

Arshad Mehmood Abbasi · Mir Ajab Khan
Mushtaq Ahmad · Muhammad Zafar

Medicinal Plant Biodiversity of Lesser Himalayas–Pakistan

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Preface

Although medicinal plants have a rich history of utilization in all cultures, no one knows when or where plants first began to be used in the treatment of various ailments. From the very beginning of human existence, humans have familiarized themselves with plants and have used them in a variety of ways throughout the ages. Primitive humans began to distinguish those plants suitable for nutritional purpose from others with a definitive pharmacological action. This relationship has grown between plants and humans, and many plants have come to be used as drugs. Ethnobotany is the traditional knowledge of indigenous communities, about the surrounding plant diversity, and the study of how the people of a particular culture and region make use of indigenous plants. The Himalayan region is among the largest mountain systems of the world, with uncounted and unique medicinal plant resources. Interactions between humans and the natural system help in maintaining the richness of species, communities, and genetic materials on both productive and wild lands. The Lesser Himalaya range is an extension of the mighty Greater Himalayas. The Lesser Himalayas have a unique ecology, vegetation, and diversity of medicinal flora due to tremendous variations in the altitude, climate, and associated wildlife.

The utilization of medicinal plants in modern medicine suffers from the fact that although plants are used to cure diseases, scientific evidence in terms of modern medicine is lacking in many cases. Different societies use plants according to their own beliefs, knowledge, and previous experiences. Their knowledge about the use of the plants is usually not known to other societies or to scientists. These hidden areas need to be explored. This book provides a brief introduction to the Lesser Himalayas' ethnobotanical aspects, marketing, and anthropogenic pressure on medicinal flora. It comprises 100 medicinal plant species, including pteridophytes, gymnosperms, and angiosperms (monocots and dicots), along with their scientific descriptions and traditional uses.

We have tried to convey a maximum of knowledge regarding medicinal plant diversity in a minimum of words. There is always room for improvement. Readers are the best judges to evaluate this effort. We believe readers have a moral obligation to convey suggestions for our book's future improvement. It would be our greatest achievement if this book could attract students of botany, biodiversity, plant taxonomy, ethnobotany, and ecology, as well as wildlife naturalists, tourists, and others who have some lovely feeling for nature.

Islamabad, Pakistan

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Contents

1 Introduction: Lesser Himalayas—Pakistan and Medicinal Plant Wealth	1
1.1 Pakistan	1
1.1.1 Physical Regions	2
1.1.2 Biodiversity	2
1.1.3 Ecological Zones.....	2
1.1.4 Critical Ecosystems.....	3
1.2 Himalayan Range.....	3
1.2.1 Topography.....	5
1.2.2 Glaciers and Rivers	5
1.2.3 Climate	5
1.2.4 Flora	7
1.2.5 Fauna	8
1.2.6 Livestock	9
1.2.7 Culture.....	9
1.2.8 Occupations.....	9
1.3 Medicinal Plants.....	10
1.4 Folk Recipes.....	12
1.5 Diagnosis and Prescription	13
1.6 Processing of Medicinal Plants	13
1.6.1 Collection and Identification	13
1.6.2 Preservation.....	14
1.6.3 Storage.....	14
1.6.4 Marketing	14
References.....	14

2 Ethnobotanical Aspects	17
2.1 Ethnobotany	17
2.2 Medicinal Uses.....	20
2.3 Use of Plants as Food.....	21
2.4 Fuelwood Species	22
2.5 Fodder Species	24
2.6 Agricultural Implements	27
2.7 Fencing and Hedges.....	28
2.8 Construction Material	28
2.9 Miscellaneous Uses.....	28
2.10 Grafting.....	29
2.11 Beekeeping.....	29
2.12 Marketing of Medicinal Plants.....	30
2.13 Anthropogenic Pressure	32
2.13.1 Fire	32
2.13.2 Browsing	33
2.13.3 Grazing.....	33
2.13.4 Grass Cutting	34
2.13.5 Lopping	34
2.13.6 Torchwood	34
2.13.7 Climatic Factors	35
2.13.8 Wild Animals and Insects	35
2.13.9 Agriculture	35
2.14 Recommendations.....	36
References.....	37
3 Medicinal Plants Inventory	39
3.1 Section A Pteridophytes.....	39
3.1.1 <i>Adiantum capillus-veneris</i> Linn	39
3.1.2 <i>Equisetum debile</i> Roxb.....	41
3.1.3 <i>Pteridium aquilinum</i> (L.) Kuhn.....	43
3.2 Section B Gymnosperms.....	45
3.2.1 <i>Abies pindrow</i> Royle	45
3.2.2 <i>Pinus roxburghii</i> Sargent	47
3.2.3 <i>Pinus wallichiana</i> A.B. Jackson	48
3.3 Section C (1) Angiosperms (Monocots)	50
3.3.1 <i>Allium cepa</i> Linn.	50
3.3.2 <i>Allium sativum</i> Linn.	52
3.3.3 <i>Acorus calamus</i> L.....	53
3.3.4 <i>Arisaema utile</i> Hook.f.ex Schott	55
3.3.5 <i>Colchicum luteum</i> Baker	57
3.3.6 <i>Aloe vera</i> Linn.	59
3.3.7 <i>Cynodon dactylon</i> (L.) Pers.	60
3.3.8 <i>Cyperus rotundus</i> Linn.	61
3.3.9 <i>Polygonatum verticillatum</i> All.	64

3.3.10	<i>Sorghum halepense</i> (L.) Pers.	65
3.3.11	<i>Triticum aestivum</i> Linn.	67
3.3.12	<i>Zea mays</i> Linn.	69
3.4	Section C (2) Angiosperms (Dicots).....	71
3.4.1	<i>Acacia catechu</i> (L.F.) Wild.....	71
3.4.2	<i>Acacia modesta</i> Wall.	72
3.4.3	<i>Acacia nilotica</i> Linn.	74
3.4.4	<i>Achyranthes aspera</i> Linn.....	77
3.4.5	<i>Ajuga bracteosa</i> Wall., ex Benth.	79
3.4.6	<i>Amaranthus viridis</i> Linn.	80
3.4.7	<i>Argyrobolium roseum</i> (Camb.) Jaub. & Spach	82
3.4.8	<i>Berberis lycium</i> Royle	83
3.4.9	<i>Bergenia ciliata</i> (Haw.) Sternb.	86
3.4.10	<i>Boerhaavia procumbens</i> Banks ex Roxb.	87
3.4.11	<i>Bombax ceiba</i> Linn.	89
3.4.12	<i>Brassica campestris</i> Linn.	91
3.4.13	<i>Calotropis procera</i> (Wild) R. Br.	92
3.4.14	<i>Cannabis sativa</i> Linn.	94
3.4.15	<i>Carissa opaca</i> Stapf-ex Haines	96
3.4.16	<i>Cassia fistula</i> Linn.....	99
3.4.17	<i>Cedrela toona</i> Roxb. ex Wild.....	100
3.4.18	<i>Chenopodium ambrosioides</i> Linn.	102
3.4.19	<i>Cichorium intybus</i> Linn.	104
3.4.20	<i>Cissampelos pariera</i> L.	106
3.4.21	<i>Citrus limon</i> (Linn.) Burm.....	108
3.4.22	<i>Clematis grata</i> Wall.....	109
3.4.23	<i>Convolvulus arvensis</i> Linn.	111
3.4.24	<i>Cuscuta reflexa</i> Roxb.	112
3.4.25	<i>Dalbergia sissoo</i> Roxb.	114
3.4.26	<i>Datura innoxia</i> Miller	116
3.4.27	<i>Debregeasia saeneb</i> (Forssk.) Heper and Wood	117
3.4.28	<i>Dodonaea viscosa</i> Linn.	119
3.4.29	<i>Euphorbia prostrata</i> Ait	121
3.4.30	<i>Ficus carica</i> Forssk.	122
3.4.31	<i>Ficus virgata</i> Wall. ex Roxb.....	124
3.4.32	<i>Fumaria indica</i> (Hauskan) Pugsley.....	126
3.4.33	<i>Grewia tenax</i> Drum. ex Burret.....	127
3.4.34	<i>Hedera helix</i> Alin Auct.....	129
3.4.35	<i>Indigofera garadiana</i> Wall.	131
3.4.36	<i>Ipomoea nil</i> (Linn.) Roth.....	132
3.4.37	<i>Justicia adhatoda</i> (Linn.) Nees	134
3.4.38	<i>Mallotus philippensis</i> (Lam.) Muell. Arg.	137
3.4.39	<i>Melia azedarach</i> Linn.	139
3.4.40	<i>Mentha longifolia</i> (Linn.) Huds	141
3.4.41	<i>Mentha royleana</i> Linn.	143

3.4.42	<i>Myrsine africana</i> Linn.....	145
3.4.43	<i>Olea ferruginea</i> Royle.....	147
3.4.44	<i>Otostegia limbata</i> (Benth.) Boiss	148
3.4.45	<i>Oxalis corniculata</i> Linn.	150
3.4.46	<i>Paeonia emodi</i> Wall. ex Royle.....	152
3.4.47	<i>Papaver somniferum</i> L.	153
3.4.48	<i>Phyla nodiflora</i> (L.) Greene	155
3.4.49	<i>Phyllanthus emblica</i> Linn.	156
3.4.50	<i>Pimpinella diversifolia</i> (Wall.) D.C.	158
3.4.51	<i>Pistacia chinensis</i> Bge.	160
3.4.52	<i>Plantago lanceolata</i> L.....	162
3.4.53	<i>Plantago major</i> Linn.	163
3.4.54	<i>Portulaca oleracea</i> L.....	165
3.4.55	<i>Prunus persica</i> (Linn.) Batsch	166
3.4.56	<i>Punica granatum</i> Linn.	168
3.4.57	<i>Quercus incana</i> Roxb.	171
3.4.58	<i>Quercus leucotrichophora</i> A. Camus	172
3.4.59	<i>Ranunculus laetus</i> Wall. ex Hook. F. & Thoms.	174
3.4.60	<i>Rhus chinensi</i> L.	175
3.4.61	<i>Rosa brunonii</i> Lindley.....	178
3.4.62	<i>Rosa indica</i> Linn.	179
3.4.63	<i>Rumex dentatus</i> Linn.....	180
3.4.64	<i>Rumex hastatus</i> D. Don.....	182
3.4.65	<i>Salvia moorcroftiana</i> Wall. ex Benth.....	184
3.4.66	<i>Sageretia brandrethiana</i> Atich., J.L.S.	185
3.4.67	<i>Solanum nigrum</i> L.....	187
3.4.68	<i>Solanum surratense</i> Burm. f.....	189
3.4.69	<i>Tagetes minuta</i> Linn.	190
3.4.70	<i>Taraxacum officinale</i> Weber.....	192
3.4.71	<i>Tribulus terrestris</i> L.....	193
3.4.72	<i>Trichodesma indicum</i> (L.) R. Br.	195
3.4.73	<i>Tylophora hirsuta</i> Linn.....	197
3.4.74	<i>Verbascum thapsus</i> Linn.	198
3.4.75	<i>Viola canescens</i> Wall. ex Roxb.	199
3.4.76	<i>Vitex negundo</i> Linn.....	201
3.4.77	<i>Vitis vinifera</i> Linn.....	203
3.4.78	<i>Withania somnifera</i> (L.) Dunal	204
3.4.79	<i>Woodfordia fruticosa</i> (L.) S. kurz.....	206
3.4.80	<i>Zanthoxylum armatum</i> DC. Prodr.....	208
3.4.81	<i>Zizyphus numalaria</i> Linn.	209
3.4.82	<i>Zizyphus oxyphylla</i> Edgew.	211
	References.....	213
	Index	217

List of Figures

Fig. 1.1	A panoramic view of Pakistan Himalayas.....	4
Fig. 1.2	Amazing Saiful Malook Lake	6
Fig. 1.3	Hydrology and <i>Pinus</i> vegetation	6
Fig. 1.4	Floral diversity.....	8
Fig. 1.5	Fauna and flora	9
Fig. 1.6	Collection of medicinal plants.....	13
Fig. 2.1	A delicious wild fruit.....	22
Fig. 2.2	Wild <i>Pyrus</i> verity.....	22
Fig. 2.3	Fuel wood	24
Fig. 2.4	Fodder for live stock.....	25
Fig. 2.5	Wood for construction purpose	27
Fig. 2.6	Apiculturing.....	29
Fig. 2.7	A local herbal dealer.....	31
Fig. 2.8	Himalayan nomads	33
Fig. 2.9	Grazing pressure.....	34
Fig. 2.10	Torch wood extraction	35
Fig. 3.1	<i>Adiantum capillus-veneris</i> Linn	40
Fig. 3.2	<i>Equisetum debile</i> Roxb.....	42
Fig. 3.3	<i>Pteridium equilinium</i> (L.)	44
Fig. 3.4	<i>Abies pindrow</i> Royle.....	46
Fig. 3.5	<i>Pinus roxburgii</i> Sargent	47
Fig. 3.6	<i>Pinus wallichiana</i> (L.).....	49
Fig. 3.7	<i>Allium cepa</i> Linn	50
Fig. 3.8	<i>Allium sativum</i> Linn	52
Fig. 3.9	<i>Acorus calamus</i> L.....	54
Fig. 3.10	<i>Arisaema utile</i> Hook.f.ex Schott	56
Fig. 3.11	<i>Colchicum luteum</i> Baker	58
Fig. 3.12	<i>Aloe vera</i> L	59
Fig. 3.13	<i>Cynodon dactylon</i> (L.) Pers.....	62
Fig. 3.14	<i>Cyperus rotundus</i> Linn	63

Fig. 3.15	<i>Polygonatum verticillatum</i> All	65
Fig. 3.16	<i>Sorghum halepense</i> (L.) Pers.....	66
Fig. 3.17	<i>Triticum aestivum</i> Linn.....	68
Fig. 3.18	<i>Zea mays</i> Linn	70
Fig. 3.19	<i>Acacia catechu</i> (L.F) Willd	72
Fig. 3.20	<i>Acacia modesta</i> Wall	73
Fig. 3.21	<i>Acacia nilotica</i> Linn	75
Fig. 3.22	<i>Achyranthes aspera</i> Linn.....	78
Fig. 3.23	<i>Ajuga bracteosa</i> Wall. ex Benth	79
Fig. 3.24	<i>Amaranthus viridus</i> Linn.....	81
Fig. 3.25	<i>Argyrolobium roseum</i> (Camb.) Jaub & Spach	83
Fig. 3.26	<i>Berberis lycium</i> Royle	84
Fig. 3.27	<i>Bergenia ciliata</i> (Haw) Stemb.....	86
Fig. 3.28	<i>Boerhaavia procumbens</i> Benks. ex Roxb.....	88
Fig. 3.29	<i>Bombax ceiba</i> Linn.....	89
Fig. 3.30	<i>Brassica campestris</i> Linn	91
Fig. 3.31	<i>Calotropis procera</i> (Wild) R. Br	93
Fig. 3.32	<i>Cannabis sativa</i> Linn.....	95
Fig. 3.33	<i>Carrisa opaca</i> Stapf. ex Haines.....	97
Fig. 3.34	<i>Cassia fistula</i> Linn.....	99
Fig. 3.35	<i>Cedrela toona</i> Roxb. ex Willd	101
Fig. 3.36	<i>Chenopodium ambrosioides</i> Linn.....	103
Fig. 3.37	<i>Cichorium intybus</i> Linn.....	105
Fig. 3.38	<i>Cissampelos pariera</i> Linn	107
Fig. 3.39	<i>Citrus limon</i> (Linn.) Brum.....	108
Fig. 3.40	<i>Clematis grata</i> Wall.....	110
Fig. 3.41	<i>Convolvulus arvensis</i> Linn	112
Fig. 3.42	<i>Cuscuta reflexa</i> Roxb.....	113
Fig. 3.43	<i>Dalbergia sissoo</i> Roxb	115
Fig. 3.44	<i>Datura innoxia</i> Miller.....	117
Fig. 3.45	<i>Debregeasia saeneb</i> (Forssk) Heper and Wood.....	118
Fig. 3.46	<i>Dodonaea viscosa</i> Linn	120
Fig. 3.47	<i>Euphorbia prostrata</i> Ait	122
Fig. 3.48	<i>Ficus carica</i> Forssk.....	123
Fig. 3.49	<i>Ficus varigata</i> Wall. ex Roxb.....	124
Fig. 3.50	<i>Fumaria indica</i> (Hausskan) Pugsley	126
Fig. 3.51	<i>Grewia tenex</i> Drum. ex Burret.....	128
Fig. 3.52	<i>Hedra helix</i> Alin Auct	130
Fig. 3.53	<i>Indigofera garadiana</i> Wall	132
Fig. 3.54	<i>Ipomoea nil</i> (Linn.) Roth.....	133
Fig. 3.55	<i>Justicia adhatoda</i> (Linn.) Nees	135
Fig. 3.56	<i>Mallotus philippensis</i> (Lam) Muell. Arg.....	138
Fig. 3.57	<i>Melia azedrach</i> Linn.....	140
Fig. 3.58	<i>Mentha longifolia</i> (Linn), Huds.....	142
Fig. 3.59	<i>Mentha royleana</i> Linn	144

Fig. 3.60	<i>Myrsine africana</i> Linn.....	145
Fig. 3.61	<i>Olea ferruginea</i> Royle.....	148
Fig. 3.62	<i>Otostegia limbata</i> (Benth), Boiss	149
Fig. 3.63	<i>Oxalis corniculata</i> Linn.....	151
Fig. 3.64	<i>Paeonia emodi</i> Wall. ex Royle.....	153
Fig. 3.65	<i>Papaver somniferum</i> L	154
Fig. 3.66	<i>Phyla nodiflora</i> (L.) Greene	156
Fig. 3.67	<i>Phyllanthus emblica</i> Linn.....	157
Fig. 3.68	<i>Piminella diversifolia</i> (Wall) D.C.....	159
Fig. 3.69	<i>Pistacia chinensis</i> Bge.....	160
Fig. 3.70	<i>Plantago lanceolata</i> L.....	162
Fig. 3.71	<i>Plantago major</i> Linn	164
Fig. 3.72	<i>Partulaca oleracea</i> L.....	165
Fig. 3.73	<i>Prunus persica</i> (Linn.) Batsch.....	167
Fig. 3.74	<i>Punica granatum</i> Linn.....	169
Fig. 3.75	<i>Quercus incana</i> Roxb	171
Fig. 3.76	<i>Quercus leucotrichophora</i> A. Camus.....	173
Fig. 3.77	<i>Ranunculus laetus</i> Wall. ex Hook. F & Thoms	175
Fig. 3.78	<i>Rhus chinensis</i> L.....	176
Fig. 3.79	<i>Rosa brunonii</i> Lindley.....	178
Fig. 3.80	<i>Rosa indica</i> Linn	180
Fig. 3.81	<i>Rumex dentatus</i> Linn	181
Fig. 3.82	<i>Rumex hastatus</i> D. Don	183
Fig. 3.83	<i>Salvia moorcroftiana</i> Wall. ex Benth.....	185
Fig. 3.84	<i>Sageretia brandrethiana</i> Atich., J.L.S.....	186
Fig. 3.85	<i>Solanum nigrum</i> L.....	188
Fig. 3.86	<i>Solanum surratense</i> Burm, f.....	189
Fig. 3.87	<i>Tagetes minuta</i> Linn	191
Fig. 3.88	<i>Taraxacum officinale</i> Webber.....	192
Fig. 3.89	<i>Tribulus terrestris</i> L.....	194
Fig. 3.90	<i>Trichodesma indicum</i> (L.) R. Br.....	196
Fig. 3.91	<i>Tylophora hirsuta</i> Linn.....	197
Fig. 3.92	<i>Verbescum thapsus</i> Linn.....	199
Fig. 3.93	<i>Viola canescens</i> Wall. ex Roxb.....	200
Fig. 3.94	<i>Vitex negundo</i> Linn	202
Fig. 3.95	<i>Vitis vinifera</i> Linn	203
Fig. 3.96	<i>Withania somnifera</i> (L.) Dunal.....	205
Fig. 3.97	<i>Woodfordia fruticosa</i> (L.) S. Kurz.....	206
Fig. 3.98	<i>Zanthoxylum armatum</i> DC. Prodor	208
Fig. 3.99	<i>Zizyphus numalaria</i> Linn.....	210
Fig. 3.100	<i>Zizyphus oxyphylla</i> Edgew	212

Chapter 1

Introduction: Lesser Himalayas—Pakistan and Medicinal Plant Wealth

Abstract The Himalaya Range is a mountain range in Asia, separating the Indian subcontinent from the Tibetan Plateau. It is the name of a massive mountain system that includes the Karakoram, the Hindu Kush, and other lesser ranges that extend out from the Pamir Knot. The Himalayan mountain system is the planet's highest mountain range and home to the world's highest peaks. The Pakistani Himalayas are located south and east of the Indus River, which originates close to the holy mountain of Kailash in western Tibet, marking the range's true western frontier. The Lesser Himalayas are a prominent range 2,000–3,000 m (6,600–9,800 ft) high formed along the Main Boundary Thrust fault zone, with a steep southern face and gentler northern slopes. These Himalayas lie north of the Sub-Himalayan Range or Siwalik Range and south of the Great Himalayas. The Lesser Himalayan range is one of the unique emporiums of medicinal plant diversity. The most commonly utilized plant species are *Berberis lyceum*, *Bergenia ciliate*, *Cassia fistula*, *Cichorium intybus*, *Datura innoxia*, *Justicia adhatoda*, *Mallotus philippensis*, *Melia azedarach*, *Mentha longifolia*, *Mentha royleana*, *Myrsine africana*, *Punica granatum*, *Solanum nigrum*, *Viola canescens*, and *Zanthoxylum armatum*.

Keywords Climate • Flora and fauna • Folk recipes • Hydrology • Lesser Himalayas—Pakistan • Medicinal plant processing

1.1 Pakistan

Pakistan stretches from the Arabian Sea to the high mountains of Central Asia and covers an area of 803,944 km². It lies approximately between 24° and 37° north latitude, and between 61° and 78° east longitude. It neighbors Iran to the west,

Afghanistan to the north, China to the northeast, and India to the east and southeast along a 2,000-km, partially contested border. There is a 1,000-km coastline along the Arabian Sea.

1.1.1 Physical Regions

Pakistan can be divided physiographically into four regions:

1. The great highlands
2. The Balochistan Plateau
3. The Indus Plain
4. The desert areas

The Himalayan and the trans-Himalayan mountain ranges, rising to an average elevation of more than 6,000 m and including some of the world's highest peaks, such as K2 (8,611 m) and Nanga Parbat (8,126 m), make up the great highlands that occupy the northernmost part of the country. The Balochistan Plateau, a broken highland region about 300 m in elevation with many ridges crossing it from northeast to southwest, occupies the western and southwestern sectors of the country. The Indus Plain, the most prosperous agricultural region of Pakistan, covers an area of 520,000 km² in the east and extends to 1,100 km from northern Pakistan southward to the Arabian Sea. In the southeast are the desert areas.

1.1.2 Biodiversity

Pakistan has 225 Protected Areas (PAs), 14 national parks, 99 wildlife sanctuaries, and 96 game reserves. It is a land of rapidly shrinking wetlands, some of them of international significance, of wondrous juniper forests, of minute life forms that buzz their way to a magical existence, of stunning mountains, and much more. Pakistan covers a number of the world's ecoregions, ranging from the mangrove forests stretching from the Arabian Sea to the towering mountains of the western Himalayas, Hindu Kush and Karakoram. The country lies at the western end of the South Asian subcontinent, and its flora and fauna are composed of a blend of Palearctic and Indomalayan elements, with some groups also containing forms from the Ethiopian region.

1.1.3 Ecological Zones

Pakistan is divided into nine major ecological zones. The World Wildlife Fund–Pakistan (WWF-P) is working to conserve the environment through its Target Driven Programmes (TDPs), which address issues pertaining to samples of forest,

freshwater, marine ecosystems, species, toxics, and climate change. The emphasis is on conserving representative sites of ecologically important areas within these Target Driven Programmes. Conservation of desert ecosystems is included under forests. In most of its projects, WWF-P supports local community initiatives to conserve natural resources and helps look for ways to improve community livelihoods. Almost all conservation projects have the following common features and priorities: partnership with local bodies and capacity building at all levels from local communities to government bodies.

1.1.4 Critical Ecosystems

Under the WWF's Global 200 initiative, ecosystems have been ranked to carry out conservation through comparative analyses. It covers all habitats on land masses and in the oceans. The Earth has been divided into 238 ecoregions by the United Nations, the National Geographic Society, and the WWF. Five of these ecosystems are in Pakistan. The Global ecoregions of Pakistan are

1. The Rann of Kunth grasslands
2. The Tibetan Plateau
3. The Western Himalayan Temperate Forests
4. The Indus Delta ecosystem
5. The Arabian Sea

1.2 Himalayan Range

The Himalaya Range, or the Himalayas, is a mountain range in Asia separating the Indian subcontinent from the Tibetan Plateau. It is also the name of a massive mountain system that includes the Karakoram, the Hindu Kush, and other, lesser, ranges that extend out from the Pamir Knot. The Himalayan mountain system is the planet's highest and is home to the world's highest peaks, the eight-thousanders, which include Mount Everest and K2. The main Himalaya range runs, west to east, from the Indus river valley to the Brahmaputra river valley, forming an arc 2,400 km long, which varies in width from 400 km in the western Kashmir–Xinjiang region to 150 km in the eastern Tibet–Arunachal Pradesh region.

The Pakistani Himalayas are located south and east of the Indus River, which originates close to the holy mountain of Kailash in western Tibet, marking the range's true western frontier. The river enters Pakistan from India, flowing northwest to Skardu. It then continues on this bearing and is joined by the Hunza River south of Gilgit. From here it flows south and west, eventually flowing from the Himalayan foothills onto the Indian planes. The Himalayas are a totally separate range from the Karakoram, which run parallel to the north. The Himalayas in Pakistan are green and fertile as compared



Fig. 1.1 A panoramic view of Pakistan Himalayas

to the arid Karakoram and Hindu Kush further north. The Himalayas have a considerably higher precipitation level during the monsoon months, creating an environment for rich pine forests and grassy meadows that more closely resemble Canada or Kyrgyzstan than the Karakoram Mountains. The Himalayas are spread across three of Pakistan's provinces. The northern area encompasses the Nanga Parbat massif and its surrounding valleys, Azad Jammu, and Kashmir. The extreme southeast corner of the North-West Frontier Province (Pakhtoonkhawa) includes portions of the Lesser Himalayas, also known as the Middle Himalayas. As with the rest of the country, the region has a strong Muslim identity. Most residents are Sunnis, with some Shi'as in the Astor Valley's upper tributaries. Languages spoken include Shina, Pashto, Hindko, and Kohistani; however, nearly everybody also speaks Urdu. The region south of the Gilgit represents diverse ethnicities and cultures, making it interesting to visit for this reason alone (Fig. 1.1).

The Lesser Himalayas are a prominent range 2,000–3,000 m (6,600–9,800 ft) high formed along the Main Boundary Thrust fault zone, with a steep southern face and gentler northern slopes. These Himalayas lie north of the Sub-Himalayan Range or Siwalik Range and south of the Great Himalayas. They are nearly continuous except for river gorges, where rivers from the north gather like candelabra in a handful of places to break through the range. In Pakistan these mountains lie just north of Rawalpindi district, covering the districts of Batagram, Mansehra,

and Abbottabad as well as Pakistan Administered Kashmir. These mountains are also home to Pakistan's important hill stations, including Murree, Ghora Gali, and Nathia Gali. It snows during a few months of the year, but no glaciers are found in this region.

1.2.1 Topography

The Himalayas are among the youngest mountain ranges on the planet and consist mostly of uplifted sedimentary and metamorphic rock. According to the modern theory of plate tectonics, their formation is a result of a continental collision or progeny along the convergent boundary between the Indo-Australian Plate and the Eurasian Plate. Such a formation is referred to as a "fold mountain." The Pakistani Himalayas were formed as a result of the collision of the Indian subcontinent with Asia. This process of plate tectonics is ongoing, and the gradual northward drift of the Indian subcontinent still causes earthquakes. Nanga Parbat stands on the southern tectonic plate, while Rakaposhi stands on the northern plate with the Indus River dividing the two. While the Himalayas formed relatively slowly, the Karakoram were rapidly pushed upwards, resulting in their comparatively dense topography.

1.2.2 Glaciers and Rivers

The Himalayan range encompasses about 15,000 glaciers, which store about 12,000 km³ of freshwater. The 70-km-long Siachen Glacier at the India–Pakistan border is the second-longest glacier in the world outside the polar region. Some of the other more famous glaciers include the Gangotri and Yamunotri (Uttarakhand), Nubra, Biafo, and Baltoro (Karakoram region), Zemu (Sikkim), and Khumbu glaciers (Mount Everest region). Some of the world's major rivers, including the Ganges, Indus, Brahmaputra, Yangtze, Mekong, Salween, Red River (Asia), Xunjiang, Chao Phraya, Irrawaddy River, Amu Darya, Syr Darya, Tarim River, and Yellow River, rise in the Himalayas. Their combined drainage basin is home to some 3 billion people in countries including Afghanistan, Bangladesh, Bhutan, People's Republic of China, India, Nepal, Burma, Cambodia, Tajikistan, Uzbekistan, Turkmenistan, Kazakhstan, Kyrgyzstan, Thailand, Laos, Vietnam, Malaysia, and Pakistan (Figs. 1.2 and 1.3).

1.2.3 Climate

The climate of the Himalayas ranges from tropical at the base of the mountains to permanent ice and snow at the highest elevations. The amount of yearly rainfall increases from west to east along the front of the range. This diversity of climate,



Fig. 1.2 Amazing Saiful Malook Lake



Fig. 1.3 Hydrology and *Pinus* vegetation

altitude, rainfall, and soil conditions generates a variety of distinct plant and animal communities. On the Indo-Gangetic plain at the base of the mountains, an alluvial plain drained by the Indus and Ganga-Brahmaputra river systems, vegetation varies from west to east with rainfall. The xeric Northwestern thorn scrub forests occupy the plains of Pakistan and the Indian Punjab. Further east lie the Upper Gangetic plains moist deciduous forests of Uttarakhand and Uttar Pradesh and the Lower Gangetic plains moist deciduous forests of Bihar and West Bengal. These are monsoon forests, with drought-deciduous trees that lose their leaves during the dry season.

1.2.4 Flora

The flora of the Himalayas varies with climate, rainfall, altitude, and soils and includes elements from tropical Indochina, temperate East Asia, the Palearctic region, the Deccan Plateau and the low-lying areas along with the support of mixed evergreen forests. Although most of these semi-evergreen forests have long since been converted into human uses, vestigial patches appear mostly in small protected areas. The alluvial grasslands and savannas along the foothill valleys are among the tallest in the world. Characteristic species in these highly productive grasslands include *Saccharum spontaneum*, *Phragmites kharka*, *Arundo donax*, *Imperata cylindrica*, *Erianthus ravennae*, *Andropogon* spp., and *Aristida ascensionis*. The lower hill slopes above 1,000 m are cooler and less drought-stressed. These areas are dominated by subtropical evergreen broadleaf forests. The eastern Himalayas' temperate forests are dominated by evergreen broadleaf trees and mixed conifers (e.g., *Quercus*, *Lauraceae*, *Tsuga*, *Taxus*) in the lower reaches and winter-deciduous broadleaf species (e.g., *Acer*, *Betula*, *Magnolia*) in the upper reaches. The drier, south-facing slopes support extensive stands of arboreal *Rhododendron* species that may co-occur with oak (*Quercus semecarpifolia*) or other ericaceous species such as *Lyonia ovalifolia*. These temperate forests support a rich epiphytic community, consisting of a variety of dicots, orchids, ferns, and mosses. Bamboo (*Arundinaria* spp.) is dominant in the unexploited places, especially where it provides early-successional ground cover following fire. Subalpine conifer forests begin from about 3,000 m and extend to 4,000 m. In the eastern Himalayas, *Tsuga*, *Picea*, or *Larix* dominate these forests between 3,000 and 3,500 m and *Abies* dominates above 3,500 m. Junipers are widespread along the timberline and may form dwarf krummoltz formations above 4,700 m. The dry slopes and inner valleys support *Pinus* and *Cupressus* on basic limestone soils. Above the tree line, the vegetation is a moist alpine scrub community of dense juniper and *Rhododendron* shrubberies that extend to about 4,500 m. From 4,500 to 4,700 m, the vegetation consists of alpine meadows with a diverse assemblage of alpine herbs and smaller-stature woody shrubs, such as a variety of dwarf *Rhododendrons*, and numerous alpine herbs such as *Potentilla*, *Ranunculus*, and the alpine *Saussure* species. Periglacial and subnival communities occur in the high alpine areas above 4,700 m, where the short growing



Fig. 1.4 Floral diversity

season, high winds, and unstable soils allow only specialized plants to survive. Some of the common genera found here are *Androsace*, *Arenaria*, *Saxifraga*, *Meconopsis*, and *Primula* (Fig. 1.4).

1.2.5 Fauna

Knowledge of the fauna of the eastern Himalayas region is poor. Most of the information available is on the larger vertebrates that are easily observed and inventoried. Overall, more than 175 species of mammals and in excess of 500 species of birds are known from the region. The mammalian fauna in the lowlands is typically Indo-Malayan, consisting of langurs (*Semenopithicus* spp.), golden langur (*Trachypithecus geei*), pygmy hog (*Sus salvinus*), hispid hare (*Caprolagus hispidus*), flying squirrel (*Biswamoyopterus biswasi*), wild dogs (*Cuon alpinus*), sloth bear (*Melursus ursinus*), gaur, and several species of deer such as muntjacs (*Muntiacus muntjak*) and sambar (*Cervus unicolor*), snow leopards, Asiatic black bear (*Ursus thibetinus*), blue sheep (*Pseudois nayur*), takin (*Budorcas taxicolor*), Himalayan tahr (*Hemitragus jemlahicus*), and red panda (*Ailurus fulgens*). Some species of birds restricted to the region include the Manipur bush quail (*Perdica manipurensis*), chestnut-breasted partridge (*Arborophila mandelli*), Blyth's tragopan (*Tragopan blythii*), Temminck's tragopan (*Tragopan temminckii*), Selater's monal (*Lophophorus sclateri*), Tibetan eared pheasant (*Crossoptilon harmani*), rusty-bellied shortwing (*Brachypteryx hyperythra*), white-winged duck (*Cairina scutulata*), white-bellied heron (*Ardea insignis*), black-necked stork (*Grus nigricollis*), and Bengal florican (*Houbaropsis bengalensis*) (Fig. 1.5).

Fig. 1.5 Fauna and flora

1.2.6 Livestock

Cattle, goats, sheep, buffalo, camels, ass, horses, mules, and domestic poultry are common livestock of the range.

1.2.7 Culture

Although the young generation is fond of modern culture, religious bonds are very strong and the majority of the population prefers Islamic traditions and follows the path of Allah. Islamic traditions stand out in the area. People generally wear *shalwar qameez* with a blanket or coarse chador during winter season. Chapple and shoes are common footwear. The use of ornaments among females is also common in the area. Women adorn themselves with earrings and bangles.

1.2.8 Occupations

The majority of the population depends on agriculture for their subsistence, but the income from agriculture is too meager to meet the population's needs. Many local residents have left the country in order to earn more money, and others have migrated to different parts of the country. In addition to agriculture and business, all sorts of occupations are available here, including cobbler, blacksmith, weaver, carpenter, barber, and day laborer. The people do government/military work on the top of their independent private jobs.