Chapter-3

STUDY AREA

3.1 Introduction

Arunachal Pradesh, the land of rising sun, attained its statehood on 20th February 1987. It is situated in the north-eastern part of India with 83743 km² area. Itanagar is the capital of Arunachal Pradesh and located at an altitude of 530m above m.s.l. It is named after Ita fort meaning fort of bricks, built on 14th century AD. Arunachal Pradesh has generally a rugged terrain characterized by hills, mountains and valleys. The elevation ranges from 50m near Assam border to 6500m along the Tibet China border (Mehta et al., 1999).

The undivided Subansiri district was a part of Lakhimpur district of Assam up to 1914 and it was called Lakhimpur Frontier Tract of the “North east Frontier Tract”. In 1919, the Lakhimpur Frontier Tract along with western sector was renamed as “Balipara Frontier Tract”. In 1946, it was again renamed as “Subansiri area” with its headquarter at North Lakhimpur. In 1954, It became Subansiri Frontier Division and headquarter was shifted to Ziro. As per the provision of Arunachal Pradesh Act (1980) Subansiri district was bifurcated into Lower and Upper Subansiri districts. The Subansiri district formed by covering the area of the Daporijo sub-division, and rest of the area of erstwhile Subansiri district was placed under Lower Subansiri. In September, 1992, Lower Subansiri district was again bifurcated and Papumpare district was formed. In June, 2000 Kurung Kumey district was curved out from the erstwhile Lower Subansiri district. There are 5 administrative circles viz. Ziro (Sadar), Yachuli, Pistana, Raga and Dollungmukh in Lower Subansiri district.

3.2 The Lower Subansiri District

The name of the district is divided from the Subansiri River, a tributary of Mighty Brahmaputra. Subansiri river originates from Tibet and enters Arunachal Pradesh from west and north-west of Taksing circle and finally merges with Brahmaputra in plains of Assam. The terrain of district is mostly mountainous. District
has a kidney shaped-valley inhabited by a tribe popularly known as “Apatani”, who have evolved a remarkable system of irrigation and fish-cum Paddy cultivation. They do not practice jhuming (shifting cultivation), sparing mountains surrounding the valley which have dense forests as compared to other areas, where jhuming is prevalent. Nishis are dominant tribe in Lower Subansiri. They are found in all 4 circles of the district except Hapoli Circle. Sulungs are third largest tribe. Generally they do laboures job and are always busy in hunting and food ccollection. They inhabit very tough terrain of Dollungmukh circle.

3.2.1 Location

The Lower Subansiri district lies between the 27° 21'-28° 00' N latitude and 93° 34'-94° 14' E longitude. The district is surrounded by Kurungkume, Papumpare, West Siang and Upper Subansiri districts and total geographic area of the Lower Subansiri is 3037 km². It generally has a rugged terrain characterized by high hills and valleys with an elevation range of 150 to 2900m. The district lies in Eastern Himalayas physiographic region and Subdued Eastern Himalayas agroecological zone in Arunachal Pradesh. It has high floral and faunal diversity.

3.2.2 Geology

According to published data of Geological Survey of India (GSI), Arunachal Pradesh can be divided geologically in to four parts viz. Tertiary, Gondwana, unfossiliferous sediments and the metamorphose. The district mostly comprises sedimentary rocks like sandstones, shales and clay with calcareous beds and lases of coal of Gondwana and tertiary stage.
3.2.3 Drainage

Plenty of streams and rivers flowing in the varied topography of the area, maintain the natural drainage system. Fig. 3.2 depicts the watershed of study area. Three rivers namely, Subansiri, Kamla and Raga are the main rivers of the district. Subansiri and Kamla originate from snowy Mountain of China and form the watershed system of the district. Subansiri originates from China and enter into Arunachal Pradesh from Taksing circle of Upper Subansiri district. The major part of this river flows in the Upper Subansiri district. These rivers finally merge in to mighty Brahmaputra in plains of Assam. In Lower Subansiri it flows only on part of Dollungmukh circle and distinguish the boundary between West Siang and Lower Subansiri. The major tributaries are Kamla, Sipu and Gayu river. Sipu and Gayu river meet with Subansiri river in Dollungmukh. Kamla river originates from snowy mountain ranges from Tibet and receives many tributaries. It flows from north-west to south-east, intersecting the district.
and finally meets the Subansiri river in Raga circle. There is a beautiful lake in Ziro circle called Tale lake in Tale Valley Wildlife Sanctuary.

The other rivers and nallah such as Pein, Pange, Siphe, Persen, Kele, Pambuk, Pai, Sika, Pabu, Tentir, Puchi, Tale, Chiya, Karing play a major role in formation of watershed of the district.

Fig. 3.2. Drainage map of study area.

3.2.4 Physiography

Physiographically, this district can be divided in two parts viz. the Shivalik foothills and the Lesser Himalayas. Foothill areas are covered with Tropical Semi-evergreen Forest, which receives heavy rainfall during southwest monsoon. This region
lies in Dollungmukh circle of the district. Region above the foothill is dissected by a lot of streams and gullies. Grasslands start from Yazali plains to Joram and in Apatani valley. A small patch of grasslands are also occur in surroundings of New Painya, Old Painya and in Tamen near Kamla river. Plateau is another physiographical feature in this district called Apatani plateau. Lesser Himalayas area also called as northern and north eastern hill region comprised of Kamla and Tale valleys.

3.2.5 Soil

Soil is the basic resource for sustaining all life forms. As per the resource atlas of Arunachal Pradesh in 1999, the older alluvial, tarai, skeletal mountain soil, mountain meadow, red sandy and red loamy soil types are found in the district. Generally, the soil has a high degree of acidity due to high litterfall and low temperature. These soils have high organic content due to thick deposition of litter on soil surface. The soil is very deep, well drained and loamy skeletal on moderate slope (Maji et al., 2001). Soil on very steep slopes is skeletal having loamy surface with severe erosion and moderate stoniness.

3.2.6 Climate

The climate of the district varies from place to place as well as season to season. The climate is largely influenced by the nature of terrain depending upon altitude, aspect and location. The winter season extends from December to February. The summer season extends from March to May. The duration of south-west monsoon extends from June to September while post monsoon exist from October to November. The foot-hills areas of the district have moderate climate in comparison to higher regions, which are very cold during winter. December and January are generally the coldest, and July and August are the warmest months.

3.2.6.1 Rainfall

The average annual rainfall in the district is 3000 mm. Rainfall in the valleys and southern parts is heavier than in the northern parts of the district. During the monsoon period more than 70 per cent of the rain over the southern half occurs while in the
northern parts, it is about 60 per cent. The south-west monsoon occurs from May to September and is responsible for more than three-fourth of the total annual rainfall. The north-east monsoon accounts for the balance rainfall from November to April.

3.2.6.2 Temperature

The relative humidity in the district is always high throughout the year except during winter months. It varies from 45 to 90 per cent throughout the year. In winter the morning sky is obscured by lifted fog, which clears with the advance of the day. The district remains heavily clouded in the monsoon season. Winds are generally strong.

3.2.7 Socio-economic condition

According to the census 2001, the total population of the district is 49,462 (25,247 males and 24,215 females). The Apatani and Nishi women are skillful weavers. Basketry is the popular handicraft among the men folk. Mithun (Bos frontalis) and Pig (Sus domesticus) are the only animal which are used in husbandry and other occupation.

3.2.8 Transport

There is no railway track in the district. The nearest railway stations are Harmutti and North Lakhimpur in Assam. Air and road are the main means of transport. Majority of the roads are constructed and maintained by Border Road Task Force (BRTF) and Garrison Road Engineering Force (GREF). Dollungmukh circle of the district has no road connectivity. Ziro to Tale valley has only foot-track. Fig. 3.3 depict the road network in the study area. Twice in a day, helicopter service from Naharlagun (Itanagar) to Ziro is available by “Pawan-Hans” helicopter which also supply food and medicine in remote areas of the district where road connectivity is not proper.

3.2.9 Biodiversity

The district represents wide-ranging climatic conditions with high rainfall and high humidity. The soil is also fertile due to rich organic content. Lower Subansiri district encompasses high biological diversity. The phytogeographical position and mountains with deep valleys, from the wide variation in climate; has resulted in high
biodiversity with fascinating flora and fauna (Chatterjee, 1939). Lower Subansiri has one Wildlife Sanctuary named Tale Valley Wildlife Sanctuary.

**Fig. 3.3.** Road and settlement map of study area.

3.2.9.1 Fauna

The district is rich in fauna. Barking deer (*Muntiacus muntjak*), wild boar (*Sus scrofa*), wild cat (*Felis silvestris*), bat (*Pipistrellus pipistrellus*), foxes (*Vulpes vulpes*) are common. Mammals like tiger (*Panthera tigris tigris*) and bear (*M ursus ursinus*) are very rare but leopard (*Neofelis nebulosa*) are very common. The number of elephants (*Elephas maximus*) is very high in Dollungmukh circle. Mithun (*Bos frontalis*) the state animal, which is found in wild and domesticated forms, has religious and socioeconomic value. Reptiles are also common in the district. King cobra (*Ophiophagus hannah*) and python (*Python molurus*) are common. The important birds hornbill, jungle fowl, water bird and
pigeon are very common. The wood peckers are found in the coniferous forest. The insectivores and rodents e.g. rats and flying giant squirrel are very common, which are supposed to cause a lot of damage to the agricultural fields. The population of wild animals is declining due to hunting and poaching for food and ornamentals. Deforestation is also responsible for changing the natural habitats.

3.2.9.2 Flora

Baishya (1999) has reported the 6000 species of flowering plants and 500 species of pteridophytes. The sub-tropical to temperate climate and high rainfall in Arunachal Pradesh provides suitable habitat for the growth of gymnosperms. Out of the total 48 species of gymnosperms, 24 are found in the state (Parmer, 2002). Arunachal Pradesh has large number of endemic species. Chowdhry (1999) provides a list of 238 endemic species in the state. The state is very rich in different species of Musa and Citrus germplasm. Rao (1994) reported that rice cultivation is practiced upto 2700m. The state is also rich in crop production, maize, soyabeans, bean, pumpkin, potato, ginger and garlic are grown widely (Paroda and Arora, 1991). The timber of this state has great demand for uses in furnitures and household articles. Bamboo is widely distributed in Arunachal Pradesh. 23 genera and 120 species are listed out from India (Biswas, 1988), of which 26 species belonging to 9 genera are from Arunachal Pradesh (Haridasan, 1996). Large number of orchid species is also reported from the state. Arunachal Pradesh is nature's repository of medicinal plants.

The forests are generally dense and primary in nature except in Ychuli and in some parts of Raga circle due to anthropogenic pressure. Champion and Seth (1968) classified vegetation of the district into six broad types i.e. (i) Eastern Submontane Semi-evergreen Forest (ii) East Himalayan Sub-tropical Wet Hill Forest. (iii) Secondary Moist Bamboo Brake (iv) Sub-tropical Pine Forest (v) East Himalayan Moist Temperate Forest (vi) East Himalayan Dry Temperate Coniferous Forest. Kaul and Haridasan (1987) classified the forest and compared them with Champion and Seth's (1968) Class further. They categorized the Champion and Seth (1968) categories into sub-classes:
1. Tropical Semi-Evergreen Forest (2B)

The forest is generally found on foothills and river banks up to an elevation of 600m. The top canopy consists of deciduous trees while lower canopy consists of evergreen trees, shrubs, climbers and lianas. It may be further divided into two subtypes:

a) Low Hills and Plains Semi-Evergreen Forest (2B/1a)

The top story of this forest is dominated by Schima wallichi, Terminalia myriocarpa, Castanopsis indica, Altingia excels, Canarium strictum, Gmelina arborea, Phoebe goalparensis, Lagerstroemia parviflora, Quercus lamelosa, Ficus species etc. The middle and lower storeys consist of Crateva religiosa, Croton chlorocalyx, Gynocardia odorata, Turpinia nepalensis. Ground floor is covered with Phrynium imbricatum, Saurauia punduana, Citrus species, Petris quadrisurtia, Musa species etc.

b) Riverain Semi-Evergreen Forest (2B/C1)

These forests are found along the river banks. Common species, which are present in the top storeys, are Bombax cieba, Dubanga grandiflora, Bischofia javanica, Canarium strictum, Lagerstromia parviflora etc. The middle and lower storeys are dominated by species of Calamus, Ficus, Melosoma, Randia, Vellebrunne etc. The ground is covered by dense clumps of Phragmites, Saccharum, Hedychium species etc.

2. Sub-Tropical Broadleaved Evergreen Forests (8B/C1)

This type of forest is found from 900 to 1800m altitude. They are basically evergreen and dense in nature. The dominant tree species of the top story are Castanopsis armata, Castanopsis indica, Kydia calycinia, Michelia oblonga, Quercus lamellosa, Quercus semicarpifolia, Prunus nepalensis, Schima wallichi, Streculia hamiltonii, Gracina acuminata etc. The small trees are Actinidia callosa, Berberis wallchiana, Camellia caudate, Lasianthus longicauda, Rubus moluccanus, Viburnum foetidium, Streculia hamiltonii etc. The herbs are dominated by Polygonum species, Campanula khasiana, Osbeckia stellata etc. Some ferns are also associated with herbs namely Equisetum species, Lycopodium clavatum etc. Clematis gauriana, Holboellia latifolia, Tinospora sinensis etc are common climbers.
Fig. 3.4. Pine Forest (a,b), Pine forest with valley cultivation (c, d, e), grassland (f).
Assessment of carbon budget in forest ecosystems of Lower Subansiri district

**Fig. 3.5.** Sub-tropical broadleaved (a, b), Semi-evergreen forest (c, d), Sub-tropical broadleaved with terrace cultivation (e, f).
Assessment of carbon budget in forest ecosystems of Lower Subansiri district

**Fig. 3.6.** Temperate broadleaved (a, b, c), Rhododendron spp. (c, d), temperate coniferous (e, f).
Assessment of carbon budget in forest ecosystems of Lower Subansiri district

Fig. 3.7. Bamboo spp. (a, b, c, d, e, f)
Fig. 3.8. Current jhum (a, b), Abandoned Jhum (c, d, e), Degraded dorest (f).
3. Sub-Tropical Pine Forest (9/C2/8B/2S1)

This forest is found from 1200-1800m. The dominant species are Pinus wallichiana, Alnus nepalensis, Betula alnoides etc. The herbaceous species are Pogostemon, Ajuga, Potentilla in association with Pteridium aquilinium, Gleichenia glauca etc.

4. Temperate Broadleaved Forest (11B/C1)

The forest occurs between 1800-2800m altitude. The differentiation between Sub-tropical Broadleaved and Temperate Broadleaved is very difficult upto certain height due to intermixing of species e.g. Castanopsis and Quercus species, but the presence of Rhododendron and Illicium, differentiate between them. Trees like Acer pectinatum, Acer oblongum, Quercus spp., Castanopsis indica, Populus ciliate, Symplocos racemosa etc are in top storeys. The middle storeyes are dominated by species of Rhododendron, Prunus, Acer etc and lower storeys is covered by Illicium griffithi, Berberis wallichiana, Caryopteris odorata, Debregesia longifolia, Lyonia ovalifolia etc. The ground is covered by shrubs like Mahonia acanthiifolia, Vaccinium prengelli, Myrsine semiserrata etc are very common along with ferns, climbers, orchids and epiphytes.

5. Temperate Coniferous Forest (13/C6)

The forest type occurs between 2800-2950m altitude. The snowfall is low in comparison to other places. Top storey is covered by Taxus wallichiana and Cephalotaxus species associated with some broadleaved species like Rhododendron, Photinia, Betula, Ilex etc. Climbers are Crawfurdia, Potentilla, Streptolirion etc. Ground is generally covered by ferns and some herbaceous species.

6. Secondary Moist Bamboo Brakes

This type of forest occurs in patches throughout the district. Generally secondary bamboo brakes represented in semi-evergreen forest but in temperate coniferous forest a lot of bamboo patches occur in clumps. Broadleaved forests also have few small patches of bamboo along with trees. Dendrocalamus hamiltonii, Dendrocalamus giganteus, Bambusa pallida, Bambusa tulda, Cephalostachyum capiatum, Chimonobambusa callosa etc. are common species.
7. Secondary forests

Jhuming is commonly practiced in the whole district. The post-jhum regrowth generally makes secondary forests in the district.

a) Shifting Cultivation

It is a traditional method of cultivation in some circles of the district, which was somewhat sustainable earlier because of long jhum cycle (20-30 years). But in recent past, due to high anthropogenic pressure, the jhum cycle has reduced to 2-5 years, which leads to low fertility and high soil erosion (Kushwaha et al., 1983) and loss of biodiversity. The shifting cultivation is practiced mostly in tropical and subtropical areas of the district. After the land fertility is lost, cultivators move to another place to repeat the process. The abandoned fallow experiences regrowth of bamboo, weeds and shrubs.

b) Degraded Forest

This type of forest has very low density of trees and they are not too tall compared to primary forest. Generally, this type occurs in sub-tropical area. Bahunia and Mallotus are the common species. Ground is covered by shrubs like Croton, Rubus, Randia, Clerodendron with weed species like Mikania micrantha, Eupatorium odoratum, E. adenophorum, E. riparium and Ageratum conyzoides.

c) Grasslands

The grasslands are generally seen in sub-tropical abandoned area due to shifting cultivation, felling and fire etc. The grass species occur with association with some scattered trees of Bombax ceiba, Dubanga grandiflora etc. The Ergrostis tenella, Imperata cylindrica, Paspalum dilatatum are common.