

Chapter 3

STUDY AREA

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The present study the small Himalayan state of India (Sikkim) was taken for the collection of field data, after analysis the collected field data was correlated with satellite product of the same area.

3.1. The Himalayan State of Sikkim

Sikkim, a small Himalayan state of India, with total area of 7096 km² lies in geographical coordinates between 27° 00' 24" N to 28° 07' 24" N latitudes and 88° 00' 58" E to 88° 55' 25" E longitudes. The location of Sikkim state in India is shown in Figure 3.1.



Fig. 3.1. Location map of Sikkim

It is located north of the Darjeeling-hills of West Bengal, and shares international border with Nepal in the west, China in the north and north east and Bhutan in the east. The state is extending approximately 114 km from north to south and 64 km from east to west. The entire part of it is interlaced with jungle clad ridges and deep ravines created through major mountain peaks and the river valleys and extremely dense forests (Champion & Seth, 1968). Sikkim is also referred as the “Abode of snow” by Risley, (1894) and it is also known as landform of resplendent floral and faunal aggregation. The state is predominantly mountainous virtually with no plain land. The altitudes Sikkim above mean sea level (amsl) varies between 284 m (at Melli) to 8598m (summit of Mt. Kanchandzonga). Within the 75km along the elevation one can cross the tropical to snowline area in the state figure 3.2.

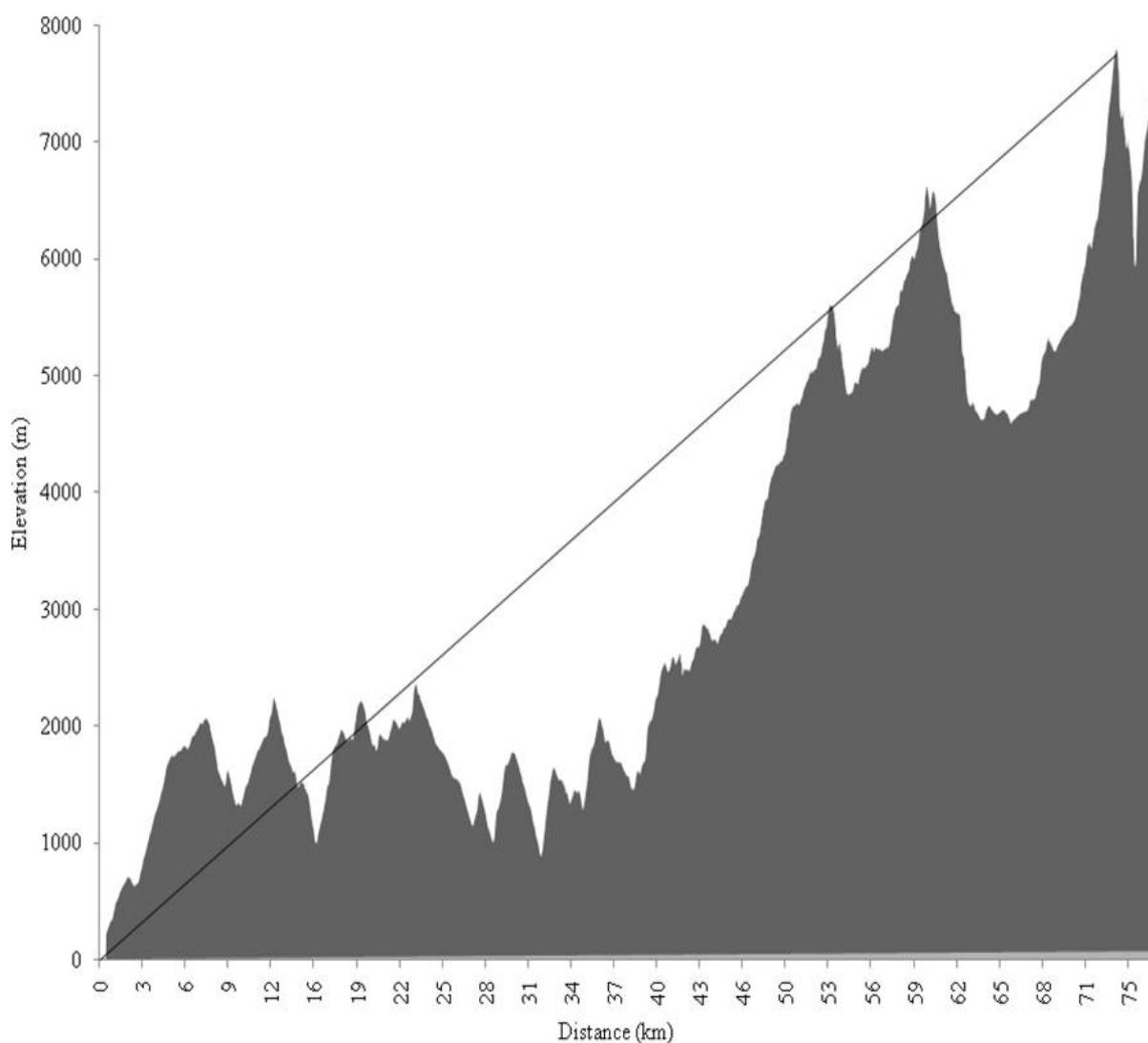


Fig. 3.2. Profile along the altitude of Sikkim with the distance in Kilometers

The highest mountain Mt. Khangchendzonga (8598 m) adorns the state with its beautiful snow covered mountain range. Sikkim Himalaya is the drainage basin of mighty rivers Tista and Rangit. The

variation in altitude from south to north within a short distance has resulted in too much of micro-climatic variations. Sikkim can be divided into three botanical zones viz., tropical, temperate and alpine, depending on the elevation and characteristics of the vegetation. The foothills of Sikkim are covered with forests consisting of the species of *Shorea*, *Haldina*, *Dalbergia*, *Dillenia*, *Artocarpus*, *Ficus*, *Bauhinia*, *Litsea*; *Lagerstroemia*, *Terminalia* etc. In the lower hill ranges (600 – 1500 m) the forests chiefly include the species of *Schima*, *Syzygium*, *Duabanga*, *Engelhardtia*, *Ficus*, *Castanopsis*, *Pandanus*, *Cyathea*, *Magnolia*, *Quercus*, *Saurauia*, *Photinia*, *Juglans*, *Leucosceptrum*, etc. (ISRO, 1994).

The temperate vegetation comprises of forests dominating with the species of *Alnus*, *Acer*, *Betula*, *Magnolia*, *Rhododendron*, *Larix*, *Berberis*, *Salix*, *Cotoneaster*, *Vaccinium*, *Daphne*, *Sorbus*, *Rubus* and the herbaceous species of *Aconitum*, *Anemone*, *Potentilla* etc. *Abies densa*, *Larix griffithiana*, *Tsuga dumosa*, *Picea spinulosa* and *Taxus wallichiana* var. *chinensis* represents the coniferous belt in the altitudinal range of 2700 – 3900 m. The Rhododendron-Conifer forests comprise of the several species of *Rhododendron*, *Daphne*, *Betula* etc. mark the timberline at the altitude of 4000 m. The alpine vegetation which occurs above 4500 m and up to a limit of 5500 m is confined to moorlands of coarse meadows with many stunted and dwarf shrubby species of *Rhododendron*, prostrate plants of *Juniperus squamata*, and cushion-like herbaceous species of *Arenaria*, *Androsace*, *Aconitum*, *Cassiope*, *Saxifraga*, *Primula*, *Pinguicula*, *Sedum*, *Rheum*, *Saussurea*, *Gentiana*, *Kobresia*, *Carex* etc. (ISRO, 1994).

3.2. Distribution of Forest Vegetation vis-à-vis Elevation

Based on altitude, the vegetation of Sikkim is classified into following categories:

3.2.1. Low Hill Forests (tropical to sub-tropical, up to 900 m): From the base (244 m) to 900 m, semi-evergreen broad-leaved forests with trees, 24 – 36 m high are the main vegetation structure. The rainfall is heavy, even up to 500 cm annually. Epiphytes like orchids, aroids etc. are abundantly represented. The undergrowth is luxuriant and varied. *Shorea robusta* is very common, covering large tracts especially along the Tista and Rangit rivers. *Schima wallichii*, *Bauhinia purpurea*, *Toona ciliata*, *Stereospermum tetragonum*, *Bombax ceiba*, *Dillenia pentagyna*, *Lagerstroemia parviflora*, *Sterculia villosa*, *Terminalia myriocarpa*, *Terminalia tomentosa* and *Albizia* spp. are prominent components of these forests. Similarly, other trees occasionally met with includes *Garuga pinnata*, *Aglaia spectabilis*, *Amoora rohituka*, *Chukrasia tabularis*, *Evodia meliifolia*, *Ailanthus integrifolia* subsp. *calycina*, *Duabanga grandiflora*, *Tetrameles nudiflora*, *Celtis tetrandra*, *Castanopsis indica*, *Syzygium formosum* and *Magnolia champaca* together with laurels like *Ocotea lancifolia*, *Phoebe hainesiana*, *Phoebe attenuata*, *Litsea monopetala* and *Cinnamomum bejolghota*. Several species of *Artocarpus* such as *Artocarpus integer* and *Artocarpus chama* together with *Bischofia javanica* also occur. Large planted trees of *Ficus elastica* are often seen along the banks of the river Tista, alongside Pakyong road, and near Dickchu. Occasionally interspersed in the forest are *Ficus semicordata* and *Pandanus furcatus*. Tree-ferns are not uncommon in the low-land forests of Sikkim (ISRO, 1994; Hajra & Verma 1996).

3.2.2. Middle Hill Forests (subtropical, 750 – 1500 m): These are largely dominating with many evergreen species. The trees are usually 20 – 30 m height in this zone. Epiphytes and climbers occur in large numbers. The undergrowth is not usually dense and consists of numerous herbaceous and shrubby species. *Castanopsis tribuloides*, *Castanopsis indica*, *Schima wallichii*, and *Phoebe*

hainesiana are the commonest tree species between 750 m and 1200 m. *Magnolia champaca* and *Stereospermum tetragonum* may also be seen in this region. Other prominent components of the forests of this region are *Drimycarpus racemosus*, *Juglans regia*, *Engelhardtia spicata*, *Spondias mombin*, *Exbucklandia populnea*, *Magnolia cathcartii*, *Magnolia hodgsonii*, *Saurauia napaulensis*, *Ficus auriculata*, *Ficus semicordata*, *Betula alnoides*, *Alnus nepalensis*, *Terminalia* spp., *Macaranga* sp., *Litsea monopetala*, *Ocotea lancifolia*, *Phoebe attenuata*, and members of Meliaceae. Large evergreen trees of *Quercus glauca*, *Lithocarpus elegans*, *Quercus serrata* and *Quercus griffithii* grow in dense formations between 1200 and 1600 m or above. Bamboos may also be found near human settlements in these hills. It will not be out of place to mention that *Cryptomeria japonica* is being extensively cultivated in this zone and that is creating problems with the survival of local species. It covers large areas and forms dense forests in areas between 1200 m and 2400 m. The ground vegetation underneath these forests is very little due to lack of sun light and unsuitable substratum. Only a few ferns are known to grow in the periphery these forests (ISRO, 1994; Hajra & Verma 1996).

3.2.3. Upper Hill forests (Wet temperate, 1500 – 2700 m):

The forests are evergreen with medium-sized trees, rarely over 24 m height. There are a number of deciduous tree species but those form only a small proportion. Oaks and laurels form large patches in otherwise mixed forests. The oaks have branched spreading crowns and are abundantly covered with mosses and other epiphytes. The forests are extremely thick and the requisite amount of moisture is available for the ground growing as well as epiphytic vegetation. The shelter of trees provided shade and prevents rapid air movements to a considerable extent. This results in a prolific growth of small herbs, shrubs and ferns on the forest floor. Woody climbers are frequent but not conspicuous. Several altitudinal zones may be distinguished by the preponderance of certain species such as laurels between 1800 and 2100 m, *Quercus lamellosa* between 2100 and 2400 m and *Lithocarpus pachyphyllus* between 2400 and 2700 m, though freely overlapping. *Magnolia cathcartii*, *Magnolia campbellii*, *Machilus edulis*, *Lithocarpus fenestratus* and *Castanopsis hystrix* are quite common in all the forests up to 2100 m. Between 2100 and 2400 m of altitudes *Quercus lamellosa*, *Castanopsis tribuloides*, *Acer campbellii*, *Magnolia doltsopa* and *Magnolia cathcartii* are dominant species. *Quercus lineata*, *Betula alnoides* and *Symplocos lucida* are also frequently met with former being quite prominent species. The oaks constitute the greater part of the trees of top canopy and Lauraceae is usually relegated to the second storey, though numerically predominant. Laurels like *Machilus gammieana*, *Machilus gamblei*, *Machilus edulis*, *Litsea sericea*, *Litsea elongata*, *Litsea kingii*, *Neolitsea zeylanica* and *Cinnamomum bejolghota* Sweet are not uncommon. *Alnus nepalensis* grows mainly along water courses and is the chief colonizer of new landslip areas. *Magnolia doltsopa* is one well known timber tree of this zone (ISRO, 1994; Hajra & Verma 1996).

Still higher up, between 2400 m and 2700 m or so *Quercus lamellosa*, *Lithocarpus pachyphyllus*, *Castanopsis tribuloides*, *Acer campbellii*, *Magnolia campbellii*, *Symplocos lucida* and *Taxus wallichiana* are the prominent elements of these forests. Above 2700 m in this zone *Lithocarpus pachyphyllus* occurs in pure formations. Under the shade of these trees *Rhododendron griffithianum* finds a favourable place. Dwarf bamboos, *Arundinaria* spp. are common as undergrowth at higher altitudes (ISRO, 1994; Hajra & Verma 1996).

3.2.4. Rhododendron-Conifer Zone (cold temperate or sub-alpine, 2700 – 3600 m):

The forests of this zone are also evergreen, mainly composed of Rhododendrons and conifers. Quite often *Lithocarpus pachyphyllus* and *Quercus lineata* formations are extending above 2700 m altitude and *Acer campbellii*, *Acer caudatum*, *Betula utilis* and *Magnolia campbellii* may also be met with though very infrequently. As one proceeds higher up, there is a gradual replacement of oaks by *Rhododendron arboreum*, *Rhododendron campanulatum*, *Rhododendron grande* and other species of the genus. *Betula utilis* is occasionally found in the high level *Rhododendron* forests at the head of Lachen valley near or above Yumaysamdong (3300 m). *Taxus wallichiana* grows in the forests as one proceeds above Lachung. At about 2700m – 3000 m in northern valley, *Tsuga dumosa* grows in abundance and is the dominant tree. It also grows at Tsokha, West Sikkim. *Picea spinulosa* grows abundantly on all the hills around Lachen intermixed with *Tsuga dumosa* but are not extended above 3000 m. The bamboo, *Thamnocalamus spathiflorus* forms dense undergrowth in silver-fir forests, especially where fire has destroyed the tree canopy. *Abies densa* also occurs almost in pure formations between Karponang and Chhangu (East Sikkim), and Yumaysamdong to Thangu (North Sikkim) extending upto 3600 m or a little above. Few trees of *Salix disperma* are also seen growing near Thangu along the streams. *Rhododendron arboreum* forms scrub on steeper slopes at about 3000 m. Above the tree-line, the vegetation is a sort of mosaic of *Rhododendron campanulatum*, *Rhododendron wightii*, *Rhododendron thomsonii*, *Rhododendron cinnabarinum* and *Rhododendron decipiens* scrubs on slopes near Tsomgo (3900 m) and near Thangu (4000 m). *Rhododendron anthopogon*, *Rhododendron setosum* and *Rhododendron barbatum* may also be occasionally met with in such formations. Grasslands are frequent at 2700 m altitude and above. Some species of *Arisaema* may be found in open places. Various species of *Aconitum* grows abundantly on the forest-floor underneath Rhododendrons at high altitudes especially around Thangu (ISRO, 1994; Hajra & Verma 1996).

3.3. Occurrence and distribution of forest types

The forested vegetation of Sikkim, which is located entirely within the Eastern Himalaya, is with wide range of variations. The details of forest types in Sikkim are presented below in Table 3.1.

Table 3.1. Details of forest types found in Sikkim, Eastern Himalaya, India [Adapted from: Grierson & Long, 1983; Champion & Seth, 1968].

S. No.	Forest type as per Grierson & Long (1983)	Characteristic species	Altitude range	Forest type as per Champion & Seth (1968)	
1	Sal (<i>Shorea robusta</i>) forest	<i>Shorea robusta</i> <i>Terminalia myriocarpa</i> <i>Schima wallichii</i> <i>Phyllanthus emblica</i> <i>Mallotus philippensis</i> <i>Bombax ceiba</i>	300 – 900	3C/Ci a	East Himalayan sal forests
2	Chir pine (<i>Pinus roxburghii</i>) forest	<i>Pinus roxburghii</i> <i>Woodfordia fruticosa</i> <i>Phoenix acaulis</i>	500 – 900	9/C _{1b}	Himalayan chir pine forests

S. No.	Forest type as per Grierson & Long (1983)	Characteristic species	Altitude range	Forest type as per Champion & Seth (1968)	
3	Subtropical forest	<i>Terminalia myriocarpa</i> <i>Tectona grandis</i> <i>Duabanga grandiflora</i> <i>Tetrameles nudiflora</i> <i>Dillenia pentagyna</i> <i>Ailanthus integrifolia</i>	300 – 900	3C/C _{3b}	East Himalayan moist deciduous forest
4	Warm broad-leaved forest	<i>Schima wallichii</i> <i>Engelhardtia spicata</i> <i>Macaranga nepalensis</i> <i>Castanopsis indica</i> <i>Choerospondias axillaris</i> <i>Ostodes paniculata</i>	900 – 1700	8B/C ₁	East Himalayan sub-tropical wet hill forest
5	Alder forest	<i>Alnus nepalensis</i>	1500 – 2000	12/IS ₁	Alder forest
6	Evergreen Oak forest	<i>Castanopsis</i> sp., <i>Quercus</i> sp., <i>Magnolia</i> sp., <i>Juglans regia</i> <i>Symplocos</i> sp., <i>Acer campbellii</i>	1700 – 2800	11B/C ₁	East Himalayan wet temperate forests
7	Dwarf bamboo thicket	<i>Arundinaria maling</i> <i>Thamnocalamus spathiflorus</i>	2600 – 3100	12/DS ₁	Montane bamboo brakes
8	Mixed conifer forest	<i>Tsuga dumosa</i> <i>Lithocarpus pachyphyllus</i> <i>Larix griffithii</i> <i>Picea smithiana</i>	2700 – 3100	12/C _{3a}	East Himalayan moist temperate forest
9	Conifer forest	<i>Abies densa</i> <i>Tsuga dumosa</i> <i>Sorbus macrophylla</i> <i>Prunus cornuta</i>	2800 – 3700	13/C ₆ , 14/C ₂	East Himalayan dry temperate coniferous forest, Larch forest, East Himalayan sub-alpine forests
10	Alpine thicket	<i>Rhododendron</i> spp., <i>Betula utilis</i> , <i>Acer</i> spp., <i>Juniperus</i> sp.	3500 – 4500	15/C ₁	Birch/Rhododendron scrub
11	Alpine scrub	<i>Juniperus</i> sp., <i>Rhododendron</i> spp., <i>Caragana</i> sp., <i>Ephedra gerardiana</i>	4000 – 5500	15/C ₂ , 16/C ₁ , 16/E ₁	Dwarf <i>Rhododendron</i> scrub, Dry alpine scrub, Dwarf Juniper scrub

3.3.1 Forest Type Distribution as per Champion and Seth (1968)

Champion & Seth (1968) characterized the forests of Sikkim also and the forests of east district of Sikkim were divided as under:

3.3.1.1. Tropical Semi-Evergreen Forests-3C/C1 (300 – 900 m):

The vegetation of tropical semi-evergreen zone, located between 300 - 900 m altitudes, consisting of mainly tropical dry deciduous to semi-evergreen species with *Shorea robusta* as a dominant species. Sal is mainly found upto Tista valley. Some of the common tree species are *Terminalia myriocarpa*, *Dalbergia sissoo*, *Albizia lucida*, *Haldina cordifolia*, *Callicarpa arborea* and *Anogeissus latifolia* with certain bamboo species as undergrowth. In the East division, this forest type is restricted to the low elevation areas of Singtam Range, Rongli Range and Pakyong Range. This forest type is also found in Amba Reserved forest (RF), Pacheykhani RF, Bhasme RF, Dhanuke RF, Burdang RF, Ralep RF, Khamdong RF, Tinek RF, Burung RF, Song RF Salingay RF, Tumlabong RF, Linku RF, Dikling RF Khani RF, Sitey RF, and Tarpin RF.

3.3.1.2. Sub-Tropical Mixed Broad Leaved Hill Forests-8B/C1 (900 – 1800 m):

Some tall evergreen species like *Schima wallichii* Choisy, *Alnus nepalensis*, *Prunus cerasoides*, *Engelhardtia spicata* var. *integra* are associated with other trees including species of *Macaranga*, *Castanopsis*, *Syzygium*, *Sapium* etc, are also seen in this altitude zone. This forest type is mostly found in tree clad areas (area outside forest). In the forest areas it is found restricted in areas like Karthok RF and Sumin RF of Singtam and Pakyong Range.

3.3.1.3. Upper Hill-Himalayan Wet Temperate Forests-11B/C1 (1800 – 2400 m):

This is a transitional zone between sub-tropical mixed broad leaved to sub-temperate zone with species ranging from *Machilus*, *Alnus*, *Quercus* and *Symplocos*. The evergreen tree dominates this region and the undergrowth is mainly of species of bamboos. This is the most broadly distributed forest type in the Sikkim state and is occupying about 221.19 km² of forest land, which is nearly half of the total forest area of 512 km² (WPR, 2013). This forest type is found in 43 compartments in Gangtok Block, Pangthang Block, Pathing Block, Rangpo Block, Pakyong Block, Kyongnosla Block, Assam Block and Rongli Block.

3.3.1.4. Sub-alpine Forests (2400 – 3000 m):

The typical temperate forests consists of species of *Abies* and *Pinus* mixed with *Picea*, *Tsuga* and *Juniperus* covering broad areas intermixed with species of *Quercus*, *Rhododendron*, *Machilus* and *Betula*. This forest type is distributed in Zuluk area and Kyongnosla area of East district of Sikkim.

3.3.1.5. Moist Alpine Forests (2700 – 3700 m):

The Moist alpine forest zone mainly consists of *Rhododendron* species intermixed with temperate evergreen species of plants. The forest cover becomes sparse as altitude increases and often restricted to grooves of the hills. This forest type is mainly found in Kyongnosla Block and Phadamchen Range in East Sikkim.

3.3.1.6. Dry Alpine Forests (3700 – 4500 m):

The vegetation of dry alpine vegetation is practically of scattered scrubs, often barren. Most of the species are of stunted thorny scrubs because of unfavorable conditions of a lesser amount of soil cover and severe frost. The species of *Juniperus*, *Berberis* and *Salix* are commonly available in this region. The forest type was divided into two zones. One is Alpine barren (without vegetative cover) and Alpine scrub (with bushes). This forest type is found in Tsomgu, Kupup, and Gnathang of East district Sikkim.

3.4. Location of East District

East district Sikkim lies at the south-eastern part of Sikkim. Geographical coordinate of the district is 27° 08' 2.88" N to 27° 25' 32.28" N latitudes and 88° 26' 26" E to 88° 54' 25" E longitudes (Figure 3.3). The administrative jurisdiction of the East district of Sikkim spreads over a geographical area of 954 km². The total area comprises of 512.09 km² of reserved forest, 63.29 km² of *Khasmal* and *Gorucharan* forest land. A total area of 378.62 km² is under non-forestry areas which include Agricultural land, roads and urban areas, etc.

The whole tract is very mountainous and consists of series of ridges and valleys. The general topography of the district is highly undulating. Slopes ranged from moderately steep to very steep. Due to the abrupt rise of mountains and ridges form the drainage channels which often flow through deep gorges, there is conspicuous absence of flat land within the slope range of 1 % to 15 %. The tract dealt with is drained by river Tista, Rangpo Chhu, Ratey Chhu and Reshi Khola ('chhu' & 'khola' = river). The river Tista and Rangpo Chhu are the main rivers which have a number of perennial and seasonal tributaries. The famous Tsomgo and Mememcho lakes are the main sources of Rangpo Chu in the up-stream. The detailed of forest range of East district Sikkim is in Table 3.2.

Table 3.2. Detailed of Forest Range of East Sikkim (*Source: FEW&MD, 2010*)

Administrative unit	Forest Range	Area (ha)
East District	Gangtok	10408.97
	Kyongnosla	17980.97
	Pakyong	6452.09
	Pathing	3422.10
	Phadamchen	15733.12
	Rongli	12641.50
	Singtam	13873.72
	Tumin	5650.96
	Ranipool	9236.66
	Total	95400 ha

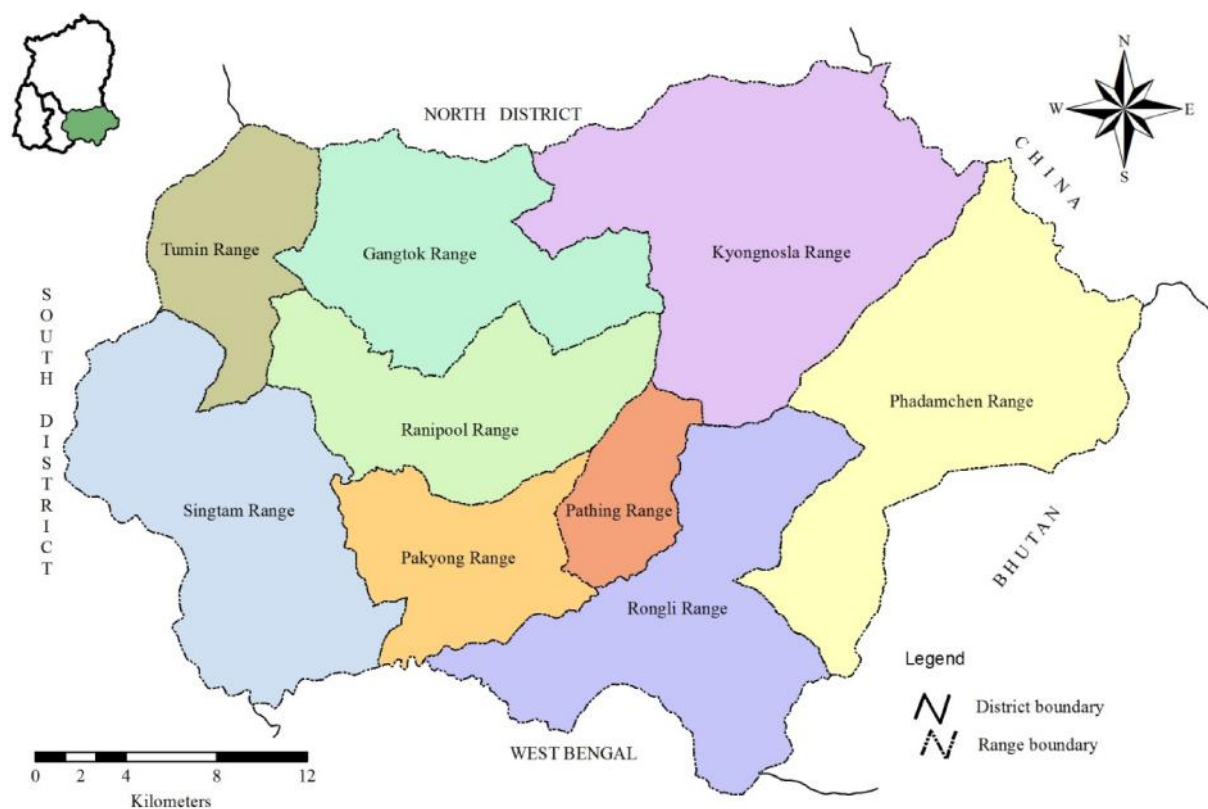


Fig. 3.3. Forest Range map of East Sikkim

East district of Sikkim shares the border with Bhutan, China and the state West Bengal. The border between China and Bhutan has several passes which had been used as the trade routes in the past. Important passes are Chola, Yak La, Nathula, Jelep La, Dong Chul La, and Batang La lying with China border and Dokala, Kephyak La, and Pangolakha with Bhutan border. In 2006 Nathula pass has been reopened for the trade related activities with China.

Recently, East district of Sikkim has been divided into four sub divisions *viz.*,

- i. Gangtok sub-division with Gangtok Range, and Ranipool Range.
- ii. Pakyong Sub-division with Pakyong Range and Pathing Range
- iii. Rongli Sub-division with Rongli Range, Phadamchen Range; and
- iv. Rangpo sub-division with Singtam Range and Rangpo forest block

The area of the reserved forest (RF) after excluding the RF of the protected areas is 301.33 km². As per the records available from the Land Revenue Department, Government of Sikkim, the division has nine forests range and fifteen forest blocks (Fig.3.3). The concept of compartmentalization of reserved blocks into separate compartments has been initiated recently. There are a total of 90 compartments in the division. The average area of each compartment is approximately 335 ha.

The human population of the district is 2, 45,040 s (DESM&E, 2013) with diverse climate, topography and rich biodiversity. East district of Sikkim is bounded by river Tista in west, river Dichu and Rathechu in North, river Reshi and Rangpo with Darjeeling district of West Bengal in South and Chola range in the north-east and Bhutan in south-east.

3.4.1. Protected areas in East District: Sikkim holds 31% of the geographical area under the Protected Area Network (PAs), much higher than country's national average. In the east district of Sikkim, a network of protected area is pervasive. There are three PAs located within the boundary of East district and are Fembong Lho Wildlife Sanctuary, Kyongnosle Alpine Sanctuary and Pangolakha Wildlife Sanctuary (Lepcha & Das 2012).

In East district of Sikkim elevation varies between 340 m at Rangpo to about 4649 m near Nathula. The lower part of the district has the tropical and sub-tropical evergreen forest (Rangpo, Singtam) followed by temperate forest and in the higher elevation the sub-alpine and alpine in (Gnathang, Nathula, Kupup and Chhangu). The landscape of the sub-alpine and alpine region being hilly terrain, rocks, covered with scrubs to thick forests in different areas, which ultimately turns out to be practically unfavorable for human settlements.

The vegetation of tropical and sub-tropical region of East district is consisting of the species of *Shorea*, *Haldina*, *Dalbergia*, *Dillenia*, *Artocarpus*, *Ficus*, *Bauhinia*, *Litsea*; *Lagerstroemia*, *Terminalia*, etc. In the lower hill ranges (600 – 1500 m) the forests chiefly include the species of *Schima*, *Syzygium*, *Duabanga*, *Engelhardtia*, *Ficus*, *Castanopsis*, *Pandanus*, *Cyathea*, *Magnolia*; *Quercus*, *Saurauia*, *Photinia*, *Juglans*, *Leucosceptrum* etc. The temperate vegetation comprises forests consisting of the species of *Alnus*, *Acer*, *Betula*, *Magnolia*, *Rhododendron*, *Larix*, *Berberis*, *Salix*, *Cotoneaster*, *Vaccinium*, *Daphne*, *Sorbus*, *Rubus* and the herbaceous species of *Aconitum*, *Anemone*, *Potentilla*, etc. *Abies densa*, *Larix griffithii*, *Tsuga dumosa*, *Picea spinulosa* and *Taxus wallichiana* represent the coniferous belt.

The vegetation of the alpine region of East district Sikkim is completely unusual. *Abies*, *Salix*, and *Rhododendron* scrubs are the most dominating type of vegetation supported by several minute spiny short herbs. Devoid of the predictable extremely harsh climate, it still supports a large number of animals including birds, mammals, fishes, etc. Perhaps it is also not wrong to say that it appears to be the home of some of the endemic animal species of Sikkim particularly of *Sikkim Stag*, *Blue sheep*, etc. Some notable places those fall under the region are Tsomgo lake, Kupup, Kyongnosla, Nathula, Memen Chho, Nathang, Padamchen, etc. As such, Tsomgo, Memen Chho, Bidang Chho, Lampokhkri etc. are some of the lakes those contribute substantially in terms of sustaining wildlife and promoting tourism. Most importantly, two important sanctuaries of Sikkim, namely Kyonglasha Alpine Sanctuary (31 Km²) and Pangolakha Wildlife Sanctuary (128 Km²) are located in this region. Some of the important nurseries of alpine medicinal plants are being developed in the nearby areas of these sanctuaries by the Forest Department, Government of Sikkim for *ex-situ* conservation of rare and endangered medicinal and other valuable plant species. Notable species under the conservation process includes *Aconitum ferox*, *Bergenia ciliata*, *Neopicrorhiza scrophulariiflora*, *Nardostachys jatamansi*, *Sinopodophyllum hexandrum*, *Panax pseudo-ginseng*, etc.

As elsewhere, floristic components representing here is entirely diverse from the one that appear in temperate and tropical regions. It upholds a majority of highly valuable economical plants including medicinal and aromatic, dye yielding, timber yielding etc. Different species of *Rhododendrons*, known for their medicinal and aesthetic values, are the major floristic components of this region. Interestingly, rare orchids of some genera e.g. *Orchis*, *Spiranthes*, *Habenaria* etc. are also nicely represented in the vegetation.

The alpine region of East district of Sikkim including the places like Nathula, Jalepla, Baba Mandir, Men-men Chho and Tsomgo lake have been already been identified as important tourist hubs by the government of Sikkim. Apart from these, the reopening of the trade center at Sherathang near Nathula between India and China further enriches the importance of the area.

Alpine and sub-alpine regions of East district of Sikkim covers an important strategic international border with China and kingdom of Bhutan. As such, the major areas of this region have been occupied for the national army and for their camps, etc. However, a negligible number of the highlanders including Sherpas, Bhutias, Tibetans and others in the form of laborers, supplier etc. partially inhabit the area.

3.5. Plant diversity in the Sikkim Himalaya

Sikkim Himalayan region is characterized by a rich floral diversity (Hajra & Verma 1996). This region is rich in floral diversity, housing many endemic elements and large number of species those have become rare, threatened or endangered (Pandey, 1991; Bhujel, 1996). Sikkim Himalaya is characterized by the rich forest cover and great drainage region of the rivers Tista and Rangit which constitutes the hills of Sikkim and Darjeeling district of West Bengal in the Eastern Himalaya. The area thus covers several ecological zones *viz.*, subtropical, temperate, sub-alpine and alpine. In such a small area sharp climatic differences in different ecological zones have promoted a rich flora (Rai *et al.*, 2000). Sikkim Himalaya together with Darjeeling hills of West Bengal has 577 species of trees, which come close to 20 species/km². The timber trees, fodder trees, fuel-wood trees, Drug/dye/fiber trees, other plants consisting the young formation of Sikkim Himalayan system.

Sikkim is also rich in medicinal and aromatic plant diversity, with well over 500 species of medicinal plants, many of them are reported to be endemic in Sikkim Himalaya (Lepcha 2011) Medicinal and aromatic plants make up the largest economic resource being tapped in the Himalayan region (Sharma & Sharma, 2010).

The Sikkim Himalaya is a synonym to Himalayan floral bounty and has the distinction of being recognized as one of the “Hotspots” in the Hindu Kush Himalaya for its high biological diversity (Arrawatia & Tambe 2011). It harbors 4000 species of flowering plants comprising of 38 species of Rhododendron, 450 species of Orchids, 9 Conifer species and 300 species of pteridophytes. With only 0.2% of total landmass of India it harbors more than 26 % of the total flowering plants of the country. This signifies the vast floral diversity of the state. The luxuriant forest cover also supports wide variety of non timber forest produces such as bamboos, canes, wild edible fruits and aromatic plants. The state is a repository of potential medicinal plants. Sikkim Himalaya is inhabited by three major ethnic communities Nepali, Lepcha and Bhutia each having distinct cultural heritage and excellent knowledge of the plant wealth in their environment. Initially, the Bhutia communities settled mostly in high mountains in alpine and sub alpine belts in north, the Lepchas restricted their settlement in dense forests in temperate and sub temperate forests of Dzongu, North Sikkim where as the majority of Nepalese lived in temperate and sub tropical belts. These ethnic groups lived in perfect harmony with nature worshipping high mountains, forests, rivers and lakes as their guardian deities to sustain their livelihood and protect themselves from famine, disease and other natural calamities. They made judicious use of the forests resources and forest produce for their basic necessities *viz.*, food, fuel, fodder and timber (Verma, 2009)

3.5.1. Endangered plants

The flora of Sikkim in the last 10–15 years were under great pressure due to biotic factors, mostly anthropogenic, like various developmental projects viz., construction activities, heavy deforestation by burning, tree-felling and clearing land for the preparation of agricultural fields. Landslides, forest fires, climate change, etc. are also partially due to anthropogenic activities and are increasing quite fast that is easily visible. These activities have destroyed many rich diversity centres. They led to environmental degradation due to which a large number of precious rare plants have been lost or endangered within a very short spell of time. These include: *Acer sikkimense*, *Pimpinella tongloensis*, *Pimpinella wallichii*, *Pternopetalum radiatum*, *Tibetoseris depressa*, *Arenaria thangoensis*, *Dendrobium treutleri*, *Cymbidium eburneum*, *Cymbidium hookerianum*, *Cymbidium whiteae*, *Cymbidium elegans*, *Cypripedium himalaicum*, *Tipularia cunninghamii*, *Diplomeris hirsuta*, *Paphiopedilum venustum*, *Zeuxine pulchra*, *Aconitum ferox*, *Cotoneaster simonsii*, *Picrorhiza kurrooa*, *Acronema pseudotenera*, *Angelica bulbigena*, *Ceropegia hookeri*, *Ceropegia lucida*, *Codonopsis affinis*, *Rhopalocnemis phalloides*, *Carex sahnii*, *Lloydia himalensis*, *Neottia acuminata*, *Calanthe alpina*, *Ophiorrhiza lurida*, *Nardostachys jatamansi*, *Dennstaedtia elwesii*, *Hymenophyllum levingei*, *Panax pseudoginseng*, *Calamus nambariensis*, *Livistona jenkinsiana*, *Begonia tenuifolia*, *Begonia satrapis*, *B. sanctata*, *Lagerstroemia minuticarpa*, *Cyclogramma squamaestipes* Tagawa, *Oreopteris elwesii*, *Christiopteris tricuspis*, *Rhynchospora rugosa* subsp. *brownii* etc. (Hajra & Verma 1996).

3.5.1.1. Number and status of endangered plants

The lists of some of endangered and endemic flowering plants of the area has been provided in Table 3.3.

Table 3.3. Endangered and endemic flowering plants known to grow in the East district of Sikkim (Source: FE&WLMD; WPR. 2013)

Species	Family	Altitude (m)	Habit
<i>Anemone demissa</i>	Ranunculaceae	3200-4600	Herb
<i>Clematis andersonii</i>	Ranunculaceae	-	Herb
<i>Ranunculus brotherusii</i> var. <i>tanguticus</i>	Ranunculaceae	3000-4300	Herb
<i>Ranunculus sikkimensis</i>	Ranunculaceae	ca 4800	Herb
<i>Arenaria thangoensis</i>	Caryophyllaceae	ca 4500	Herb
<i>Stellaria decumbens</i> var. <i>acicularis</i>	Caryophyllaceae	Above 3300	Herb
<i>Uvaria lurida</i> var. <i>sikkimensis</i>	Annonaceae	Upto 800	Climber
<i>Berberis concinna</i>	Berberidaceae	3350-3950	Shrub
<i>Berberis umbellata</i>	Berberidaceae	2000-3500	Shrub
<i>Sinopodophyllum sikkimensis</i>	Berberidaceae	3000-3500	Herb

Species	Family	Altitude (m)	Habit
<i>Mahonia napaulensis</i>	Berberidaceae	ca 2500	Shrub
<i>Corydalis cavei</i>	Papaveraceae	2700-4300	Herb
<i>Corydalis changuensis</i>	Papaveraceae	3660-3900	Herb
<i>Draba humillima</i>	Brassicaceae	4500-5000	Herb
<i>Draba stenobotrys</i>	Brassicaceae	4000-5000	Herb
<i>Solms-laubachia platycarpa</i>	Brassicaceae	2000-3000	Herb
<i>Viola placida</i>	Violaceae	2500-3000	Herb
<i>Hypericum monanthemum</i> subsp. <i>filicaule</i>	Hypericaceae	3500-4000	Herb
<i>Hypericum williamsii</i>	Hypericaceae		Shrub
<i>Sabia campanulata</i> var. <i>kingiana</i>	Sabiaceae	800-1600	Climber
<i>Astragalus zemuensis</i>	Fabaceae	ca 3600	Herb
<i>Brachycaulos simplicifolius</i>	Rosaceae	ca 4575	Herb
<i>Cotoneaster sikkimensis</i>	Rosaceae		Shrub
<i>Potentilla saundersiana</i> var. <i>subpinnata</i>	Rosaceae	4000-4900	Herb
<i>Spiraea subrotundifolia</i>	Rosaceae	3000-4300	Shrub
<i>Saxifraga coarctata</i>	Saxifragaceae	ca 4570	Herb
<i>Saxifraga melanocentra</i>	Saxifragaceae	ca 4400	Herb
<i>Saxifraga pulvinaria</i>	Saxifragaceae	4250-4570	Herb
<i>Saxifraga inconspicua</i>	Saxifragaceae	4265-5000	Herb
<i>Saxifraga umbellulata</i>	Saxifragaceae	3600-5300	Herb
<i>Epilobium gouldii</i>	Onagraceae	3600-4300	Herb
<i>Trichosanthes cucumerina</i>	Cucurbitaceae	Up to 2500	Climber
<i>Begonia satrapis</i>	Begoniaceae	ca 3600	Herb
<i>Acronema nemaefolia</i>	Apiaceae	ca 3600	Herb
<i>Acronema pseudotenera</i>	Apiaceae	3000-4000	Herb
<i>Pimpinella sikkimensis</i>	Apiaceae	1000-2600	Herb
<i>Acronema hookeri</i>	Apiaceae	2600-3600	Herb
<i>Pimpinella tongloensis</i>	Apiaceae	-	Herb
<i>Pternopelalurn radiatum</i>	Apiaceae	ca 3600	Herb
<i>Pleurospermopsis sikkimensis</i>	Apiaceae	4300-5300	Herb
<i>Angelica nubigena</i>	Apiaceae	ca 3800	Herb

3.5.2. Endemic plants

Endemics constitute another important element of biologically interesting plants. Being confined to narrow and restricted ecological niches, they are quite prone to extinction due to prevailing adverse biotic and/or natural factors. Sikkim as such has comparatively less number of endemics because many of them range from Nepal to Bhutan. It is estimated that the total number of endemics truly confined to Sikkim may be 2 % of the total number in the floral elements. These include *Calamagrostis debilis*, *Calamagrostis tripilifera*, *Catabrosa aquatica*, *Cyathopus sikkimensis*, *Drepanostachyum intermedium*, *Poa gammieana*, *Trisetum flavescens*, *Carex sahnii*, *Rhynchospora rugosa* subsp. *brownii*, *Dendrobium treutleri*, *Anaphalis cavei*, *Anaphalis hookeri*, *Anaphalis subumbellata*, *Artemisia thellungiana*, *Blumea sikkimensis*, *Cremanthodium decaisnei*, *Cremanthodium palmatum*, *Youngia stebbinsiana*, *Gentiana glabriuscula*, *Gentiana recurvata* subsp. *prainii*, *Gentiana pluviarum*, *Gentiana recurvata*, *Inula macrosperma*, *Jaeschkea microsperma*, *Ligularia dux*, *Ligularia hookeri*, *Ligularia pachycarpa*, *Saussurea fastuosa*, *Saussurea laneana*, *Saussurea nimborum*, *Saussurea obscura*, *Saussurea pantlingiana*, *Swertia ramosa*, *Swertia rex*, etc. (Hajra & Verma 1996)

To conserve the depleting resources of this region, several attempts have been made in the recent past by the Government of Sikkim. Kanchanjanga National Park, Fambonglo Wildlife Sanctuary, Kyonglasa Wildlife Sanctuary and Kabi Sacred Groove are good examples where several endangered taxa have been conserved. A few botanical gardens viz. Jawaharlal Nehru Botanical Garden, Saramsa Botanical Garden in East district of Sikkim wherein exist and insist conservation of many species. But, at present, the main emphasis is to relocate or recollect the threatened taxa and attempts should be made for their *in situ* conservation. However, in some cases the help of advance technologies viz., tissue culture, cryopreservation etc. can be used with advantage. In addition to this, the areas of diversity centres like Pangolakha Wildlife Sanctuary, Kyonglasa Alpine Sanctuary etc. should be brought under full protection with high level of restriction for the visitors (Lepcha & Das 2012).

3.5.3. Medicinal plants

Sikkim Himalayan region is the abode of a large variety of medicinal plants. *Prezwaliskia tangutica*, *Nardostachys jatamansi*, *Picrorrhiza kurrooa*, *Aconitum luridum*, *Sinopodophyllum hexandrum*, *Dactylorhiza hatagirea*, *Taxus wallichiana*, *Ephedra gerardiana* and *Lycopodium clavatum* constitute the most important medicinal plants of the alpine zone. Several medicinal plants like *Dichroa febrifuga*, *Houttuynia cordata*, *Artemisia vulgaris*, *Rubia cordifolia*, *Panax pseudoginseng*, *Dioscorea deltoidea*, *Digitalis purpurea*, *Bergenia ciliata* are quite common in temperate and sub-temperate zones.

Tropical zone is also quite rich in the medicinal flora wherein plants viz. *Chilocostus speciosus*, *Vitex negundo*, *Solanum viarum*, *Cissampelos pariera*, *Woodfordia fruticosa*, *Oroxylum indicum*, *Alstonia scholaris*, *Abroma augusta* and to some extent *Rauvolfia serpentina*, *Terminalia chebula*, *Holarrhena pubescens* etc. grow in good number (Hajra & Verma 1996).

3.6. Elevation

Elevation is one of the important parameter of this study. The elevation of East district Sikkim is ranging from 340 m at Rangpo to about 4649 m near Nathula. Aspect and slope are other important parameters of this study, during our study we see the vegetation types on different slope and aspect, most of the

study area covered in between 10° to 45° slope, over 60° slope is very less within the study area NRIS, 2006.

3.7. Soil

Soil is another important parameter to study the vegetation. The organic material of the soil has powerful effects on its development, fertility and moisture availability. Soil is the outer skins of the earth where all living and nonliving things exist to support the biological elements. Soil is classified in different classes, texture and types as per requirement. In the present study we used the soil data produced by the Soil Survey of India NRIS, 2006.

3.8. Climate

Temperature and rainfall are the major factors to study the vegetation of the study area. In Sikkim Indian Meteorological Department (IMD) have only two Meteorological Stations in Sikkim, viz. Gangtok and Tadong. Recently Indian Space Research Organization (ISRO) installed 18 Automatic Weather Stations (AWS) in different parts of Sikkim. And, in the present study, both, IMD and ISRO-AWS data has been used.

3.9. Drainage System

There are two major river systems in the state of Sikkim. They are Tista and Rangit. The Singalila and the Chola Ranges of Eastern Himalaya determine the boundary of the two rivers. The 98 percent of the state is drained by Tista, Rangit and their tributaries and sub-tributaries. As per Geological Survey of India (GSI, 2012), on the eastern side of Tista valley water contributed by Rilli, Rongpo, Rani Chhu and Dickchu are spectacular. The Rongpo Chhu, the biggest eastern tributary is symmetric barring a small part constricted towards north which emanates from Memenchho Lake in the Rongli Sub-division. The other eastern tributaries are symmetric. The lengths of the eastern tributaries are smaller compared to the western tributaries. The drainage pattern in Tista and Rangpo Chhu is mostly a mixture of trellis and sub-dendritic and sub-parallel. However, in the northern part directional trellis type drainage pattern is observed. The important rivers and streams flowing through East district of Sikkim is given below in Table 3.4. Additionally, presence of 77 wetlands has been reported from the East district. The wetlands have been identified and mapped through satellite remote sensing. The lists of important wetlands are in Table 3.5.

Table 3.4. Important rivers of East district of Sikkim (*Source:* NRIS, 2006)

Name of the River/Stream	Name of the River/Stream	Name of the River/Stream
Rongli Khola	Hante Khola	Taksam Chu
Sukdang Khola	Khari Khola	Yalli Chu
Chhuba Khola	Khali Khola	Leh Khola
Chhungi Khola	Chunabhatti Khola	Ramitey/Mendu Khola
Sawa Khola	Simana Khola	Aksu Khola
Rishi Khola	Kue Khola	Rangchang Khola
Lingtam Khola	Rangpo Khola	Di-Chu

Name of the River/Stream	Name of the River/Stream	Name of the River/Stream
Rankey Chhu	Sage Chu	River Tista
Navey Chhu	Malten Chu	Rora Chu
Nathang Chhu	Chhange Chu	Reshi Khola
Byu Chhu	Sanu Chhange	Tsang Rang Chu/Kali Khola
Lungze Chhu	Rong Chu	Re Chu
Jaldhaka river (Di-Chhu)	Richu Khola	Chuba Khola
Danak khola	Ralong Khola	Samdong Chu
Pache Khola	Kali Khola	Ratey-Chu
Dikling Khola	Khani Khola	Lay Khola
Rangdu Khola	Sang Khola	Gop Chu
Martam Khola	Pagla Khola	Buthang Khola
Aho Khola	Namphe Khola	Setei Khola
Andheri Khola	Richu Khola	Thekabong Khola, etc.

The lakes are the important water bodies and are the major sources of drinking water for all the living beings existing under an ecosystem. As of now Sikkim has 534 wetlands and 104 rivers. They have been mapped at 1:50K scale including the smaller water bodies occupying less than 2.25ha, with total area of 7477 ha (Sharma *et, al.*, 2010; NWA 2011; Panigrahy *et, al.*, 2012). There are 77 wetlands with the total area of 905 ha in the East district (Figure 3.4). The wetland serves as source of water for the wild animals and human beings. Most of these high altitude lakes are often being snow fed and remain snow covered during winter. However, some lakes tend to remain snow covered almost round the year. The dimensions of these lakes vary from a few meters to around hundred meters in length, but most of these lakes appear to be shallow and deep as well. These are permanent water bodies and it seems to have formed through the continuous process of so-called “glaciations”. Although all these lakes have their own specific names, some are devoid of, especially those, which are situated in isolated region. The lakes are pronounced as *Pokhri* or *Jeel* in Nepali, *Chhoka* or *Tso* or *Chona* in Bhutia; *Chho* or *Dah* by Lepchas. (Verma, 2009)

Some of the fascinating lakes of the East district in the alpine region are Tsomgo Chho, Bidang Chho, Men-men Chho etc. The congenial climate, rich biodiversity, blooming flowers, panoramic view of mountains and valleys, pristine lakes and forests contribute the growth of tourism in the state. It has been estimated that approximately 3 – 4 lakh tourists have visited this area in the recent past. The simulation based on the trend of tourists visited in past are expected to be jump up from 7.6 – 10.4 lakhs of tourists would visits Sikkim during the year 2017 (Joshi & Dhyani, 2009).

Therefore, they have been considered as an important contributor for the tourism sector in Sikkim, These resourceful lakes will certainly play a crucial role for such steady rise in the inflow of tourists that may have direct or indirect impact on the economic growth of the state as well. The drainage/ stream map of east district of Sikkim is in Figure 3.5.

Table: 3.5. Lists of important lakes in East district Sikkim (Source NWA 2011)

Name of the Lake	Name of the Lake	
Aritar lake	Jelep Chho	Bitang Chho
Chumpo Chho (Jor Pokhari)	Nampo Chho	Lam Pokhari
Chhokhya Chho	Men-men Chho	Tsomgo Chho
Chham Chho	Namnang Chho	Rathechhungu Chho
Nangpo Chho	Sherathang	Kupuk Chho
Laba Chho	Syebiruka Chho	
Three Sister Chho		

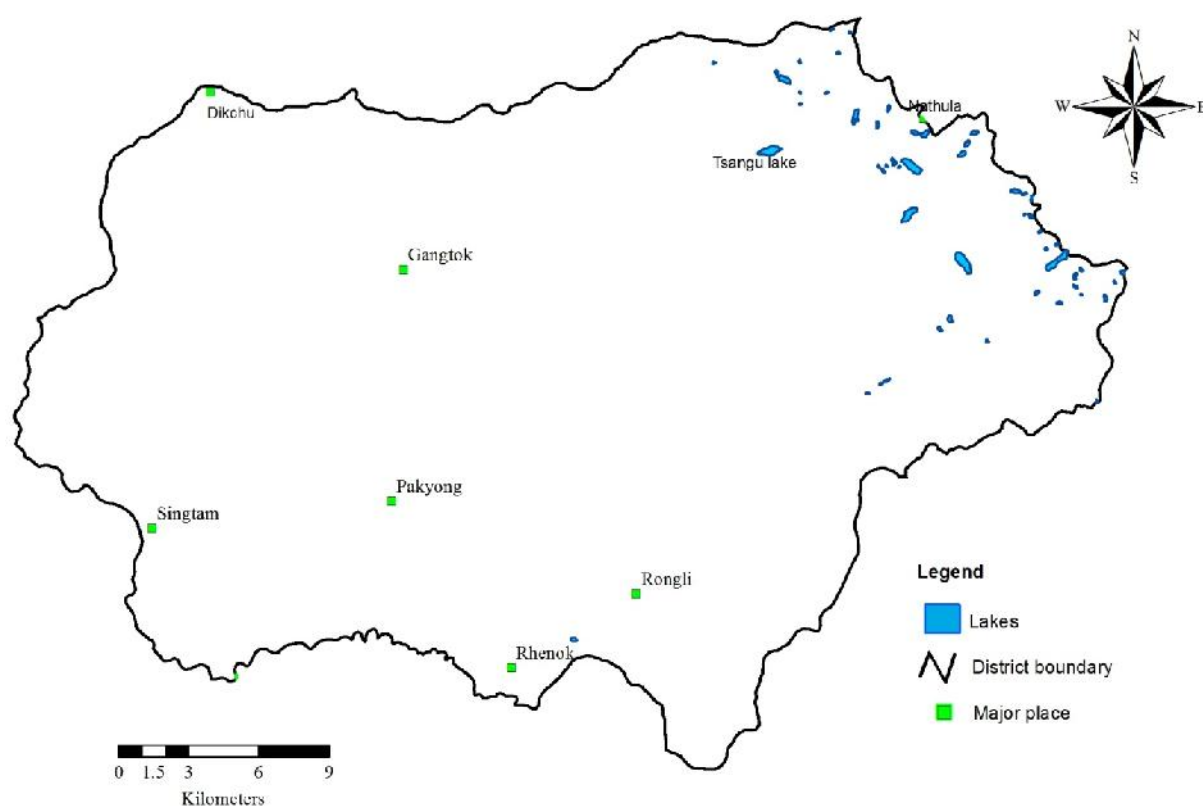


Fig.3.4. Wetlands in East Sikkim

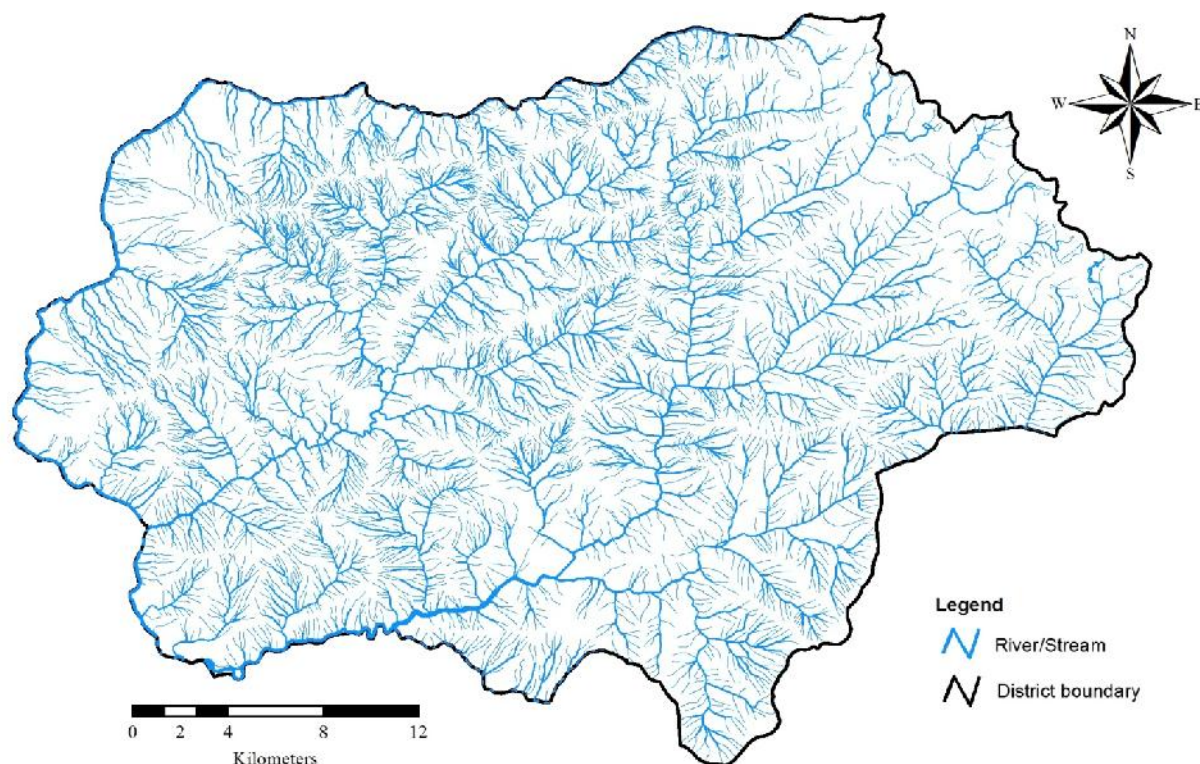


Fig. 3.5. Drainage/stream map of east district indicates very dense network

3.10. Communication network

Road is the most common and widespread among the modes of transportation. Roads are the arteries of a country and are most essential for progress. Roads of Sikkim are basically classified as national highways, state highways, district roads (major and minor) and village roads on their dimensions and functional status. Major roads of east district Sikkim along with NH-10 are shown in Figure 3.6.

Sikkim is one of the hilly states of the country under North East Region. There is only one National Highway linking the state with the other parts of India. NH- 10, along the bank of the River Tista, is the gateway to the rest of the world for Sikkim facilitating movement of goods and services. Thus, it may be considered as the lifeline of the state. The other important categories of roads in Sikkim are Border roads, State highways, district roads etc. Therefore, in Sikkim the roads affairs are being looked after by different organizations like Border Roads Organization, State PWD (Roads and Bridges), Rural Management and Development Department, etc. A part of the NH-10 falls within East district, between Rangpo and Gangtok, while Jawaharlal Nehru road connects the capital city Gangtok with Nathula on the Sino-Indian international boarder (Verma, 2009).

3.11. Socio-economic status

Sikkim, earlier a protectorate of India with a monarchy government came into existence as 22nd state of India in the year 1975. The population of the state is only 6, 07,688 as per the 2011 census (DESM&E 2013). Sikkim being very rich in cultural heritage, many communities, cultures and customs of different

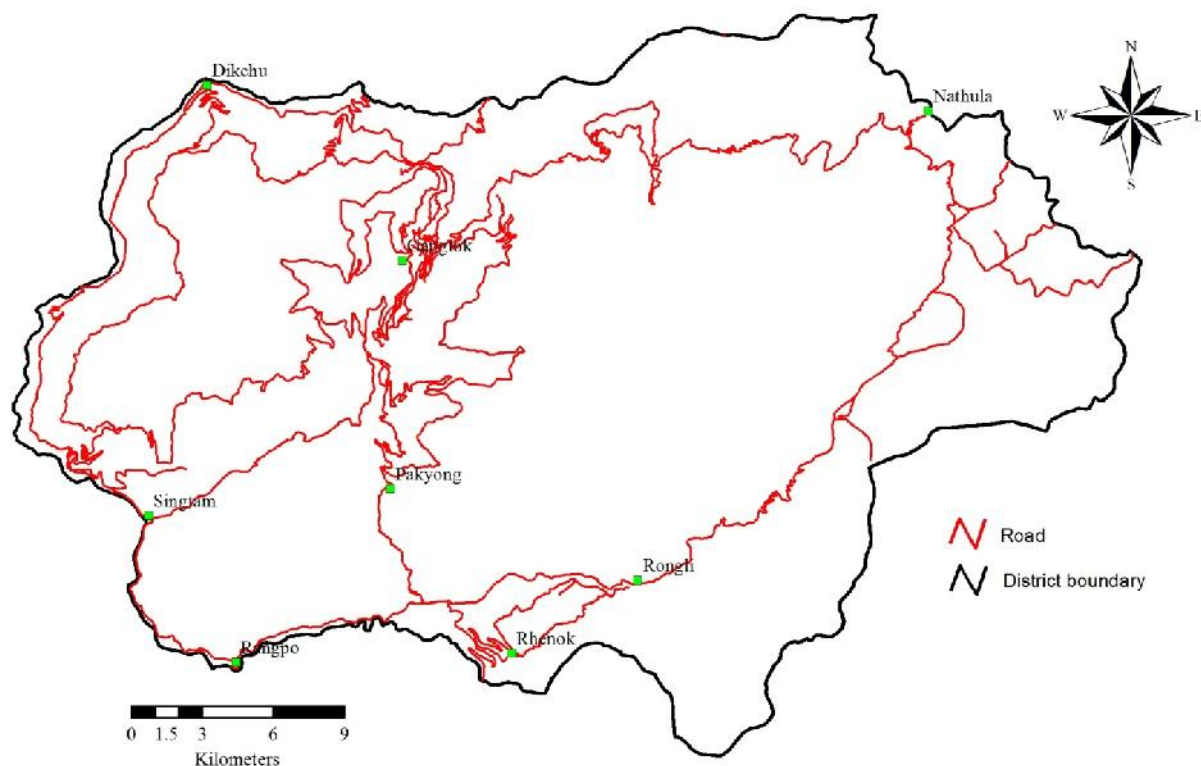


Fig. 3.6. Road network in east district of Sikkim shows less density

hues intermingle freely here in State, where majority (68 %) are Hindus, 28 % of the population are Buddhists and rest 4 % are others. In Sikkim, the predominant communities are Nepalis, Lepchas and Bhutias. In spite of many external influences, Sikkim has proved to be resilient accepting the benefits of progress while retaining their ethnic identity (Verma *et al.*, 2009).

The socioeconomic conditions of a place mostly depend upon the livelihood pattern and economic scenario of the region, which mostly comes from employment, agriculture as well as the business sector, which all are attributing to the socio-economic condition any region. Agriculture is the most important aspect of livelihood and healthy livelihood comes from healthy agricultural productivity. Many studies have confirmed that major crops of Sikkim now-a-days are in great threat and crop productivity is continuously going down during the last three decades. Drastic loss in productivity of many crops in the recent times are creating major problem for the farmers in Sikkim.

At the same time, productivity of the some crops viz., paddy, maize, ginger, potatoes have been declining as compared to the previous decades in the state. On the other hand, green vegetables which grow in the winter months are now-a-days susceptible to various kinds of pests and diseases. At present, the decreasing production in the agriculture sector is the key concern in Sikkim.

The present study in Sikkim Himalaya covers the elevation range of 500 – 3300 m, that is from the tropical forests (upto 900 m) to temperate conifer forests (above 2800 m) of East district (Champion & Seth, 1968). The Eastern Himalayan Mountain are part of IUCN recognized Himalaya Biodiversity Hotspot (Das *et. al.*, 2013). With altitudinal range from the foot hills of the Himalaya, plains to the

Mount Everest, the climatic condition of these region is tropical hot to cold which cause wide distribution of varieties of animals and vegetation types. In Sikkim within the 75 km distance one can cross the foot hills of Himalayas (284 m) to 8598m (Mt. Kanchandzonga) (Figure 3.2). Within this very small extend of the geographical area all vegetation zone started from tropical to cold alpine meadows can be accessed easily. So, this is an ideal region to study the species richness along the elevation gradient.

We studied the diversity pattern of trees, shrubs, herbs and epiphytes along an elevation gradient in East district of Sikkim Himalaya in India. The aim of the present study was to determine the species richness and to analyze species composition of plant as well as the distribution pattern of life-forms along the altitudinal gradient in the Sikkim Himalayas.

3.12. Fauna

The forests of East Sikkim is one of the reservoir for the numerous faunal species including mammals, birds, butterflies, beetles, snakes etc. This district also supports a large number of species, which have been enlisted for highly vulnerable and volatile mammalian species. The Indian Bison, Takin, Serow, Goral, Barking Deer, Himalayan Langur, Red Panda, Leopard Cat, Large Indian Civet, etc. and Pheasant, Tragopan and flock of partridges as well as large numbers of migratory birds like ducks were reported from the area (Lachungpa, *et al.*, 2011).

Interestingly, the study area has also recorded one of the noted establishments for the migratory route of tiger, through the Neora Valley National Park in West Bengal, which is situated in the southeast part of East district. The record reveals that the tigers have used this belt of forest for more than hundred years ago. The Red (Barking) deer in eastern Sikkim through the display of trophies and hunting records. The deer is identified as a sub-species of *Cervus elephus*, either *C. elephus* subsp. *wallichi* with the probable synonym *C. elephus* subsp. *affinis*. However, too little is been known about it probably now extinct in Sikkim (Dolan & Killmar, 1988), considered it “almost as a mythical animal”. However, R.F. Peacock in the ‘Larger Deer of British India’ (JBNHS 43(3): 1942) quotes a note from Col. F.M. Bailey for their appearance and distribution in between Chumbi Valley and Bhutan. According to him, occasional anthropogenic interference in the forests of Chumbi region (TAR) might have been driving those rare species of Deer back into Bhutan through the Pangolakha forest which he once noted in the summer of 1921 at above Lingmotang in the Chumbi Valley. Red Panda, Musk deer and Bharal (blue sheep) are among the highly endangered animals very rarely sighted during the last decade.