*, 2014).

Identifying the benefit and cost of conservation, and determining production systems for medicinal and aromatic plants (MAP) are believed to decide whether plant species conservation should take place in nature or the nursery or both (Schippmann *et al.*, 2005). In addition, cost benefit analysis is also required to evaluate whether and how logging of medicinally valuable species make short-term or long-term economic and socio-cultural sense (Shanley & Luz, 2003). Though such studies have not been carried out in Parbat, the plants of *in-situ* and *ex-situ* conservation area were observed to have great economic benefit for the local communities, public and private land owners. Selling medicinal plants in various forms (preparing tablets, pills, juice and powder) were reported to have benefitted the ethnic people.

#### **6.20 Phytochemical Analysis**

Wild edible plants contain protein, carbohydrate, starch, fat, vitamin, and mineral required for the

local residents to a greater extent (Sundriyal, 1999). Among the plants consumed in Nepal, some have been analyzed in terms of their nutritional constituents (Bhandari & Kawabata, 2004; Upreti & Shrestha, 2006; Gauchan *et al.*, 2008; Sharma *et al.*, 2009; Acharya & Acharya, 2010; Bhattarai *et al.*, 2009; Joshi & Siwakoti, 2012; Singh *et al.*, 2012; Shrestha, 2013; Upreti *et al.*, 2012; Thapa, 2014).

Many VDCs of Parbat district depend upon a variety of plants for their survival. Though the people are gradually involved in agriculture, the use of wild edible plants is still prominent. These plants are a good source of nutrients. The present analysis showed high nutritional values in different plant parts. Nutritional constituents of *Pyrus pashia*, *Prunus cerasoides*, *Morus australis*, *Rubus ellipticus*, *Zanthoxylum armatum*, *Castanopsis indica*, and *Diplokenma butyracea* showed somewhat similar value compared with the previous studies (Sundriyal, 1999; Abbasi *et al.*, 2014). The nutritive values of the plants of Parbat district are found in comparable range with the value of wild edible species from different parts of the Nepal (Bhandari *et al.*, 2003, Abbasi *et al.*, 2014; Bajracharya, 1980). In the present investigation, the proximate chemical analysis of important edible plants is observed to be highly nutritive which suggests that the wild edible species are good sources of various nutrients.

The richness of Nepal in biodiversity has long been recognized (Hara *et al.*, 1978; Caldecott *et al.*, 1994) showing its 10<sup>th</sup> rank in Asia and 31<sup>st</sup> in the world (Caldecott *et al.*, 1994; Biodiversity Profile Project, 1995). Of the 6,653 Angiosperms (Rokaya *et al.*, 2010), 534 Pteridophytes and 31 Gymnosperms (DPR, 2007), 1792-2331 plants are recorded to have medicinal values (Rokaya *et al.*, 2010). Nonetheless, examination of the medicinal plants through phytochemical screening is very limited (Karanjit *et al.*, 2007; Bhattarai *et al.*, 2008; Chhetri *et al.*, 2008; Prakash *et al.*, 2008; Rawal *et al.*, 2009; Adhikary *et al.*, 2011; Baral *et al.*, 2011; Karmacharya, 2011; Shrestha, 2011; Amatya & Pradhan, 2012; Baral *et al.*, 2012, Gyawali and Kim, 2012; Parajuli *et al.*, 2012; Rokaya *et al.*, 2012; Aryal *et al.*, 2014, Giri *et al.*, 2014; Srivastava *et al.*, 2014).

Compared with the phytochemical studies of *Swertia chirayita* (Wang *et al.*, 2003), *Zanthoxylum armatum* (Chhetri *et al.*, 2008), *Taxus wallichiana* (Nisar, 2007), *Rhodendron setosum* (Chhetri *et al.*, 2008), *Ipomoea carnea* (Sahayaraj & Ravi, 2008), *Vitex negundo* (Dhakal *et al.*, 2009), *Bergenia ciliata* (Adhikary *et al.*, 2011; Yadav & Agarwala, 2011), *Tinospora cordifolia* (Wani *et al.*, 2011), *Rauvolfia serpentina* (Bhatnagar *et al.*, 2013), *Centella asiatica* (Devkota & Jha, 2010; Haque *et al.*, 2012), *Litsea monopetala* (Islam *et al.*, 2012), *Rheum moorcroftianum* (Wani *et al.*, 2012), *Piper longum* (Anu *et al.*, 2013), Orchids (Johnson & Janakiraman, 2013), *Justicia adhatoda* (Godghate & Sawant, 2013), *Juglans regia* (Ganesh *et al.*, 2013), *Asparagus racemosus* (Ravishankar *et al.*, 2012; Thenmozhi *et al.*, 2013), *Ricinus communis* (Vandita *et al.*, 2013),

*Justicia adhatoda* (Giri *et al.*, 2014), *Ricinus communis*, *Tinospora cordifolia* (Devi & Bhasker, 2014; Mishra *et al.*, 2014), *Pogostemon glaber* (Naise & Bhadange, 2014) the values in this study resembled very much. This finding, however, differed from some other studies. Unlike the observation that found absence of tannin in *Justicia adhatoda* (Arora, 2013), presence of tannin and shikimic acid in *Michelia doltsopa* (Geetha *et al.*, 2011), presence of carbohydrate, flavonoids, tannin and alkaloids in *Acorus calamus* (Saxena & Saxena, 2012), presence of saponins, tannin, steroid and flavonoids in *Urtica dioica* (Maobe, 2013) and the absence of tannin, terpenoids, flavonoids and alkaloids in *Ricinus communis* (Rao *et al.*, 2013), the present study observed the opposite.

Available literature on antioxidant activities and reducing power of medicinal plants (Ayoola *et al.*, 2008; Sharma *et al.*, 2009; Itodo *et al.*, 2010; Peteros & Uy, 2010; Roersch, 2010; Damodar, 2011; Sutharsingh *et al.*, 2011; Haque *et al.*, 2012; Loganayaki *et al.*, 2012; Rana & Sutee, 2012; Gargouri *et al.*, 2013; Khan *et al.*, 2013; Okach *et al.*, 2013) have suggested potential use of plants for regenerative biological activities such as antiapoptosis, antiaging, anticancerous, antiinflammation, antiatherosclerosis, cardiovascular protection and inhibition of angiogenesis and cell proliferation. The present study observed maximum presence of carbohydrate and phenol, but moderate presence of flavonoids and steroid in *Abies spectabilis* suggesting good presence of antioxidant. DPPH test revealed that *Abies spectabilis* contained high percentage inhibition compared with the standard (Ascorbic Acid) showing comparable relation of antioxidants activity with phenolic compound. This result, however, failed to corroborate the results observed by Tote *et al.* (2009).

Other studies have analyzed *Centella asiatica* and observed very high IC<sub>50</sub> value (Rahman *et al.*, 2012; Desai *et al.*, 2013), and scrutinized *Coelogyne nervosa* and found cytotoxic with IC<sub>50</sub> 126 µg/ml (Shibu *et al.*, 2013). Some studies have examined *in vitro* antioxidant activity of extracts from methanolic leaves and barks of four *Litsea* species extensively and reported that the extracts showed significant antioxidant properties and thus could serve as free radical inhibitors, acting possibly as primary antioxidants (Choudhury *et al.*, 2013). An assessment of Fazal *et al.* (2011) for DPPH free radical scavenging activity in medicinal plants used for herbal formulation indicated that *Acorus calamus* yielded (69.8 %) and *Rauvolfia serpentina* yielded (61.8%). The present study observed much less values of these plants.

The value for flavonoid compound from *Spiranthes sinensis* observed in this study resembled the finding of Liang *et al.* (2014) who found the plant to be a good inhibitor of tyrosinase activity. An excellent presence of flavonoid compounds in *S. sinensis*, as observed in the present study, could be beneficial to protect the human body against oxidative damage, both internally and externally.

Assessment of antioxidant activities of ethyl acetate extract from *Urtica dioica* in the present study suggested slightly different value compared with quite recent study (Ghaima *et al.*, 2013). Significant antioxidant activity of the methanol extract of *U. dioica* comparable to standard antioxidant compounds like  $\alpha$ -tocopherol, ascorbic acid and butylated hydroxyl anisole was also observed (Ghaima *et al.*, 2013). This activity may be due to significant presence of phenols and phenolics in *U. dioica*, as observed in this study.

The present study exhibited potent antioxidant activity of *Valeriana hardwickii* in comparison to that of ethanol, aqueous and petroleum ether extracts. This supports the finding of Sajad *et al.* (2014), who found that acetone and hexane extracts contain potent antioxidant activity. Total phenolic content in acetone extract was found to be 186  $\mu\text{g/ml}$  followed by hexane extracts having 175  $\mu\text{g/g}$  gallic acid equivalents. IC<sub>50</sub> value of acetone extract was found to be 15.60  $\mu\text{g/ml}$  followed by hexane extracts viz. 18.00  $\mu\text{g/ml}$  in DPPH radical scavenging assay (Sajad *et al.*, 2014).

Decrease in the absorbance of DPPH in the presence of antioxidants is correlated with the free radical scavenging potential of the antioxidant. The results indicated that the antioxidant activity of *Zanthomonas armatum* oil is lower than that of ascorbic acid. *Z. armatum* oil showed antioxidant activity with IC<sub>50</sub> value of  $27.0 \pm 0.1$   $\mu\text{g/ml}$  while IC<sub>50</sub> value for ascorbic acid was  $15.0 \pm 0.5$   $\mu\text{g/ml}$ . The antioxidant effectiveness of the essential oil is probably due to a relatively high content of bornyl acetate, cymene,  $\alpha$ -copaene,  $\gamma$ -terpinene, camphene,  $\beta$ -ocimene and linalool (Negi *et al.*, 2012, Kanwal *et al.*, 2015). Our results are in agreement with the above mentioned reports.

Phenolics and flavonoids are established to show antioxidant activity through their scavenging or chelating activity (Kessler *et al.*, 2003). The antioxidant activity, however, is not the sole property of phenolics; other compounds including vitamins C and E, carotenoids, and chlorophylls are also recognized to work in synergy with antioxidants (Rice-Evans *et al.*, 1995). Several other studies have reported a high correlation of phenolic content and antioxidant activity (Qusti *et al.*, 2010; Haque *et al.*, 2012). In the present analysis, *Piper longum*, *Camellia kissi*, *Benincasa hispida*, *Neolitsea pallens*, *Neopicrorhiza scrophulariiflora*, *Gaultheria fragrantissima*, *Ricinus communis*, *Taxus wallichiana*, *Valeriana jatamansii*, *Asparagus racemosus*, *Centella asiatica*, *Rubia manjith*, *Cuscuta reflexa*, *Nephrolepis auriculata*, *Abies spectabilis*, *Acampe papillosa*, *Zanthoxylum armatum*, *Acorus calamus*, *Swertia chirayita*, *Coelogyne corymbosa*, *Juglans regia*, *Sambucus adnata*, *Tinospora sinensis*, *Paris polyphylla*, *Bryophyllum pinnatum*, *Swertia angustifolia*, *Spiranthes sinensis*, *Zizyphus mauritiana*, *Dioscorea deltoidea*, *Zanthoxylum acanthopodium*, *Mahonia napaulensis*, *Mentha spicata*, *Indigofera bracteata*, *Litsea cubeba*, *Rauvolfia serpentina*,

and *Chlorophytum nepalense* showed higher antioxidant activity in correspondence with higher phenolic compounds. This relation indicated that high DPPH activity is related to the phenolic compounds in these plants.

### **6.21 Identification of new claims**

The present research identified new claims related to four major areas: the different varieties of medicinal plants, cross-cultural use, medicinal uses, and phytochemical value of the plants in the studied area. Reported ethnobotanical plant species were compared with the previous research works of Thapa (2012) and Bhattarai *et al.* (2011).

The current study documented 401 ethnobotanical plant species belonging to 289 genera under 114 botanical families (Table 17, 18 and 19). This finding was significant when compared with the previous studies. Thapa had recorded the use of 75 species of medicinal plants belonging to 46 families and 72 genera whereas Bhattarai *et al.* (2013) had found 45 plants species belonging to 32 families under 44 genera. The present study identified the use of 359 new plant species among the ethnic tribes. A total of 60 plants in the fact sheet published by the Department of Plant Resources under the category of threatened medicinal and aromatic plants in Nepal, 24 plant species were found in the studied area (Table 32). Similarly, among 30 plants in the fact sheet, 23 species were found to be listed in the category of medicinal plants prioritized for research and development (Table 28), and 10 plants in the group of medicinal plants prioritized for agro-technology development were reported in the studied area (Table 29). Similarly, 12 plant species were found in the category of protected plants of Nepal (2 plants in the category of banned for the collection, transportation and trade; 4 plants in the category of banned for export outside the country without processing; 5 plants banned for felling, transportation and export; 1 plant banned for export without identification and certification (Table 30). Importantly, 8 plant species listed under the category of Nepalese flora under CITES appendices were discovered during this study (Table 31). This showed that Parbat district is affluent with vast floristic diversity of ethnobotanical plants.

The use of 397 medicinal plants for diseases/ailments treatment revealed 114 different types of ailment. Previously, 39 ailments (Thapa, 2012) and 24 ailments (Bhattarai *et al.*, 2013) were found. Of the 114 ailments reported in this study, 72 are new (see the box below). Notably, the use of *Kalanchoe spathulata* to treat cancer and tuberculosis, *Bergenia ciliata* and *Persicaria runcinata* to treat heart problems, *Elaeocarpus sphaericus* to cure mental disorders, *Aster diplostephioides* used for the remedy of paralysis, *Datura stramonium* to heal rabies, *Mimosa pudica* to treat uric acid, *Bauhinia variegata* used as tonic and blood purifier, *Terminalia chebula* to administer eye problem, *Glycyrrhiza glabra* to treat genito-urinary diseases and scorpion stings, *Eryngium foetidum* to cure infertility complication were not observed for such uses by the tribes in the previous studies.

**New diseases: 72**

Abortification, Abscesses, Anaemia, Aphrodisiac, Appetizer, Asthma, Bee stings, Beriberi, Bladder stones, Blood pressure, Blood purification, Body pain, Cancer, Chest pain, Chicken pox, Colic pain, Convulsion (epileptic seizure), Cracks, Earache, Eczema, Epilepsy, Flatulence, Gonorrhoea, Gout, Gynaecological problems, Heart problems, Hemiplegia, Hemorrhage, Hepatitis, Hypertension, Hysteria (psychological), Ill waist, Indigestion, Infertility complication, Inflammation, Influenza, Insect bites, Intestinal diseases, Intestinal ulcer, Itches, Kidney problems, Leprosy, Liver disorders, Lungs problems, Malaria, Measles, Mental disorders, Mouth and tongue problems, Muscular pain, Nasal congestion, Nausea, Nervous Imbalance, Neuralgia, Nose bleeding, Paralysis, Peptic ulcer, Piles, Pimple problems, Pneumonia, Pregnancy, Proliferation, Rabies, Respiratory problems, Ringworm, Scorpion sting, Seminal weakness, Snakebites, Sore nipples, Sore throat, Sprains, Swellings, Syphilis, Tonic (weakness and dizziness), Uric acid, Urinary problems, and Vomiting.

A comparative study of the plant species use among the three ethnic communities showed: a) the use of multiple plant species for the treatment of the same diseases/ailments: *Pyrus pashia* and *Bauhinia vahlii*, for instance, were used to cure diarrhoea; b) the use of a single plant for different purpose: *Cassia fistula*, for example, was used to cure hematuria, diarrhoea and dysentery (*Gurung*), asthma, diabetes, eczema, abortification and gargling (*Magar*), skin disease, syphilis, sore throat, asthma, diabetes, eczema, abortification, scorpion stings and snake bites (*Majhi*); c) the use of the same plant for different diseases/ailments: *Mimosa pudica*, for instance, to administer uric acid, asthma, fever, cough, and piles (*Majhi*), uric acid, asthma, fever, cough, glandular swelling of children, kidney and urinary problem, and piles (*Magar*) and to treat piles (*Gurung*).

Proximate analysis of 40 wild edible species and phytochemical screening of 61 medicinal plants were determined. The plant species showed different level of presence of moisture, crude fiber, fat, starch, carbohydrate and protein. *Dioscorea alata* contained highest moisture ( $92.01 \pm 2.9$ ); *Nephrolepis auriculata* showed highest crude fiber content ( $19.5 \pm 2.1$ ); *Diplomenma butyracea* indicated highest fat percentage ( $7.2 \pm 0.2$ ); *Dioscorea alata* had highest starch content ( $11.25 \pm 1.9$ ); and carbohydrate content ( $22.35 \pm 2.1$ ); and *Ficus semicordata* had highest protein content ( $14.35 \pm 1.7$ ). The values of flavonoids, protein, carbohydrates, alkaloids, phenol, steroids, saponins, glycosides, steroid and terpenoids were determined. Flavonoids was found in sixteen plants, alkaloids in thirty one plants, phenolic contents in fifty three plants, saponin in forty three plants, and steroid in forty eight plants and glycosides in twenty six plants. Similarly, sixteen plants showed positive indication in Ninhydrin test, thirty three in Benedict's test, twenty seven in Salkowsakis test, seventeen in Shinoda test, and twenty eight in terpenoids test.

**Table 28** Medicinal plants prioritized for research and development

S.N.	Scientific Name	Family	Nepali Name
1.	<i>Acorus calamus</i> L.	Araceae	Bojho
2.	<i>Asparagus racemosus</i> Willd.	Asparagaceae	Satawari
3.	<i>Azadirachta indica</i> A. Juss	Meliaceae	Neem
4.	<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	Pakhanbed
5.	<i>Cinnamomum tamala</i> (Buch-Ham.) Nees & Eberm.	Lauraceae	Tejpat
6.	<i>Dactylorhiza hatagirea</i> (D. Don) Soo.	Orchidaceae	Panchaunle
7.	<i>Dioscorea deltoidea</i> Wall. ex Griseb	Dioscoreaceae	Bhayaakur
8.	<i>Gaultheria fragrantissima</i> Wall.	Ericaceae	Dhansingare
9.	<i>Juglans regia</i> L.	Juglandaceae	Okhar
10.	<i>Neopicrorhiza scrophulariiflora</i> (Pennell) D.Y. Hong	Scrophulariaceae	Kutaki
11.	<i>Phyllanthus emblica</i> L.	Euphorbiaceae	Amala
12.	<i>Piper longum</i> L.	Piperaceae	Pipla
13.	<i>Podophyllum hexandrum</i> Royle	Berberidaceae	Laghupatra
14.	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz.	Apocynaceae	Sarpagandhaa
15.	<i>Rheum australe</i> D. Don	Polygonaceae	Padamchaal
16.	<i>Rheum moorcroftianum</i> Royle	Polygonaceae	Padamchaal
17.	<i>Rubia manjith</i> Roxb.ex Flem.	Rubiaceae	Majitho
18.	<i>Sapindus mukorossi</i> Gaertn.	Sapindaceae	Reetha
19.	<i>Swertia chirayita</i> (Roxb.ex Fleming) Karsten	Gentianaceae	Chiraito
20.	<i>Taxus wallichiana</i> (Zucc.)	Taxaceae	Lothsalla
21.	<i>Tinospora sinensis</i> (Lour.) Merr.	Menispermaceae	Gurjo
22.	<i>Valeriana jatamansii</i> Jones	Valerianaceae	Sugandhawal
23.	<i>Zanthoxylum armatum</i> DC.	Rutaceae	Timur

**Table 29** Medicinal plants prioritized for agro-technology development

S.N.	Scientific Name	Family	Nepali Name
1.	<i>Asparagus racemosus</i> Willd.	Asparagaceae	Satawari
2.	<i>Dactylorhiza hatagirea</i> (D. Don) Soo.	Orchidaceae	Panchaunle
3.	<i>Neopicrorhiza scrophulariiflora</i> (Pennell) D.Y. Hong	Scrophulariaceae	Kutaki
4.	<i>Piper longum</i> L.	Piperaceae	Pipla
5.	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz.	Apocynaceae	Sarpagandhaa
6.	<i>Swertia chirayita</i> (Roxb. ex Fleming) Karsten	Gentianaceae	Chiraito
7.	<i>Taxus wallichiana</i> (Zucc.)	Taxaceae	Lothsalla
8.	<i>Tinospora sinensis</i> (Lour.) Merr.	Menispermaceae	Gurjo
9.	<i>Valeriana jatamansii</i> Jones	Valerianaceae	Sugandhawal
10.	<i>Zanthoxylum armatum</i> DC.	Rutaceae	Timur

**Table 30** Protected Plants of Nepal

## I. Banned for the collection, Transportation and Trade

S.N.	Scientific Name	Family	Nepali Name
1.	<i>Dactylorhiza hatagirea</i> (D. Don) Soo.	Orchidaceae	Panchaunle
2.	<i>Juglans regia</i> L.	Juglandaceae	Okhar

## II. Banned for export outside the country without processing (not applicable for cultivated products)

3.	<i>Abies spectabilis</i> (D. Don) Mirb.	Pinaceae	Bungasalla
4.	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz.	Apocynaceae	Sarpagandhaa
5.	<i>Taxus wallichiana</i> (Zucc.)	Taxaceae	Lothsalla
6.	<i>Valeriana jatamansii</i> Jones	Valerianaceae	Sugandhawal

### III. Banned for felling, transportation and export

7.	<i>Acacia catechu</i> (L. f.) Willd.	Mimosaceae	Khayar
8.	<i>Bombax ceiba</i> L.	Bombacaceae	Simal
9.	<i>Juglans regia</i> L.	Juglandaceae	Okhar
10	<i>Michelia champaca</i> L.	Magnoliaceae	Champ
11	<i>Shorea robusta</i> Gaertn.	Dipterocarpaceae	Sal

### IV. Banned for Export without identification & certification

1.	<i>Neopicrorhiza scrophulariiflora</i> (Pennell) D.Y. Hong	Scrophulariaceae	Kutaki
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**Table 31** Nepalese flora under CITES appendices

S.N.	Plants Species	Family	Nepali Name	Appendix
1.	<i>Ceropegia pubescens</i> Wall.	Asclepiadaceae	Ban semi	II
2.	<i>Dioscorea deltoidea</i> Wall. ex Griseb.	Dioscoreaceae	Bhayaakur	II
3.	<i>Meconopsis regia</i> G. Taylor	Papaveraceae	Kesar	III
4.	Orchidaceae (Orchids)	Orchidaceae	Sungava, Sunakhari	II
5.	<i>Podocarpus neriifolius</i> D. Don	Podocarpaceae	Gunsee	III
6.	<i>Podophyllum hexandrum</i> Royle	Berberidaceae	Laghupatra	II
7.	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz.	Apocynaceae	Sarpagandhaa	II
8.	<i>Taxus wallichiana</i> (Zucc.)	Taxaceae	Lothsalla	II

**Table 32** Threatened medicinal and aromatic plants in Nepal

S.N.	Plant Species	Family	Nepali Name	Threat Category	
				CAMP	IUCN
1.	<i>Acacia catechu</i> (L.f.) Willd.	Leguminosea	Khayar	-----	T
2.	<i>Allium hypsistum</i> Stearn	Alliaceae	Jimbu	V	-----
3.	<i>Arisaema costatum</i> (Wall.) Mart. ex Schott	Araceae	Banko	-----	-----
4.	<i>Asparagus racemosus</i> Willd.	Asparagaceae	Satawari	V	
5.	<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	Pakhanbed	-----	T
6.	<i>Corydalis megacalyx</i> Ludlow.	Papavaraceae	Bhutkesh	EN	-----
7.	<i>Crateva unilocularis</i> Buch.-Ham	Capparaceae	Sipleegaan	EN	R
8.	<i>Dactylorhiza hatagirea</i> (D. Don) Soo.	Orchidaceae	Panchaunle	EN	-----
9.	<i>Dioscorea deltoidea</i> Wall. ex Griseb	Dioscoreaceae	Bhayaakur	EN	T
10.	<i>Elaeocarpus sphaericus</i> (Gaertn.) K. Schum.	Elaeocarpaceae	Rudraksha	-----	V
11.	<i>Michelia champaca</i> L.	Magnoliaceae	Champ	CR	EN
12.	<i>Neopicrorhiza scrophulariiflora</i> (Pennell) D.Y. Hong	Scrophulariaceae	Kutaki	V	-----
13.	<i>Oroxylum indicum</i> (L.) Kurz.	Bigoniaceae	Talelo	EN	-----
14.	<i>Paris polyphylla</i> Sm.	Liliaceae	Satuwa	V	V
15.	<i>Piper longum</i> L.	Piperaceae	Pipla	V	-----
16.	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz.	Apocynaceae	Sarpagandhaa	CR	EN
17.	<i>Rheum australe</i> D. Don	Polygonaceae	Padamchaal	V	V
18.	<i>Rheum moorcroftianum</i> Royle	Polygonaceae	Padamchaal	NT	-----
19.	<i>Rubia manjith</i> Roxb. ex Flem.	Rubiaceae	Majitho	V	-----
20.	<i>Swertia angustifolia</i> Buch.–Ham. ex D. Don.	Gentianaceae	Chiraito	EN	-----
21.	<i>Swertia chirayita</i> (Roxb. ex Fleming) Karsten	Gentianaceae	Chiraito	V	V
22.	<i>Taxus wallichiana</i> (Zucc.)	Taxaceae	Lothsalla	EN	-----
23.	<i>Tinospora sinensis</i> (Lour.) Merr.	Menispermaceae	Gurjo	V	-----
24.	<i>Valeriana jatamansii</i> Jones.	Valerianaceae	Sugandhawal	V	-----

CR= Critically endangered, DD = Data deficient, EN =Endangered, K= Insufficiently known, NT= Nearly threatened, V= Vulnerable, R= Rare, T = Threatened, CAMP = Conservation Assament and Management Planing, IUCN= International Union for Conservation of Nature

## CHAPTER 7

### 7. CONCLUSIONS AND RECOMMENDATIONS

#### 7.1 CONCLUSIONS

The present research was set out to explore various aspects of ethnobotany in Parbat district of Nepal. The focus was on floristic composition, vegetation analysis, phytochemical analysis, ethnomedicinal uses, ethnodomestication, plant utilities for different purposes, cross-cultural pattern of uses, informants consensus factors ( $F_{IC}$ ) and fidelity level (FL) value of plant species. The study also examined superior/identical nutritional status of the plant species in terms of carbohydrate, starch, protein, fat and fiber contents. The findings contribute to the database of traditional indigenous knowledge of the plants in Parbat district. In particular, the information documented in this study may serve as baseline data for future studies on nutritional values and possible side effect, and to identify plants that can improve nutrition and increase dietary diversity in the study areas.

The district is observed to be rich in plant species used for a wide range of purposes. The use of ethnobotanical plants by the three ethnic communities means that the district substantially provides medicinal plants for traditional healing practice. Among the 401 reported plant species, 397 species are used to cure both human and veterinary diseases, 27 species for fish poisoning, and 33 species to cure 15 different types of veterinary diseases. Similarly, 24 plant species are reported to have specific antidotes to treat snake bites, scorpion stings, bee stings, insect bites and rabies.

In addition, the plants are found to have good food value. The available wild edible plant species play a significant role in the food and nutrient security of the ethnic communities of Parbat. The use of these plants as a major source of food is bound to increase when the stock of cultivated crops dwindles. These plants form a good source of protein, fat, vitamins, sugars, and minerals, and interestingly they are available in different months/seasons of the year. It can be concluded that the selected plants can contribute significantly to the nutrient requirements of the community and as a supplement to other major sources.

The plants also provide ecological security as they are disease resistance, grow in diverse climatic and habitat conditions, and ensure sufficient production despite adverse conditions. Studied wild plants can be incorporated in commercial crop plants and this might improve the economic condition of ethnic community. This might be strong motive for local people to conserve wild fruit

species and encourage their domestication as dryland agro-biodiversity and agroforestry; live fence and in area closure of pasture areas. It needs to be emphasized that it is necessary to investigate further into nutritional profiles, processing methods, cultivation techniques, conservational studies and pharmacological properties of the reported plant species. Such study can contribute to educate the ethnic people about their importance and improve food scarcity status. It suggests that the ethnic communities rely highly on the plant species not only for medicinal purpose but also for other purposes.

The ethnic people's understanding and the use of medicinal plants are found to ground on traditional beliefs. Knowledge transfer practice among the ethnic communities is reported to be received from parents and grandparents orally. Along with the family bound transfer of tradition, gender issue is reported to play significant role in the selection of successor, *i.e.*, male members are chosen to transfer their knowledge. The finding from cross-cultural study implies for stronger efficacy of certain taxa. Hence, the most urgent need is to record and institutionalize the indigenous knowledge in different ethnic communities on plant in the form of digitalization database before its extinction.

The medicinal plants are found to be put on use to treat 114 different types of diseases/ailments, categorized into 17 different illness groups. The use of multiple plants for a single ailment or a single plant species for multiple uses is observed. The highest numbers of species (98) are reported to administer in fever; and single species *Calotropis gigantea* is used to treat 16 diseases. Regarding the plant parts, leaves, roots/rhizomes/tubers, stems/barks/woods, fruits, whole plants, seeds, flowers, resins, corms, gums, inflorescences, needles and pods are reported to be the most commonly used plant parts. These parts are noted to be used in a variety of ways for remedy preparation: juice, paste decoction, powder, and infusion. These modes are prepared using hot and cold water as the solvent; but occasionally, other additives like milk, honey, oil and ghee are added. Various routes of administration are reported, very frequent of which are oral, external and topical/dermal/cosmetics, and nasal; the least being internal. The plants are used for various purposes such as medicinal purpose, fodder, human consumption, ornamental and ceremony, furniture, manure, fuelwood, fibers, fishpoisoning, fibers, musical and sports instruments, alcoholic beverages, art and artifacts, cosmetics, biofencing, dyes, soaps, incense, oil extraction, agricultural tools, bio-briquette, traditional ink, charcoal, insecticide. It is common among the healers to prescribe approximate and non-uniform allowing the patients to understand in their own sense. The dosages are observed to depend on disease types, duration of infection, and treatment method.

Other considerations are also taken into account: age groups, sex, and physical appearance of the patients.

A number of ethnomedicinal plants are observed to have absolute consensus among the three ethnic groups. Cancer had the greatest agreement with  $F_{IC}$  of 0.98, followed by cardiovascular (0.93), pediatric diseases (0.92), and gynaecological disorders (0.90) which shows the higher degree of agreement of the informant's knowledge about each category of ailments. *Centella asiatica*, used for Musculoskeletal and nervous system; *Crateva unilocularis*, used for cardiovascular disease; *Dactylorhiza hatagirea*, used for urinogenital and venereal ailments; *Swertia chirayita* used for cardiovascular diseases are found to have 100% fidelity. Other plants with more than 96% FL value include *Glycyrrhiza glabra* for urinogenital and venereal ailments, *Juglans regia* for musculoskeletal and nervous system, *Paris polyphylla* for gastro-intestinal, parasitic and hepatobiliary and *Taxus wallichiana* used for cancer respectively. Such a higher value suggests that the traditional knowledge is still effective.

The result pointed out the fact that wild edible species are significantly important in the life of ethnic people in Parbat district. Though the people have been using the edibles without having appropriate knowledge about nutritional composition of what they eat, the edible were found to have high value. The plants having rich nutritional status of carbohydrate, protein, starch, fat and fiber contents are *Morus australis*, *Dioscorea alata*, *Diplokenma butyracea*, *Nephrolepis auriculata*. It can be concluded that wild edible fruits have scope for their use as an alternative source of bio-nutrition. The potential outlined by the finding necessitates study of other edible species so as to identify promising species for inclusion in agro and farm-forestry, and reforestation programme which have so far focused only on timber species. Plantation of wild edible plants will ultimately improve food base for humans.

Phytochemical screening of methanolic extracts revealed the presence phenol, tannins, terpenoids, saponins, steroids, alkaloids. Results indicated that a number of plants are rich in phenolics and thus exhibited highest antioxidant and reducing activities. Total phenolic content had positive correlation with antioxidant capacity. It was observed that the leaf extract contain high level of phenolic content. The finding of this study suggests that plant leaves could be a potential source of natural antioxidant that can work as therapeutic agents in preventing or slowing down the progress of ageing and age associated oxidative stress related degenerative diseases. The results of preliminary qualitative phytochemical study showed the presence of flavonoids, protein and amino acids, carbohydrate, alkaloids, phenol, saponins, glycosides, steroid and terpenoids. Because, the plants have substantive phytochemical value, these plants can be potential source of new useful

drugs. Further research on anti-nutrients and antioxidants of wild species would be useful in selecting nutritious fruits from wild resources, analyzing phytochemical characterization of the extracts, and identifying bioactive compounds.

What is observed from the screening of phytochemical and antioxidant properties of 61 different plants is promising. First, the finding lends support to the folkloric uses of medicinal plant in traditional medicine. Second, it presents a strong case for some plants as a source of potential antioxidant which can be used in the treatment of various ailments. The methanolic extracts carry a number of compounds like flavonoids and triterpenes means that they are responsible for marked free radical scavenging potential. This could prove beneficial for future if the extracts are to be evaluated for analgesic activity. The scope for isolation of desired compound can be an advantageous step in field of drug discovery from natural sources. The abundance of secondary metabolites found in the studied plants suggest that they can contribute to a number of antioxidant purposes like antidiuretic, anti-inflammatory, antianalgesic, anticancer, anti-viral, anti-malarial, anti-bacterial and anti-fungal activities. They can be used in preventing or slowing the progress of ageing and age associated oxidative stress related degenerative diseases. The phytochemical properties identified by this study might be helpful in coping with different diseases in this region. Importantly, the analysis is also important for pharmaceuticals companies to formulate the new drugs.

The area is observed to have poor cultivation of valuable medicinal plants, and the ethnic groups collect the plants from the wild. In addition, as there is no practice of permanent storage, the villagers still maintain the practice of collecting fresh plants and using as per their requirements. This situation is highly likely to cause depletion of medicinal plant or even result into extinction from natural habitat. To preserve the plants, it is essential to establish medicinal gardens for *ex-situ* conservation by mobilizing the local ethnic people. Similarly, *in-situ* conservation will help highly usable and depleting species by propagating, and reintroducing them.

## 7.2 RECOMMENDATIONS

- The observation that certain taxa have higher value points to an urgent need is to record and institutionalize the indigenous knowledge in digital database. The pattern of ethnobotanical study can be further extended by taking into consideration a comparative study of the plant-uses existing among a specific group of ethnic community residing in different parts of the country.

- An appropriate conservation planning is essential to preserve the medicinal and aromatic plants in Parbat district. There is also a need to start research leading to the genetic improvement and manipulation through plant breeding, genetic engineering, and tissue culture on various wild edible species. Moreover, developing a best growth stage versus harvest calendar will help obtain the highest nutrient content available for different species as the nutritional quality of the edible parts of any species changes at different growth stages.
- To preserve the plants in natural habitat, it is essential to establish medicinal/herbal gardens for *ex-situ* and *in-situ* conservation by mobilizing the local ethnic people. Such establishments will help highly usable and depleting species by propagating, reintroducing, regularly monitoring and evaluating processes. Identifying the benefit and cost of conservation, and determining production systems for medicinal and aromatic plants (MAP) can help to decide whether plant species conservation should take place in nature or the nursery or both.
- Applications of the selected target plant as food supplement for human health care need to be evaluated; meantime, clinical trial, animal trial and ultimately human trial is essentially needed to commercialize various functional food and other herbal products.
- The preferred wild edible plants at community level should be given proper attention in the light of agrobiodiversity and agroforestry by complementing local knowledge and modern practices. If properly mobilized, this can enormously contribute to the ecological balance and economic resilience of people. It is, therefore, necessary to use the documented, nutritional, toxicity analysis of wild edible plants. Policy enhancement is recommended to properly utilize and manage the existing potential of wild edible plants.
- Reported medicinal plants need to be analyzed and investigated by fractionation of the extracts and then analysed for active compounds responsible for antioxidant, anti-alzheimer and antidiabetic, anticancerous. Experimental validation of these remedies may help in developing new drugs. This will be a great contribution for pharmaceutical and herbal industries in Nepal. It will also be worthwhile to study the anti-nutritional factors and toxicity of different edible plant parts. It will greatly enhance the existing knowledge about the nutritional values. Study about the lower group of plants which is not included in this study can further be researched as it also contains various medicinal properties.

- Based on the nutrition value observed in the plant species, food package for school children between 6-14 years can be prepared. The package of 100 g containing 15% protein, 25% fat, and 35% carbohydrate with 400 Kilocalories will help the children in the remote areas and places at higher altitude like Parbat to save from malnutrition. The consumption of these plants will help to meet the nutritional requirement of the children.
- The medicinal plants can be tracked through the establishment of barcoding database using plant DNA barcoding techniques; it will help to identify the specific medicinal plants and understand the ecology, evolution and conservation of the potent indigenous and endemic medicinal significant plants.