Chapter 5
Species Diversity and Use Patterns of the Alpine Flora with Special Reference to Climate Change in the Naran, Pakistan

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5.1 Introduction

This chapter provides an introduction to the study area and its main physiographic and floristic features with reference to present vegetation study and sampling locations. The various mountain ranges that are collectively known as the Himalayas stretch for some 2500 km across five central Asian countries and comprise one of the earth's most complex, diverse and remarkable biomes, characterized by a comparatively harsh climate, a strong degree of resource seasonality and diversity of both plant species and communities (Kala and Mathur 2002; Oommen and Shanker 2005). Existing in the range of world's largest mountain ranges, north-western Pakistan is one of the places having high phytogeographic and floristic importance. Due to their location, rugged landscapes and critical geopolitical situation, however, many of the more remote mountainous valleys in this region have not yet undergone detailed vegetation studies. Furthermore, most of the botanical accounts that have been published comprise qualitative data without proper quantification (Dickoré and Nüsser 2000; Ahmad et al. 2009; Signorini et al. 2009; Khan et al. 2013a; Khan 2013). Far less effort has been made to provide quantitative descriptions of the plant communities along geo-climatic, environmental gradients in order to elucidate the main determinants of local or regional vegetation patterns (Dasti et al. 2007; Malik and Husain 2008; Wazir et al. 2008; Saima et al. 2009; Khan et al. 2011; Khan et al. 2013b).

The Naran is a mountainous valley in the western Himalayas situated in Pakistan, some 270 km from the capital, Islamabad (34°54.26′ N to 35°08.76′N latitude and 73°38.90′ E to 74°01.30′ E longitude; elevation range 2450–5000 m above mean sea level). The entire area is formed by crosswise ridges of mountains on either side of the river Kunhar which flows in a north-east to south-west direction down the

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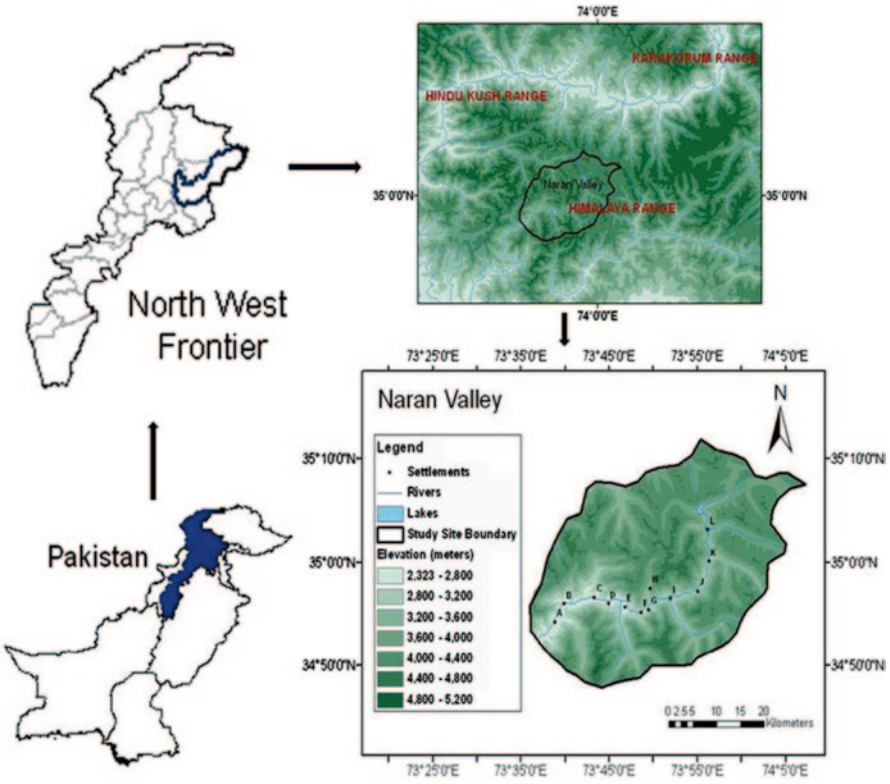

Fig. 5.1 Maps showing the location of the project area, the Naran valley, with respect to Pakistan and the three largest mountain systems (the Himalayas, Hindu Kush and Karakorum), and the altitudinal range and position of the 12 sampling localities (*A*–*L*) in the valley (see Chaps. 4 and 5 for more detail)

valley to the town of Naran. The river Kunhar has its source at Lake Lulusar near the Babusar Pass at an elevation of 3455 m. It is bounded on the south-east side by Azad Kashmir, on the north by Chilas and Gilgit agencies and on the west by Kohistan and Battagram districts and Mansehra Tehsil. It forms the most northern part of British India and is now a part of the District Mansehra, Khyber Pakhtunkhwa, Pakistan (Figs. 5.1 and 5.2). Geographically, the Naran valley is located on the extreme western boundary of the Himalayan range, from where after the Hindu Kush range of mountains start to the west of the river Indus. Floristically, the valley has been recognized as an important part of the western Himalayan province with some vegetation features that are Sino-Japanese in nature due to the influence of the rain-bearing monsoon winds (Ali and Qaiser 1986; Takhtadzhian and Cronquist 1986).

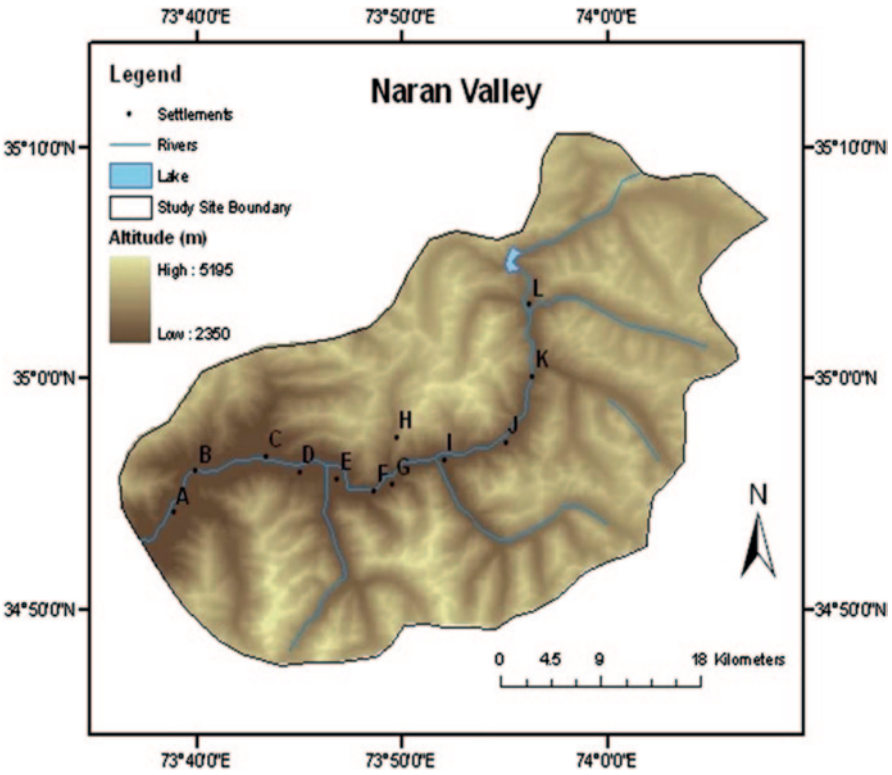

Fig. 5.2 Map of the Naran valley (project area) showing elevation range and location of its settlements (*A–L*) nearby which phytosociological and ethnobotanical surveys were carried out. (Elevation data were obtained from the ASTER GDEM, a product of METI and NASA). *GDEM* Global Digital Elevation Map, *METI* Ministry of Economy, Trade, and Industry, *NASA* National Aeronautics and Space Administration

5.2 Geology

The 2500 km-long Himalayan range resulted from a continental collision between the Indian and Eurasian plates about 60 million years ago, causing an uplift process which is continuing even today. The Naran valley is situated on the extreme north-western margin of the Indian Plate (Fig. 5.3). The rocks of the valley can be subdivided into basement rocks of amphibolites, marble, dolomite, quartzite and deformed granite (O'Brien et al. 2001; Foster et al. 2002; Wilke et al. 2010). Geologically, the area is very important as the Kaghan/Naran ultrahigh-pressure (UHP) assemblage is at the exposed leading edge of the Indian Plate continental crust, where it is still colliding against the Kohistan arc of the Eurasian Plate (Parrish et al. 2006; Clift et al. 2008).

Fig. 5.3 Map showing the location of the project area with respect to its regional geological setting; the Naran valley is located at the junction of the Indian and Eurasian plates. (http://eol.jsc.nasa.gov/handbooks/arabianpages/platesmap.jpg)

5.3 Climate

Monsoon winds are the main source of precipitation and also a primary force controlling erosion and climatology and hence topography and vegetation in the Himalayas. In the western Himalayas and especially in the Naran valley, high mountains situated at the opening of the valley act as a barrier to the incoming summer monsoon from the south and limit its penetration into the upper northern parts of the valley (Clift et al. 2008; Syed et al. 2010). Thus, summers remain cool and relatively dry and most of the valley has a dry temperate climate with clear seasonal variations. Total average annual precipitation is low at only 900–1000 mm but there is heavy snowfall in winter which may occur at any time from November to April (average annual snowfall is 3 m). The range reflects a sharp increase in depth of snow with increasing altitude. There is a distinct wet season in January–April, whilst the driest months of the year are June–November (Fig. 5.4).

Most of the year, the monthly average temperature remains below 10°C. December, January, February and March are the coldest months during which temperatures remain below freezing. June–August is the main growing season, with average daytime temperatures in the range 15–20 °C (Fig. 5.5). Melting snow (May–September)

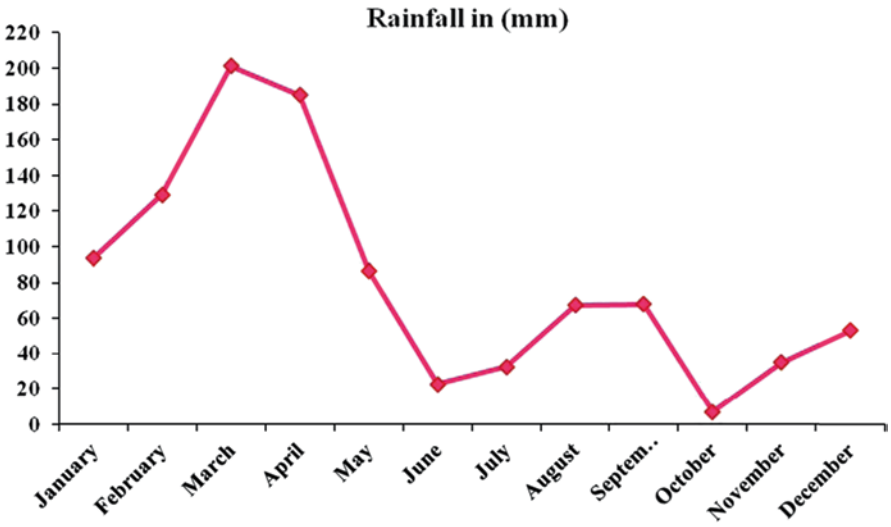

Fig. 5.4 Average monthly rainfall recorded in the Naran valley over the period of 10 years, 1998–2008. (Source: Department of Metrology Islamabad, Pakistan)

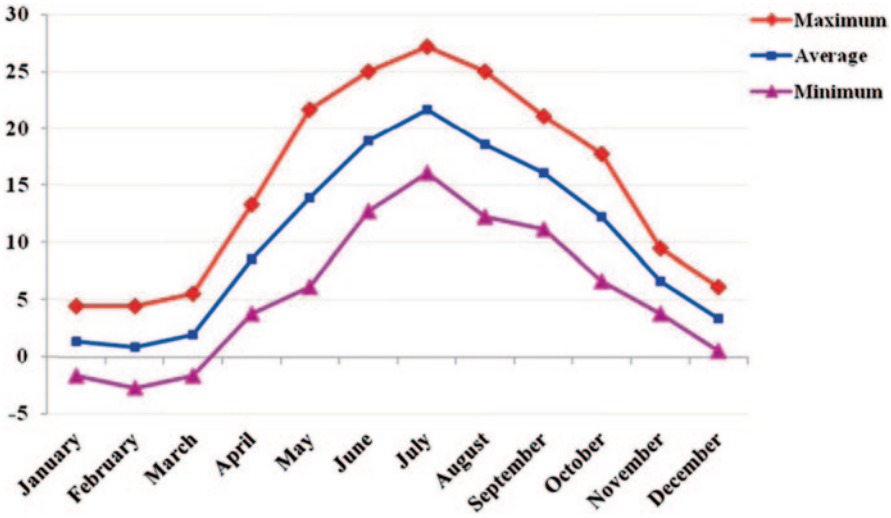

Fig. 5.5 Monthly minimum, maximum and average temperatures recorded at the town of Naran in the southern part of the valley (recorded at an altitude of 2450 m) for the years 1998–2008. (Source: Department of Metrology Islamabad, Pakistan)

is the main source of water for both plant growth and the river Kunhar and also gives rise to avalanches at the onset of summer which not only disrupt travel in the valley but also cause enormous erosion to habitats and damage to the vegetation (De Scally and Gardner 1994) (Fig. 5.6).

Fig. 5.6 Picture showing avalanche near the village of Damdama (near the settlement '*B*', is referred to, on the area map, Figs. 5.1 and 5.2) in the Naran valley; the snow has been excavated to make way for traffic

5.4 Biophysical Environment

Ecosystem studies of habitat types have not been undertaken extensively in Pakistan, especially in the Himalayan valleys. Champion and Harry (1965) described for the first time the forest types of Pakistan, using the following broad categories: swamps, dry subtropical forests, tropical thorn forests, subtropical pine forests, Himalayan moist temperate forests, Himalayan dry temperate forests, subalpine forests and alpine scrub. Beg (1975) defined major habitat types as tropical swamps, tropical thorn forests, tropical dry deciduous forests, subtropical semi-evergreen forests, subtropical forests, moist temperate forests, dry temperate forests, subalpine forests, alpine vegetation and cold desert. All of these vegetation types, except the swamps, are represented in the northern part of the country (Champion and Harry 1965; Beg 1975).

The Naran valley is situated on the extreme margin of the western Himalayas and thus forms a part of the internationally recognized western Himalayan floristic province of the western Asiatic subregion of Irano-Turania. Its geographical, geomorphological, geological, climatic and vegetational setting makes it somewhat transitional between the Himalayas, Hindu Kush and Karakorum ranges. This lends particular phytogeographical interest to the valley and its vegetation.

5.4.1 Vegetation

The vegetation of the western Himalayan province is predominantly under the influence of monsoon winds and can be classified into different vegetational zones on the basis of temperature, humidity and altitude (Champion and Harry 1965; Takhtadzhian and Cronquist 1986). A brief description of the habitat types that occur within the Naran valley and their associated vegetation is provided below.

Fig. 5.7 The Naran valley showing moist temperate forests/habitats (in between the settlements '*A*' and '*B*', is referred to, on the area map, Figs. 5.1 and 5.2) at relatively low elevations and mostly confined to north-facing slopes

5.4.1.1 Moist Temperate

Evergreen forests with some mixture of deciduous broad-leaved trees occur across an altitudinal range of 2400–3100 m above sea level (asl); they are found as far north as the middle of the valley, mainly occupying the cooler, moister north-facing slopes. These forests are dominated by conifers, in particular *Pinus wallichiana, Abies pindrow, Cedrus deodara* and *Picea smithiana.* The understory vegetation consists of both evergreen and deciduous species, amongst which the shrub species *Viburnum grandiflorum, V. cotinifolium* and *Sorbaria tomentosa* are important. Dominant herb species include *Achillea millefolium, Impatiens bicolor, Fragaria nubicola, Geranium* spp., *Viola* spp. and *Plantago* spp. (Fig. 5.7). This vegetation also provides a suitable habitat for the unique animal species.

5.4.1.2 Dry Temperate

This habitat type is the most characteristic of the Hindu Kush mountain range, but also occurs in the inner ranges of the Himalayas and the Karakorum in the north-west. In the Naran valley, this habitat is characterized by patchy shrubby species of *Artemisia, Ephedra, Cotoneaster, Rosa* and *Rubus* spp. at elevations of 2600–3100, particularly in the inner valley. Amongst the tree species of this zone, *Juniperus excelsa* and a few evergreen species of *Pinus wallichiana, Cedrus deodara* and *Picea smithiana* are important. This habitat type receives usually low rainfall in summer and heavy snowfall in winter (Fig. 5.8) and is usually subjected to intense grazing and also partial use by Markhor (*Capra falconeri*) in the winter (Champion and Harry 1965).

Fig. 5.8 Dry temperate vegetation/habitat, which mainly dominates in the middle section of the valley on southern slopes (picture was taken near the settlement '*G*', is referred to, on the area map, Figs. 5.1 and 5.2)

Fig. 5.9 Subalpine vegetation/habitat occupies a relatively narrow zone and is replaced at higher altitudes by alpine grassland (picture was taken near the settlement '*K*', is referred to, on the area map, Figs. 5.1 and 5.2)

5.4.1.3 Subalpine

This habitat type occupies a narrow zone between the coniferous tree line and the alpine pastures. The elevation range of this zone varies slightly from place to place, but is usually in the range 3100–3500 m. Important flora of this zone include *Betula utilis* at the tree line, along with species of *Juniperus, Rhododendron, Primula, Bergenia* and *Poa* (Fig. 5.9). This habitat type is important for snow partridge (*Larwa larwa*) and western horned tragopan (*Tragopan melanocephalus*).

5.4.1.4 Alpine Pastures

This habitat type starts between 3300 and 3500 m where the coniferous tree line ends and the subalpine habitat merges in grasslands up to the altitude of 4500 m

Fig. 5.10 Alpine pastures above the tree line (picture was taken at an altitude of 3600 m near the settlement '*E*', is referred to, on the area map, Figs. 5.1 and 5.2)

or above. This is a relatively productive habitat type and people use it for livestock grazing and collection of non-timber products during the summer months. The vegetation is dominated by a number of herb species, including species of *Potentilla, Anemone, Gentiana, Poa, Polygonum, Iris* and *Aster* (Fig. 5.10). This habitat is typically inhabited by snow partridge (*Larwa larwa*) and Himalayan ibex (*Capra sibirica hemalayanus*).

5.4.1.5 Cold Desert and Permanent Snow

These habitat types are found at the highest altitudes on only a few peaks in the valley. The vegetation of cold desert habitat is xerophytic in nature and emerges only for a very short growing period following snow melt. Typical plant species associated with this habitat type include *Gentianod* and *Polygonum* spp. Snow partridge (*Larwa larwa*) and Himalayan ibex (*Capra sibirica hemalayanus*) are found on the periphery of this habitat (Fig. 5.11).

5.4.2 Kunhar River

The Kunhar is the main river of the Naran valley. It originates from Lake Lulusar and is joined by several other small tributaries (*nalhas*) at various locations on its journey, including the Gittidas Nalha, Jalkhad Nalha, Burwai Nalha, Wettar Nalha, Jora Nalha, Dadar Nalha, Shanak Nalha, Sapat Nalha, Kinarida Nalha, Barjalida Nalha and the Saiful Maluk Nalha. The main sources of water to the main river and its tributaries are melting snow and natural springs, with a smaller contribution from rainfall during the summer (Fig. 5.12).

Fig. 5.11 Cold desert/permanent snow on the highest peaks in the valley. These habitats retain snow cover throughout much or all of the year and thus have an extremely short growing period (picture was taken above the settlement '*F*' at an altitude of 4500 m, is referred to, on the area map, Figs. 5.1 and 5.2)

Fig. 5.12 The river Kunhar flowing near the village of Soach in the Naran valley (picture was taken from an altitude of 4000 m, above the settlement '*C*', is referred to, on the area map, Figs. 5.1 and 5.2)

5.4.3 Lakes

The Naran valley is also known as a 'land of lakes' due to the presence of nine lakes in the valley. The most important amongst these are Lake Lulusar, Lake Saiful Maluk, Dhodipatsar Lake, Anso Jheel (Lake), Jati Jheel and the Jalkhad Lake (Census Report 1998). Further information on the two more spectacular and largest lakes, Lakes Lulusar and the Saiful Maluk, are given below.

5.4.3.1 Lake Lulusar

Lake Lulusar near the Babusar Pass is a beautiful, natural lake surrounded by the mountains from all sides and located at an elevation of 3455 m. It forms the source

Fig. 5.13 Lake Lulusar: the source of the river Kunhar and the end point of the Naran valley, western Himalayas (near settlement '*L*', is referred to, on the area map, Figs. 5.1 and 5.2)

of the river Kunhar and also the upper limit of the Naran valley. This is an irregular shaped lake about 300 m wide and 2.5 km long (Fig. 5.13). The Naran valley is blocked at the end of the lake by high mountains, but a pass allows a rough way to cross over into the Chilas valley (a tributary valley of the Indus River). This is the 4173 m-high Babusar Pass which provides views of the Nanga Parbat (The Naked Mountain, 8126 m).

5.4.3.2 Lake Saiful Maluk

Lake Saiful Maluk is one of the most famous and beautiful lakes in the Himalayas. It is about 500 m long and 460 m wide, situated at an elevation of 3220 m, near Naran town in a tributary valley and in the shadow of the Malika Parbat (Queen of the Peaks, 5290 m). It gives rise to the Saiful Maluk stream (*nalah*), which merges with the river Kunhar at the edge of Naran town. It is an important tourist spot in the valley and people come to see the spectacular scenery and hear the local legend about the prince Saiful Maluk who fell in love with a fairy named Badri Jamala (Fig. 5.14).

5.4.4 Peaks

There are a number of peaks in the Naran valley, amongst which the highest is the Malika Parbat which rises on the north-eastern boundary of Lake Saiful Maluk, to an elevation of 5290 m (Fig. 5.15). Other high peaks are Shikara and Bichfa (both having a height of 4877 m), and Bogi and Raja with heights of 4852 and 4720 m, respectively (Fig. 5.16).

Fig. 5.14 The Lake Saiful Maluk situated at a distance of about 6 km from the Naran town (settlement '*A*', is referred to, on the area map, Figs. 5.1 and 5.2) is one of the region's most beautiful lakes and a famous tourist spot

Fig. 5.15 The Malika Parbat (Queen of the Peaks, 5290 m) is situated immediately to the north-east of Lake Saiful Maluk

Fig. 5.16 The Bogi peak (4852 m) (picture was taken near the settlement '*J*', is referred to, on the area map, Figs. 5.1)

Fig. 5.17 View from Lalazar near Batakundi, taken in early August 2009, showing crop fields of potatoes and peas (picture was taken near the settlement '*D*', is referred to, on the area map, Figs. 5.1 and 5.2)

Fig. 5.18 Crop fields at the Batakundi research station showing peas and potatoes at the end of July 2010 (near settlement '*E*', is referred to, on the area map, Figs. 5.1 and 5.2)

5.5 Agro-Ecology and Important Agricultural Crops

The harsh climate in this high altitude valley means that the growing season is reduced to a very short summer and hence agricultural activities are limited. The whole area is mono-cropic, i.e. only one crop can be grown in a year, and only summer (kharif) crops are cultivated. The main crops are potatoes and peas. Recently with the help of Germany, the government of Pakistan has established a research station at the Upper Batakundi village, for the production and provision of potato seeds (tubers) to the local farmers (Figs. 5.17 and 5.18).

Other crops are maize, rye, fodder, wheat, beans and cauliflower, but with less frequency and production. Fruit trees, including pears, plums, walnuts and apples, are also grown in the area but less frequently. A lack of financial support and poor communication and transport links are the main hurdles to improved practices of

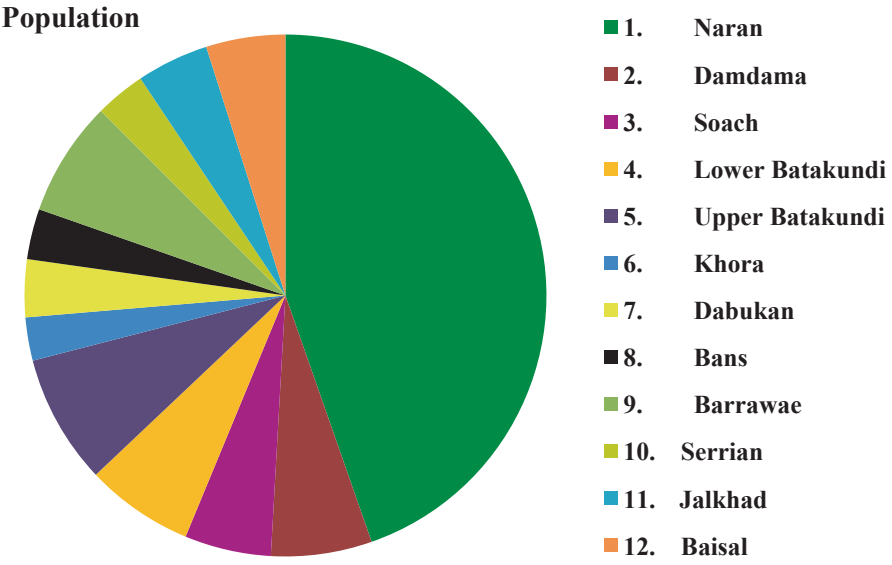

Fig. 5.19 Distribution of total human population of about 22,000 amongst the 12 main localities of the Naran valley, western Himalaya, Pakistan

land development and agriculture. The river Kunhar and its tributaries provide water for irrigation in summer, whilst natural springs and streams are the main sources of drinking water (Fig. 5.18).

5.6 Demography of the Main Villages of the Valley

The population of the Naran valley is exclusively rural, and mostly people live in temporary settlements and even in tents in the upper parts of the valley due to the prevailing high levels of poverty. The local economy is mainly based on farming and rearing of livestock. Although exact data on the population of this area are not available because most of the inhabitants are seasonal migrants or nomads and their number varies according to the season, it is believed that approximately 22,000 people inhabit the valley each year (Fig. 5.19).

5.7 Main Localities (Villages of the Valley)

Severe winter weather compels the inhabitants of the Naran valley to follow a nomadic lifestyle, with many people making temporary arrangements to reside at high altitudes during the summer months and returning to lower altitudes during the winter. The following sections provide brief descriptions of some of the more important villages/localities of the area.

5.7.1 Naran Town

The name of the valley is attributed to the small beautiful Naran town situated at the junction of the river Kunhar and the Saiful Maluk stream (34°54.423′ N latitudes 073°39.034′ E longitudes, 2451 m). About half of the population of the valley (10,000) reside in the Naran, which not only serves as a base for the whole valley but also as the entry point to the tributary valley of the Lake Saiful Maluk. From here one can ride a jeep or horse or hike on foot to several picturesque lakes, tributary valleys, landscapes and peaks. The people of Naran town are semi-nomads and most of them migrate to the plains during the winter season. The economy of the residents is primarily based on agriculture, domestication of animals and trade in forest products, whilst some also own restaurants, hotels and shops. There are a few watermills and a small power station. Tourists come for picnics and to stay in the Naran during the summer season.

5.7.2 The Lower and Upper Batakundi

The economy of these two villages (34°55.180′ N latitudes and 073°46.620′ longitudes (lower) and 34°55.250′ N latitude and 073°46.660′ (upper), 2610 and 2540 m, respectively, is based on farming and rearing of livestock. Potatoes and peas are cultivated widely as both the villages occupy much of the plain area compared to other localities. The main source of irrigation is the river Kunhar, its tributaries and springs. Each village has two primary schools, each for boys and girls.

5.7.3 Barrawae

Barrawae village (34°56.344′ N latitudes 073°52.034′ E longitudes, 2903 m) is located in a region that is under the ownership of Muzamil Shah, a lord (Syed) of the Kaghan. There are primary schools for boys and girls. The people are nomadic, dwelling in the area during the summer and returning to the lower villages of Kaghan, Mhandri and Jarid during the winter months (Figs. 5.20, 5.21, 5.22).

5.7.4 Jalkhad

Jalkhad village (35°00.065′ latitudes and 073°56.333′ longitudes at 3120 m) is located between Barrarwae and the Baisal. This region is in use of the Pakistani army, whilst the inhabitants include Gujars and Pathans. The economy of the local people is mainly based on livestock raising (goats and sheep), as the climate is less suitable for crop production in the upper parts of the valley, although people also cultivate potatoes and peas, but on a smaller scale compared to the villages lower down the valley. The people migrate to the plain areas during the winter season.

Fig. 5.20 Pictures giving glimpse of the ecotourism; hotels near the Naran village on the bank of the Saiful Maluk stream/tributary

Fig. 5.21 Terrace cultivation (after deforestation) near Upper Batakundi village, July 2009 (picture was taken near the settlement '*E*', is referred to, on the area map, Figs. 5.1 and 5.2)

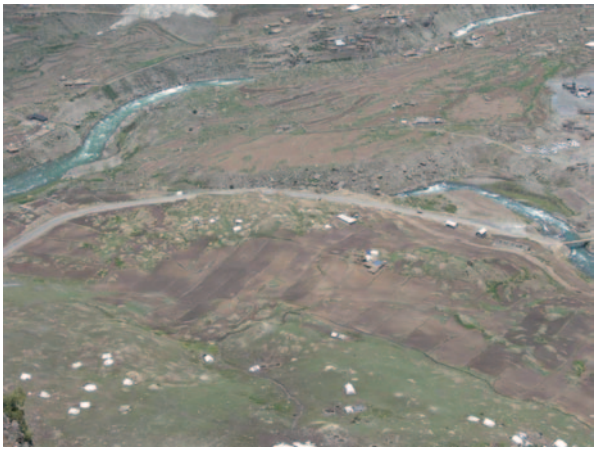

Fig. 5.22 Fields being prepared for potato crops near Barrawae village, June 2010 (picture was taken near the settlement '*I*', is referred to, on the area map, Figs. 5.1 and 5.2)

Fig. 5.23 Tent village of grazers at the Baisal '*L*', is referred to, on the area map (the last village of the valley, above 3200 m)

5.7.5 Baisal

Located near Lake Lulusar at 3220 m (35°02.322′ N latitudes and 073°56.183′ longitudes), this settlement comprises a few grazers/nomads who live here in temporary shelters/tents during the summer. Lake Lulusar is located at a distance of about 5 km from Baisal towards the north (Fig. 5.23).

The names of other main villages referred to in this study are Damdama, Soach, Khora, Dabukan and Bans.

5.8 Ethnology

Various tribes including the Gujars, Syeds, Swati and Kashmiri inhabit the valley. The most important amongst these are the Gujars (descendents of the Indian Aryans) who are famous for their unique culture, way of life, rituals and bravery. The Gujars are concentrated in the upper parts in most of the valleys in Pakistan where they cultivate rain-fed slopes, and are generally more aware of traditional knowledge of plant use and local ecology (Ahmad et al. 2009). The Gujars were designated by the British as a martial race who were thought to be naturally strong in battle, and possessing qualities like courage, faithfulness, autonomy, physical strength, discipline and firmness. They are the original inhabitants of the Indo-Pak subcontinent (Chauhan 1998). Their life is very harsh and, to some degree, comparable to the prehistoric people. They are very hard-working people and easily face any ruthless situation, particularly natural hazards and climatic constraints. They migrate to the upper parts of the Naran valley with their livestock in the summer and come back to the plains during the winter (Lyon 2002). The Gujars have their own specific language called Gujri which is amongst one of the most ancient languages of the world. The origin of Gujri goes back to 400 BC and it has a rich vocabulary.

Fig. 5.24 Herd of sheep and goats grazing on a southern slope immediately after snow melt. Rearing sheep and goats is one of the main sources of livelihood in the Naran valley (picture was taken near the settlement '*D*', is referred to, on the area map, Figs. 5.1 and 5.2)

It is also considered to be the mother tongue of the present-day Urdu and Punjabi languages (Wayne 1996).

Amongst the other main tribes in the Naran region are Swati (who came from the Swat valley about 500 years ago); they are descendants of the ancient Kushan dynasty, and Syeds are the religious people of the area. These tribes in combination form the major population and have inhabited the Naran valley since at least 300–400 years ago (Bellew 1994). Most of the people speak the Gujri or Hindko languages.

5.9 Livelihoods

Human life in the Naran valley is a continuous challenging effort for survival. Usually, people have more than one type of occupation in order to maintain a sustainable livelihood. Usually, every household keeps cattle, the numbers and types of which vary from a few to hundreds. In the lower and middle valley, the second most common profession is growing crops. Most of the people execute these two professions simultaneously. Having cultivable lands and a more moderate climate, people grow crops in the lower valley which gradually decrease along the valley with altitudinal increase and disappear at the valley's upper boundaries. The people of the upper valley mainly rely on rearing livestock and collection of wild plants. Grazing livestock is dominant in the valley (Fig. 5.24).

5.9.1 Mountains Vegetation: A Wider Picture with Respect to Climate Change

Plants and plant communities survive at the edge of life in high mountains all over the world; these are also ecosystems where climatic change is more visible and

where species extinction is very rapid (Kullman 2010; Khan and Ahmad 2014). Mountains are the most remarkable land forms on the earth's surface with prominent vegetation zones based mainly on altitudinal and climatic variations. Aspect variation also enhances habitat heterogeneity and brings micro-environmental variation in to the vegetation pattern (Clapham 1973; Shaheen et al. 2011; Khan et al. 2014). High mountains all over the globe are important hot spots for endemic floras (Dirnböck et al. 2001; Vetaas and Grytnes 2002; Casazza et al. 2005, 2008; Fu et al. 2006; Nowak et al. 2011; Halloy and Mark 2003; Kazakis et al. 2007).

Mountain vegetation has manifold functions not only within the mountain system itself but also regionally in the adjacent lowland ecosystems by regulating floods and flows in streams. The Himalayas are the birthplace of ten of the largest rivers in Asia and a large and important carbon sink. Economy of south Asian countries is mainly based on the flow of these rivers from the Himalayas. These rivers ensure food security by providing irrigation water for rice and wheat crops which are the major staple food (Archer and Fowler 2004; Rasul 2010). Regionally, shrubby vegetation of high altitudes also regulates avalanche movements and protects soil (Hester and Brooker 2007). Ecological changes in the Himalayas affect the global climate by bringing about changes in temperature and precipitation patterns of the world. Globally, these mountains also play important role in combating the climate change and greenhouse effects. The diverse Himalayan vegetation ranges from tropical evergreen species in the south-east to thorn steppe and alpine species in the north-western parts (Behera and Kushwaha 2007). At high altitude, the extent of vegetation cover is related to the melting of snow. Irregular loss of its ice might have dangerous rise in world sea levels (Xu et al. 2009). These mountains are extremely sensitive to global climatic change (Thompson and Brown 1992). Such hazardous glimpses have already been observed in the form of flood in Pakistan, India, China and Thailand in the past 3 years. They are also important places for investigating global warming and climate change.

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