Chapter three

Study area
3.1 General overview

A scenic mountainous South Asian region, the state of Jammu and Kashmir falls politically within the Indian union and is located in the north western extremity of the Himalayan biodiversity hotspot between 32°10' and 37°10'N latitudes and 72°30' and 80°30'E longitudes. Covering a total area of about 2,22,236 km² (Hussain, 2002), (including 1,20,849 km² under the occupation of Pakistan and China), the state is divided into three provinces (Figure 3.1) viz. Jammu (26293 km²), Ladakh (59146 km²) and Kashmir Valley (15948 km²), (Anonymous, 2010), with each province differing markedly from one another in its climate, vegetation and culture.

![Figure 3.1 Map of Jammu and Kashmir outlining the three provinces.](image)

But nevertheless these provinces appear as a unified natural system in their own rights and within their confinement contain a vast and extremely rich geographic, physiographic, ethnic, demographic, linguistic and cultural diversity. With about 19.95% of the total geographical area (falling on Indian side of LoC) covered by forests (Anonymous 2009),
that consists mostly of coniferous, broad leaved, deciduous and other evergreen woody elements, the state is divided into three floristic regions: alpine desert flora of Ladakh, subtropical flora of Jammu and predominantly temperate flora of Kashmir. Geologically, the rock formations belong to three broad groups: the Panjal which includes the outer hills, plains and middle mountains; the Zanskar which embraces almost whole of the eastern region from Spiti to Lahul and Karakoram in north and the Tertiary groups which involve the valley of Kashmir and other river valleys (Wadia, 1953). Agriculture is the main stay of economy with more than 75% of the population being directly or indirectly dependant on this sector (Anonymous, 2010).

3.2 Kashmir valley

Formed by the folding and faulting as the Himalayan mountain chain was thrust between the Himalayan sub continent and the rest of Asia, the valley of Kashmir runs northwest to southeast along the strike of the mountain chain which gives it a clearly defined physical boundary. The region is drained by river Jhelum (Veth in Kashmiri), its tributaries and numerous other fast moving snow-fed streams with the mighty Jhelum cutting through Pir Panjal at the Baramullah gap. Geologically, the valley exhibits a sequential record of great alpine orogeny, including sedimentations, tectonics and volcanicity that followed the Himalayan orogeny, with ‘Karewas’ of Pleistocene Ice age being its most conspicuous feature. The rock formations are varied and belong to all age groups from Achaean complexes to recent alluvium. Floristically the region is very rich and harbours an amazing diversity. The vast areas covered by grasslands and meadowlands further add to its aesthetic splendour and resource profusion. These grasslands spread across a broad altitudinal and latitudinal gradient and are present nearly across all breadth of Kashmir valley. The present study is carried out in few of these grasslands located at district Bandipora.
3.3 District Bandipora (Gateway of Gilgit)

Situated on the banks of world famous Lake Wular, Bandipora is a newly formed district of Jammu and Kashmir, carved out (April, 2007) of erstwhile district Baramullah with an area of 398\(^1\) sq Km (MOIB, 2010). The topography of district represents a mix of beautiful mountains, flat and gently sloping lands, fast flowing streams like Madhumati and Arin and few small intermountain valleys. It is surrounded on its west by Kupwara, on the south by Ganderbal and Baramullah and on the east by Kargil. But on the north and northeast it is bounded by Neelum and Skardu, (Pakistan) respectively, which put it among the strategically important places of Kashmir. Climate is temperate cum mediterranean type, with wet and cold winters and relatively dry and moderately hot summers being the main features. However towards the uppermost reaches, it remains cold almost throughout the year. Winter starts from the middle of November and severe winter conditions at lower altitudes continue till middle of February/March while at higher reaches they even extend till late April. A long term mean of rainfall data based on limited information available for different years showed that on an annual basis, in about 73.53± 5.02 days the area receives an average rainfall of 82.63±4.85cm (Figure 3.2). Underlying rock formations, in age, range from Pre Cambrian to Quaternary with hard, hilly and mountainous terrain comprising of igneous and metamorphic rocks belonging to Panjal traps and Zewan beds. The enclosing mountains comprise of crystalline rocks such as granite, genesis and schists and sedimentary rocks such as slates, phyllites and schists with embedded limestone (Malik et al., 2011). In higher hilly zones, because of prolonged persistence of snow which inhibits its

\(^1\)Note: The boundary of the district has not been finalised yet by the concerned agencies, so the discrepancies could exist in the geographical area figured above.
formation and development, soil appears thin, highly unstable, poor and less productive. But in relatively flatter and low lying lands, the soils are fertile, rich in nutrients and more productive.

![Figure 3.2 Rainfall data of the district Bandipora for different years.](image)

Source: Irrigation and Flood Control Department, Srinagar. Regional Meteorological Centre, Srinagar.

Administratively, the district is divided into three tehsils viz Sonawari, Bandipora and Gurez. Of these, it is the latter region which is known for its green valleys and snow capped mountains and where the most picturesque and species rich alpine meadows are located. As out of the four, three sites fall within this valley, it is discussed in detail.

### 3.4 Gurez valley (Crown of Kashmir)

Located on banks of river Kishenganga, in northeast of Srinagar, the main valley of Gurez (also spelled as Gurais) extends between (34° 30′ to 34° 41′ N) and (74° 37′ to E74° 46′ E) latitudes at an average altitude of about 2370 m a.s.l. It is surrounded on its north by Ladakh, by Bandipora on the south, by Ganderbal on its southeast and on the west by Kupwara with its peripheries touching Line of Control (LoC) that divides the states of India and Pakistan. The valley is nestled among high towering peaks and lofty and glaciated

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2 The data for the missing years is not available from the concerned authorities.
mountains which are not just an unvarying landmass but show great differences in elevation, aspect, rock type, ruggedness and glacial work which coalesce to make contrasting land surfaces. One has to cross the coldest and dangerous peak Razdan (Razdan pass) located above 4000 m a.s.l. to reach the valley. The pass not only connects the region with the rest of Kashmir but also divides the two on geographical, socio-cultural and linguistic lines. The valley is drained by mighty Kishenganga River between Kaobal Gali in east and Kanzalwan in west while other aquamarine and crystal streams also run through it. Historically, a part of ancient Dardistan, the valley is scattered over two distinct regions called Gurez valley and Tilel valley that are separated from each other by lofty limestone mountains which have a good forest cover. Rock formations of the valley are very diverse with oldest rocks found belonging to the Pre-Cambrian era. Climate is temperate with four usual seasons a year and heavy precipitation (snow) during winters that keeps the valley snow bound and cut off from the rest of the world for almost six months. Winters are very severe and temperatures even dip to -20ºC (Ara, 1994). At higher steep slopes and exposed ridges, soil is immature, thin and at places only bed rock is visible. However, descending down in coniferous forests, the soils extend to greater depths and are medium to fine textured and more productive. The diverse topography, unique environment, climate, varying habitats and peculiar physical characteristics of the valley contribute to its verdant surroundings, unsurpassed beauty and above all a rich biodiversity. As fascinating as its beauty and biodiversity, is its inimitable culture as it houses a unique Shina speaking tribe of Dards - 30000 inhabitants of Shin Communities who have been cut off from their mainland Astore, Gilgit, Chilas and other regions of Karakoram across the LoC in Pakistan and are ethnically and culturally quite distinct from Kashmiris. Though over the past few decades, the region has been influenced much by Kashmiri culture but it still represents a distinct socio-cultural, traditional and linguistic identity.
It has rich dense coniferous and broad leaved forests and species mostly found are *Acer caesium*, *Abies pindrow*, *Pinus wallichiana*, *Picea smithiana*, *Juniperus macropoda*, *Taxus wallichiana*, *Betula utilis* and *Syringa emodi*. Though few of these conclude only at tree line, a few however extend in their distribution. Some important shrubs of the area include *Syringa emodi*, *Spiraea hypercifolia*, *Hedysarum cashmerianum*, *Lathyrus humilis*, *Rosa macrophylla*, *Parrotiopsis jacquemontiana* and *Hippophae rhamnoides* while *Salix elegans*, *Juglans regia*, *Cotoneaster bacillaris*, *Sorbus foliolosa*, *Corylus jacquemontii* and *Betula utilis* constitute some important broad leaved species of its forests. At higher elevations, vegetation is rather sparse and dotted mostly with moraines, boulders and slopes of varying steepness with few important shrubs like *Cassiope fastigiata* and *Rhododendron anthopogon* growing as extensive patches while few colorful flowering herbs represented by *Bergenia ciliata*, *Trollius acaulis*, *Geum elatum*, *G. urbanum*, *Sedum spp*, *Saussurea spp*, make up the herbaceous component. The reported wildlife includes endangered snow leopard (*Panthera uncia*), hangul deer (*Cervus elaphus hangul*), barking deer (*Muntiacus muntjak*), musk deer (*Moschus moschiferus*), Himalayan black bear (*Selenarctos thibetanus*), Himalayan brown bear (*Ursus arctos*), common leopard (*Panthera pardus*), markhor (*Capra falconeri*), ibex (*Capra ibex*) and long tailed marmot (*Marmota caudata*) besides few reptiles like *Mabuya carinata*, *Agama himalayana* and *Gloydius himalayanus* are also found distributed in it. Adding to this, the valley is also known for its aquatic resources which nourish the world class trout namely Snow Trout (*Shizothorax*), Brown trout (*Salmo trutta fario* L.) and Rainbow trout (*Salmo gairdneri*) besides many other species.

### 3.5 Study sites

The selection of study sites, but for Matri, is primarily based on conditional permission provided by authorities. However in all the four grassland areas, the diverse topography and
high landscape heterogeneity is much apparent and consequently varying habitat types and land formations ranging from low lying flat lands and gentle slopes to snow bound higher elevations are brought under intensive study. Except Matri, which due to relatively light and irregular snowfall in winter remains accessible from late April to early November, these grasslands remain snow free from early June to mid October, with a growing season of not more than 160±10 days. The main plant growth occurs in July and August. Frequent winds, cloudiness, drizzling mist and fog are common features in first part of growing season, while clear sky with longer duration of sunshine are common in the latter part. All across, July remains hottest and humid and on an overall basis, Matri is much warmer and less moist as compared to other grasslands. Few important characteristic features of these grasslands are provided in Table 3.1; an approximate location of these grasslands is given in Figure 3.3, while a pictorial illustration of the diverse facets of the surveyed grasslands is provided in photo plates 1-3.

Table 3.1 Important characteristic features of the four studied grasslands.

<table>
<thead>
<tr>
<th>Property</th>
<th>Matri</th>
<th>Viji</th>
<th>Patalwan</th>
<th>Minimarg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate Area (ha)</td>
<td>630</td>
<td>900</td>
<td>1200</td>
<td>1000</td>
</tr>
<tr>
<td>Number of grazing days</td>
<td>160±10</td>
<td>125±10</td>
<td>140±10</td>
<td>130±10</td>
</tr>
<tr>
<td>Grazing area (ha/animal)</td>
<td>0.118</td>
<td>0.097</td>
<td>0.107</td>
<td>0.096</td>
</tr>
</tbody>
</table>

ha = hectares

3.5.1 Matri (Mantri Gali)

Located too close to district headquarters of Bandipora, this is the only grassland site which falls outside Gurez valley and is grazed for relatively longer periods than others. It extends between 34°30´N - 34°31´N and 74°46´-74°47´E, with altitude ranging from 3100- 3500 m above sea level. Soils are mostly hill type with brown to black at surface and brown in sub-

Although the grasslands seem comparable in the areas they occupy (based on which grazing area (ha/animal) has been calculated) but there are major differences in the proportion of the areas where these grasslands grow the vegetation.
soil. Enroute to higher alpine areas; it acts as a main grazing base, with relatively little variation in slope and habitat types compared to others. The nomads and pastorals from both nearby and far off places use this area as a first summer grazing ground and a resting place for their livestock.

Figure 3.3 Map (not to scale) of study area showing the approximate location of the four grasslands. The boundaries and geometric co-ordinates are not shown because the area is restricted.

Users are mostly Kashmiri Chopans and Gujjars whose livestock consists mostly of sheep, goat, few cattle and horses but no buffaloes. The adjacent forest has Pinus wallichiana and P. roxburghiana on drier slopes while Cedrus deodara occurs occasionally deep down the area. While patches of Juniperus wallichiana are found scattered towards its lower
elevations, a few tress of *Pinus* are also found scattered towards higher slopes which possibly appear as remnants of an old forest patch. Himalayan Black Bear and Common Leopard were commonly sighted here.

3.5.2 **Viji (Viji Gali)**

Extending between latitudes (34°33’-34°34’N & 74°43’-74°45’E) and altitudes (3668 to 4170 m.a.s.l.), this grassland exhibits a typical alpine topography with a distinct landscape. Relatively high soil wetness, total absence of tree species in and around its immediate periphery and occurrence of big sized rocks and stony boulders over its vast tracts are few of its important topographical features. Soils are coarse, well drained but acidic all over. Except that it remains snow bound for almost seven months a year from late October to early May, there are no climatic records of this grassland. However, during the study period, when it remains open as a summer grazing ground, days were warmer and temperatures ranged from 12°C (early June) to 27°C (July) during the growing season. But nights were cool with high speed cool winds blowing across the grassland. Users comprise mostly of Chopans and Bakerwals while Gujjars are very less. The area is grazed mostly by sheep, goat, few cattle and horses, while Brown Bear, Himalayan black Bear, common Leopard and long tailed Marmot are notable wildlife of the area.

3.5.3 **Minimarg**

Located at a distance of 16 kms from the headquarters (Dawar) of Gurez Valley, on its eastern side, this grassland extends between 34°31’-34°33’ N and 74°51’-74°53’ at an altitude ranging between 3100-4250 m a.s.l and is accessible only by foot on a steep path. The diverse topographic features offer many habitats and microhabitat types for a variety of herb species to grow in main grassland area while woody *Pinus, Oak, Betula* and *Cedrus* grow in nearby adjacent forest. A few *Betula* trees are also scattered in main grassland, which is traversed by a stream running across it. With the melting of snow, vegetation starts
growing from late April and comes to its full bloom during July to September and starts dying out by end of October. At its lower altitudes, grazing starts in early June, reaches a maximum in July-August when its higher altitudes are also grazed and stops by early October. The area is also important as all three ethnic communities (nomadic Bakerwals, semi nomadic Gujjars and semi- sedentary Kashmiri Chopans) utilize it, with Gujjars almost equal in number as Bakerwals while Chopans are least. Besides domestic livestock, some wild animals like Himalayan black bear, barking deer and Marmot (*Marmota himalayana*) are also common in this area.

### 3.5.4 Patalwan

Extending between 34°31'-34°35’N latitude and 74°49’-74°51’E longitudes and altitudes at 3190-4328 m a.s.l., this grassland also occurs on the eastern side of Dawar, Gurez valley. Users are a mix of all three ethnic tribes with Bakerwals dominating, followed by Chopans with Gujjars the least. The grassland is characterised by boulders of varying sizes and has a big stream originating from higher mountain reaches and flowing across on its eastern side. The slope shows marked fluctuations with rocky outcrops and cliffs being present at many locations across the grassland. The area is traversed by numerous human tracks and trails which people use to visit Gurez. A patch of *Betula utilis*, most of them growing in a tilted fashion exist on the relatively steep slope on its north western side while a small patch of forest also grows on the main grassland, within which small herbaceous patches occur in an interspersed fashion. The lower reaches of the area (not included in the grassland) are heavily forested. The wild life and the pattern of grazing are similar to Minimarg.
Overview of Gurez valley, with river Kishenganga flowing through it.

Panoramic view of the higher altitude peaks of Gurez.
Seasonal migration of Bakerwals.

Gujjar family enroute to higher grasslands. Chopans at their summer camping hut.
Summer settlements of Bakerwals at Patalwan

Summer grazing by migratory sheep at Minimarg.